



history | f.a. (tony) furfari

# Early Development of the Incandescent Lamp

**L**ike most inventions, the incandescent electric lamp resulted from the contributions of many inventors. Early scientists, such as William Robert Grove, Moses G. Farmer, St. George Lane-Fox, and others, sought to use strips of metal having high melting points, such as platinum or iridium, as incandescing illuminants. Others tried amorphous forms of carbon such as that employed for arc-lamp electrodes [1].

## The First Patents: Sawyer and Man

In January 1880, William Edward Sawyer and Albon Man filed a patent application in which they stated:

Our improvement consists, firsts, of the combination, in a lamp-chamber composed wholly of glass as described in Patent No. 205,144, of an incandescing conductor of carbon made from a vegetable fibrous material, in contradistinction to a similar conductor made from mineral or gas carbon, from such vegetable carbon, and combined in the lighting circuit within the exhausted chamber of the lamp.

William Sawyer was born in New Hampshire and became known as an excellent electrician. His early employment was in railway telegraphy. He achieved recognition at an early age for his inventive ability. As an electrician, Sawyer belonged to the practical school rather than the scientific. His inventions were not so remarkable for originality of conception as for ingenuity of application.

His genius was constructive. His inventions were bright innovation of old ideas rather than departures toward new principles [2].

In 1881, Sawyer published a book on electric lighting by incandescence that, for a long time, was the best work on the subject. Sawyer was granted 46 U.S. patents during the period 1874–1885 [3].

The name Albon Man was well known in the history of the electric incandescent lamp. He was born in

Washington, DC, to be employed in the U.S. Treasury Department. In January 1871, he was appointed attorney and counselor to the U.S. Supreme Court. In July 1892, Union College awarded him the honorary degree of doctor of philosophy.

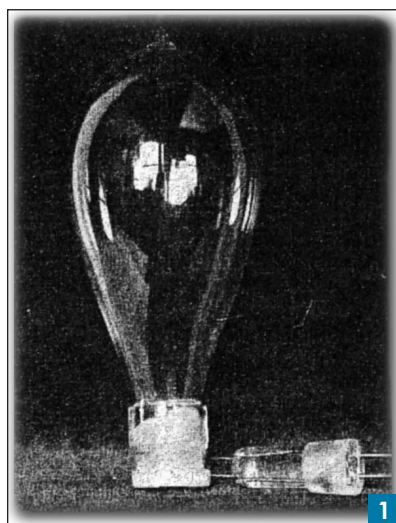
From his youth, Albon Man kept current in his interest of scientific progress, particularly in the practice of electricity and chemistry. Man was about twice Sawyer's age when the two men joined forces to develop commercial electric lighting. Many inventions having reference to lamp development were patented by Sawyer and Man conjointly and some by Sawyer separately. In July 1878, Sawyer, Man, and five other individuals formed the Electro-Dynamic Light Company.

A fierce legal contest arose in 1879 in which Sawyer and Man contested patent claims made by Thomas A. Edison. The U.S. Patent Office declared an interference between the Sawyer and Man application of January 1880 and one filed the previous month by Edison. A protracted content resulted in a decision rendered in 1885 by the Commissioner who stated:

I think it is fully and clearly shown that Sawyer and Man were the first inventors of the incandescent conductor for an electric lamp formed of carbonized paper.

Accordingly, on 12 May 1885, a patent issued to the Electro-Dynamic Light Company, assignee of Sawyer and Man, containing these claims:

An incandescing conductor for an electric lamp of carbonized fibrous or textile material and



The 1880s Westinghouse incandescent lamp.

Westville, New York, entered Union College in 1845, graduated in 1849 in both literary and scientific courses, and was elected a member of the Phi Beta Society. After studying law with his uncle, Albon P. Man of New York, he was admitted to the Bar of New York in February 1852. During his law practice, Man held many positions. He was elected district attorney of Franklin County, New York, in 1860 and in December 1862, went to

HARPER'S WEEKLY. December 18, 1886

**THE WESTINGHOUSE ELECTRIC COMPANY**

OF

**PITTSBURGH,**

Manufacturers of Isolated Incandescent Plants, and Contractors for Central Stations.

It is believed that the advantages of our System place us beyond competition.

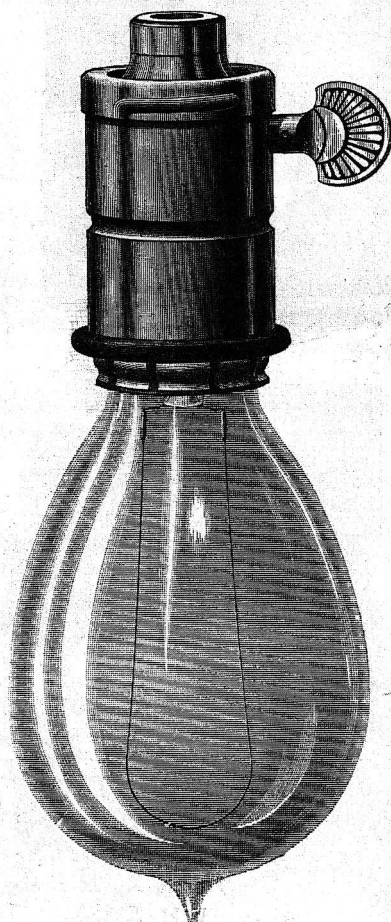
Capital investing for dividends will do well to close no contracts until our proposals are considered.

Address

**THE WESTINGHOUSE  
ELECTRIC CO.,  
Pittsburgh, Pa.,**

or

**WESTINGHOUSE,  
CHURCH, KERR, & CO.,  
17 Cortlandt Street,  
New York.**



16 Candle-power Lamp.

2

The stopper lamp used at the Chicago World's Fair in 1893.

of an arch or horseshoe shape substantially as herein-before set forth.

The combination, substantially as hereinbefore set forth, of an electric circuit and an incandescing conductor of carbonized fibrous material, included in and forming part of the said circuit, and a transparent hermetically-sealed chamber in which the conductor is enclosed.

The incandescing conductor, for an electric lamp, formed of carbonized paper, substantially as described.

### New Technology... Many New Companies

Various interchanges of rights under

the Sawyer-Man patents had been affected between the Electro-Dynamic Light Company, incorporated in 1878; the Eastern Manufacturing Company, incorporated about a year later; the Sawyer-Man Illuminating Company, organized in 1883; and the Consolidated Electric Lighting Company, incorporated in 1882. Sawyer and Man's original company, Electro-Dynamic Light, ceased to exist in 1881. Eventually the Consolidated Company acquired practical control of the other companies.

In 1886, the Sawyer-Man Electric Company was formed as a result of negotiations between the Consolidated Company and the Thomson-Houston Electric Company, later a part of the General Electric Company. Nine-tenths of the stock of the Sawyer-Man Electric Company was

owned by the Thomson-Houston Company which received a license under the Sawyer-Man patents.

In 1887, the Consolidated Company acquired all the stock of the Sawyer-Man Electric Company, including that previously owned by the Thomson-Houston Company, the latter receiving in exchange certain bonds and shares of the Consolidated Company.

Westinghouse used a Stanley-Thompson patent covering the use of carbonized silk threads for making filaments in its initial lamp manufacturing in Pittsburgh. This was not considered as carbonized fibrous material and, therefore, did not conflict with the terms of the Sawyer-Man patent. Westinghouse lamp manufacturing was then under supervision of L. Reineman and later under Alexander de Lodyguine and Alexander Wurtz; Alexander Wurtz later left Westinghouse to join the Carnegie Institute of Technology.

In December 1888, the Thomson-Houston Company sold its Consolidated stock to Westinghouse, but continued to be licensed under the Sawyer-Man patents. When lamp production by Westinghouse was moved to a new factory at West 23 Street, Phoebus Alexander was placed in charge. He was succeeded by Frank S. Smith, who came to the company soon after graduating from college and for years was engaged in general engineering work for the company. Smith eventually became general commercial manager of the Pennsylvania Power and Light Company. Frank Smith was, in turn, succeeded by Walter Cary, who had been secretary of the Gibbs Electric Manufacturing Company. Mr. Cary was made general manager of the Sawyer-Man Electric Company, late vice president of the parent company as well as of the Lamp Company, and became president of the Bryant Electric Company.

Later, in 1907, the assets and liabilities of Sawyer-Man company were taken over by Westinghouse, and the name was changed to the Westinghouse Lamp Company.

Meanwhile, the United States Electric Company, organized in 1878, was developing a lamp based upon inventions of Moses G. Farmer, Edward Weston, Hiram Percy Maxim, and others. There were



patents on the hydrocarbon treatment of illuminants, which were regarded as of prime importance, as well as a patent for carbonized amorphous cellulose, which was later extensively used by Westinghouse and General Electric.

The United States Company had also developed excellent dc generators and motors and had become a strong factor in the business of electric lighting systems.

In 1889, Westinghouse leased the United States Company and later purchased it. In this manner Westinghouse brought under its control practically all of the important incandescent electric lamp patents except those of the Edison Company.

### About the Lamp Bulb

On 27 January 1880, Edison had secured a patent containing the following claims:

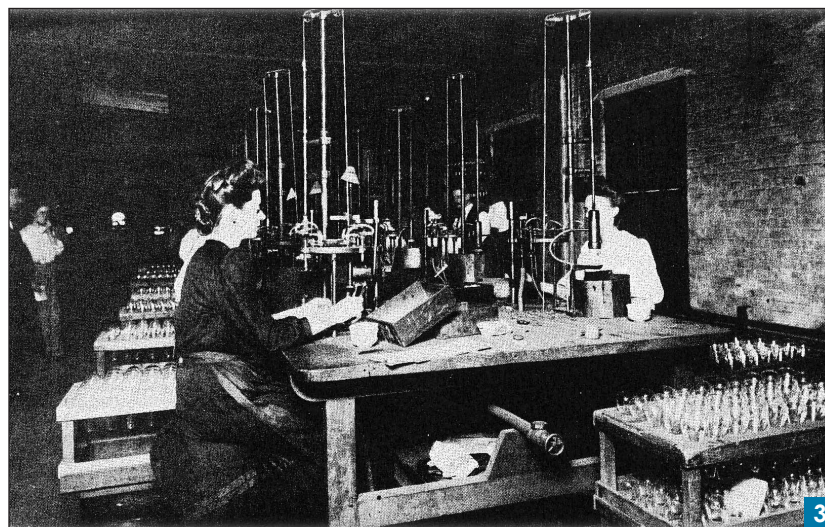
An electric lamp for giving light by incandescence consisting of a filament of carbon of high resistance made as described and secured to metallic wires, as set forth.

The combination of carbon filaments with a receiver made entirely of glass, and conductors passing through the glass, and from which receiver the air is exhausted, for the purpose set forth.

The container shown in the Sawyer-Man patent was made in two parts: a tubular glass main portion closed by a glass disc ground and sealed to form an airtight joint. The Edison container was a continuous glass bulb.

The Westinghouse company believed that a successful defense could be made against the Edison patent, especially as Sawyer-Man had disclosed the light-giving element of carbon, although it was of large cross-section and, thus, of relatively low resistance compared with those used by Edison.

The advantage of using a thin, high-resistance, light-giving element had been previously set forth by Lane-Fox in connection with platinum filaments, and the use of a continuous



Westinghouse employees working to produce 250,000 lamps for the 1893 Chicago Colombian Exposition.

all-glass container was well known in an allied art as shown by the prior Crookes radiometers. Nevertheless, in a suit brought under the Edison patent, the Court ultimately held that it required invention on the part of Edison to substitute a high-resistance carbon filament for the platinum wire described in a prior patent in France, and to combine it with an all-glass globe so as to prevent the disintegration of the carbon by "air washing."

### The Chicago World's Fair of 1893

At about the time that the Edison patent was sustained, the Westinghouse Company secured the contract for lighting the World's Fair at Chicago. A serious question then arose as to whether it would be possible for Westinghouse to manufacture the large number of lamps that would be required for that big undertaking. Mr. Westinghouse enjoyed solving problems of that nature and was not fazed by it.

Sawyer-Man had made lamps with two-part containers. The Edison patent claim called for an all-glass globe. In a very short time, the Westinghouse staff produced the so-called "stopper lamp" and developed the tools for making this lamp. It consisted of a high-resistance carbon filament enclosed in an exhausted bulb closed at one end by a glass stopper, which was ground to fit closely into the neck of the bulb and sealed after the manner of Sawyer and Man. This made, in

effect, a two-part globe, and the Court refused to hold it an infringement of the Edison all-glass globe patent. Ingenious machines were devised to quickly grind the stoppers into the bulb-necks and the lamps were supplied in sufficient quantities to light the World's Fair and meet other commitments by Westinghouse.

Although many of the lamps had long lives, there were lamps that developed defective seals and had to be replaced. Skill was displayed by the plant staff in meeting the tremendous task of manufacturing the large quantities of lamps required to keep the Fair buildings and grounds adequately lighted, and Westinghouse made provisions for constant replacements of defective lamps. The result was that the lighting was a pronounced success.

Upon the expiration of the Edison patent, the Westinghouse company resumed manufacture of the all-glass globe type of lamp. When the lamp business outgrew the capacity of the West 23rd Street factory, it was transferred to a new factory in Bloomfield, New Jersey.

### References

- [1] "Early history of the Westinghouse Electric & Manufacturing Company," Educational Dept. Extension Course, 1925.
- [2] "Death of an american electrician," *Electrical World*, vol 1, pg 309, May 19, 1883. Available: <http://frognet.net/~ejcov/sawyer.html>
- [3] Albon Man [Online]. Available: <http://home.frognet.net/~ejcov/man.html> IAS