The rise of the patent department: A case study of Westinghouse Electric and Manufacturing Company

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Abstract

The patent department of Westinghouse Electric Company was organised in 1888. When George Westinghouse invented and industrialized air brakes he applied for patents in his own name. Those patents were administered mainly by patent attorneys in Pittsburgh. After the formation of the Electric Company, in 1886, organisation of patent management progressed. For a while, the patents invented by engineers were assigned to George Westinghouse personally; however, almost all of the electrical patents were assigned to the company in 1888. Thus, the idea of corporate intellectual property was adopted. At the same time the patent department was formed in Pittsburgh. It was directed by Charles A. Terry, a patent attorney, who began administering patent applications internally. The internalisation of patent management was necessitated by the increase in the number of engineers and in their output. To support patent administration it was desirable for the company to conduct patent work by using in-house patent attorneys rather than external law firms. However, external attorneys continued to play decisive roles in acquisition, licensing and enforcement. On the other hand, the corporate intellectual property system within the Electric Company was somewhat limited by the paternalistic management style of George Westinghouse. Whereas the patent department was established in 1888, there was not a definite rule covering employee inventions until around 1910.

I. Introduction

A typical knowledge worker is the attorney who turns 'new and useful process, machine, manufacture, or compositions of matter, or any new and useful improvements thereof' (US Patent Law) into legal terms as patent applications, and administers patent-related affairs. Such practices by attorneys-at-law, or patent attorneys, continued from the beginning of patent systems in each country; in England the first patent law was instituted in 1624, and in the USA in 1790. However, practices such as patent administration, were concentrated and organised in corporations in the late 19th century. Although the organisation of knowledge workers in the modern enterprise is one of the most powerful forces that accelerated the 'knowledge economy', only a few studies have pointed out that the change can be traced back to the 19th century. This paper aims to clarify the evolution of corporate patent management and organisation in US companies.

Catherine L. Fisk examined an aspect of the rise of corporate patent management.[1] By surveying a significant number of legal cases, she described the processes through which judicial decisions in the 1870s allowed employee inventions within the workplace to be the possessions of employees as inventors but later accepted in 1920 to allow employers and companies to take hold of such inventions. Institutionalisation of employee inventions in companies is an essential subsystem used by modern corporations to take advantage of the patent system. However, the institutionalisation of it inevitably required management and the organisation to administer the patent rights and knowledge as corporate properties. Almost no research has shed light on this aspect of the development of patent management and organisation in modern enterprises. In this paper, the development of the patent department, and such patent management practices as patent application, safekeeping, guarding against infringements, licensing, and enforcement, will be illustrated.

Prior to the establishment of patent departments, patent-related practices were conducted mainly by inventors, or entrepreneurs themselves, who organised the corporation and their patent attorneys. Therefore, in the case of the Thomson-Houston

[1] Catherine L. Fisk, *Working Knowledge: Employee innovation and the rise of corporate intellectual property, 1800–1930* (Chapel Hill, NC: The University of North Carolina Press, 2009).

Electric Company, the process of establishing a patent department could also be considered as the process of establishing specialised patent department roles.[2] However, there could be other paths. In this paper the establishment and development of the patent department of the Westinghouse Electric Company (hereafter the Electric Company), which George Westinghouse founded, will be examined.[3] How was the department organised? What reasons forced them to form the patent department? What kind of talented people took over such tasks? To tackle these questions this paper employs patent statistics collected from an internet database, the official gazettes of the US Patent and Trademark Office, and archival materials collected from the records of Westinghouse Electric Corporation and the George Westinghouse Museum Research Collection of the Heinz History Center in Pittsburgh, Pennsylvania, USA.

This paper is organised as follows. First, the patent management by George Westinghouse, prior to the establishment of the Westinghouse Electric Company, is described. Then, the formation and development of the patent department of the Electric Company is described.

II. George Westinghouse and his attorneys

1. Industrialisation of the air brake system

It was not until the early 1880s that George Westinghouse became interested in electrical engineering. Prior to the formation of the Electric Company in 1886, Westinghouse invented many devices associated with air brakes, railway switching, signal systems and natural gas, industrialising them for around 20 years. This section highlights the business of Westinghouse and patent management prior to 1886.

The career of George Westinghouse began in his father's machine shop, G. Westinghouse & Co., in Schenectady, New York. He developed a rotary steam engine,

[2] Shigehiro Nishimura, 'The Organization of Corporate Patent Management in US Companies: A case study of the Thomson-Houston Electric Company', *Kansai University Review of Business and Commerce* 13 (March 2011), 41-63.
[3] The name of the electrical company was the Westinghouse Electric Company originally; it reorganised in 1890 to the Westinghouse Electric and Manufacturing Company. In this paper, both companies are commonly called the Electric Company.

acquiring his first patent in 1865. Moreover, he invented a steel car replacer and frog, for railways, and applied for patents for these inventions.[4] He organised Rawls, Wall, and Westinghouse to conduct the frog business, with two partners who invested $5,000 each. However, the following year he liquidated the firm and left for Pittsburgh.[5] While in Schenectady, he had already been interested in air brakes and had invented some related devices. His first air brake patent, US Patent No. 88,929, was filed from Schenectady and issued on April 13th 1869.

Between 1868 and 1869, George Westinghouse completed the original development of an air brake system, with the support of Ralph Baggley, in Pittsburgh. Then, to industrialise his inventions, he organised the Westinghouse Air Brake Company, capitalised at $500,000 in 1869.[6] As president of the company, he continued improving and inventing new devices.

Westinghouse's air brake system was developed from his original straight-air brake into an automatic-air brake; to that he added the invention of new essential devices, such as the triple valve in 1873, and the quick-action triple valve in 1888.[7]

During the 1870s George Westinghouse spent the greater part of his time in Europe. One of his aims was to sell his air brake system to British railway companies. In 1872 the Westinghouse Continuous Brake Company was established, in New York, to manage the European export business, eventually resulting in the formation of the Westinghouse Brake Company Limited, in England, in 1881.[8] In England, he became interested in the interlocking and blocked signal system prevalent there. He purchased the American rights to the UK patent for interlocking and blocked signals, and then improved these devices in 1880. Moreover, he invented the electro-pneumatic device for switch and signal, acquiring patents for it in 1881.[9] To industrialise his inventions, he bought two companies, the

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[4] Henry G. Prout, *A life of Westinghouse* (New York: Charles Scribner's Sons, 1922), 7–8.
[5] Harold C. Passer, *The Electrical Manufacturers, 1875–1900: A study in Competition, Entrepreneurship, Technical Change, and Economic Growth* (Cambridge, MA: Harvard University Press, 1953), 129; Quentin R. Skrabec, Jr., *George Westinghouse: Gentle Genius* (New York: Algora Publishing, 2007), 37.
[6] Passer, *The Electrical Manufacturers, 1875–1900*, 129–130.
[7] Prout, *A life of Westinghouse*, 34–43.
[8] Prout, *A life of Westinghouse*, 62–63.
[9] Prout, *A life of Westinghouse*, 10, 213–223.

Union Electric Signal Company and the Interlocking Switch and Signal Company, both of which had essential patents, and combined them into the Union Switch & Signal Company in May 1881.[10]

In addition to railway air brakes and switch and signals, George Westinghouse managed the natural gas business in Pittsburgh. His core competence could probably be described as a technique in the regulation and control of fluid pressure, which was built up in the course of developing air brakes and pneumatic devices. The natural gas business represented the adaptation of this core technique to a different market. He invented 38 patents, covering gas distribution and regulation devices, and formed the Philadelphia Company, in 1884, to supply gas to the residents of Pittsburgh.[11] **(See Table 1 and 2)**

Patent applications by George Westinghouse prior to 1885, during which he engaged mainly in the air brake business, should be reviewed. **Table 1** shows the trend of patent applications of which George Westinghouse was the inventor.[12] The number of US utility patents that he acquired in his lifetime was 353, not counting re-issued patents. As shown in this table, he had an intensive period of invention in the middle of the 1880s. Furthermore, since the 1890s were when he organised many companies and managed them, he continued to invent and patent many inventions. **Table 2** shows what sort of patents George Westinghouse invented. In this table his 131 patents, applied for prior to the end of 1885, are sorted by their current US patent classification.[13] The majority of his patents were classified in air brake related groups, such as USC 303, 'Fluid-pressure and analogous brake system'; USC 137, 'Fluid handling'; and USC 188 'Brakes'; in the switch and signal related group, such as USC 246, 'Railway switches and signals'; and in the natural gas group, USC 48, 'Gas: heating and illuminating'.

[10] Farnsworth, M. M., 'The Union Switch and Signal Company: A review of its predecessors, formation, developments, growth, activities, acquisitions and affiliates', June 4 1948, in George Westinghouse Museum Research Collection, Box 15 FF2.
[11] Prout, *A life of Westinghouse*, 16, 224–9.
[12] In this table, the patents issued are sorted by the date of application. For 23 patents issued prior to May 1873, that had no record of the date of application, this paper regarded the date of issue as the date of application.
[13] As of February 2012.

2. Patent management by attorneys

By reviewing George Westinghouse's businesses and patents prior to 1886, it can be seen that he invented a substantial number of devices, mainly by himself, industrialising them in the United States and abroad. In this section we examine how his patents were administered to support his business and who was in charge of his patent management.

George Westinghouse's first patent for the rotary steam engine, which was applied for and issued when he was in Schenectady, was filed by his attorneys, Munn & Co.[14] This law firm had its main office in New York City and was one of the biggest law firms at that time. Around 1860 a third of the patent applications to the US Patent Office were administered by that firm.[15] His second patent, which was for the car replacer, was applied for directly to the Patent Office.[16] While it might be considered that George Westinghouse prepared petitions, specifications and drawings by himself, because one of the witnesses of this patent was J. Van Santvoord, who was a partner of a New York law firm, Van Santvoord & Hauff,[17] we know that he was assisted by this law firm in the course of the application. The law firm involved in filing the third patent, for the railway frog, was Van Santvoord & Hauff. After the fourth patent, which was issued in 1869 and covered the air brake, almost all patents issued for George Westinghouse were administered by attorneys in Pittsburgh. The law firm involved with the patent issued in 1869 was Bakewell & Christy; after 1871 the name changed to Bakewell, Christy & Kerr. After the latter part of 1873, the name of the attorney involved was George H. Christy. William Bakewell and George H. Christy were competent attorneys in Pittsburgh. Christy had consistently been one of George Westinghouse's patent attorneys, and administered some part of Westinghouse's patents and his related companies from 1868 to 1909 at the time of Christy's death. Thomas B. Kerr was trained in patent law at Bakewell and Christy's firm, and later became a partner. Kerr, as is seen later, was committed to the formation of the patent department of the Electric Company. He became a director of this company and supported George

[14] US patent no. 50,759.
[15] Kenneth W. Dobyns, *The Patent Office Pony: A History of the Early Patent Office* (Fredericksburg, VA: Sergeant Kirkland's Museum and Historical Society, 1994), 129.
[16] US patent no. 61,967.
[17] V. W. Middleton, *Names and Addresses of Attorneys Practicing before the United States Patent Office* (Washington, DC: Thomas McGill & Co., 1889), 62.

Westinghouse and his companies throughout his lifetime.[18]

During this period, all of the patents invented by George Westinghouse were issued in his own name and not assigned to others. Of those patents relating to him and his companies, only a limited number were assigned to the company at the time of issue. Only two patents in 1879 were issued in the name of the Westinghouse Air Brake Company, that is, they were assigned to the company. One of them was invented by Henry Herman Westinghouse, George's younger brother, and another was invented by Thomas W. Welsh. Both of these patents were administered by Christy. The number of patents assigned to the Union Switch & Signal Company was 30; all of them were filed between 1881 and 1884. Fourteen of these patents were administered by Frank L. Pope and his law firms, Pope & Edgecomb and Pope, Edgecomb, & Butley. Thirteen were filed by Christy. Two patents were filed by others, and one patent was not filed by any attorney. Pope, as will be seen later, was a New York patent lawyer and an expert in electricity. Because patents were issued in the name of the company, that is, assigned to the company at the time of issue, clearly from an early period, management of the Union Switch and Signal was aware of the concept of corporate intellectual property, 'A corporation can possess and control intellectual property.' Since the patents of the Union Electric Signal Company, a company previously acquired by Westinghouse, were assigned to the company, the idea could have been derived from the predecessor company.

How were prior artefact research and patent acquisitions administered? Prior artefact research was administered mainly by patent attorneys in Pittsburgh. At the time George Westinghouse began his air brake business, patent attorneys investigated the relative position of his inventions in the mosaic of earlier air brake patents. They found that a similar invention was patented in England, around 30 years before; however, the patents had already expired because the device was not practical. This was reported to the board of directors of the company.[19] Stimulated by the report, Westinghouse decided to extend his air brake business to England. Patent attorneys in Pittsburgh performed a crucial role in the

[18] Charles A. Terry, 'The Early History of the Westinghouse Electric & Manufacturing Company', Educational Department, 1925, in Record of Westinghouse, Assignment 4, Box 37, FF 1; Prout, *A life of Westinghouse*, 100, 137–8.
[19] Francis E. Leupp, *George Westinghouse: His life and achievements* (Boston, MA: Little, Brown, and Company, 1919), 73–4.

growth of the company.

In addition, acquisitions and assignments of patents of others were administered by patent attorneys in Pittsburgh. George Westinghouse was personally assigned some patents from engineers, the first of which were the patents invented by Charles G. Welch, entitled 'Brake-pipe coupling and valve', filed on December 24th 1879.[20] Although Welch was an engineer in Huntingdon, Pennsylvania, his relationship with Westinghouse is unknown. This patent was filed by Christy as his attorney. Moreover, the patents invented by James T. Hambay of Pittsburgh and by Edwin C. Merrill of Pittsburgh were administered by Christy. However, there were some patents not filed by Christy. One of these was a patent invented by Morris S. Verner, entitled 'Pipe joint and line', filed in 1884, and which was administered by James I. Kay, a Pittsburgh attorney. Moreover, the patent invented by Cassius R. Shepler, entitled 'Conduit for gas or other fluid', and filed in 1885, was filed by the same attorney. George Westinghouse actively and liberally bought others' patents when he considered them crucial and essential for his business.[21] Such acquisition and assignment was probably supported and administered by Pittsburgh attorneys.

Hence, patent administration of George Westinghouse and his companies was at first borne by patent attorneys in New York, and later mainly by Pittsburgh attorneys. George Westinghouse had knowledge of patent laws and procedures as he investigated prior artefacts and filed petitions directly with the Patent Office; however, he used external resources to administer his patents. Even in the latter part of the 19th century, there were a substantial number of patent attorneys in the United States; thus, inventors and entrepreneurs could easily contact them. A list of patent attorneys issued in 1889 contains the names of about 3,800 patent attorneys active in the US at the time. The number of patent attorneys who had offices in New York was 977, of whom 682, about 70%, were located in New York City. In Pennsylvania there were 364 attorneys, of whom 159 were in Philadelphia and 47 were in Pittsburgh. We can recognise the magnitude of these numbers when we compare them with similar numbers from other countries. In 1889 the number of chartered patent agents in the UK was 222;[22] in 1899 the number of registered patent

[20] US patent no. 224, 256.
[21] Leupp, *George Westinghouse*, 103; Prout, *A life of Westinghouse*, 48.
[22] Great Britain Patent Office, *Seventh Annual Report of the Comptroller General of Patents, Designs*

attorneys in Japan was 138.[23]

III. Evolution of the patent department

1. Westinghouse Electric Company

During the first two decades of his career, beginning in his father's machine shop, George Westinghouse engaged mainly in the fields of air brakes, railway switches and signal systems to become a leading figure in those fields. He then decided to enter into a relatively different field: electrical equipment and lighting. Westinghouse Electric Company, established in 1886, got the order for the lighting equipment at the Columbian Exposition at Chicago in 1893. Westinghouse's system generated alternating current and used a 'stopper lamp', evading the famous Edison's bright lamp patents.[24] In the same year, the Electric Company secured the contract for installation of alternating current generating equipment at the Niagara Falls power station, partly because the Electric Company rapidly accumulated and developed alternating current techniques. After the great success achieved in 1893, the Electric Company developed their electrical systems, particularly turbo-generators, by acquiring licences for the US patents of Person's turbine in 1895,[25] and began the electric train business. The Electric Company became the second largest electric company, the General Electric Company (GE) was the largest, and aggressively entered into foreign markets prior to World War I.

The technology and products that allowed the Electric Company to enter into the electrical equipment business were mainly not invented or developed by George Westinghouse, as in the case of air brakes. Instead, he organised competent engineers and their patents to become a big business in this area. At the Electric Company patent attorneys played a substantial role.

George Westinghouse's interest in electricity developed when he considered whether he could control the switch and signal system with electricity; he began to

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and Trademarks, 1890.

[23] Nihon Benrishi Kai (Patent Attorney Association), *Benrishi seido 100 nen shi* (100 years of the patent attorney system) (Tokyo, 2000), 256–9.

[24] Passer, *The Electrical Manufacturers, 1875–1900*, 142–3.

[25] Prout, *A life of Westinghouse*, 185–6.

examine the business of using a direct current lighting system in late 1883.[26] Soon afterwards, he became acquainted with William Stanley, who developed a self-regulating dynamo, through H. H. Westinghouse, who was the president of the Westinghouse Machine Company at that time. In 1884 George Westinghouse contracted with Stanley to join the staff of the Union Switch and Signal Company and to engage in the development of incandescent lighting systems. In this phase Thomas B. Kerr and Franklin L. Pope, on behalf of George Westinghouse, examined Stanley's patents, as well as other electrical patents, and advised him.[27]

In 1885 he became interested in electrical transmission using an alternating current. Learning of a type of transformer developed in Europe by Gaulard and Gibbs, he promptly ordered the transformer and Siemens's alternator. As early as November 1885, the transformer and generator were transferred from London with Reginald Belfield, who was an assistant of Gaulard and Gibbs. Westinghouse began to develop a practical transformer by examining the imported transformer with Stanley, Belfield, who was employed by Westinghouse, and other staff. On the other hand, he 'instructed Pope to make a careful investigation of the Gaulard and Gibbs patent situation and to study the possibilities of their system'.[28] In February 1886, when a prospectus of the Electric Company had already been prepared, Westinghouse dispatched Pope and Guido Panteleoni, who was employed by him, to England to secure the American rights to the inventions of Gaulard and Gibbs. They successfully negotiated with the inventors and contracted for $5,000.[29] The petition for the patent was filed on March 6th 1886; the patent, entitled 'System of electric distribution', was issued on October 26th of the same year. The application was administered by Pope and Edgecomb.[30]

In March 1886 the electrical department of the Union Switch and Signal Company broke away to become the Westinghouse Electric Company, capitalised at $1 million. The first board comprised George Westinghouse as the president, H. H. Westinghouse, John

[26] Prout, *A life of Westinghouse*, 91.
[27] Prout, *A life of Westinghouse*, 94–5; Skrabec, Jr., *George Westinghouse*, 103.
[28] Prout, *A life of Westinghouse*, 102–3.
[29] Leupp, *George Westinghouse*, 138; Prout, *A life of Westinghouse*, 112.
[30] US patent no. 351, 589.

Caldwell, John Dalzell, Frank L. Pope, John McGinley, C. H. Jackson, and Robert Pitcairn.[31] As Pope was a board member, patent attorneys clearly played an essential role in the organisation of the electric company.

However, they needed to develop some essential components, such as induction motors and alternating current meters, to complete the system. Since George Westinghouse was not an expert in electrical artefacts, the development was conducted by fellow engineers and employees.[32] Those who engaged in developmental work in early phase of the company included: Nikola Tesla, who invented the induction motor; Oliver B. Shallenberger, who invented the AC meter; Albert Schmid; Benjamin G. Lamme, who joined the company in 1888 and later become a Chief Engineer; Charles F. Scott, who soon became a professor at Yale University; Lewis B. Stillwell; and Loyall A. Osborne.[33]

How many patents were filed and issued? **Figure 1** shows the trend of patent applications of George Westinghouse, Westinghouse Air Brake Company and the Electric Company, between 1886 and 1914. While patents with George Westinghouse as assignee were more than the number of others in 1886, the number of patents of the Electric Company began increasing after 1902; more than 100 patents per year were filed after 1905. It should be noted that rapid growth in the number of patent applications occurred in the mid-1900s.

The increase in patent applications by the Electric Company was achieved by the creation and extension of its research and development organisation. The evolution of the research and development organisation was as follows.[34] For about 10 years, after the beginning of the company, there was no department or component specifically devoted to research; the engineers who founded the company did their research and development individually. As early as 1895 some parts of the factory were designated to do research and investigation. At the time, a chemist was employed to 'discover what caused failures of such materials as brass, copper, and steel'.[35] Reorganisation of the engineering

[31] Skrabec, Jr., *George Westinghouse*, 102–3.
[32] Prout, *A life of Westinghouse*, 123.
[33] Prout, *A life of Westinghouse*, 153–4; Leupp, *George Westinghouse*, 134–5.
[34] T. K. Phares, 'History of the Westinghouse Research Laboratories', 1941, 1–7, in the Record of the Westinghouse Electric Corporation, Box 163, FF 20.
[35] Phares, T. K., 'History of the Westinghouse Research Laboratories', 5.

department in 1902, when Charles E. Skinner was appointed to the position in charge of research, was a significant step. In 1906 the Research Division was organised under the supervision of Skinner. It was just around 1906 when the number of Electric Company patent applications began increasing rapidly. In 1910 a new two-storey building for research work was built at the East Pittsburgh factory of the Electric Company. The chemical and physical testing laboratory and the magnetic laboratory were established in this facility.[36]

That extension of the research and development organisation stimulated the number of research and patent applications can be seen in the number of inventors. **Table 3** shows the figures of the Electric Company's patent applications and the number of inventors associated with them between 1886 and 1914. The number of applications increased coincidently with the number of inventors after 1902. It could be considered that the increase of patent applications was achieved not only by the start-up engineers but also by many new engineers joining the company.

2. The patent department and its organisation

Five patents in 1886 and 51 patents in 1887, assigned to the Electric Company, were issued. However, for a few years after the organisation of it, patents invented by the engineers who worked with George Westinghouse were assigned to George Westinghouse. In 1886 patents invented by Belfield, Henry M. Byllesby, Philip Lange, Albert Schmid, Shalenberger and Stanley were filed and assigned to George Westinghouse. While, in 1887, patents invented by Byllesby, Lange, Shallenberger and Stanley were assigned to George Westinghouse, but subsequently the number of such patents decreased significantly. The majority were assigned to the Electric Company. After 1888 almost all of the patents related to electrical devices were filed in the name of the company. The concept of corporate intellectual property appeared within a few years of the creation of

[36] The next substantial organisational change was the creation of the first unit of the Westinghouse Research Laboratories in 1916. Skinner recognised the necessity of research laboratories being independent and apart from routine testing work, and persuaded top management to create it. In 1917 a unit for researching electrical lamps was formed under H. C. Rentschler's direction. In 1921 the lamp research department was transferred to Bloomfield, New Jersey, to become a second laboratory.

the organisation, whereas, in the case of the brake company, such a concept had not appeared before 1886.[37]

In this section we will examine patent administration in the early phases of the electrical business. The year before the organisation of the Electric Company, George Westinghouse was assigned seven patents by Stanley. The attorney for these patents was Pope & Edgecomb of New York. The distribution of attorneys for patents, who filed in 1886, is as follows: 31 patents assigned to George Westinghouse were administered by Pope & Edgecomb, of which 24 were invented by his fellow engineer, who developed the transformer and alternating current system; eighteen patents issued in 1887 were administered by Pope & Edgecomb, of which 11 patents were invented by fellow engineers.

Table 4 shows patent administration for the Electric Company between 1886 and 1914. This table reveals that: early corporate patents were administered by Pope & Edgecomb and Pope, Edgecomb, and Terry; that after 1889 the patents were administered by Charles A. Terry; that Terry administered patents with Harold S. MacKaye and Wesley G. Carr; and that after 1896 almost all of the corporate patents were administered by Carr. The number of patents filed by Carr soared during and after 1905. Referring to this trend, we will **(see table 4)**

describe the organisation of patent management at the Electric Company.

In the first few years, corporate patents were filed by law firms in New York, such as Pope & Edgecomb, and Pope, Edgecomb and Terry. However, the movement to build a patent department occurred as early as 1888. Thomas B. Kerr, who had been one of George Westinghouse's attorneys, asked C. A. Terry, a partner with Pope, Edgecombe and Terry, to come to Pittsburgh and take charge of patent management for the Electric Company. Terry moved to Pittsburgh and administered patent applications and litigations

[37] After the organisation of the Electrical Company, George Westinghouse continued to file and apply for patents in his own name, in some cases. Furthermore, he personally continued to buy and acquire the patents of others. In these cases, patent administration was conducted by Christy or J. Snowden Bell, who was patent attorney specializing in railways.

there. Then, in 1888, the patent department was formed with Terry as the manager.[38]

Terry worked in Pittsburgh until 1892, when George Westinghouse asked him to return to New York to be involved more closely in litigation. His New York office became one of the bases of the patent department. At the same time, Harold S. MacKaye joined the patent department and took up patent administration. The attorney of patents was Terry & MacKaye, as shown in the table. In 1894 they acquired Wesley G. Carr, previously examiner of the United States Patent Office. He was an expert in patent law and electrical technology because of his long experience in the electric division of the Patent Office.[39] Given that Terry, MacKaye and Carr were patent attorneys, it is assumed that they administered the patent applications in the department after 1895. Of these three attorneys, MacKaye became independent in 1896, and Terry became the secretary of the company in 1891 and vice president in charge of law and patent affairs in 1909. After 1896 almost all of the patents of the Electric Company were administered by Carr, the manager of the department; he later became the general patent counsel of the company.

The internalisation of patent management, indicating that almost all of the patent administration litigation work was conducted not by external resources but by a department organised in the company, occurred in 1888, when Terry formed the patent department. Why did they decide to organise the department and administer patents internally? According to Terry, it was because 'The ever increasing number of inventive engineers called for a like increase of the corps of Patent Attorneys and it was found expedient to conduct much of the general litigation and contract work through attorneys in direct employ of the company.'[40] As a result of the increase of inventors and of the number of applications, the patent department extended by acquiring talented people from other sections of the company. For instance, Victor S. Beam, who joined the company as an apprentice in 1889 just after his graduation from Princeton, became an assistant to Terry in the New York patent department. Furthermore, engineers, such as Echoltz, went into the patent department; he joined the staff in 1910. This reinforcement of the

[38] Terry, 'The Early History of the Westinghouse Electric & Manufacturing Company', Introduction.
[39] Terry, 'The Early History of the Westinghouse Electric & Manufacturing Company', Assignment 4, Page 51–53.
[40] Terry, 'The Early History of the Westinghouse Electric & Manufacturing Company', Assignment 4, Page 52.

department enabled the company to secure a substantial number of patents after 1905.

While patent attorneys played a decisive role in the formation of the Electric Company as described above, patent management, such as purchasing and acquisition of licences, continued to be conducted by and with external law firms. Thomas B. Kerr, who was committed to the establishment of the patent department, played a decisive role in securing the patents for the induction motors of Nikola Tesla. Kerr advised George Westinghouse that the importance of the Tesla patents should be thoroughly examined. Westinghouse dispatched H. M. Byllesby, who was the vice president of the Electric Company at that time, to Tesla's laboratory at Liberty Street in New York. Westinghouse instructed Kerr to negotiate with Tesla over purchasing the patents, stating that. 'If the Tesla patents are broad enough to control the alternating motor business, then Westinghouse Electric Company cannot afford to have others own the patents.'[41] Eventually Westinghouse and Tesla contracted, in July 1889, for purchase of patents by Westinghouse, and for one year service to the company; in turn Tesla received $500,000.[42] After that, Kerr moved to New York and formed a law firm named Kerr, Curtis, and Page, with Leonard E. Curtis and Parker W. Page. With Page being a solicitor for Tesla, this firm conducted patent litigations over the Tesla patents successfully.[43] This firm continuously supported the development of alternating current system for the long term.[44]

Both internal and external patent attorneys took part in the agreement with GE and its administration. At the time when the Electric Company and GE accepted the cross-licensing agreement in 1869, the Electric Company held the Tesla patents, which were essential for alternating current devices. At the same time, GE held the trolley patents, invented by Van Depoele, which were essential for the electric railway business. The two rivals agreed to grant each other licences based on all of their patents, except for the electric lamps. This agreement allowed each company to sell products without payment of royalty to the extent of such agreed percentages as 61.5% for GE and 37.5% for Westinghouse. If either company exceeded the stipulated percentage, that company

[41] Skrabec, Jr., *George Westinghouse*, 115.
[42] Skrabec, Jr., *George Westinghouse*, 114–6.
[43] Terry, 'The Early History of the Westinghouse Electric & Manufacturing Company', Assignment 4, Page 51.
[44] Prout, *A life of Westinghouse*, 100.

should pay royalty to the other; a Board of Patent Control was set up to supervise the agreement. As members of this Board, George Westinghouse and Paul D. Cravath, who was the attorney, and C. A. Terry and B. H. Warren, as alternates, were delegated.[45]

3. Employee invention and paternalism

Along with the establishment of the patent department, almost all of the patents invented by engineers of the Electric Company were assigned not to George Westinghouse but to the company; such patents were regarded as corporate property. Then, how did they manage the treatment of employee inventions?

Apparently there were two kinds of engineers who worked with George Westinghouse. One was in partnership with the Electric Company or George Westinghouse; the other was employed by the company. We will examine how inventions were treated in each case.

One of the engineers in partnership with the company, or with George Westinghouse, was William Stanley. At first Stanley contracted with Westinghouse to assign all of his inventions, on the condition that Westinghouse should manufacture the products and sell them; for this Stanley got 10% of the profit of the company and $5,000 per year as a salary.[46] When he left for Great Barrington, in 1885, they negotiated a new contract. In this contract George Westinghouse agreed to give Stanley 10% of the shares of the newly established company, namely the Electrical Company. Moreover, it was provided that Stanley should maintain his laboratory and assign all of the inventions to the company. For this Stanley would receive $600 per month for the cost of the laboratory and $4,000 per year as a salary, in addition to the shares.[47]

The engineers who worked with Westinghouse, in the early days of the Electric Company, contracted with the company regarding the treatment of their inventions, although they were not partners or shareholders. As of January 1889, H. M. Byllesby, O. B.

[45] Westinghouse Electric and Manufacturing Company, *Annual Report* (June 23rd 1897), 6–7; Prout, *A life of Westinghouse*, 163–4, 251.
[46] Passer, *The Electrical Manufacturers, 1875–1900*, 131.
[47] Passer, *The Electrical Manufacturers, 1875–1900*, 136.

Shallenberger, R. Belfield, A. Schmid, Philip Lange and A. L. Reinmann contracted with the company. For instance, it was provided that Byllesby should, 'For a period of three years from the 17th day of March, 1886', assign to the company 'all inventions and improvements relating to electric lighting systems, methods, apparatus, appliance, or fixtures'.[48] Varying terms and scopes depended on the engineer; it was provided in the case of Reinmann that 'So long as remaining in the employ of The Westinghouse Electric Company, improvements in incandescent electric lamps and in processes, methods, and apparatus for the manufacture of said lamps' should be assigned to the company.[49]

In contrast, it appears that in the case of other engineers employed by the company, there was no distinctive arrangement covering their inventions. B. G. Lamme, who joined the Electrical Company on May 1st 1889, and who later become a chief engineer, said that, 'There had been no agreement in these matters when I came into the company.'[50] When the problem about compensation for his inventions occurred, in the latter part of 1892, the problem was solved by mutual consent with Lemuel Bannister, the manager of the company, and C. A. Terry. At that time employee inventions were assigned to the company under the belief that, 'It was sometimes the practice to put a man under a contract for a specified time, the agreement covering all back work in the way of patents.'[51]

This situation continued until around 1910. Hugh Rodman was a research engineer of the Westinghouse Machine Company, not the Electric Company. He made 'such investigations as Mr. Westinghouse or the management directed, and as a matter of course, turning over the results to the company'.[52] Once, in the course of his work, he invented a chemical process and substance that did not directly connect with company's business giving rise to the question of how to manage it. At that time the company claimed that 'its money and equipment having been used, the processes belonged to it'.[53]

The definitive provisions for employee inventions did not exist for such a long time

[48] 'Copy Agreement as executed, the provisional form of which was schedule to the Article of Association', MS. Marconi 2788, Marconi Archives, Oxford University.
[49] "Copy Agreement," MS. Marconi 2788.
[50] Benjamin G. Lamme, *Benjamin Garver Lamme Electrical Engineer: An autobiography*, (New York, NY: G. P. Putman's Sons, 1926), 173.
[51] Lamme, *Benjamin Garver Lamme Electrical Engineer*, 173–4.
[52] Leupp, *George Westinghouse*, 245.
[53] Leupp, *George Westinghouse*, 245.

because of George Westinghouse's paternalistic style of management. A paternalistic attitude was consistent with that applied to patent affairs. At first George Westinghouse was so liberal that he could expend a large sum of money to develop works and acquire many patents. This attitude caused the crisis of 1890, during which the company reorganised as the Westinghouse Electric & Manufacturing Company.[54] At that time a banker claimed that, 'Mr. Westinghouse wastes so much on experimentation, and pays so liberally for whatever he wishes in the way of service and patent rights that we are taking a pretty large risk if we give him a free hand with the fund he has asked to raise.'[55] His liberal attitude had partly been limited by the systems of the company. Around 1899 a committee, composed of engineers, was instituted to evaluate patents, in order to systematically control the purchase of them.[56]

However, his paternalistic management style still continued. The question of managing H. Rodman's invention was settled by a decision of George Westinghouse. Rodman insisted that, 'As the company was not interested in chemical manufacturing, it should retain only a working right to the process, leaving me to patent them for my own benefit in other respects.'[57] On the contrary, the company insisted that the invention should be retained by the company and be corporate property. There was no definite rule over such questions, thus, the settlement of this problem was sent to George Westinghouse. He decided that 'Though the company might legally maintain its right to the inventions, he would make no move to do so, and he not only turned over to me the entire rights in the inventions, but offered me enough capital to erect and run a small factory, of which he let me in full control.' Moreover, Rodman felt 'great satisfaction in adding that the investment proved worthwhile, and in bearing this witness to his fine generosity!'[58]

Another reason may have caused his approach to respecting to patent rights. Westinghouse regarded patent rights as a part of the dignity of man, and completely

[54] Arthur S. Dewing, *Corporate Promotions and Reorganizations* (Cambridge, MA: Harvard University Press, 1914), 165–202.
[55] Leupp, *George Westinghouse*, 159.
[56] Skrabec, Jr., *George Westinghouse*, 207–8
[57] Leupp, *George Westinghouse*, 245.
[58] Leupp, *George Westinghouse*, 245.

respected them. Although he did indeed organise and employ fellow engineers, he 'saw the progress of American technology as the progress of individuals, not corporate research'.[59] He did not rigidly regard the patents invented by the engineer as corporate intellectual property; instead, he emphasised the human right. Because rigid and definite provisions over the management of employee patents apparently conflicted with his opinions, the legal provision for employee invention was not established during George Westinghouse's presidency until 1911.

IV. Conclusion

The patent department of the Electric Company was organised in 1888. In the case of Thomson-Houston Electric, which was run by a founder with as strong a personality as George Westinghouse's, the patent department was also formed in approximately 1888. One of the reasons for the establishment of this patent department was the increase in engineers and patent applications as a result of aggressive mergers with, and acquisitions of, competitors. Before then, most of the patent management was conducted by Elihu Thomson himself, and his patent attorneys. In the course of organisation, administrative work formerly conducted by them was institutionalised. While the internalisation of patent attorneys had not occurred until 1890s in Thomson-Houston, the two companies share something in common in that both closely allied with competent patent attorneys acting as a patent department to conduct patent management.

When George Westinghouse invented and industrialised air brakes he applied for patents in his own name; those patent applications were administered mainly by patent attorneys in Pittsburgh. While he sometimes bought patents necessary for his business from others, such administration as acquisition and assignment were conducted by external resources. After the formation of the Westinghouse Electric Company in 1886, the organisation of patent management progressed. For a while those patents that were invented by engineers were assigned to George Westinghouse personally; however, almost all of the electrical patents were assigned to the company in 1888. That is, the concept of corporate intellectual property was adopted. At the same time the patent department was

[59] Skrabec, Jr., *George Westinghouse*, 238.

formed in Pittsburgh, directed by patent attorney Charles A. Terry, and began administering patent applications and related activities. The internalisation of patent management was caused by the increase of the number of engineers and their output. To support related patent applications, it was desirable for the company to conduct patent work by using in-house patent attorneys rather than external law firms. However, external attorneys continued to play decisive roles in acquisition, licensing and enforcement.

On the other hand, the corporate intellectual property system of the Electric Company was somewhat limited by the paternalistic management style of George Westinghouse. This pattern is relatively different from the case of Thomson-Houston Electric, whose management was modernised at an early stage. In the Westinghouse case, where the patent department was established in 1888, there was no definite rule over employee inventions until around 1910.

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Table 1: Patents invented by George Westinghouse

Year of Application	Number	Year of Application	Number
1865	1	1890	11
1866		1891	6
1867	1	1892	10
1868	1	1893	1
1869	1	1894	6
1870	2	1895	6
1871	4	1896	8
1872	10	1897	9
1873	13	1898	6
1874	7	1899	4
1875	6	1900	10
1876	2	1901	8
1877		1902	3
1878	1	1903	11
1879	15	1904	8
1880	8	1905	12
1881	17	1906	4
1882	4	1907	6
1883	7	1908	11
1884	13	1909	6
1885	18	1910	10
1886	32	1911	2
1887	13	1912	3
1888	9	1913	8
1889	6	1914	3

Note: Except of re-issued patents.

Table 2: Distribution of George Westinghouse's patents

Class	Class Information	Number	%
303	Fluid-Pressure And Analogous Brake Systems	33	25.19
48	Gas: Heating And Illuminating	20	15.27
137	Fluid Handling	19	14.50
246	Railway Switches And Signals	11	8.40
188	Brakes	10	7.63
	others	18	13.74
	Total	131	100.00

Note: Filed prior to 1885.

Table 3 The number of patents and inventors
Westinghouse Electric & Manufacturing Company

	patents	inventors			n.a.
		Total	US	Foreig Countries	
1886	5	4	4		
1887	51	10	10		
1888	41	11	9	2	
1889	36	18	17	1	
1890	19	7	6	1	
1891	10	5	5		
1892	23	7	7		
1893	16	6	6		
1894	23	11	9	2	
1895	28	9	8	1	
1896	26	11	11		
1897	24	11	11		
1898	21	8	8		
1899	44	19	19		
1900	22	15	12	3	
1901	32	16	16		
1902	56	33	28	5	
1903	61	38	37	1	
1904	94	41	36	5	
1905	149	75	68	7	
1906	182	77	72	5	
1907	128	63	57	6	
1908	168	72	70	2	
1909	105	55	47	7	1
1910	142	76	68	8	
1911	149	84	74	10	
1912	123	80	71	9	
1913	231	107	100	7	
1914	384	141	134	7	

n.a.=not available

Table 4 Attorneys of Patents: Westinghouse Electric & Manufacturing Company

	G. H. Christy	Pope, Edgecomb and Terry *	C. A. Terry	Terry and MacKaye	H. S. MacKaye	Terry, MacKaye, and Carr	W. G. Carr	G. H. Parmelee	G. H. Stockbridge	J. S. Green	others
1886	1	3									1
1887		50									
1888		37		1							1
1889		3	28								5
1890			19								
1891			9								1
1892			6	10	7						
1893				15							
1894				21			1				1
1895				1		27					
1896						1	25				
1897			1				21				
1898							16				5
1899			7				32	1			4
1900							20	2			
1901							19	8	2		3
1902			3				30	5	15		2
1903							48		4		8
1904			3				80				10
1905							147				2
1906							180				2
1907			1				120				6
1908							163				4
1909							101				3
1910							138				2
1911							143				4
1912							113			1	4
1913							222			1	5
1914							348			17	3
Total	1	93	77	48	7	28	1,967	16	21	19	76

Note: * Included the Pope and Edgecomb.

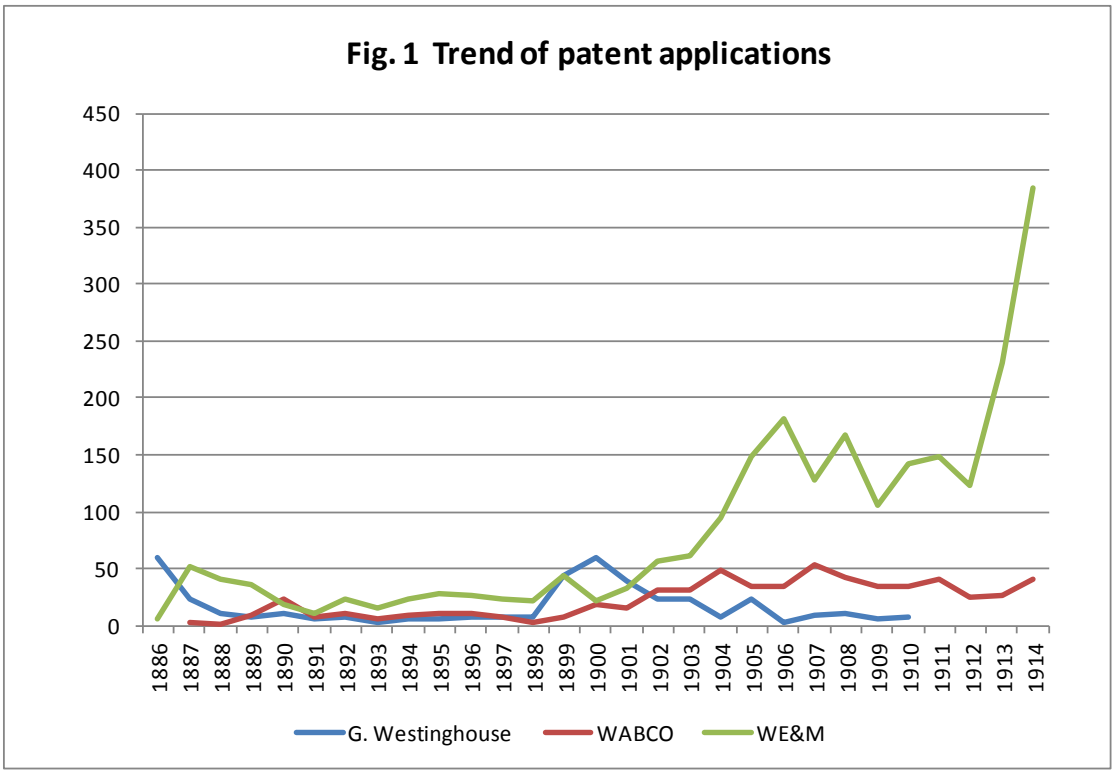
Fig. 1 Trend of patent applications
450
400
350
300
250
200
150
100
50
0
1886
1887
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1892
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G. Westinghouse
WABCO
WE&M

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