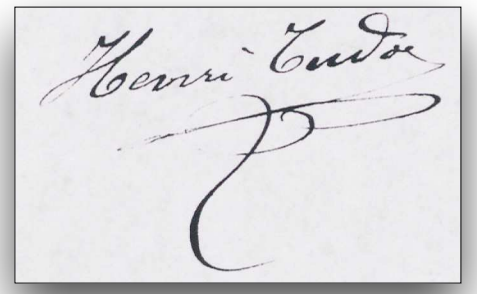
(photo: archives Commune de Rosport)

Henri TUDOR (1859 - 1928)

the inventor



(LU patent n° 711)

Pierre WEYLAND

(June 2024)

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Henri TUDOR, the inventor

Family background [1]

John Sanders TUDOR (1761 -)

Henri TUDOR's grand-father John Sanders TUDOR [2] was born in 1761 in Llanarth, Wales. [3]

In 1802 he married Blanch CROFT in Llantilio Crossenny, also in Wales. The couple settled in Llanarth where their first child was born and where the couple lived until 1804. Between 1805 and 1809 the TUDOR-CROFT family lived in Somerset where two more children were born. In 1809 the TUDOR-CROFTs moved back to Llanarth where John Thomas TUDOR, the father of Henri TUDOR, was born in 1811. [4]

John Thomas TUDOR (1811 - 1894)

It would appear that in 1831, at the age of 20, John Thomas TUDOR left Wales.

Several sources report a rumour that he left for Belgium to join Leopold's army, or rather Leopold's court. [5] [6] [7]

> *Gefolge des ersten belgischen Königs Léopold I. (von Sachsen-Coburg. 1790 - 1865) kommt John Thomas Tudor (1811 - 1894) im Jahr 1831 nach Belgien.*

Another, perhaps more reliable, source puts this rumour in doubt: [8]

> *Zu der Annahme, dass John Thomas Tudor in der Eskorte des belgischen Königs (Leopold I) nach Brüssel kam, erhielt ich ein Schreiben (1988) von Marie Tudor-Célis, Enkelin von Henri Owen Tudor, wohnhaft in Brüssel, das folgenden Passus enthält:*
>
> > *"Il y a quelques années j'ai rencontré Monsieur Lorette, Directeur de la Société Royale des Amis du Musée Royal de l'Armée et d'Histoire Militaire à Bruxelles, à qui j'avais rapporté l'anecdote concernant la venue de John Thomas Tudor en Belgique avec la suite de Léopold 1er.*
> >
> > *Monsieur Lorette m'a affirmé que le Musée possédait la liste de l'escorte officielle du Roi, que le nom de Tudor n'y était pas repris et que, de plus, pour éviter toutes susceptibilités (déjà à l'époque) il n'y avait aucun Anglais dans la suite du Roi.*
> >
> > *Il est question ici, bien entendu, toujours de documents officiels et d'escorte officielle.*
> >
> > *Peut-être mon aïeul était-il venu à la même époque dans les Pays-Bas ou accompagnait le Roi à titre privé ?"*

A more recent, well-researched, publication also doubts whether John Thomas had any connection to Leopold I. [9]

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[1] *see also Emile Hoffmann, "Henri Owen Tudor, Ingénieur, Commémoration du centième anniversaire de sa naissance", 1959*

[2] *possibly "John Saunders TUDOR"*

[3] *FamilySearch database (KH81-NF1)*

[4] *In two Rosport census reports (1885, 1890) his birthplace is given as Abergavenny, also in Wales*

[5] *Kurt Jäger, Gespeicherte Energie: Geschichte der elektrochemischen Energiespeicher, 1994, page 24*

[6] *Emile Hoffmann, d'Lëtzebuerger Land, 19 February 1960, page 3: "Une tradition orale, qui n'a pu être vérifiée, affirme qu'il serait venu sur le continent en 1831, dans l'escorte du premier Roi des Belges, Léopold Ier*

[7] *Obermosel-Zeitung, 23 November 1934, page 2: "Im Jahre 1850 heiratete John Thomas Tudor, als Offizier unter KönigLeopold aus England gekommen, Fräulein Irmina [Marie] Loser, Tochter des langjährigen Bürgermeisters von Rosport."*

[8] *A. Steinmetz, Die Tudors in Rosport, 2004, page 12*

[9] *Henri Werner & Ernest Reiter, Henri Owen Tudor, An idea and where it led, 2012, page 15*

In 1839/1840, however, in the wake of Luxembourg's independence, John Thomas TUDOR settled in Rosport with the family LOSER. [10]

Seit 1839 ist er in Rosport/Luxemburg ansässig.

This is confirmed by the Rosport Census of 31 December 1847 in which it is stated that John Thomas had been living in Rosport for 7 years. [11]

The presence of the LOSER family in Rosport can be retraced as far back as the beginning of the 18th century. [12]

Comte Conrad DE GOURCY spent some time with John Thomas TUDOR in the years 1861 and 1865 and described him in the following terms:

1861 [13]

> *… M. Tudor, catholique du pays de Galles, qui, étant venu, il y a une quinzaine d'années [1846 ??], parcourir la Belgique et le pays de Luxembourg, pour y chasser et pêcher, a fini par s'y fixer, en épousant la fille d'un propriétaire châtelain, maire de sa commune depuis longues années.*

1865 [14]

> *M. Tudor, avant son mariage étant jeune, voyageait pour chasser et pêcher; il n'avait jamais cultivé, mais il est devenu bon cultivateur en lisant de bons ouvrages d'agriculture; en visitant pendant treize années qu'il a cultivé, plusieurs fois sa patrie où il a des amis bons cultivateurs. Il a suivi leurs conseils, a ramené de bonnes machines agricoles, des taureaux durham, des béliers southdown, des cochons du Leicestershire, etc.*

Another French farmer reported on his visit to John Thomas TUDOR in Rosport in 1856 in the following terms: [15]

> *J'ai emprunté au Grand-Duché, non cet assolement, mais cette méthode de culture. Je l'ai puisée dans l'exploitation que gérait, à Rosport, près d'Echternach, M. Tudor, agriculteur anglais très habile, qui était venu se fixer dans ce pays où il a contribué à répandre les procédés de culture britannique.*
>
> *M. Tudor cultivait, en majeure partie, un sol argileux. L'état de ses terres faisait contraste avec celles de ses voisins. J'ai visité son exploitation dans une saison d'été très pluvieuse. En parcourant le territoire de Rosport, M. Tudor me disait: je ne vous montrerai pas mes sillons vous les reconnaîtrez, entre tous, à l'ameublissement comme à l'état de propreté du sol.*
>
> *Effectivement, toutes les terres cultivées par cet agronome, très judicieux observateur, portaient en quelque sorte sa signature. Au milieu d'une sole de plantes sarclées salie par des herbes que la pluie aidait à croître et à pulluler dans un sol compact et visqueux, je distinguais çà et là des pièces propres, dans lesquelles la terre était douce au toucher, grenue, perméable.*

In 1843 John Thomas TUDOR's status in the LOSER farm was given as "*rentier*, *Rentner*". [16]

It seems to be well established that upon settling with the LOSERs in Rosport in 1840 he took a keen interest in improving the agricultural processes on the farm and it is recognised that he was one of the initiators of the creation of an "*Ackerbauverein*" in Luxembourg. [17]

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[10] *Kurt Jäger, Gespeicherte Energie: Geschichte der elektrochemischen Energiespeicher, 1994, page 24*
[11] *Rosport Census of December 1847 (page 178/292)*
[12] *FamilySearch database (G6RN-86P)*
[13] *Comte Conrad de Gourcy, Voyage agricole en France, Allemagne, Bohème, Belgique (1861), page 24*
[14] *Comte Conrad de Gourcy, Voyage agricole en France, Belgique, Hollande et sur les bords du Rhin, (1865), page 142*
[15] *Dr Félix Schneider, Situation agricole du grand-duché de Luxembourg, 1869, page 16*
[16] *Rosport Census of December 1843 (page 194/287)*
[17] *Luxemburger Land in Wort und Bild, 8 September 1895, pages 5-6*

Herr John Tudor wurde im Jahre 1845 nach England gesandt, um die Einrichtungen der dortigen Ackerbau-Gesellschaften zu studieren und dann eine Gesellschaft zu bilden, welche unseren Verhältnissen anzupassen wäre. Am 8. Oktober 1846 wurde die Gesellschaft constituirt unter dem Namen: "Großherzoglicher Ackerbauverein".

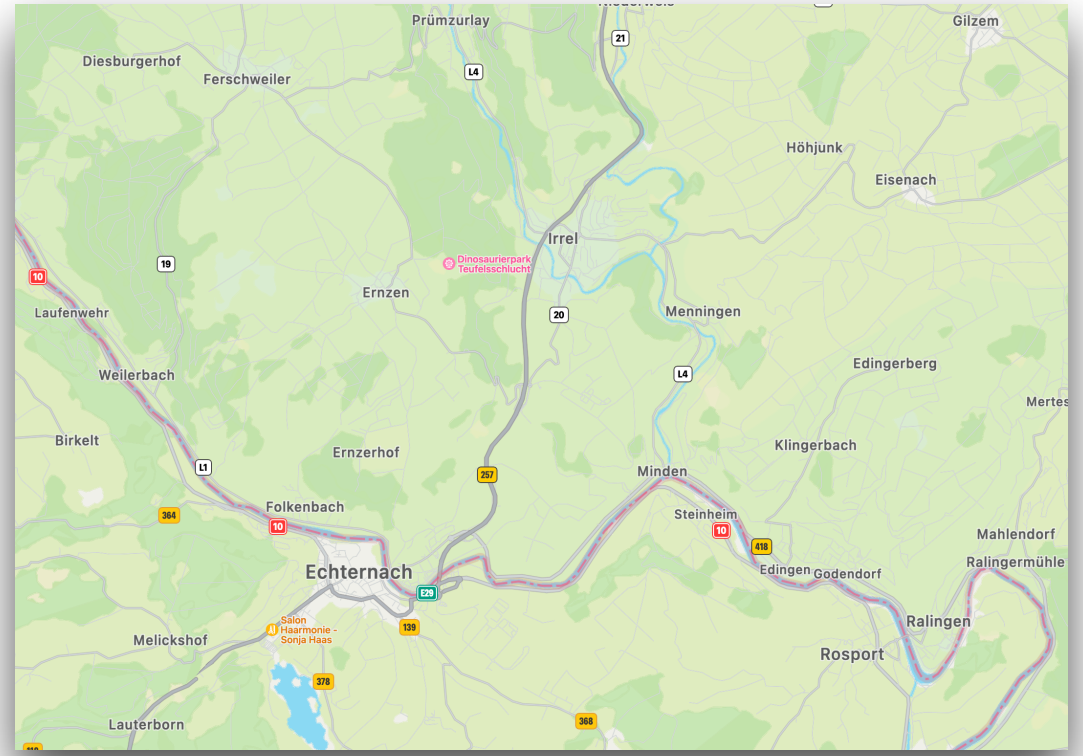
In December 1846 John Thomas TUDOR left Rosport and the LOSER family for the "*Këppenhaff*"(Kippenhof/Brandenbourg) near Diekirch where he stayed with Octave PÉRIN-D'AUGNY [18] until the end of 1849. [19] His presence in *Këppenhaff* on 1 December 1847 is documented in the Bastendorf Census of 1847 [20]. In the (1 December) 1849 Bastendorf Census his name no longer appears [21] and in the 1851 Census a new resident/owner (?) is reported in *Këppenhaff*. [22] (see also Addendum 4)

When John Thomas originally came to live with the LOSERs in 1840, their youngest daughter Marie LOSER was aged only 12. She had thus grown up on the farm next to John Thomas up to 1848 and when she reached the age of 21, in July 1849, John Thomas and Marie married in Rosport on 30 January 1850.

In the same year they moved in with the LOSERs in Rosport where their first son Hubert was born in 1850.

The 1855 and 1857 Census reports give evidence of the presence of the TUDOR-LOSER family in Rosport. A second son, named Robert, was born in 1857 in Rosport.

In 1858 John Thomas TUDOR decided to set up his own farm and rented the Diesburgerhof in Ferschweiler, Prussia, some 20 km northwest of Rosport. This is confirmed by the December 1858 Rosport Census which shows that the TUDOR-LOSER family was no longer resident in Rosport.



[18] *FamilySearch database*

[19] *A. Steinmetz, Die Tudors in Rosport, 2004, page 12*

[20] *Bastendorf Census of December 1847*

[21] *Bastendorf Census of December 1849*

[22] *The presence of the two bachelors TUDOR and PÉRIN D'AUGNY in Këppenhaff and the pregnancy of the kitchen maid Marguerite SCHMIT merits a special note (see Addendum 4)*

Comte Conrad DE GOURCY pointed out in 1861 that John Thomas was in close contact with the SERVAIS brothers in Weilerbach, on the German side of the river Sûre: [23]

> *Cet habile cultivateur [John Thomas] a eu la bonté de me conduire chez Messieurs Servais frères, propriétaires d'une forge dans laquelle ils ont monté une fabrique d'instruments aratoires, d'après des modèles que M. Tudor leur a rapportés ou qu'il leur fait venir de temps en temps d'Angleterre.*
>
> *J'ai vu chez ces Messieurs un grand nombre de machines à battre, de scarificateurs, de houes à cheval et autres instruments qui m'ont paru très-bien faits. Le beau château que ces Messieurs habitent, et leur établissement de forge sont situés de l'autre côté de la rivière qui forme la séparation du duché de Luxembourg d'avec la Prusse Rhénane.*

In a publication dated 1864 DE GOURCY also revealed the circumstances in which John Thomas TUDOR chose to take over the *Diesburgerhof* and later moved with his family to Chimay: [24]

> *Je venais à Chimay pour voir un Anglais, M. Tudor, que j'avais visité il y à dix ans [1854], près la ville d'Echternach, dans le grand duché de Luxembourg. Il s'y était fixé en se mariant; il y cultivait depuis six ans une ferme de M. son beau-père d'une manière très remarquable. Il était alors au moment de la quitter, pour en améliorer une autre, appartenant à des amis, MM. Servais maîtres de forges, habitant un beau château, sur le territoire prussien, tout près d'Echternach, où il me conduisit. Sa nouvelle ferme était peu considérable et de pauvres terres sablonneuses; le loyer n'en était que de 35 fr. Il les a tellement fertilisées, pendant une culture qui n'a duré que sept ans, en formant des composts avec de la tourbe mélangée avec de la chaux, dont il payait l'hectolitre 1 fr. 20, en l'amenant d'une distance de cinq kilomètres par de fort mauvais chemins, que MM. Servais lui ont permis volontiers de ne pas achever son bail. Ils ont pu louer ces terres améliorées à 100 fr. l'hectare en détail, tant les récoltes que M. Tudor y obtenait étaient belles. Mme Servais [25] est sœur de Mme Lamarche; [26] le mari de cette dernière dame engagea M. Tudor à venir la visiter dans ses défrichements de Chimay. Celui-ci s'y rendit trois années de suite, afin de bien connaître les résultats produits, par la culture de ces défrichements. Il se décida alors, il y a dix-huit mois [beginning of 1863], à louer la plus grande de ces nouvelles fermes, avec trois cent quarante hectares, pour un bail de vingt ans.*

John Thomas TUDOR died in Rosport in 1894. Judging from the last two Census reports in which his presence in Rosport is recorded (1887 and 1890), he had kept his British nationality until the end of his life.

Henri TUDOR (1859 - 1928)

Henri TUDOR was born on the *Diesbuergerhof* on 30 September 1859. He probably spent his first 4 years there, since the TUDOR-LOSER family left Ferschweiler at the beginning of 1863. John Thomas TUDOR was released from his contract before its term as the SERVAISs encouraged him to take over the *Bertignon* farm in Macquenoise, near Chimay (Belgium). [27] Philippe SERVAIS' wife, born WELLENSTEIN, put him in contact with her brother-in-law Charles Emmanuel Laurent François LAMARCHE [28] who was involved in a large deforestation and farming project in Chimay.

Again, Comte Conrad DE GOURCY gives us further information on the TUDORS in Chimay: [29]

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[23] *Comte Conrad de Gourcy, Voyage agricole en France, Allemagne, Bohème, Belgique (1861), pages 24-29*

[24] *Comte Conrad de Gourcy, Voyage agricole en France, Belgique, Hollande et sur les bords du Rhin, (1865), page 141*

[25] *Marie Josephine Caroline Wellenstein FamilySearch database (GWPC-MVP)*

[26] *Antoinette Françoise Félicité Wellenstein FamilySearch database (L4M1-FFC)*

[27] *Comte Conrad de Gourcy, Voyage agricole en France, Belgique, Hollande et sur les bords du Rhin, (1865), page 142*

[28] *FamilySearch database (KV1H-84P)*

[29] *Comte Conrad de Gourcy, Voyage agricole en France, Belgique, Hollande et sur les bords du Rhin, (1865), page 142*

A mon arrivée à Chimay, je me suis informé de la demeure de M. Tudor. On m'apprit qu'il était en ville. L'y ayant rejoint, il m'emmena avec son fils aîné bel enfant de douze ans, qu'il était venu chercher au collège de Chimay. Il me conduisit d'abord au superbe chalet de Mme Lamarche, très belle et fort aimable personne; nous y venions prendre Mme Tudor, toujours fort jolie femme; qui était venue avec trois enfants passer la journée chez son amie, elle a aussi de charmants enfants. Peu de temps après, nous nous dirigeâmes sur la remarquable ferme de Bertignon, à dix kilomètres de Chimay. Nous eûmes encore le temps avant la nuit, de jeter un coup d'œil sur l'intérieur de la ferme: l'habitation est petite, mais jolie et meublée très confortablement.

In 1872 Henri TUDOR, aged 13, started his schooling at the *Collège communal de Chimay.*

In 1873, when the TUDOR rental contract in Chimay came to an end, the whole family returned to Rosport. Marie LOSER's father had died in 1868, and her mother managed the Rosport estate. The 1875 Rosport Census shows that John Thomas TUDOR, upon his return to Rosport, became the head of the family and of the estate. His children were also registered as living in Rosport, although they continued their studies in Chimay where they must have resided in a boarding house during school time.

One TUDOR biographer [30] mentions that the whole family went to England for a year in 1878 to sort out an inheritance. Henri had obtained his *baccalauréat* that year and possibly took a sabbatical year before starting his university studies in Brussels in 1879.

Henri TUDOR obtained his engineering degree in 1883, but had already started earlier to investigate lead accumulators.

In 1885 he met Adolphe MÜLLER, a German industrialist/entrepreneur. [31]

1885 lernte er in Trier auf einer Verkaufsreise für die Kölner elektrotechnische Firma Spiecker & Co. Henri Tudor (1859–1928) aus dem luxemburg. Rosport kennen. Diesem war es gelungen, eine Dynamomaschine mit einem von ihm modifizierten Bleiakkumulator zu koppeln und damit Schwankungen des elektrischen Stroms auszugleichen. M. erkannte die Bedeutung von Tudors Erfindung für die Stromspeichertechnik, die mit fortschreitender Urbanisierung und Elektrifizierung für alle Bereiche der Wirtschaft immer wichtiger wurde. 1886 testete er erfolgreich im Elektrizitätswerk Echternach den Einsatz von Tudors Akkumulatoren. Diese waren durch Platten mit gerippter Oberfläche gekennzeichnet, die eine verbesserte Haftung des Bleidioxids bzw. des Bleisulfats gewährleisteten und daher eine größere Zahl von Ladungen und Entladungen erlaubten, was wiederum die Lebensdauer des Akkumulators erhöhte.

Henri TUDOR, encouraged by MÜLLER, took on the project of installing electric lighting in the city of Echternach in 1886 [32] which must have also prompted Henri TUDOR to obtain patents for protecting his invention in 1886. His invention, made a few years earlier, had been developed and perfected in Rosport outside of public scrutiny and could no longer be kept secret.

Another fact may have influenced TUDOR's decision to apply for a patent.

On 2 March 1886 a patent was granted in the USA to Charles F. BRUSH for an invention substantially identical to that of TUDOR's (see Addendum 2).

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[30] *Emile Hoffmann, d'Lëtzebuerger Land, 19 February 1960, page 3*

[31] *Reininghaus, Wilfried, "Müller, Adolph" in: Neue Deutsche Biographie 18 (1997), S. 342-343*

[32] *Obermosel-Zeitung, 7 January 1887, page 3*

Henri Tudor's patents

TUDOR's inventions and patents over the years 1886 to 1907 can be classified in 8 different categories according to their technical objectives. In a number of patents TUDOR is the sole inventor, in some patents he is named as co-inventor with Adolf MÜLLER, respectively Nicolas SCHALKENBACH.

1 - Lead-acid accumulator

On 17 July 1886 TUDOR obtained his first and only patent in Luxembourg for:

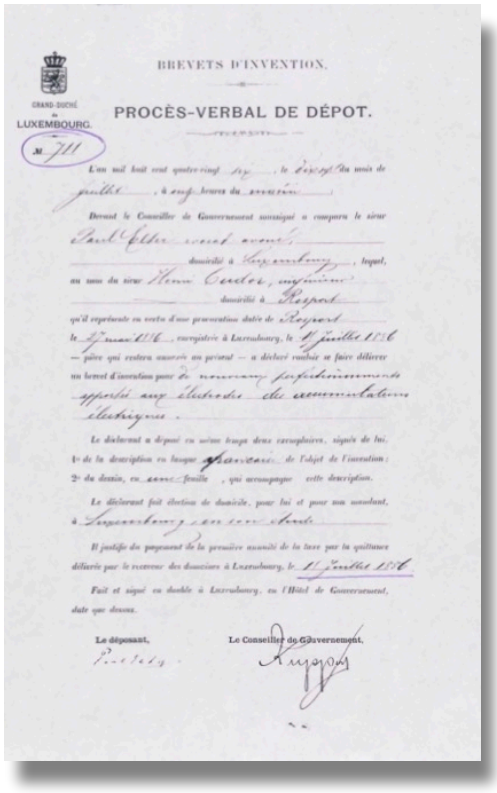
Nouveaux perfectionnements apportés aux électrodes des accumulateurs électriques. [33]

N° 711. Le 17 juillet. — A M. Henri *Tudor*, ingénieur à Rosport, représenté par M. Paul Elter, avocat-avoué, qui a fait élection de domicile, pour lui et pour son mandant, à Luxembourg en son étude ; — pour de nouveaux perfectionnements apportés aux électrodes des accumulateurs électriques.

Nr. 711. Am 17. Juli. — Dem Hrn. Heinrich Tüdor, Ingenieur zu Rosport, vertreten durch Hrn. Paul Elter, Advokat-Anwalt, welcher für sich und seinen Vollmachtgeber, zu Luxemburg in seiner Wohnung, Domizil erwählt hat ; — auf neue Verbesserungen an den Elektroden der elektrischen Accumulatoren.

Mémorial 14/08/1886 page 505

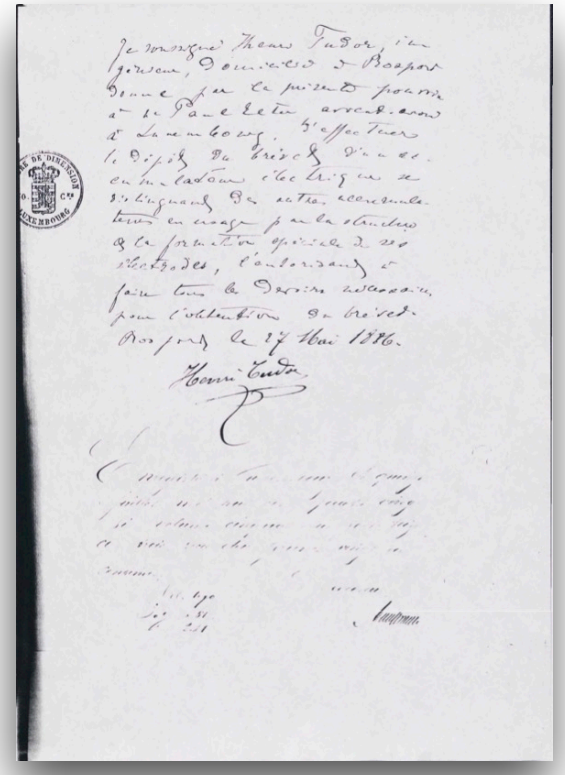
TUDOR was represented by Marc ELTER, *avocat-avoué*. [34]



BREVETS D'INVENTION.

GRAND-DUCHÉ DE LUXEMBOURG.

PROCÈS-VERBAL DE DÉPOT.



Through TUDOR's French patent N° 179.393 (basic patent and two "*certificats d'addition*") it is possible to retrace and date the 3 major development stages of his invention(s), labelled hereafter **A**, **B** and **C**:

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[33] *Mémorial 1886, page 505, Luxembourg patent N° 711*

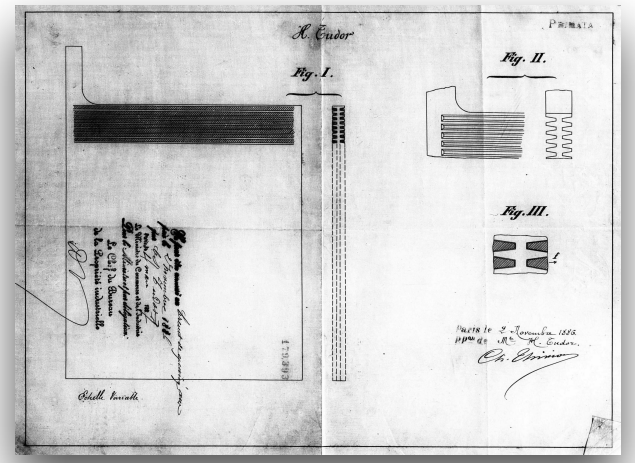
[34] *see Addendum 1 for a full transcription of the patent specification*

In later years (1898 - 1901) further improvements were patented in selected countries. These improvements are labelled **D**, **E**, **F** hereafter.

A - Application date: 2 November 1886

Luxembourg, Belgium, France

Forme particulière à rainures rapprochées symétriques et coniques données au châssis de plomb formant l'âme des électrodes et servant de support conducteur aux oxydes et sels de plomb qui y sont empâtées.



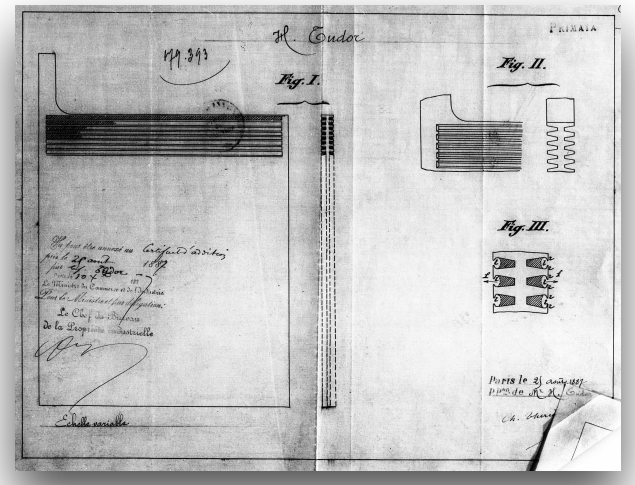
(Source: Institut national de la propriété industrielle)

B - Application date: 25 August 1887

United Kingdom, France, USA, Spain

La forme particulière des plaques-supports pour accumulateurs d'électricité consistant dans la formation de nervures et de rainures symétriques droites ou courbes et de section conique comme montré et décrit.

Forme spéciale des rainures obtenue par suite du rabattement des bords des nervures sur les plaques comme décrit et montré, à l'effet d'empêcher les masses d'oxyde de plomb de se détacher des supports.

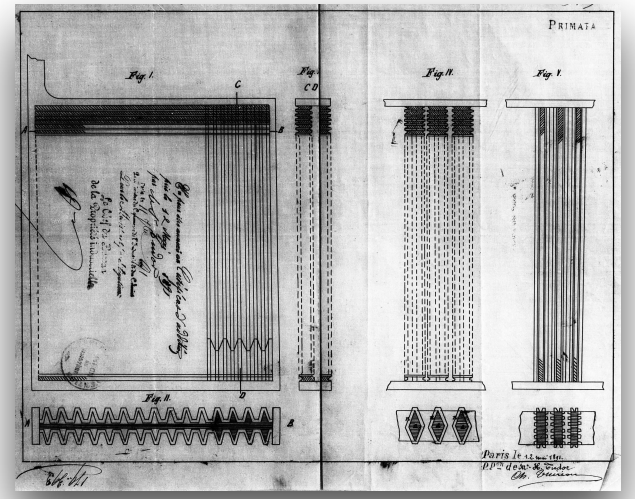


(Source: Institut national de la propriété industrielle)

C - Application date: 12 May 1891

France, Germany, Belgium, Switzerland, USA, Spain

Forme nouvelles de plaque portant sur ses deux faces, à des distances variables, des rainures, nervures ou ailettes, plus ou moins profondes, affectant une forme quelconque, et recouverte de chaque côté, soit horizontalement, soit verticalement, soit autrement, d'autres nervures plus petites et telles qu'elles ont été décrites dans les brevets précédents.



(Source: Institut national de la propriété industrielle)

D - Application date: 18 May 1896

Manufacture of Positive Lead Electrodes

United Kingdom

A process for the manufacture of positive lead electrodes for electric accumulators, such process consisting in charging the lead electrodes as positive electrodes for some time in very weak acid at first with intervals of rest and then with intervals for discharging for the purpose of forming a layer of lead oxide containing sulphate, in then reducing this oxide layer by employing the electrodes as negative electrodes and finally in arranging the electrodes in strong acid as positive electrodes and repeatedly charging and discharging the same for the purpose of converting the reduced layer into the peroxide. (no drawing)

E - Application date: 14 March 1898

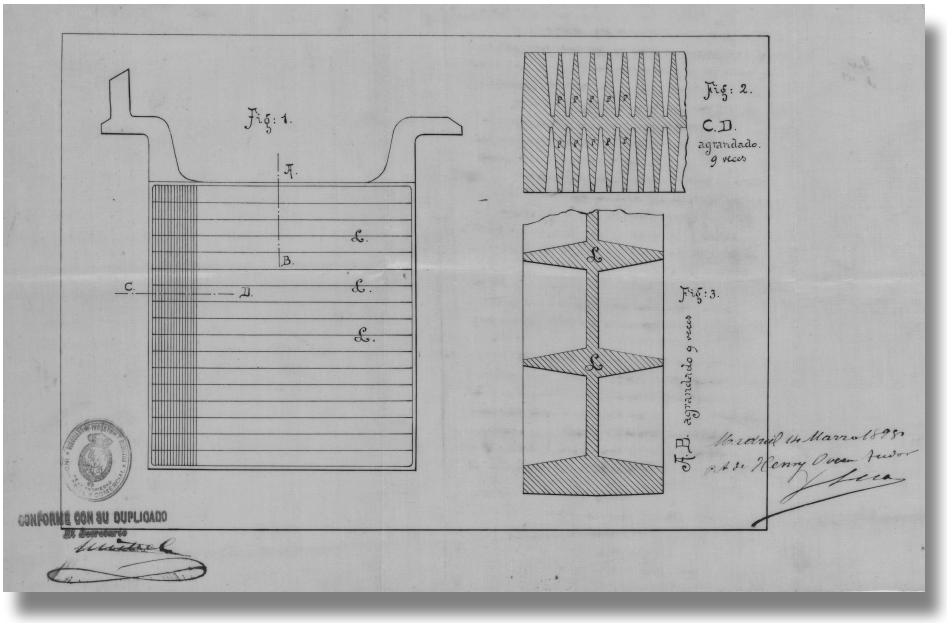
Un aparato, acumulador eléctrico "Tudor".

Spain

Yo hé vencido esta dificultad cruzando el molde en sentido transversal con una serie de canales que conducen el plomo derretido a las extremidades de las aletas permitiendo fundir estas con una altura mucho más grande.

Estos canales transversales del molde producen en las placas concluidas láminas transversales L,. L, L las que forman ángulo recto ó agudo con las costillas o aletas longitudinales primitivas.

Gracias a estas láminas transversales he conseguido producir una placa de plomo fundido de una superficie tan estensa que la capa de óxido autógeno de qué se cubre aunque es muy delgada constituye en su totalidad una masa activa suficiente para dar al electrodo la propiedad de almacenar una cantidad de electricidad considerable. Siendo los electrodos el elemento esencial de los acumuladores hé obtenido, pues, un aparato acumulador de una gran solidez al mismo tiempo que de una capacidad eléctrica muy grande.



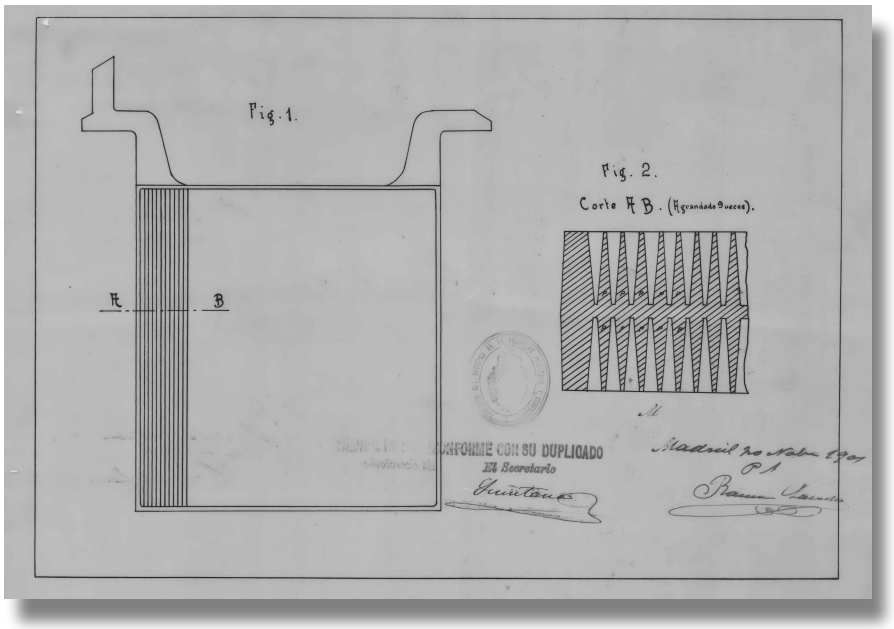
(Source: Oficina Española de Patentes y Marcas)

F -Application date: 20 November 1901

Un procedimiento para fabricar placas o electrodos de acumuladores de gran superficie con o sin láminas transversales.

Spain

En la fabricación de electrodos o placas de acumuladores eléctricos, provistos por ambos lados de aletas muy delgadas y altas, separadas entre sí por ranuras muy estrechas, pudiendo alcanzar la superficie desarrollada de la placa hasta 15 veces su superficie lineal, cuya placa o electrodo se obtiene introduciendo el plomo derretido en el molde bajo una presión cualquiera superior a la presión atmosférica, la cual se producirá por cualquiera de los medios conocidos.



(Source: Oficina Española de Patentes y Marcas)

He also obtained corresponding patents in Belgium, France, United Kingdom and USA. [35]

[35] *BE75066, FR179393 (including 2 "certificats d'addition"), GB11453/1887, US413112*

Patent situation in Germany

There is no evidence that a patent application was filed in Germany in 1886 but it seems unlikely that TUDOR and his associate MÜLLER would not have applied for a patent in that country. It is thus reasonable to assume that the *Reichspatentamt* rejected TUDOR's patent application. [36]

The following statements in a German publication of 1892 suggest that a patent obtained by French inventor FAURE [37] was considered to be dominant in Germany. [38]

> *Im Oktober 1887 übernahmen die Herrn Müller & Büsche von den Herrn Henri und Hubert Tudor die Berechtigung, die von diesen Herren konstruierte Accumulatoren-Platte fabrizieren zu dürfen, nachdem die Herren Tudor in Rosport schon zuvor längere Zeit solche Platten hergestellt hatten. Später wurde die Firma in Müller & Einbeck in 1888 umgeändert und aus dieser Fabrik ging dann später in 1891 die Aktiengesellschaft zu Hagen hervor.*
>
> *Der von dieser Gesellschaft inszenierte Patentstreit, welcher kürzlich vor dem Reichsgericht zu Leipzig entschieden wurde, stützte sich auf das Patent von Faure Nr. 19026, welches die Deutsche Edison-Gesellschaft in Lizenz von der E. P. S. Company zu London erworben hatte. Bereits geraume Zeit, ehe die Firma Müller & Büsche in Hagen i. W. angefangen hatte, Accumulatoren zu bauen, hatte die Allgemeine Elektrizitäts-Gesellschaft in Berlin, Rechtsnachfolgerin der Deutschen Edison-Gesellschaft, Accumulatoren zu bauen versucht, aber nur ungünstige Resultate erzielt. Es ist sofort klar ersichtlich, daß, wenn man die Faure'sche Patentschrift in der heute von der Accumulatorenfabrik Aktiengesellschaft gewünschten und behaupteten verallgemeinerten Auffassung gelten läßt, die Firma Müller & Büsche, ebenso wie später Müller & Einbeck gegen dasselbe durch ihre Fabrikation verstoßen hat, und zwar bis zu ihrer Umwandlung in die Aktiengesellschaft.*
>
> *Diese Lizenz ging dann an die Aktiengesellschaft zu Hagen über, welche dann den Versuch machte, aus demselben ein Monopol für ganz Deutschland zu gestalten. Man drohte sämtlichen Accumulatorenfabriken mit Patentprozessen und klagte zunächst gegen Herrn Correns auf Patentverletzung. Diese Klage beantwortete derselbe mit einer Nichtigkeitsklage gegen das Patent Faure, welche jedoch schließlich abgewiesen wurde. Es wurde erkannt, daß das Patent Faure voll zu Recht besteht, das heißt, daß ein Faure-Accumulator mit isolierenden Zwischenwänden herzustellen sei, da hierauf die Patentschrift einen besonderen Wert legt. Aus folgenden Gründen ist somit das Patent wertlos geworden:*
>
> *Durch diesen Ausspruch des Reichsgerichts ist vor allem eine Monopolisierung der Accumulatoren-Fabrikation ausgeschlossen, und da isolierende oder poröse Scheidewände in jedem Falle den inneren Widerstand der Zellen erhöhen, so ist eine solche Zelle für die Praxis absolut nicht zu brauchen. Hierdurch sind weitere Klagen auf Verletzung des Faure-Patentes ausgeschlossen.*

Antoine WEHENKEL, in a contribution to *d'L'ëtzebuerger Land* in 2003, also reflected on the patent situation in Germany around TUDOR's patents. [39] The title of the article is somewhat misleading as it refers to a TUDOR patent rather than a TUDOR invention or know-how. The article does not mention the existence of a TUDOR patent in Germany in 1888.

A publication of 1997 in this context does not mention the existence of a German patent either. [40]

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[36] *The TUDOR accumulator plate was thus not protected by a patent in Germany until 1891 when a patent for an improvement of the initial invention was granted in 1891 (DE 61656)*

[37] *DE 19026*

[38] *Johannes Zacharias, Die Accumulatoren, Jena 1892*

[39] *Antoine Wehenkel, Les cheminements étonnants du brevet de Henri Tudor, d'Lëtzebuerger Land, No 50, 12 December 2003, page 14*

[40] *Hagen Antje, Deutsche Direktinvestitionen in Grossbritannien, 1871-1918, (1997), page 125*

Ursprung der AFA war die 1887 gegründete Accumulatoren-Fabrik Tudor'schen Systems Büsche & Müller (kurz darauf Accumulatoren-Fabrik Tudor'schen Systems Müller & Einbeck). Deren Teilhaber Adolph Müller hatte per Vertrag von Henri Tudor (Luxemburg) die Produktionslizenz für den Akkumulator Tudor'schen Systems erworben. Außer in Deutschland durfte die Accumulatoren-Fabrik die Batterien in ganz Europa mit Ausnahme von Italien, Frankreich, Spanien und Großbritannien produzieren und vertreiben.

Der Akkumulator befand sich damals erst in der Entwicklung. Verschiedene Produktionsweisen konkurrierten miteinander In Deutschland hatten sowohl die AEG als auch Siemens & Halske ungefähr zeitgleich mit Adolph Müller die Produktion von Batterien aufgenommen, wobei die AEG nach den Patenten des Franzosen Faure produzierte. Siemens & Halske nach einem selbst entwickelten Verfahren.

1890 nahmen die drei Konkurrenten Verhandlungen auf. Zum einen sollte ein ruinöser Preiskrieg vermieden werden, zum anderen hatte sich das Tudor'sche System als das technisch vorteilhafteste entpuppt. AEG, Siemens und Müller & Einbeck vereinbarten deshalb die Gründung eines Gemeinschaftsunternehmens: Alle drei Partner waren an der Accumulatoren-Fabrik AG. kurz AFA zu gleichen Teilen beteiligt. Nur die neue Firma sollte in Zukunft - auf dem Gelände der ehemaligen Accumulatoren-Fabrik Müller & Einbeck - Akkumulatoren produzieren. Die AEG und Siemens verpflichteten sich, für die nächsten 10 Jahre ihren gesamten Bedarf an Akkumulatoren bei der AFA zu decken. Daß die technologische Überlegenheit der AFA jedoch nicht unbestritten war zeigt die Tatsache, daß die Firma noch im selben Jahr, zunächst für den deutschen Markt, von der Foreign and Colonial Electrical Power Storage Co. Ltd. London [41], das Faure-Patent erwarb. So wurde die entstehende Führungsposition durch horizontale Konzentration gefestigt.

[41] *name changed in September 1891 to Electrical Power Storage Co. Ltd.*

2 - Electric meters

Co-inventors are TUDOR Frères, SCHALKENBACH Nicolas

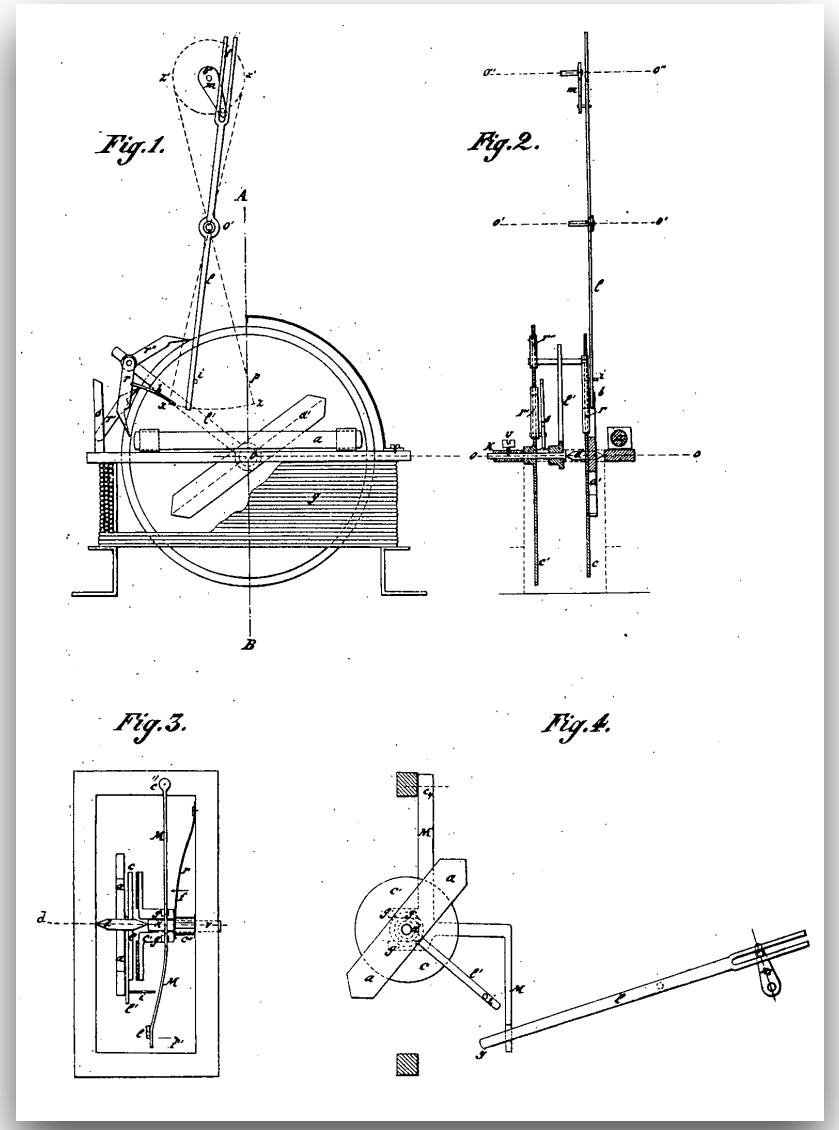
A - Application date: 25 May 1887

Improvements in Registering Meters for Electric Currents

France, United Kingdom

The apparatus has for its object to register the quantity of electricity consumed during a certain period of time, and to serve consequently, as an industrial registering meter of electricity.

The electrical meter comprises the combination of two independent wheels of which one being fixed to the galvanometer makes consequently the same angular deviations as the galvanometer itself whilst the other is periodically either forming a whole with the first or independent thereof this being effected either through the medium of a lever provided with two pawls stopping these wheels or through friction.



GB 7857/1887

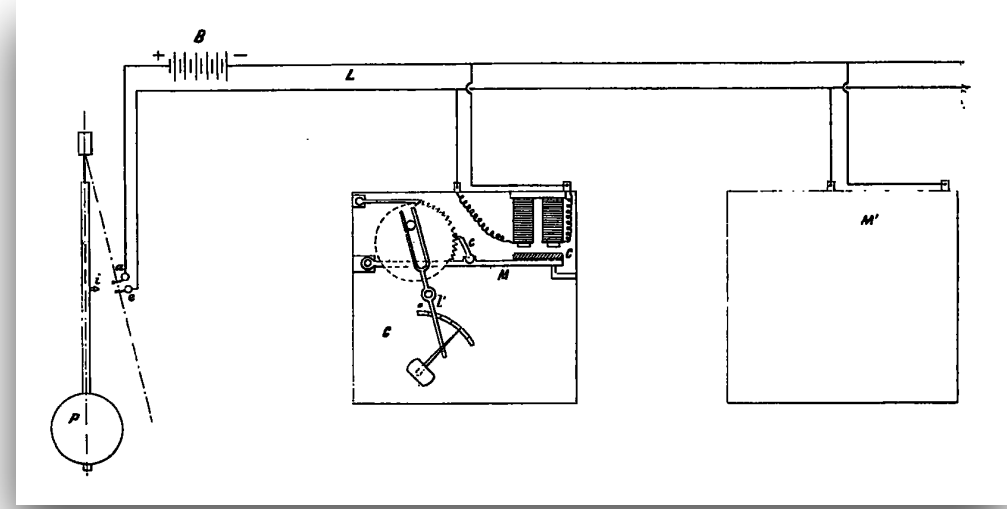
The French patent was obtained by the *Société TUDOR frères & Nicolas SCHALKENBACH*.

The corresponding British patent was granted to Henri TUDOR, indicating that the latter was the sole inventor.

B - Application date: 7 February 1889

Improvements in or appertaining to Electric Meters

United Kingdom



GB 2168/1889

A large number of the electric meters hitherto used placed at various points of consumption in a circuit or circuits of electric energy, operate by means of a motive apparatus, either a clockwork movement or an electrical one derived from the distributing circuit, in which the apparatus is placed.

These movements which act on the meters proper and register periodically the amount of electricity consumed must be very regular in their action, and the mechanism must be very reliable and accurate, if the periods during which the intensity of the current is to be registered are to follow each other at regular intervals, and it requires, therefore, to be constantly tested.

The object of this invention is first to regulate the aforesaid motion by making it dependent on and synchronous with the motion of a governing apparatus placed at any convenient point on the circuit, where it can be regulated at will, and from whence the impulses are transmitted to the different meters in the same manner as with electric clocks, and secondly to reduce the hand labour in working, by abolishing the necessity for periodical winding when clocks are used, and the continued testing of the contacts when electric pendulums are employed.

3 - Transforming currents

Co-inventors are Adolf MÜLLER and Henri TUDOR

A - Application date: 24 May 1897

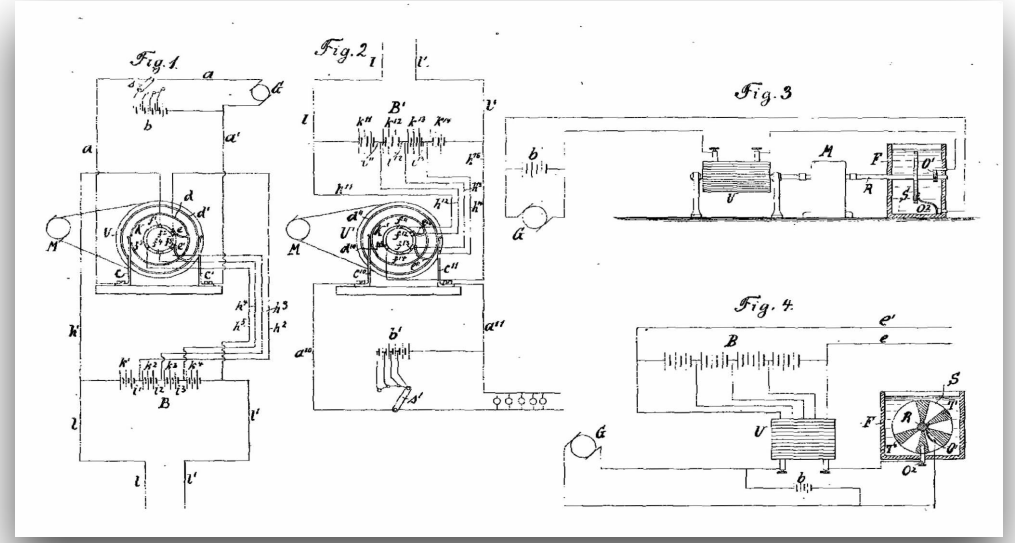
Improvements in Transforming Continuous Electric Currents

United Kingdom, France, Spain

This invention relates generally to means for transforming continuous currents at any tension into currents at any desired higher or lower tension. The chief object of the invention is to employ a current, transformed by means of storage batteries or accumulators, to transmit electrical energy from a current generator or source of current to a distance by means of conductors of small cross section and to render it utilizable at its destination, as also to convert a continuous current of any given tension into a continuous current of any other desired tension to be used in conjunction with the same source of current.

According to the invention the transformation of the current is effected without any interruption of the currents flowing through the charging and discharging circuits and without the possibility of even a momentary short-circuiting through the commutator brushes taking place. Furthermore, the arrangement enables the regulation of the current used to be suitably effected without the employment of any switch devices other than those generally known in connection with accumulators or secondary batteries.

This is effected by introducing between the two conductors or leads of the low-tension current a second accumulator or secondary battery of the same electromotive force or tension as the said circuit. This battery takes no part in diverting or reversing the current but has for its object to equalize the difference of potential arising from the interruptions of the current caused during the change of connections.



GB 12820/1897

B - Application date: 25 May 1897

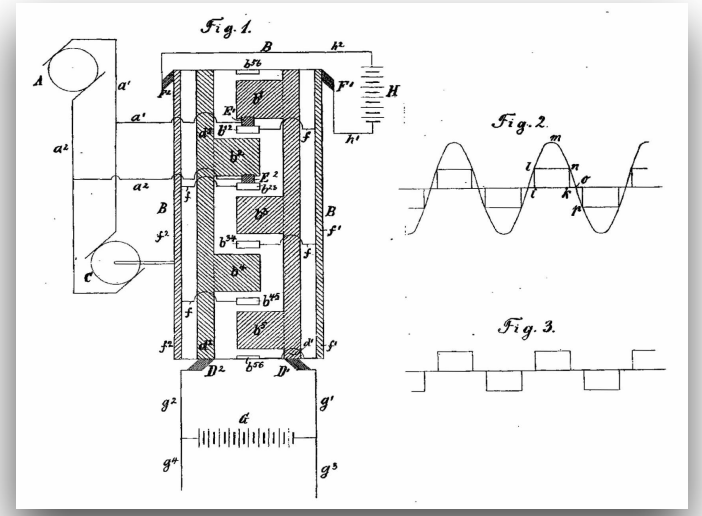
Improvements in Transforming Alternating into Continuous Electric Currents or vice versa.

United Kingdom, France, Spain

An alternating current cannot be directly employed for charging electric accumulators or secondary batteries because, as is well known, its tension or voltage alternates rapidly from a positive to a negative maximum approximately according to a sine curve, whilst the opposing electromotive force generated when charging storage or secondary batteries has a positive tension which depends solely upon the charging operation and only changes slowly.

It is, however, possible by means of a commutator, operated synchronously with the alternating current employed, not only to change the direction of the current at each alternation so as to give rise to a continuous current, but also to switch the storage battery to be charged in or out of the circuit at the moment in the phase in which the tension of the alternating current begins to rise above or fall below that of the battery. It is, therefore, possible at this instant, to disconnect without disadvantage the source of the alternating current as at this moment the tension of the primary current is exactly equal to the opposing electromotive force so that there is no current flowing through the circuit.

Now this invention has for its object an arrangement whereby an alternating current can be used for charging accumulators or secondary batteries (for the purpose of transforming the said alternating current into a continuous current) without giving rise to the above described disadvantages. This is effected by arranging that the charging current, whilst the direction of its flow is being changed or diverted by the commutator, is not interrupted and that during the space of time in which the charging-circuit is disconnected from the battery to be charged, it is maintained closed by a separate polarisation battery.



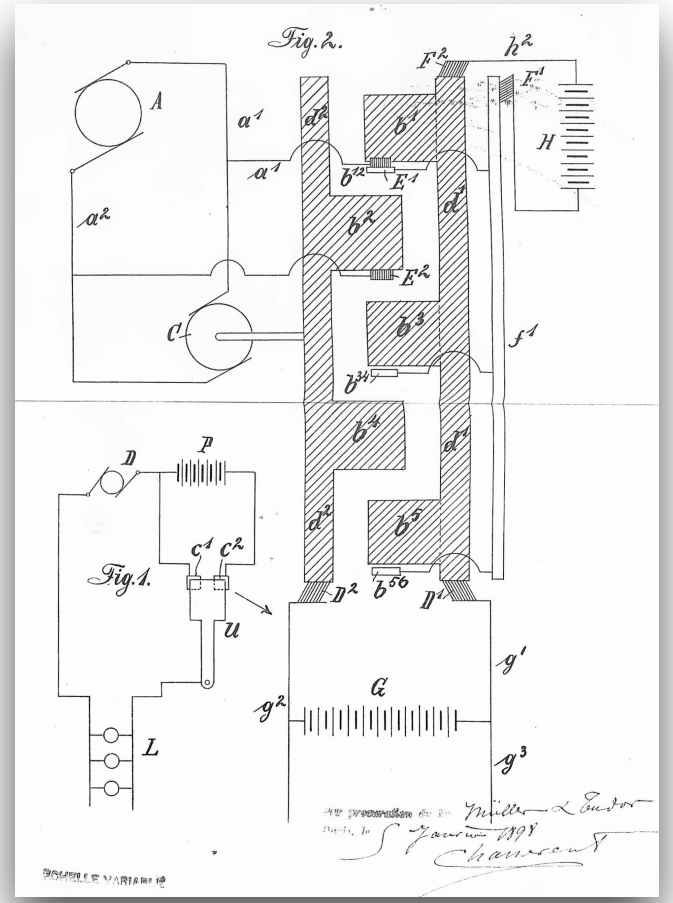
GB 12957/1897

C - Application date: 5 January 1898

Transformation d'un courant alternatif en un courant continu et vice-versa.

France, Spain

(first certificate of addition)



FR 267272

Dans la transformation d'un courant alternatif en courant continu et vice versa, au moyen d'un appareil commutateur actionné d'une manière synchrone par rapport au courant alternatif, le montage en tension, au moment de l'interruption d'un courant, à l'aide du commutateur, de la batterie de polarisation spécifiée dans le brevet principal ou de toute autre, avec le circuit à courant

alternatif et avec les appareils de dépenses ou de production, dans le but d'obtenir une mise hors circuit sans formation des d'étincelles.

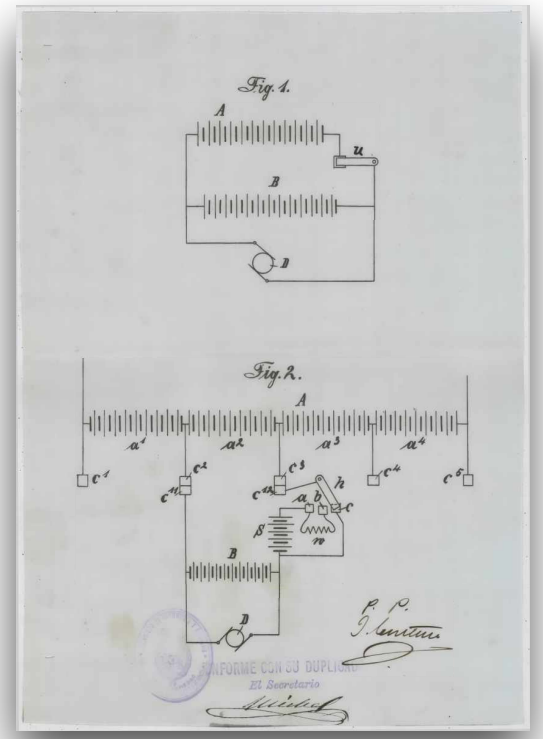
Le montage en tension, au moment de l'interruption d'un courant, d'une batterie de polarisation, d'un condensateur etc. avec la source de ce courant, dans le but d'obtenir une mise hors circuit sans formation d'étincelles.

Spain

(second certificate of addition)

La transformación de una corriente alternativa en corriente continua y viceversa por medio del aparato que se describe

En el aparato descrito en la patente principal para la transformación de las corrientes continuas, la aplicación de compartimentos auxiliares, condensadores etc. que, en el momento de la interrupción de la corriente, y hasta el momento del cierre del circuito, aumenten la fuerza electromotriz de la batería que se ha de separar del generator de electricidad; de tal manera que la corriente que llega del generator a esta batería, casi desaparece en este momento.



(Source: Oficina Española de Patentes y Marcas)

4 - Electrical propulsion of carriages and other vehicles, boats, and the like

Co-inventors are Adolf MÜLLER and Henri TUDOR

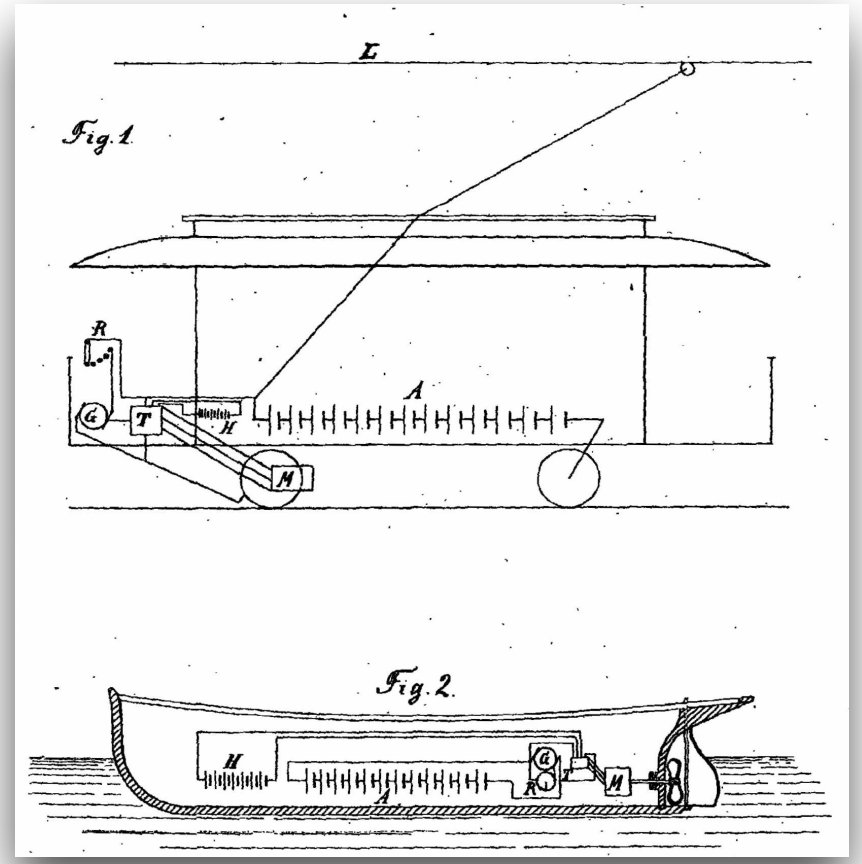
Application date: 3 July 1897

United Kingdom, Spain

Hitherto practically only continuous current machines have been employed for electrically driving vehicles of all kinds, boats and the like as such machines by employing the earth or a rail for the return circuit only require one conductor, and also because the properties of the continuous current motor, permit of considerable overloading whereby the said motor is suitable for supplying the increase of power required for starting a vehicle. The two-phase, alternate current motor, does not enter into the question because it neither starts when loaded nor supports an

overload as in this case it becomes asynchronous and stops. It has not been possible heretofore to practically employ the multiphase or polyphase current, because for directly conveying such a current at least three conductors are required, the arrangement of which is naturally very difficult, costly and not without danger, when in use.

In order, therefore, to render the excellent properties of the polyphase current suitable for driving the motors of electrical vehicles, the said current is, according to this invention, obtained from a secondary battery or accumulator which is carried in the vehicle to be driven or propelled. This, accumulator or secondary battery can either be made of such dimensions that it stores up in the vehicle the amount of energy which is necessary for the amount of work to be done or the said battery can be charged during the journey by a contact connection wherein as usual one pole can be connected through the medium of the body of the vehicle, to the rails, the earth or in the case of boats or the like the water whilst current from an overhead circuit, can be taken in the well known manner from the other pole. In both cases the continuous current of the battery is conveyed by means of a suitable commutator as a multiphase current, to the field of the multiphase current motor used for propelling the vehicle. The armatures of such a multiphase current motor can in the case of vehicles running on land be directly mounted upon the axles of the vehicles and in the case of boats or the like upon the propeller or paddle wheel shaft, so that intermediate transmission gear such as toothed wheels or the like is not required.



GB15870/1897

5 - Preventing sparking when making and breaking electric circuits

Application date: 5 January 1898

United Kingdom

This invention relates to improvements in preventing sparking when making and breaking electric circuits, the said improvements being applicable to all kinds of making and breaking devices and particularly to the transforming of electric currents by means of switches or commutators and secondary batteries.

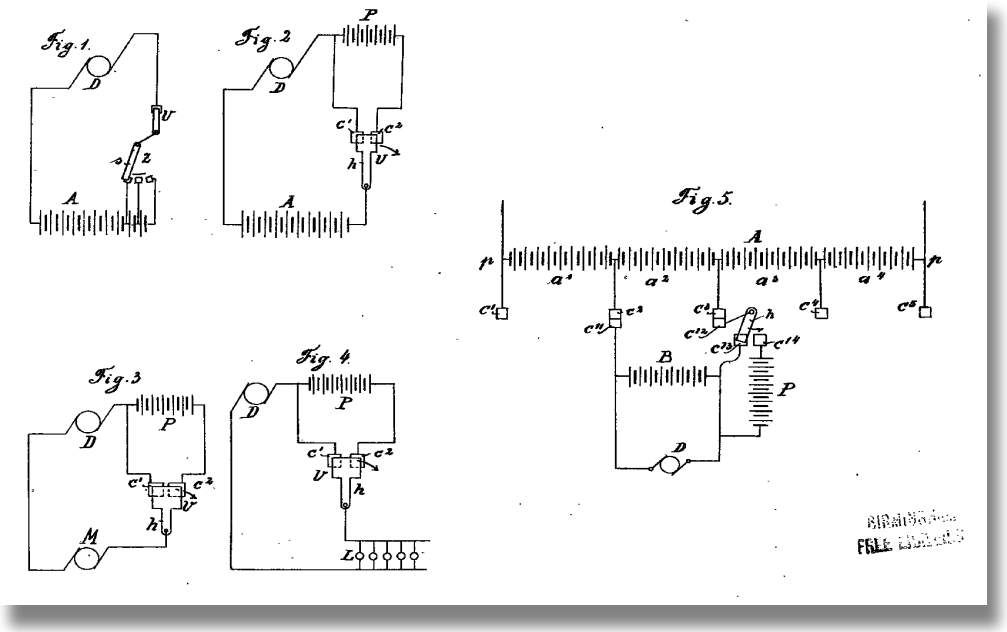
In such arrangements as hitherto used for the above mentioned purposes there exists the unavoidable disadvantage of strong and injurious sparking which often very seriously affects the life of the switch apparatus.

Now this disadvantage is effectually overcome by our invention which we will now proceed to describe :

If a secondary battery be connected with the circuit of a dynamo so as to be charged thereby, then the circuit can be broken without the formation of sparks by altering the electromotive force of the battery or accumulator by switching in more cells, in such a manner that the difference of potential between the poles of the battery is made the same as that of the dynamo. When this condition is obtained the circuit has no current flowing through it and it can be broken without the formation of sparks.

Any circuit in which an electromotive force is opposed to that of the current source can be broken in a similar manner without sparking by increasing the opposing electromotive force until it equals that of the source of current before breaking the circuit.

This is effected according to this invention by introducing into the circuit before disconnection a battery of elements which are of small capacity and easily become polarized. Elements suitable for this purpose are for instance those consisting of steel plates immersed in a potash solution, platinum plates in sulphuric acid, plain lead plates in sulphuric acid or aluminium plates in an alum solution.



GB 331/1898

6 - Dispositif de support élastique pour batteries d'accumulateurs

Application date: 1 March 1905

France

Il est fréquemment fait usage sur des véhicules divers (automobiles, wagons de chemins de fer, tramways, etc.) de batteries d'accumulateurs dites transportables. Une des principales difficultés rencontrées dans ces applications consiste à empêcher la rupture des connexions sous l'effet des chocs et des trépidations du véhicule.

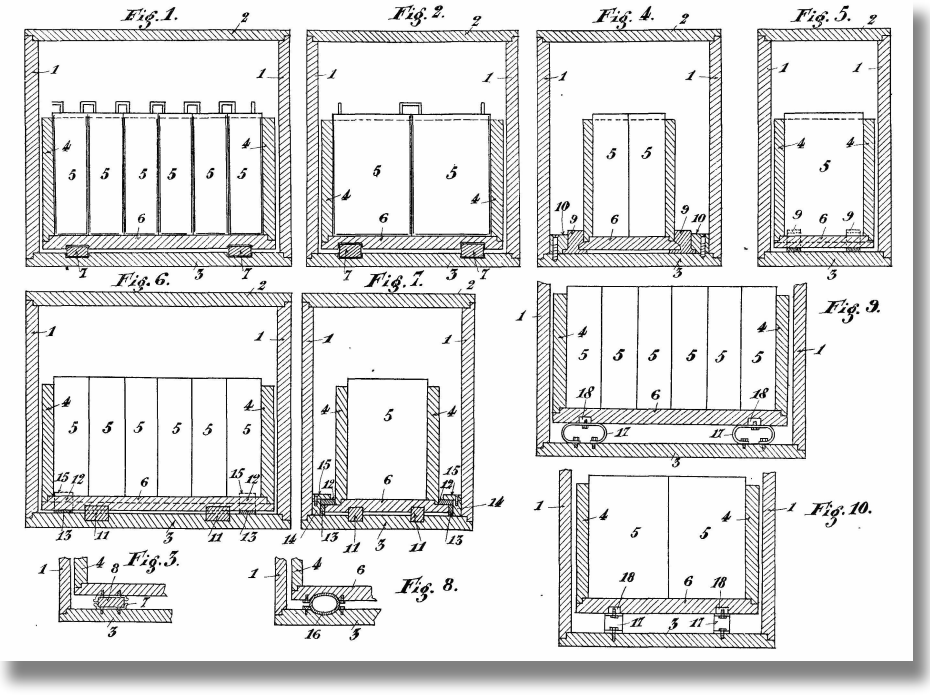
Les mêmes inconvénients peuvent se présenter pour des batteries fixes en contact avec des corps sujets à vibrations.

On a tenté d'éviter ces accidents, soit, par exemple, en faisant usage de connexions flexibles, soit en calant énergiquement, dans la caisse du véhicule, les éléments ou les bacs de groupement des éléments. Les connexions flexibles ont le défaut de se détériorer rapidement sous l'action des vapeurs acides. Le calage complet a le défaut de faire répercuter, sur la batterie, toutes les oscillations du véhicule.

Ces diverses causes amènent fatalement une altération et un cisaillement des connexions.

Le principe de la présente invention consiste à écarter, des cloisons et du plancher de la voiture, ou du local, les éléments ou les bacs contenant les groupes d'éléments et à ne plus leur laisser de contact avec ces parois que par l'intermédiaire de supports élastiques.

Ces supports sont constitués soit par des ressorts métalliques, soit par des coussins pneumatiques, soit par des tampons de caoutchouc, soit partout autre dispositif élastique; ils peuvent être combinés de façon à empêcher un déplacement de la batterie sous l'effet d'un choc violent.



(Source: Institut national de la propriété industrielle)

7 - Économiseur électrique automatique

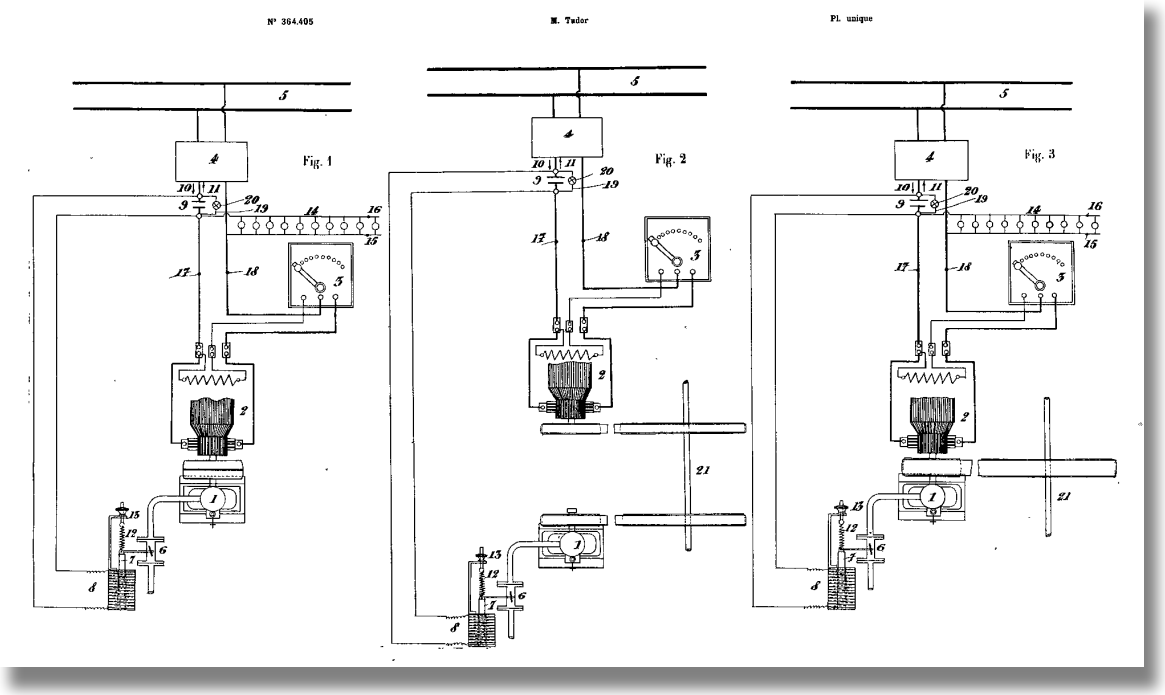
Application date: 19 March 1906

United Kingdom, France

L'économiseur électrique automatique consiste dans une combinaison nouvelle d'appareils connus, connectés entre eux électriquement et mécaniquement d'une façon particulière dans un réseau secondaire relié à un réseau primaire de distribution à voltage constant.

Cette combinaison nouvelle réalise des avantages constituant des progrès importants relativement aux ensembles précédemment connus.

Elle permet notamment aux engins d'un réseau secondaire produisant séparément ou simultanément de l'énergie mécanique ou électrique, de fournir économiquement leur énergie propre en substitution à celle plus coûteuse qui serait empruntée à un réseau primaire, et ce en n'utilisant ce réseau primaire que comme moyen de mise en marche des engins du réseau secondaire, comme régulateur, comme réserve et pour fournir l'énergie nécessaire aux à-coups que ces engins seraient normalement impuissants à produire; le tout fonctionnant sans que l'excédent d'énergie qui pourrait être produit temporairement par les engins du réseau secondaire ne puisse passer dans le réseau primaire, l'énergie produite alors se proportionnant, automatiquement, à chaque instant à l'énergie consommée.



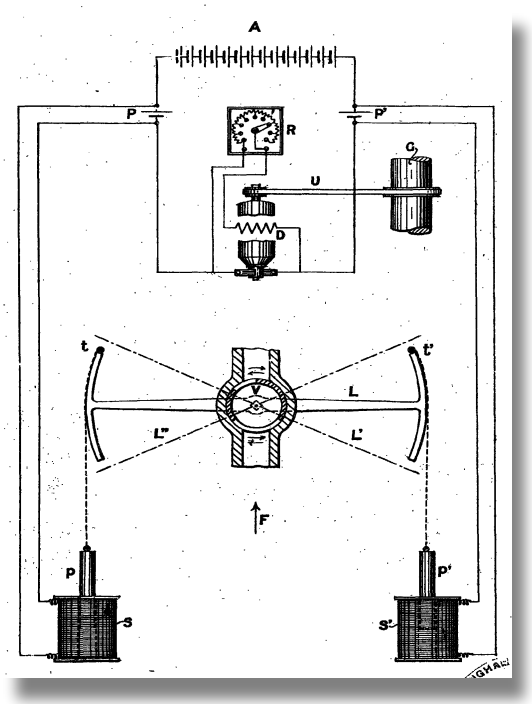
(Source: Institut national de la propriété industrielle)

8 - Apparatus for varying the speed of motive power engines

Application date: 26 April 1907

United Kingdom, **Germany**

A device for varying the speed of a motive power engine consisting of a dynamo driven by the engine, a second source of current connected in opposition to the armature current of the dynamo, and a relay or relays that are influenced by both sources of current and which in turn influence the speed of the power engine, characterised by the fact that the electro-motive forces either of the dynamo, or of the second source of current or of both are changed by known means intentionally and independently of the speed of the engine.



GB 9354/1907

Patents obtained by Henri TUDOR's associates

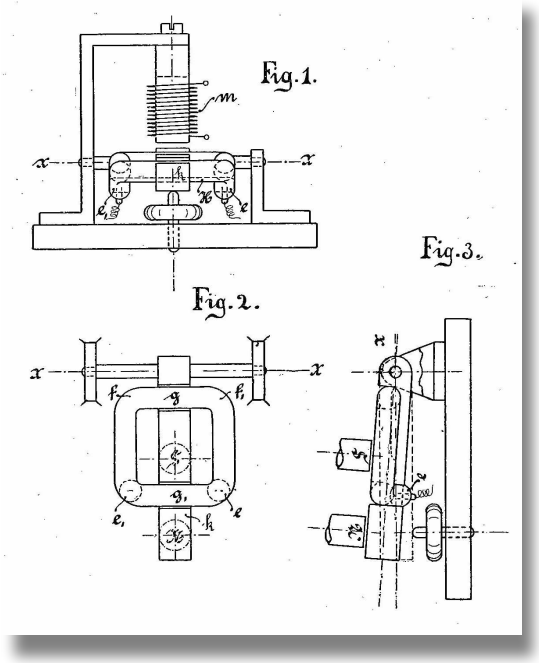
Hubert TUDOR [42]

A - Application date: 21 February 1898

Elektromagnetischer Schaltapparat mit Quecksilber

Switzerland

Ein elektromagnetischer Quecksilberschalter, bei welchem die Stromunterbrechung stets zwischen Quecksilber und Quecksilber erfolgt, gekennzeichnet durch die Anordnung eines beweglichen, elektromagnetisch verstellbaren Glasrohrsystems, in dessen Inneren mittels horizontal ausgedehnter Quecksilberbahn die Verbindung zwischen den in napfförmig versenkten Ecken des Gefäßes liegenden Stromschlußteilen hergestellt oder unterbrochen wird, sobald die Lage des Glasgefäßes um ein geringes relativ zur Horizontalebene verändert wird.



CH 16106

B - Application date: 16 May 1907

System of operating; electric vehicular traffic

United Kingdom

All systems of electric traction hitherto known may be divided into two principal categories.

> *Systems with automotors, that is to say, all systems in which the electric energy necessary for the traction is accumulated or produced on the motor vehicles themselves. All these systems have therefore motor vehicles possessing a generator group and a motor group.*
>
> *Systems based on the distribution of electric energy generated at central stations. Here the motor vehicles only possess a motor group and the energy necessary for this is generated in the central stations and conveyed by means of conductors placed along the track.*

This invention has for its object the combination of automotors with an electric line, which line has for its sole function to convey to motors, the power of which is for the time insufficient, electrical energy generated by other motors which also for the time have available a surplus of energy which they cannot themselves utilize.

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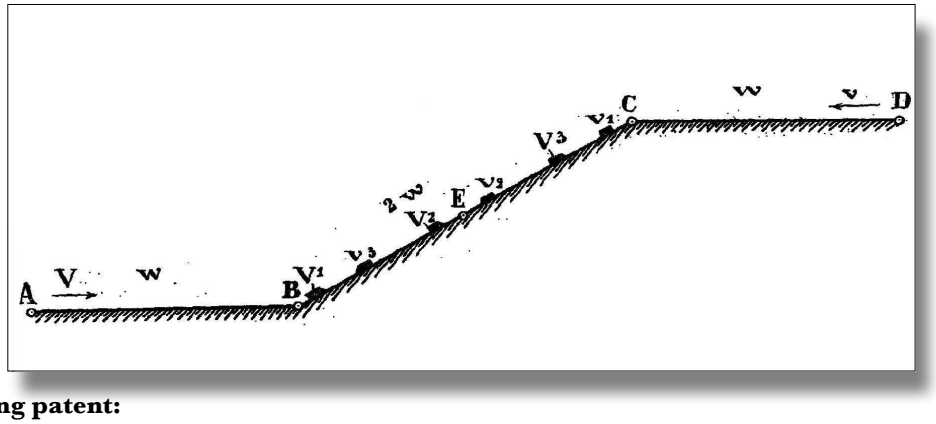
[42] *FamilySearch database (G6V3-KFC)*

The system described is in consequence characterized by the constantly balanced distribution of the electrical energy generated by différent automotors which always work under full load.

It will thus be seen that the present system is a combination of the two categories above set forth.

The motor vehicles on this system possess, like those of the systems of the first category, a generating group and a motor group. From the systems of the second category has been borrowed the electric conductor placed along the track but both the central station at a fixed point and the feeders conveying current from this central station to the conductor placed along the track are dispensed with.



Corresponding patent:

FR378545 (*Système de traction électrique par auto-moteurs et conducteurs compensateurs*)

Theodore PESCATORE [43]

A - Application date: 23 November 1900

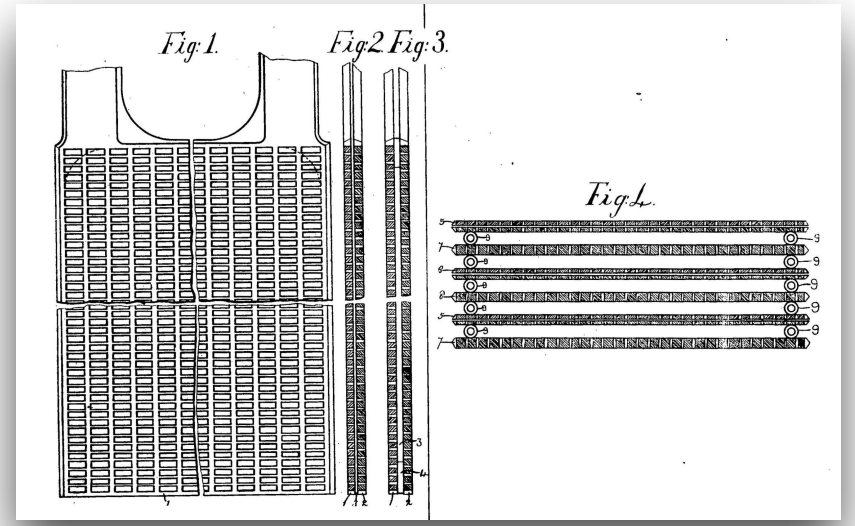
Improvements in secondary batteries

United Kingdom

This invention relates to secondary batteries, and has for its object the promotion of a good circulation of the acid in contact with the active material of the plate, and the obtaining of a very large surface of contact between the acid and the plate.

According to my invention I approximately double the area of the plate by forming the same not in one comparatively thick slab as has hitherto been the case but on the contrary in the form of two thin slabs or sheets arranged parallel to one another, the total weight of the bipartite or double plate being approximately the same as it would be if it were constructed in the usual manner in the form of a single slab. The interval formed between the two parallel plates is, when the plates are in use, filled with acid. By this construction and arrangement the area of the surface of contact between the plate and the acid is doubled. Further the thickness of the sheets being half that of the ordinary plate the circulation of the acid is materially increased by the percolation of the acid through the sheets.

[43] *FamilySearch database (G34Z-1F2), brother-in-law of Henri Tudor*



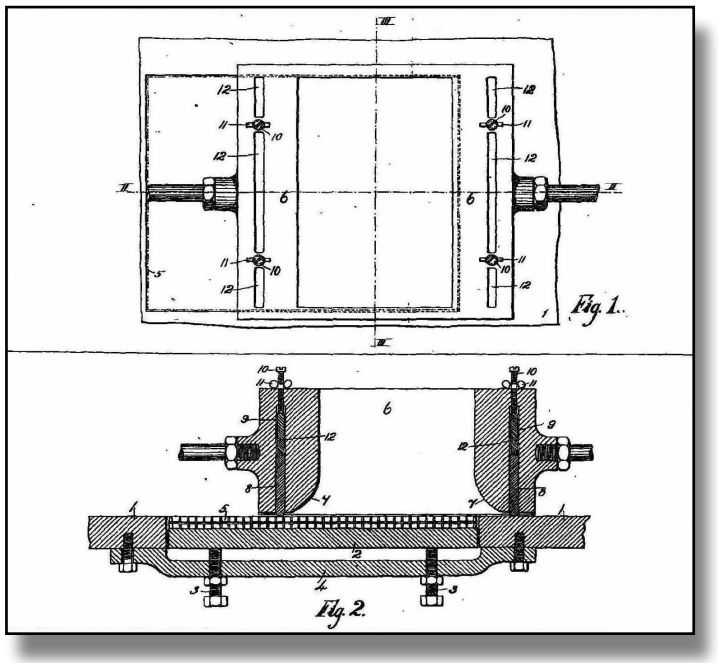
GB 21233/1900

B - Application date: 30 March 1901

Improvements in means for applying the active material to the plates of secondary batteries

United Kingdom

This invention relates to a machine or device for applying the active material to plates for secondary batteries or accumulators, and consists of an adjustable support on which the plates are placed while the active material is being applied to them, and of a bottomless receptacle for containing the active material and for applying the active material and pressing the same into the plate. The receptacle for containing the active material is characterised by its lower inner front and back edges being of rounded form and by the provision in its front and back ends of strips of india-rubber or other suitable material which are caused to press upon the accumulator plate and to compress the active material into the plate and to clean away any inequalities which may be produced during the application of the active material.



GB 6723/1901

C - Application date: 15 January 1904

Improvements in accumulators or secondary batteries

United Kingdom

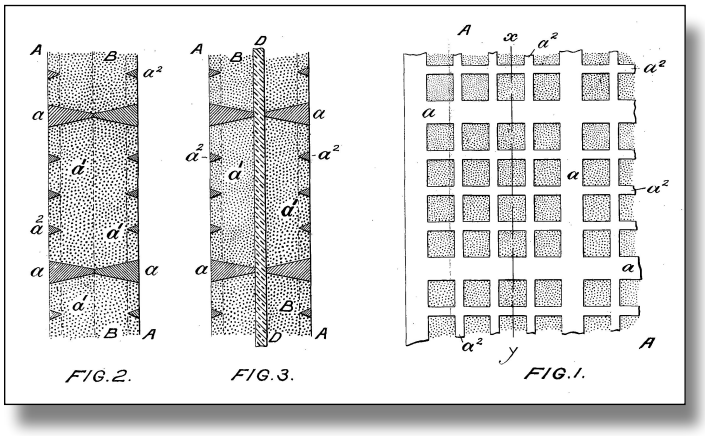
This invention relates to negative plates of secondary batteries or accumulators and is designed to produce a plate that will not lose its porousness and will constantly retain electrical contact between the several parts comprising it and consequently retain its conductivity.

The active material of the plates hitherto made consists of spongy lead which gradually shrinks under the action of charging and discharging until it becomes entirely crystallized and is practically transformed into metallic lead. The plate having thus lost its porousness becomes useless as an accumulator plate. This crystallization has been retarded or prevented by filling the interstices of the porous active material with a powdered inert material which, not being affected by the electrolytic processes or by the electrolyte, acts simply as a mechanical disturbance to prevent or retard the process, of crystallization of the active material.

I find on investigation that the action of the inert material is not limited to the prevention of crystallization but that, while acting to keep apart the grains or agglomerations of molecules of lead thereby retarding or preventing them crystallizing, small cavities are formed in which a certain quantity of gas is generated or accumulates during electrolysis which causes the spongy lead to disintegrate, and swell or expand. Consequent upon this expansion and tearing asunder of the molecules of the active spongy material electric contact is lost between its different particles and also between it and the lead plate or grid by which it is supported. This loss of contact between the parts causes loss of conductivity and when the expansion or swelling has continued for some time the plate loses its capacity.

I find by further experiment that if the active material in the interstices of the plate is mechanically prevented from swelling or expanding and constantly maintained in a state of compression the plate will retain its conductivity and efficiency for a much longer period.

My invention consists essentially in constructing an accumulator plate of hard lead grids between two of which an active material with a mixture of inert powder filling the interstices is tightly held to prevent expansion or swelling.



GB 1036/1904

Antoine Bonaventure PESCATORE [44]

A - Application date: 23 February 1910

Improvements in and relating to the ventilation of electric accumulator cells

United Kingdom

This invention relates to the ventilation of electric accumulator cells. To remove the gases evolved during the charge and to cool the electrolyte in closed electric accumulator cells, for example as used in electric boats a

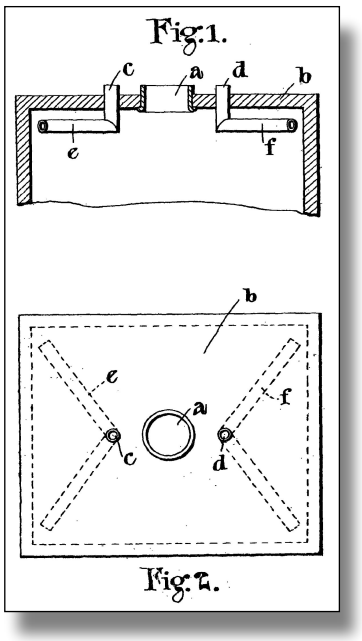
[44] *FamilySearch database (G34Z-RRR), brother-in-law of Henri Tudor*

current of air is passed over the surface of the electrolyte; this ventilation is obtained by the use of compressed air, by suction or by both compression and suction.

Heretofore the best method of removing the gases as completely. as possible was by the admission of air at the sides of the cell and its removal through an aperture situated in the centre of the lid. If, however, the openings for the admission of air be placed near the sides of the box there is a risk of electrolyte being split by the rolling or pitching of the boat.

The object of the present invention is to obtain an arrangement applicable especially to the ventilation of cells in boats obviating the danger of spilling and giving at the same time a complete removal of the gases and an efficient cooling of the electrolyte.

The invention consists, in means for the. ventilation of electric accumulator cells in which air or gases are removed from the cell by an aperture in the lid and air or the like is introduced into the cell by leads terminating near the sides of the cell and preferably in the corners. The air may be forced in at any aperture, sucked out at any aperture, or may. be forced in at one aperture and sucked out at another.



GB 4567/1910

Addendum 1

Transcription of LU patent n° 771

Description

déposée à l'appui d'une demande de brevet d'invention de 15 ans formulée par Monsieur Henri Tudor, ingénieur demeurant à Rosport, pour de nouveaux perfectionnement apportés aux électrodes des accumulateurs électriques.

Le perfectionnement réside dans une construction particulière et un nouveau genre de formation des plaques formant les électrodes des éléments secondaires ou accumulateurs, dans le brevet [but] de donner à ces électrodes une grande surface active en même temps q'une grande rigidité, une grande conductibilité électrique, en y fixant parfaitement les oxydes de plomb et enfin d'empêcher la déformation ou le boursouflement des plaques; les déformations provenant de l'accroissement et de la diminution alternatives des masses d'oxyde de plomb durant la charge et la décharge des éléments.

Fig. I: Les électrodes sont constituées par une âme en plomb coulée et ont la forme de plaques présentant sur leurs deux surfaces des rainures très rapprochées, symétriques et parallèles plus ou moins profondes et formées conséquemment.

Les nervures également coïnques [coniques] formant ces différentes rainures sont reliées à chacune de leurs extrémités à des renforts par l'intermédiaire desquels les plaques reposent sur les cales placées au fond du récipient et qui supporte ainsi tout le poids de la plaque.

Les plaques ainsi constituées forment les âmes des électrodes et servent de support aux oxydes et sels de plomb qui y seront appliqués.

Ces plaques sont placées verticalement dans des récipients renfermant de l'eau acidulée à l'acide sulfurique et sont traitées durant plusieurs jours par un courant électrique alternativement renversé d'après la méthode de Monsieur Gaston Planté. Toutes leurs surfaces se recouvrent ainsi d'une faible couche poreuse et adhérente d'oxyde de plomb et de plomb réduit.

Les rainures sont ensuite remplies d'une pâte légèrement pressée et formée par la _icturation d'oxyde de plomb minium avec de l'eau acidulée au même degré que le liquide dans lequel les électrodes viendront plonger dans la suite généralement au dixième.

De cette façon on évite toute action chimique de l'eau acidulée sur la pâte de minium au moment où l'on plonge les électrodes dans l'eau acidulée, action chimique qui désagrégerait et ferait tomber la pâte.

Les électrodes sont ensuite traitées par un courant de faible intensité jusqu'à ce que toute la pâte de minimum se soit transformée en peroxyde de plomb sur la plaque positive et en plomb réduit sur l'électrode négative.

Par suite de l'application de la pâte de minium sur des surfaces déjà recouvertes d'une légère couche poreuse est adhérente d'oxyde et de plomb réduit il résulte un enchevêtrement des particules de la pâte avec les molécules formées d'après la méthode de Monsieur Planté.

C'est ainsi que ces dernières molécules forment une liaison parfaite entre la pâte et le plomb métallique qui lui sert de support.

Durant la charge et la décharge de l'élément les particules de la pâte en se dilatant et en se contractant pourront glisser sur les molécules adhérentes à la plaque sans produire de rupture suivant les surfaces de contacts ; ruptures qui se produiraient si la même pâte avait été appliquée sur des surfaces de plomb lisses et glissantes et qui donnerait lieu à de mauvais contacts et à une forte résistance électrique dans l'élément.

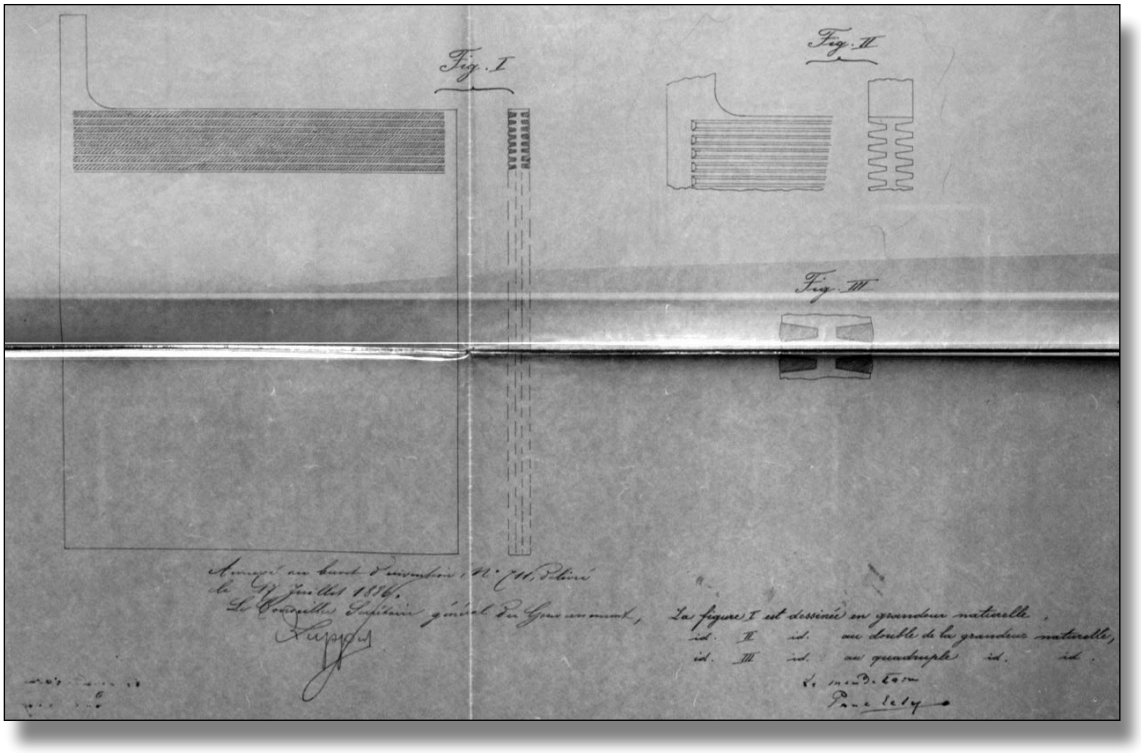
De plus, par suite de la conicité même des rainures, les réactions des pressions que la pâte exerce sur les parois des rainures en se dilatant pendant l'oxydation, permet à cette masse de pâte de se déplacer seulement dans le sens de la flèche (v. figure III) [sans flèche] *sans produire la moindre déformation ou boursouflement dans la plaque de plomb.*

En résumé

La demande a pour objet la délivrance d'un brevet pour:

1) la forme particulière à rainures rapprochées symétriques et coinques [coniques] donnée au châssis de plomb formant l'âme des électrodes et servant de support conducteur aux oxydes et sels de plomb qui y sont empâtés.

2). L'application de la pâte composée de sel de plomb et d'eau acidulée à l'acide sulfurique sur des châssis à rainures décrits précédemment et en général sur des châssis nus ou perforés de trous ou renfermant des cavités de forme quelconque dont les surfaces ont été au préalable recouvertes d'une couche d'oxyde de plomb ou de plomb réduit par voie électrique d'après la méthode de Monsieur Gaston Planté.



Addendum 2

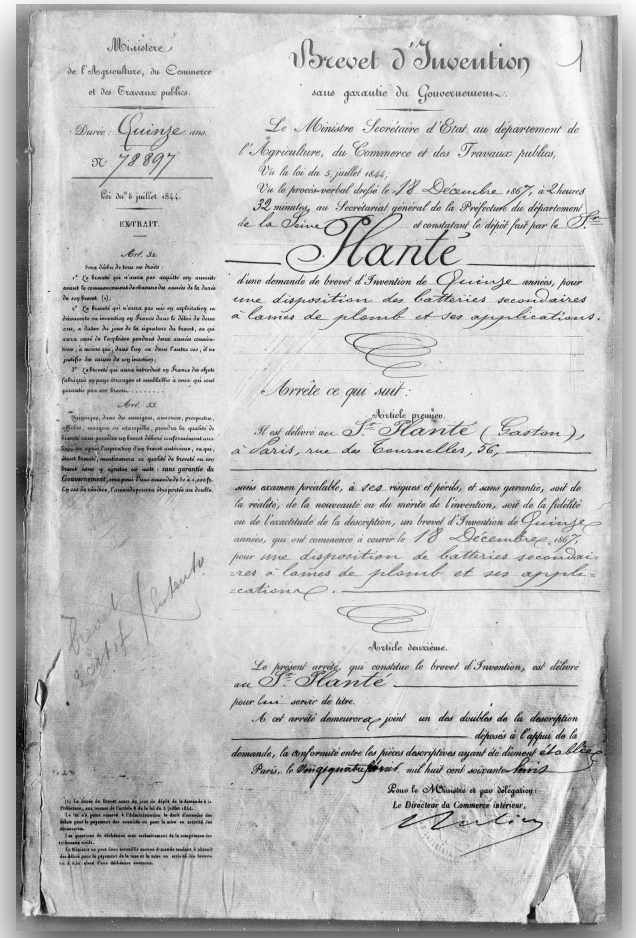
Dominating patents in the "lead-acid accumulator" field

Planté

Gaston PLANTÉ was the inventor of the lead acid accumulator.

On 18 December 1867 he filed a patent application in France and obtained patent N° 78897.

Disposition de batteries secondaires à lames de plomb et ses applications.



Ministère de l'Agriculture, du Commerce et des Travaux publics.

Durée : Quinze ans.

N° 78897

Loi du 5 juillet 1844.

EXTRAIT.

Art. 32.

Art. 33.

Brevet d'Invention

sans garantie du Gouvernement.

Le Ministre Secrétaire d'État au département de l'Agriculture, du Commerce et des Travaux publics,

Vu la loi du 5 juillet 1844;

Vu le procès-verbal dressé le 18 Décembre 1867, à 2 heures 32 minutes, au Secrétariat général de la Préfecture du département de la Seine, et constatant le dépôt fait par le Sr Planté

d'une demande de brevet d'Invention de Quinze années, pour une disposition des batteries secondaires à lames de plomb et ses applications.

Arrête ce qui suit :

Article premier.

Il est délivré au Sr Planté (Gaston), à Paris, rue des Tournelles, 36,

sans examen préalable, à ses risques et périls, et sans garantie, soit de la réalité, de la nouveauté ou du mérite de l'invention, soit de la fidélité ou de l'exactitude de la description, un brevet d'Invention de Quinze années, qui ont commencé à courir le 18 Décembre 1867, pour une disposition de batteries secondaires à lames de plomb et ses applications.

Article deuxième.

Le présent arrêté, qui constitue le brevet d'Invention, est délivré au Sr Planté pour lui servir de titre.

Il est arrêté demeurera joint un des doubles de la description déposés à l'appui de la demande, la conformité entre les pièces descriptives ayant été dûment établie.

Paris, le vingt-quatre décembre mil huit cent soixante-sept.

Pour le Ministre et par délégation :
Le Directeur du Commerce intérieur,

(Source: Institut national de la propriété industrielle)

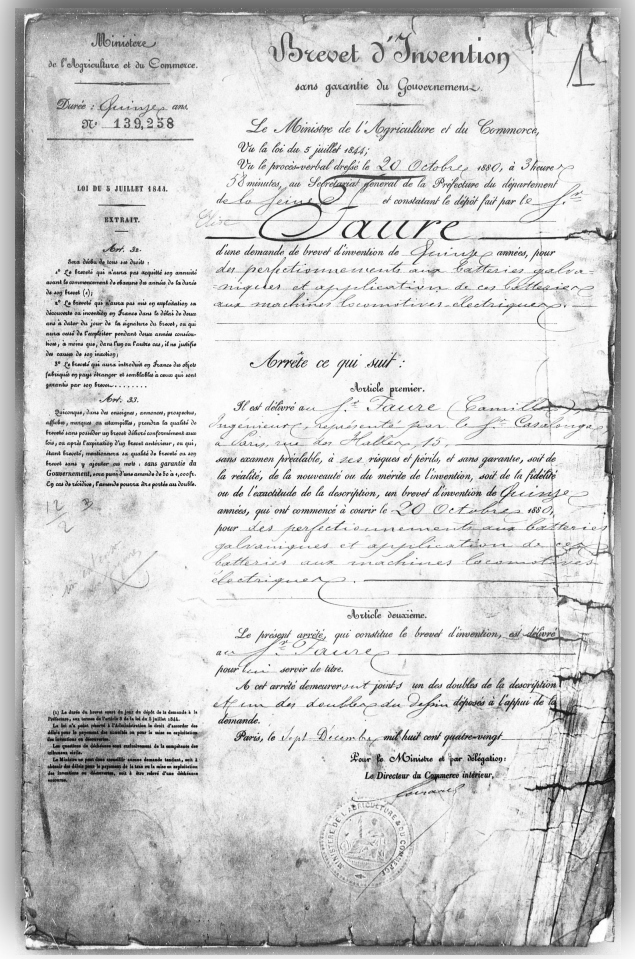
The patent expired in 1882.

PLANTÉ did not manage to make an industrial success of this invention but Camille FAURE did in 1880 by inventing a new process of preparing Planté-type electrodes in a much shorter time than by using PLANTÉ's method.

Faure

Camille FAURE filed a patent application in France on 20 October 1880 and obtained patent N° 139258. He subsequently filed 2 *certificats d'addition.*

Perfectionnements aux batteries galvaniques et application de ces batteries aux machines locomotives électriques.



Ministère de l'Agriculture et du Commerce.

Durée : Quinze ans.
N° 139,258

LOI DU 5 JUILLET 1844.

EXTRAIT.

Art. 32.

Sont déchus de tous leurs droits :

1° Le breveté qui n'aura pas acquitté ses annuités avant le commencement de chacune des années de la durée de son brevet (1);

2° Le breveté qui n'aura pas mis en exploitation sa découverte ou invention en France dans le délai de deux ans à dater du jour de la signature du brevet, ou qui aura cessé de l'exploiter pendant deux années consécutives, à moins que, dans l'un ou l'autre cas, il ne justifie des causes de ses inactivité;

3° Le breveté qui aura introduit en France des objets fabriqués en pays étranger et semblables à ceux qui sont garantis par son brevet.....

Art. 33.

Quiconque, dans des enseignes, annonces, prospectus, affiches, marques ou estampilles, prendra la qualité de breveté sans posséder un brevet délivré conformément aux lois, ou après l'expiration d'un brevet antérieur, ou qui, étant breveté, mentionnera sa qualité de breveté en ayant besoin sans y ajouter ces mots : sans garantie du GOUVERNEMENT, sera puni d'une amende de 50 à 1,000 francs. En cas de récidive, l'amende pourra être portée au double.

(1) La durée du brevet court du jour du dépôt de la demande à la Préfecture, aux termes de l'article 8 de la loi du 5 juillet 1844.

La loi n'a point réservé à l'Administration le droit d'accorder des délais pour le payement des annuités ou pour la mise en exploitation des inventions ou découvertes.

Les questions de déchéance sont entièrement de la compétence des tribunaux civils.

Le Ministre ne peut donc accueillir aucune demande tendant, soit à obtenir des délais pour le payement de la taxe ou la mise en exploitation des inventions ou découvertes, soit à faire relever d'une déchéance encourue.

Brevet d'Invention
sans garantie du Gouvernement

Le Ministre de l'Agriculture et du Commerce,
Vu la loi du 5 juillet 1844;
Vu le procès-verbal dressé le 20 Octobre 1880, à 3 heure 30 minutes, au Secrétariat général de la Préfecture du département de la Seine, et constatant le dépôt fait par le Sr Faure
d'une demande de brevet d'invention de Quinze années, pour des perfectionnements aux batteries galvaniques et application de ces batteries aux machines locomotives électriques;

Arrête ce qui suit :

Article premier.

Il est délivré au Sr Faure (Camille), Ingénieur, demeurant à Paris, rue des Halles, 15, sans examen préalable, à ses risques et périls, et sans garantie, soit de la réalité, de la nouveauté ou du mérite de l'invention, soit de la fidélité ou de l'exactitude de la description, un brevet d'invention de Quinze années, qui ont commencé à courir le 20 Octobre 1880, pour des perfectionnements aux batteries galvaniques et application de ces batteries aux machines locomotives électriques.

Article deuxième.

Le présent arrêté, qui constitue le brevet d'invention, est délivré au Sr Faure pour lui servir de titre.

A cet arrêté demeurent joints un des doubles de la description et un des doubles du dessin déposés à l'appui de la demande.

Paris, le 1er Décembre mil huit cent quatre-vingt

Pour le Ministre et par délégation :
Le Directeur du Commerce intérieur,

(Source: Institut national de la propriété industrielle)

FAURE also protected his invention by patents in Germany and the USA, two countries which examined patent applications before granting them.

His patents were challenged in the 1880s in both jurisdictions but his invention was recognised as patentable and he eventually had his broad patent claims confirmed in both states.

Patent litigation

Germany

Around 1890 the Berlin Accumulator Co., Correns and Co., de Khotinsky, Gelnhausen and Gottfried Hagen brought an action for the cancellation of FAURE's patent before the *Reichsgericht* in Leipzig. [45] At that time the patent was owned by the *Electric Power Storage Co*.

The main claim, as granted on 29 August 1882, was maintained:

> *Die vorgängige Hervorbringung einer metallischen, schwammigen (porösen) Schicht auf den Elementen der Secundär-Batterieen, sei es durch Überstreichen oder galvanische oder chemische Niederschläge, wobei diese Schicht, welche aus Blei im Zustand des Überoxydes, Oxydes oder unlöslicher Salze besteht, die Batterie befähigt, eine sehr grosse Menge von Elektricität aufzuspeichern und zu weiterer Verwendung bereit zu halten.*

[45] *Patentblatt, 1892, Nr 43, pages 611-617*

In a second decision in a patent infringement case of the FAURE patent, brought before the *Reichsgericht* in Berlin, the latter stated the following in 1894: [46]

> *Nach dem Anspruch 1, wie sich dessen Bedeutung aus seiner Fassung in Verbindung mit den Erläuterungen der Patentschrift und der Fassung des Anspruches 4 ergiebt, ist es allein wesentlich, dass die Elektroden zusammengesetzt sind aus einem Träger und beigefügter wirksamer Masse. Ob der Träger die Form einer Platte oder eines Geflechtes oder eines Gitters hat, und ob die wirksame Masse mit einem Pinsel oder anderem geeigneten Werkzeuge auf den Träger aufgetragen oder durch irgend welche Werkzeuge in den (gitterförmigen) Träger hineingepresst wird, ist gleichgültig, da es sich hierbei nur um eine Verschiedenheit des Verfahrens bei Herstellung der Elektroden handelt.*

In 1893 the FAURE patent was thus given in Germany a very broad scope of protection. Interestingly enough, the FAURE patent was due to lapse soon after, namely on 8 February 1896, which shows how important it was and how bitterly it was defended and enforced.

TUDOR's electrode, although patented, clearly fell under the protection of the FAURE patent. It certainly was an improvement on the FAURE patent as shown by its commercial success, but it was dependent on the FAURE patent. The TUDOR system needed to use the teachings of the FAURE patent.

However, the successive companies that commercialised TUDOR's accumulators in Germany had managed to avoid patent infringement claims and eventually acquired the FAURE patent in 1890 when the company *Accumulatoren-Fabrik AG.* (AFA) was created.

France

The owners of the FAURE patent in France (*Société française des accumulateurs*) conducted a patent infringement suit in France against ROUSSEAU in which the validity of the FAURE patent was challenged.

The claim, as initially formulated in France, was drafted in these terms:

> *La préparation des lames en plomb ou toute autre matière convenable faisant fonction d'éléments dans les piles de polarisation, soit avec une couche ou enduit de plomb pulvérulent obtenue par voie galvanoplastique ou autrement, soit avec des selles de plomb mélangés ou non avec des particules finement pulvérisées, de manière, par leur réduction, à obtenir une couche de métal rugueux et spongieux, à la surface des éléments, ou d'un élément, préférablement des deux éléments; étant entendu que je puis aussi, pour enduire mon élément, appliquer les oxydes d'étain et de manganèse, ou construire des piles dans lesquelles une lame de plomb est recouverte de sel de plomb, ou de plomb spongieux, et l'autre lame ou élément quelconque est recouverte d'oxyde de manganèse.*

The *Chambre des appels correctionnels de la Cour de Paris* decided on 5 May 1893 that FAURE's patent was valid. It defined the scope of protection of FAURE's invention as follows: [47]

> *Considérant que Faure eut l'idée, sans rien changer au mode de formation employé par Planté, de substituer aux plaques de plomb pur aux dépens desquelles se formait la pile secondaire, de nouvelles plaques, dans lesquelles le plomb ne jouait plus que le rôle de support et qu'il enduisait d'un oxyde ou d'un sel de plomb ;*
>
> *Que, cette matière étant beaucoup plus pénétrante aux actions chimiques développées par le courant électrique, la pile secondaire se formait plus rapidement et acquérait en quelques jours l'état spongieux recherché et se trouvait achevée dans un intervalle de 80 à 150 heures, résultat qui permettait à cette sorte de pile d'entrer dans la phase pratique de son emploi industriel;*

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[46] *Patentblatt, 1894, Nr 43, pages 122-126*

[47] *Annales de la propriété industrielle 1893-1, pages 191-203*

Considérant que ce qui caractérise l'invention de Faure c'est d'avoir remplacé, par l'application manuelle ou mécanique d'une matière plombique, le long travail que Planté n'avait su réaliser que par l'action électrolytique; de manière à ce que les premières atteintes de l'action électrolytique rencontrassent une couche métallique aussi profonde que possible combinée à l'oxygène.

USA

FAURE's patent application, filed on 20 April 1881, proceeded to grant very quickly on 3 January 1882. [48]

The main claim that was allowed was formulated as follows:

As an improvement in secondary batteries, an electrode consisting of a support coated on one or more faces with an active layer of absorptive substance such as metal or metallic compound applied thereto in the described condition so as to be or instantly become spongy, and thus capable of receiving and discharging electricity, as stated, in contradistinction to a metallic plate itself rendered spongy by the disintegrating action of electricity, substantially as and for the purpose set forth.

Brush

US inventor Charles Francis BRUSH had come up with the same invention as FAURE at about the same time. The latter, however, had filed his patent application in the USA two months earlier than BRUSH. The US Patent Office should have detected that it had received two colliding applications for substantially the same invention and it should have examined the FAURE patent application in the light of the BRUSH patent application before granting it. However, the Patent Office failed to do so and the FAURE patent issued in 1882 with a very broad claim.

BRUSH, whose patent application was still under examination in 1882, started a so-called "interference" procedure before the Patent Office [49] to prove that he had "reduced the invention to practice" in the USA before FAURE and that therefore he was entitled to the corresponding patent in the USA, rather than FAURE.

BRUSH prevailed in the interference procedure before the Patent Office and obtained 2 patents with claims as broad as those obtained by FAURE.

FAURE's US patent, however, having been already granted by the US Patent Office remained unaffected by the procedure.

The US magazine "The Electrician and Electric Engineer" summarised the patent situation in the USA in 1887 as follows: [50]

The fundamental feature in the making of the storage battery for practical use and commercial business is clearly the substitution of the mechanical preparation of the plates for the slow process of electrical formation as practiced in the Planté battery. For the control of the invention of mechanically formed electrodes there is likely to be a contest.

The Faure patent of January 3d, 1882, No. 252,002, and the Brush patents of March 2d, 1886, Nos. 337,298 and 337,299, appear to cover substantially the same invention, to wit, the mechanical formation of electrodes ready to receive a charge, in contradistinction to the electrically formed electrodes previously well known. Faure's invention was patented in France, October 20th, 1880. His application for a United States patent was filed April 20th, 1881. Brush's applications were filed June 12th and 13th, 1881, respectively. Whether by oversight on the part of the patent office or otherwise, the Faure patent of January 3d, 1882, was issued, notwithstanding the pendency of Brush's applications.

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[48] US patent N° 252002

[49] A procedure used in the USA up to 2013 for avoiding double patenting of inventions

[50] The Electrician and Electric Engineer, Vol. 6 1887, pages 1-2

As soon as the Faure patent issued and the claim became public, Brush took the only course that was open to him. He demanded an interference between his applications (of which there were several) and the Faure patent, and publicly announced in the New York press on May 17th, 1882, his rights and claims in the matter, and that they would be enforced. The interference was declared May 13th, 1882. Two other parallel interferences were also declared and another application by Faure was included, and other parties and claimants to the broad invention were brought in. Eventually the three interferences were entitled respectively, Keith vs. Shaw vs. Maloney & Burger vs. Brush vs. Faure ; Keith vs. Shaw vs. Brush vs. Faure ; and Maloney & Burger vs. Brush vs. Faure. And they proceeded together, the issues or claims involved varying slightly in the three interferences, but including the broad generic claim to the mechanical process and battery as distinguished from Planté's.

These proceedings in the patent office were greatly prolonged through motions to postpone the interferences, which were appealed through every tribunal to the secretary of the interior. Pending these delays in the patent office, and about four years ago [1883], the Faure people began a suit for infringement of the Faure patent against the Brush company. An answer was promptly filed by the Brush company, but the Faure people, apparently, have never since taken any further steps forward with the suit.

In the patent office proceedings, the testimony of all parties was finally completed and the interferences argued, and decided, all three of them, in favor of Brush, and on the resulting appeals those decisions were all sustained, and patents were in consequence issued to Brush on March 2d, 1886. The decision of the interferences in favor of Brush, and the issue of his patents, exhaust the powers of the patent office in determining title to the invention, in as much as the patent office cannot annul a patent once issued. As evidence they create a presumption in favor of Brush, but the control of the invention must be finally adjudicated in the courts.

The validity of the FAURE patent, however, was examined by a US court when the owners of the patent, the *Electrical Accumulator Co*., initiated a patent infringement suit against the company *Julien Electric Co*. The Circuit Court of New York had to decide on the validity and scope of the FAURE patent as granted in 1882.

The Court allowed the patent claim in the wording as granted initially under the provision of a "disclaimer" which *Electrical Accumulator Co*. accepted: [51]

The part of the invention which bona fide belongs to Faure is an electrode in a secondary battery consisting of a support coated with an insoluble layer of active material in the form of a paint, paste, or cement, so as to be or instantly become spongy, etc. It was this that the scientific world recognized as a discovery of great merit and importance. It was this that the distinguished Scotch electrician regarded as "marvellous". And this was the result of Faure's genius. No one anticipated him. It is honestly his. What he did not invent was an electrode, in a secondary battery, coated with a soluble layer of active material. Neither did he invent an electrode on which the active material is applied by "galvanic action, or chemical precipitation, or otherwise." The claim is broad enough to cover all these forms probably, and some of them certainly. What he is not fairly entitled to he wishes to give up, and keep what is certainly his own. He does not seek to broaden his patent, but greatly to restrict it. No one will infringe unless he constructs his battery in the one way to which the patent will be confined. This is the patentee's way, and it has many distinguishing characteristics which differentiate it from the ways pointed out by others. The matter to be relinquished is distinct and separate, and can be exscinded without mutilating what is left. No amendment is necessary. The claim, read in the light of the description, is too broad. It is sought to limit it. The disclaimer suggested will not make a new patent, or a different invention. The invention is fully described in the specification, and the limited claim will stand on that description. After giving the subject the most careful consideration it is thought that Faure was the originator of the invention just described, and that it would be unjust to him to declare the patent wholly void, if he is willing to restrict it to what is lawfully his own.

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[51] *Federal Reporter, Vol. 38, 1889, page 117-143, Electrical Accumulator Co. v. Julien Electric Co. et al.*

"TUDOR System"

In the absence of dominating patent rights owned by Henri TUDOR and his associates, their technology and combined marketing strategy is generally referred to as the "TUDOR System". [52]

> *The system adopted by the Works (Accumulator Works in Hagen, Germany) is that of Henry Tudor, and is materially different from that of any other system in use today, not only in respect to construction of plates, but also in the method of operating, managing, and employing the batteries. The latter is not the least important point, and needs more elucidation.*
>
> *Mr. Tudor has, for the first time, adopted the golden mean; the positive plate is cast and represents a surface with small parallel grooves; the positive plate shown in Fig. 1, is cast and represents a surface with small parallel grooves, while Fig. 2 gives its exact cross section. A peculiar forming process first provides the cast plate with an active layer, and after this layer has been established, red lead is applied as a paste according to Faure's method. But this paste is not intended to provide for the capacity of the plate, except during its early life (between 6 and 10 months). It falls out of the grooves after that time and is just so calculated that the Planté layer which has been formed on the surface during that time provides for the entire capacity after the first year of use.*
>
> *The surface of the conductor or plate is larger than in other known plates, and owing to this circumstance, affords not only a considerable Planté layer, but also makes possible very large rates of charge and discharge. These plates are easily charged within 4 hours and discharged within 3⅓ hours; these are the normal rates which may be doubled for short intervals. This fact is both electrically and commercially valuable.*
>
> *The Tudor accumulator is manufactured by separate companies in Germany, Belgium, Switzerland, Austria, Italy and France. All these companies guarantee their products in the following manner: The company takes care of the batteries for from one to ten years and guarantees their good working by contract; the customer has to live up to the directions given for each battery and to pay between 5 and 10 per cent of the value of the battery each year during the term of the contract. The yearly amount of payment depends on the size of the batteries, the kind of work performed by the battery, the distance from the factory, etc. Every three months, an engineer visits all the batteries to see how they are handled and how they are working, and makes his reports accordingly. Automatic devices are, if possible, made use of to control the management of large batteries. After 10 years of service, the company claims that the battery will still have the same capacity as it had at the beginning of its work. Experience with three batteries now seven years in operation seems to justify this claim. The reputation, and practical value of the Tudor accumulator for lighting purposes, has been established wherever it is known. Since some time also portable accumulators are manufactured by the Tudor Companies.*

Another source explains: [53]

> *Henri und Hubert Tudor suchten das von Faure erstrebte Ziel dadurch zu erreichen, dass sie gewissermassen das Planté'sche Verfahren zur Formirung der Platten mit dem Faure'schen Verfahren vereinigten, wobei sie den Bleiplatten eine Form gaben, bei welcher die active Masse sich vollständig frei bebewegen kann, ohne die Träger der Masse in Mitleidenschaft zu ziehen.*
>
> *Es werden statt der glatten Bleiplatten, beziehungsweise solcher von Drahtgeflecht, massive Bleikerne verwendet, welche auf beiden Seiten mit parallelen, etwa 2 bis 3 mm. tiefen Rippen versehen sind. Diese Rippen verjüngen sich nach aussen zu, wodurch eben nach Ansicht der Fabrikanten der Vortheil erreicht werden soll, dass die zwischen den Rippen befindliche active Masse nicht etwa eingekeilt oder eingeklemmt ist, sondern sich vollständig frei ausdehnen und wieder zusammenziehen kann.*

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[52] The Electrical Engineer, Vol. XIV, 16 November 1892, pages 465-468

[53] Elektrotechnische Bibliothek, J. Sack, 1892, Die elektrischen ACCUMULATOREN und ihre Verwendung in der Praxis, pages 59-64

Diese Form der Elektroden giebt ausserdem im Verhältniss zu ihrem Gewicht eine grosse Oberfläche, was in Bezug auf grossen Lade- und Entladestrom nicht zu unterschätzen ist.

Von den Elektroden werden nur die positiven Platten einer besonderen Formirung unterzogen und ungefähr 1½ bis 2 Monate nach einem modificirten Planté'schen Verfahren behandelt, worauf die Zwischenräume der Rippen mit einer aus Bleisalzen, beziehungsweise Bleioxyden bestehenden Masse ausgefüllt werden. Eine weitere, ungefähr einen Monat dauernde Formirung verwandelt diese Bleisalze in reines Bleisuperoxyd. Die negativen Elektroden werden mit einer activen Masse nicht versehen.

Das freie Spiel der activen Masse hat im Gefolge, dass sich ein Theil derselben, und zwar der nach aussen liegende, von den Elektroden abstösst. Der übrige Theil der activen Masse, welcher sich in unmittelbarer Berührung mit der durch die Formirung gebildeten Bleisuperoxydschicht befindet, verbindet sich mit diesem rein krystallinischen, mit dem Bleikern in metallischem Zusammenhang stehenden Ueberzug zu einer genügend starken Schichte. Letztere ist ebenfalls rein krystallinisch und von dem Metallkern schwer ablösbar, so dass die positive Tudor'sche Elektrode nach einem etwa einjährigen Betriebe als eine reine Planté'sche Elektrode angesehen werden kann, welcher bei richtiger Behandlung eine unbegrenzte Lebensdauer nachgerühmt wird.

Die äusserst lange Dauerhaftigkeit der Tudor'schen Elektrode findet ihre Bestätigung in der seit 1884 in der Beleuchtungsanlage in Rosport in Betrieb befindlichen Accumulatoren-Batterie, deren Elektroden nach den Untersuchungen von Kohlrausch in keiner Weise den Schluss zulassen sollen, dass der sechsjährige Betrieb, welchen sie bereits hinter sich haben, ihnen geschadet oder ihre Haltbarkeit beeinträchtigt habe. Es sei auch jetzt noch eine fernere, grosse Lebensdauer derselben wahrscheinlich.

Final note:

The "TUDOR System", consisting of a particular configuration of the plates, giving these plates a specific "Planté" treatment, applying a layer of oxydes onto the plates and subjecting these plates subsequently to several cycles of charging and discharging was probably a very precisely tuned process which had been developed by TUDOR over years.

It was not a patented system, suitable for licensing.

If the very details of the process had been disclosed in a patent, it could hardly have been policed in third party manufacturing plants.

The fact that the "TUDOR System" was not licensed to third parties and kept in-house within factories owned by TUDOR and his associates confirms this view.

Furthermore, the "TUDOR System" could not have been successfully licensed as such, as it was dependant on FAURE's patent and could not have been practised without a license from the owners of that patent, namely the company AEG.

TUDOR's associate MÜLLER resolved the problem by creating in 1890 the company AFA which incorporated AEG and thereby the new company acquired the dominant FAURE patent. The FAURE patent was still under litigation in Germany at the time and was was finally declared valid, but expired already 2 years later.

Addendum 3

Henri Tudor's patents (listing) [54]

	Title	Publication number	Date of application
1A	Perfectionnements apportés aux électrodes des accumulateurs électriques	LU 711	17/07/1886
1A		BE 75066	30/10/1886
1A	Nouveaux perfectionnements apportés aux électrodes des accumulateurs électriques	FR 179393	02/11/1886
1B	Electrodes for secondary batteries	GB 11543/1887	24/08/1887
1B	Nouveaux perfectionnements apportés aux électrodes des accumulateurs électriques	FR 179393 (1er cert.)	25/08/1887
1B	Electrodes for secondary batteries	US 413112	21/05/1889
1B		BE 78654	
1B	Un procedimiento introducido en la construcción de los electrodos perfeccionados para acumuladores eléctricos *A method introduced in the construction of improved electrodes for electric accumulators*	ES 18264	16/11/1895
1C	Nouveaux perfectionnements apportés aux électrodes des accumulateurs électriques	FR 179393 (2e cert.)	12/05/1891
1C	Platten für Electricitätssammler	DE 61656	15/05/1891
1C		BE 94869	30/05/1891
1C	Platten für Elektrizitäts-Akkumulatoren	CH 4401	24/09/1891
1C	Electrode for storage batteries	US 478661	08/01/1892
1C	Perfeccionamientos introducidos en la construcción de los electrodos para acumuladores eléctricos. *Improvements introduced in the construction of electrodes for electric accumulators*	ES 13705	25/08/1892
1D	Improvements in the Manufacture of Positive Lead Electrodes for Electric Accumulators	GB 10718/1896	18/05/1896
1E	Un aparato, acumulador eléctrico "Tudor" *An appliance, Tudor electric accumulator*	ES 22344	14/03/1898
1F	Un procedimiento para fabricar placas o electrodos de acumuladores de gran superficie con o sin láminas transversales.	ES 28823	20/11/1901
2A	Nouveau compteur d'électricité	FR 183791	25/05/1887
2A	Improvements in registering meters for electric currents	GB 7857/1887	31/05/1887
2A	Electricitäts-Messapparat	DE 42148	17/06/1887

[54] see also Emile Hoffmann, "Henri Owen Tudor, Ingénieur, Commémoration du centième anniversaire de sa naissance", 1959

	Title	Publication number	Date of application
2B	Improvements in or appertaining to electric meters	GB 2168/1889	07/02/1889
3A	Un sistema de transformación de las corrientes continuas por medio de acumuladores eléctricos. *A system for transforming direct currents by means of electric accumulators.*	ES 20901	24/05/1897
3A	Improvements in Transforming Continuous Electric Currents	GB 12820/1897	24/05/1897
3A	Système de transformation des courants continus au moyen des accumulateurs électriques	FR 267230	24/05/1897
3B	Transformation d'un courant alternatif en un courant continu et vice-versa	FR 267272	25/05/1897
3B	Improvements in Transforming Alternating into Continuous Electric Currents or vice vers	GB 12957/1897	25/05/1897
3B	La transformación de una corriente alternativa en corriente continua y viceversa por medio del aparato que se describe. *The transformation of an alternative current into direct current and vice versa by means of the apparatus described*	ES 20909	25/05/1897
3C	Un sistema de transformación de las corrientes continuas por medio de acumuladores eléctricos. *A system for transforming direct currents by means of electric accumulators*	ES 22006 (certificado)	05/01/1898
3C	Transformation d'un courant alternatif en un courant continu et vice-versa	FR 267272 (1er cert.)	05/01/1898
3C	La transformación de una corriente alternativa en corriente continua y viceversa por medio del aparato que se describe. *The transformation of an alternative current into direct current and vice versa by means of the apparatus described*	ES 22007 (certificado)	05/01/1898
4	Improvements in the Electrical Propulsion of Carriages and other Vehicles, Boats, and the like	GB 15870/1897	03/07/1897
4	Un sistema de propulsión de corriente polifácea para carruajes y barcos A polyphaceous current propulsion system for carriages and ships	ES 21120	03/07/1897
5	Improvements in Preventing Sparking when Making and Breaking Electric Circuits	GB 00331/1898	05/01/1898
6	Dispositif de support élastique pour batteries d'accumulateurs	FR 351922	01/03/1905
7	Économiseur électrique automatique	FR 364405	19/03/1906
7	Improvements in Self-regulating Installations for Producing Electrical or Mechanical Power or both Simultaneously	GB 06602/1906	19/03/1906
8	Einrichtung zur Veränderung der Geschwindigkeit von Kraftmaschinen	DE 183322	27/04/1906
8	Apparatus for Varying the Speed of Motive Power Engines	GB 09354/1907	22/04/1907

Addendum 4

"Këppenhaff"

As seen above, Henri TUDOR'S father, John Thomas, had no agricultural experience when he came to Luxembourg around 1830. He learned the art of cultivation and raising livestock when he joined the LOSER family in Rosport in 1840.

John Thomas is reported to have been a driving force in founding the Grand-Duchy's *Ackerbauverein,* [55] although his name does not appear in the list of the 22 founding members: [56]

> *John Tudor gehörte zeitlebens zu den erfahrensten und fortschrittlichsten Agronomen des Landes. Er war einer der Mitgründer des im Jahre 1846 entstandenen Großherzoglichen Ackerbauvereins, und hat auf diesem Gebiete, in gemeinsamem Schaffen mit Baron de Blochhausen, Emmanuel Servais, de Wacquant und einigen anderen Zeitgenossen, Großes geleistet.*

A later publication of 1946 gives the following account : [57]

> *Der junge Engländer fühlte sich hierlands bald heimisch. Luxemburg wurde seine zweite Heimat, um die er sich durch Förderung des Ackerbaus sehr verdient machen sollte.*
>
> *Ihm wurde rasch ein gewisser Rückstand auf diesem Gebiet klar. Wohl hatte das Wälderdepartement unter der Republik eine Kommission für Landwirtschaft erhalten; von ihren Leistungen war aber wenig zu erkennen gewesen. Auch unter Kaiser Napoleon hatte sich die Verwaltung des Bauerntums weit weniger angenommen als der Industrie; nur für Pferde- und Schafzucht war manches geschehen. Seit 1815 besserten sich die Verhältnisse allmählich ohne das Niveau des fortschrittlichen England zu erreichen.*
>
> *J. Th. Tudors aufgeschlossenes und tatkräftiges Interesse für Bodenkultur kam unsern Vätern zugute. Die von ihm auf dem Landgute Kippenhof bei Diekirch eingerichtete Musterwirtschaft wirkte aufklärend und anfeuernd.*
>
> *Tudor spielte eine Hauptrolle bei der Anregung zur Schaffung eines das ganze Land umspannenden Ackerbau-Vereins für die Ackersleute und die Freunde der Landwirtschaft. Gemeinsam mit ihm verbreiteten Gesinnungsgenossen ein Rundschreiben und entwarfen die Statuten. Ihre Werbeaktion fand weithin Anklang. Vor 100 Jahren, am 8. Oktober 1846, wurde in Mersch unter Vorsitz des Staatskanzlers und Großgrundbesitzers Baron de Blochausen die feierliche Gründungsversammlung des Königl.-Großherz. Ackerbau-Vereins abgehalten. Bereits unterm 16. Oktober genehmigte Wilhelm II. die Statuten und übernahm das Protektorat der neuen Organisation, von der reicher Segen ausgegangen ist.*

In December 1846, soon after the creation of the *Ackerbauverein,* John Thomas joined Octave PÉRIN D'AUGNY [58] in *Këppenhaff* (Kippenhoff) to set up a model farm. It would appear that the latter had rented the *Këppenhaff* farm from Baron DE BLOCHAUSEN, who owned it. [59]

Octave was the son of Dominique PÉRIN D'AUGNY, *conseiller royal à la cour de Metz,* who owned the *Château de Moestroff.* The latter was married to Joséphine RECHT, born in Luxembourg, daughter of Jean Nicolas RECHT, *propriétaire, maire de Bettendorf* and *membre du Conseil Général du département des forêts.* The couple initially lived in Metz, where their four children were born, and later acquired the property in Moestroff.

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[55] *Obermosel-Zeitung, 14 November 1923, page 3*
[56] *Diekircher Wochenblatt, 17 April 1847, page 1*
[57] *Obermosel-Zeitung, 26 October 1946, page 5*
[58] *FamilySearch database*
[59] *Henri Werner & Ernest Reiter, Henri Owen Tudor, An idea and where it led, 2012, page 17*

In the 1843 Census of Moestroff the complete family, including Octave, is listed with the following note:

La famille Périn habite momentanément Moestroff, son domicile est à Metz.

The Périns sold the Moestroff property by auction in 1845 [60] and rented a property belonging to NEYEN-PETIT in Marienthal. [61]

The 1846 Marienthal Census confirms the move and shows that Octave had left the family to take over *Këppenhaff*.

In the years 1846 to 1850 the name PÉRIN D'AUGNY ("of Kippenhoff") appears regularly in the newspapers, with reference to awards won at agricultural shows. The name TUDOR is not mentioned.

PÉRIN D'AUGNY, in a letter to the editor of a British magazine in 1849, [62] gives an interesting view on the studies he was conducting in Kippenhoff.

Foreign correspondence

Kippenhoff, Luxembourg.

Being a constant reader of your Agricultural Gazette, and having seen so much valuable information given by means of it, I shall be infinitely obliged to you, or any of your correspondents who would be kind enough to give any information upon the following subject.

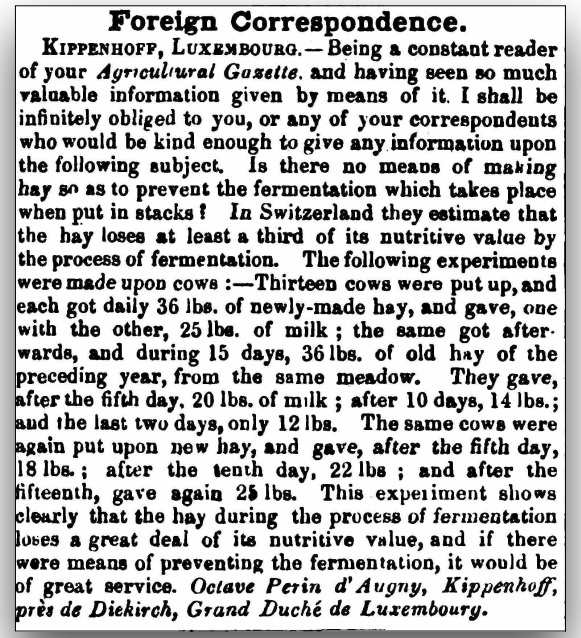
Is there no means of making hay so as to prevent the fermentation which takes place when put in stacks. In Switzerland they estimate that the hay loses at least a third of its nutritive value by the process of fermentation.

The following experiments were made upon cows :

Thirteen cows were put up, and each got daily 36 lbs. of newly-made hay, and gave, one with the other, 25 lbs. of milk ;

the same got afterwards, and during 15 days, 36 lbs. of old hay of the preceding year, from the same meadow. They gave, after the fifth day, 20 lbs. of milk ; after 10 days, 14 lbs.; and the last two days, only 12 lbs.

The same cows were again put upon new hay, and gave, after the fifth day, 18 lbs; after the tenth day, 22 lbs; and after the fifteenth, gave again 25 lbs.



Foreign Correspondence.

KIPPENHOFF, LUXEMBOURG.—Being a constant reader of your *Agricultural Gazette*, and having seen so much valuable information given by means of it, I shall be infinitely obliged to you, or any of your correspondents who would be kind enough to give any information upon the following subject. Is there no means of making hay so as to prevent the fermentation which takes place when put in stacks? In Switzerland they estimate that the hay loses at least a third of its nutritive value by the process of fermentation. The following experiments were made upon cows :—Thirteen cows were put up, and each got daily 36 lbs. of newly-made hay, and gave, one with the other, 25 lbs. of milk ; the same got afterwards, and during 15 days, 36 lbs. of old hay of the preceding year, from the same meadow. They gave, after the fifth day, 20 lbs. of milk ; after 10 days, 14 lbs.; and the last two days, only 12 lbs. The same cows were again put upon new hay, and gave, after the fifth day, 18 lbs.; after the tenth day, 22 lbs ; and after the fifteenth, gave again 25 lbs. This experiment shows clearly that the hay during the process of fermentation loses a great deal of its nutritive value, and if there were means of preventing the fermentation, it would be of great service. *Octave Perin d'Augny, Kippenhoff, près de Diekirch, Grand Duché de Luxemboury.*

This experiment shows clearly that the hay, during the process of fermentation, loses a great deal of its nutritive value, and if there were means of preventing the fermentation, it would be of great service. Octave Perin d'Augny, Kippenhoff, près de Diekirch, Grand Duché de Luxembourg.

In January 1850 Octave's father died in Marienthal and his mother left Luxembourg for France. [63]

At about the same time John Thomas TUDOR married Marie LOSER and the Kippenhoff experiment came to an end.

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[60] *Courrier Du Grand-Duché De Luxembourg, 21 May 1845, page 5*

[61] *Courrier Du Grand-Duché De Luxembourg, 30 March 1850, page 4*

[62] *Gardeners Chronicle and Agricultural Gazette, 10 March 1849, page 156*

[63] *L'indépendance luxembourgeoise, 26 October 1933, page 3*

During the year 1850 Octave PÉRIN D'AUGNY must have taken over a farm in Niederweis (Prussia), near Bitburg. [64] He was joined there by his oldest sister Adeline.

He remained a good friend of John Thomas TUDOR, judging from the fact that the two former Kippenhoff associates met in Mondorf for a thermal cure in July 1851. [65]

PÉRIN D'AUGNY kept in touch with the Luxembourg agricultural scene, as evidenced by his participation in the 1856 agricultural show in Fels (Larochette). [66]

In 1862, however, PÉRIN D'AUGNY could no longer be located in Niederweis. In a bailiff writ served on him through a local paper, he was reported "*sans domicile ni résidence connus*". [67]

> *Il résulte qu'il a été signifié et déclaré à Octave Périn d'Augny, fermier, demeurant à Niederweis, aujourd'hui sans domicile ni résidence connus, créancier hypothécaire produisant à l'ordre à charge d'Alexandre Kesch …*

In fact, PÉRIN D'AUGNY left Prussia around 1860 to take on a job as *greffier de la justice de paix* in Philippeville (Algeria). A publication dated 1866 situates him in El-Arrouch, dependancy of Philippeville. [68]

In 23 June 1871 he died in Philippeville. [69] His death was recorded in the Metz Civil Register in 1873 with the status of *célibataire*.

N.B.

Octave PÉRIN D'AUGNY's name appears in a genealogy study conducted by the descendants of Octave SCHMIT, son of Marguerite SCHMIT of Brandenbourg. [70] The latter was a cook on Kippenhoff (*Këppenhaff*) between 1846 and 1849. The descendants of Octave SCHMIT suspect that their ascendant was the son of Octave PÉRIN D'AUGNY. There is no direct evidence for this but there is good argument for raising a suspicion.

The Kippenhoff farm was run by the two bachelors Octave PÉRIN D'AUGNY and John Thomas TUDOR. They were assisted by 6 members of staff, including a cook by the name of Marguerite SCHMIT (or SCHMIDT). [71] [72] Marguerite was born in Brandenbourg in 1821 and joined the staff in Kippenhoff around December 1846, aged 25. She was not married.

In May 1849 Marguerite gave birth to Octave (named SCHMIT after her). She had left Kippenhoff for St Nicolas in France, where the boy was born as e*nfant naturel (illegitimate child)*. Octave (Octavien, Oscar) SCHMIT appears regularly in the 1851, 1855, 1861, 1864 and 1867 Census of Brandenbourg. He thus grew up in Brandenbourg.

The first name given to the *enfant naturel* possibly gives a hint as to the identity of his father.

Marguerite SCHMIT had a second *enfant naturel* in 1850 by the name of Alexis Edouard SCHMIT, born in Metz in 1850.

Her sister Anne Marie SCHMIT also had an *enfant naturel* in 1848.

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[64] *Courrier Du Grand-Duché De Luxembourg, 27 September 1851, page 2*
[65] *Courrier Du Grand-Duché De Luxembourg, 24 July 1852, page 3*
[66] *Wächter an der Sauer, 4 October 1856, page 2*
[67] *Courrier Du Grand-Duché De Luxembourg, 20 February 1862, page 4*
[68] *Almanach national: annuaire officiel de la République française, 1866, page 866*
[69] *Journal officiel del la République 9 February 1872, page 1*
[70] *Geneanet database*
[71] *FamilySearch database*
[72] *Kippenhoff 1847 Census*