

# Charles F. Brush

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**Charles Francis Brush** (March 17, 1849 – June 15, 1929) was a U.S. inventor, entrepreneur and philanthropist.

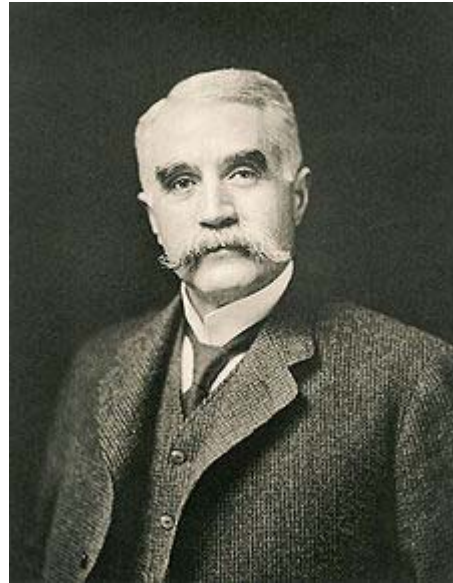
## Biography

Born in Euclid Township, Ohio, Brush was raised on a farm about 10 miles from downtown Cleveland. He had a great interest in science, particularly with Humphry Davy's experiments with the arc light; he tinkered with and built simple electrical devices such as a static electricity machine at age 12, experimenting in a workshop on his parents farm. Brush attended Central High School in Cleveland where he built his first arc light, and graduated there with honors in 1867.<sup>[1]</sup> He received his college education from the University of Michigan, where he studied mining engineering (there were no majors—as there are today—in electrical engineering). At Michigan, Brush was a member of Delta Kappa Epsilon fraternity (Omicron chapter).

In 1876 he secured the backing of the Wetting Supply Company in Cleveland to design his "dynamo" (an electrical generator) for powering arc lights. Brush began with the dynamo design of Zénobe Gramme but his final design was a marked divergence, retaining the ring armature idea that originated with Antonio Pacinotti. Brush remarked on his motivation for improving the generator in his U.S. Patent 189,997: "The best forms of magneto-electric apparatus at present before the public are unnecessarily bulky, heavy, and expensive, and are more or less wasteful of mechanical power." After comparing it to the Gramme dynamo and other European entrants, the Franklin Institute of Philadelphia judged Brush's dynamo superior due to its simpler design and maintainability after completing tests in 1878.<sup>[2]</sup>

Brush produced additional patents refining the design of his arc lights in the coming years and sold systems to several cities for public lighting, and even equipped Philadelphia's Wanamaker's Grand Depot with a system.<sup>[3]</sup> His lights were easier to maintain, had automatic functions and burned twice as long as Yablochkov candles. His generators were reliable and automatically increased voltage with greater load while keeping current constant.<sup>[4]</sup> By 1881, New York, Boston, Philadelphia, Baltimore, Montreal, Buffalo, San Francisco, Cleveland and other cities had Brush arc light systems, producing public light well into the 20th century.<sup>[2]</sup>

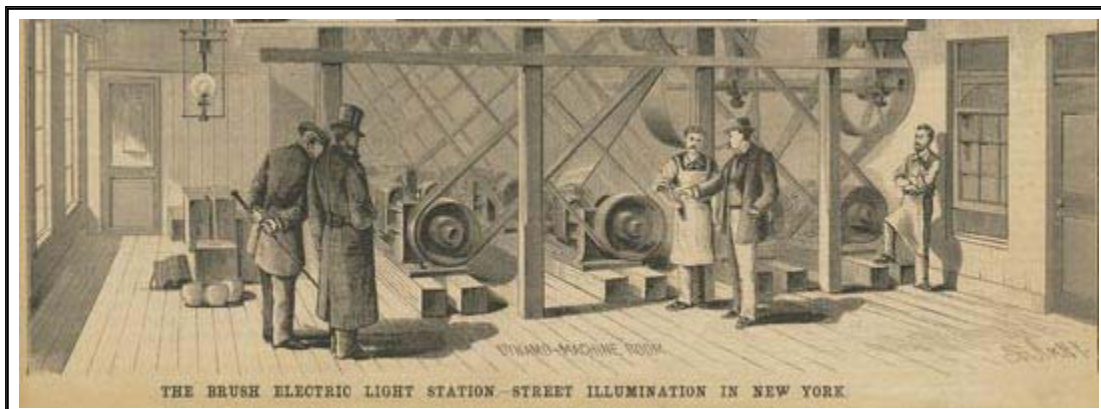
**Charles Francis Brush**



<b>Born</b>	March 17, 1849 Euclid, Ohio
<b>Died</b>	June 15, 1929 (aged 80)
<b>Alma mater</b>	University of Michigan
<b>Known for</b>	Arc lamp
<b>Influences</b>	Humphry Davy; Zénobe Gramme; Antonio Pacinotti
<b>Notable awards</b>	Edison Medal; Rumford Prize; French Legion of Honor; Franklin Medal

**Signature**

*Charles F. Brush*



New York central power plant dynamos powered arc lamps for public lighting. Beginning operation in December 1880 at 133 West Twenty-Fifth Street, it powered a 2 mile long circuit.<sup>[5]</sup>

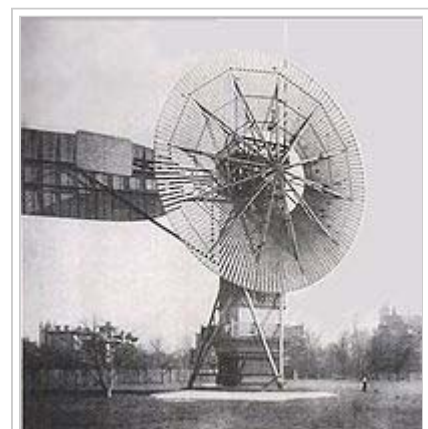
The San Francisco system was the first case of a utility selling electricity from a central plant to multiple customers via transmission lines.<sup>[4]</sup> The California Electric Light Company (now PG&E)<sup>[6][7]</sup> purchased two generators from Charles Brush's company in 1879 and soon opened a second plant with 4 additional generators. Service charges for light from sundown to midnight was \$10 per lamp per week.<sup>[8]</sup> Brush's system was lighting Broadway 2 years before Edison's Pearl Street Station began lighting New York.<sup>[2]</sup> By 1893 there were 1500 arc lights illuminating New York streets.<sup>[9]</sup>

In 1879 Brush formed the Anglo-American Brush Electric Light Corporation in Lambeth, London, England. This company eventually moved to Loughborough England and became Brush Electrical Engineering Co. Ltd.

In 1880, he established the Brush Electric Company, and though successful, faced stiff competition from Thomson-Houston Electric Company, whose arc lights could be independently turned off, and by Edison, whose incandescent lights had a softer warm glow, didn't flicker and were less costly to maintain than arc lights. In 1882 the Brush Electric Company supplied generating equipment for a hydroelectric power plant at St. Anthony Falls in Minneapolis, among the first to generate electricity from water power in the United States. Thomson-Houston bought out Brush in 1889 and eventually merged to become part of General Electric in 1891. After selling his interests in Brush Electric, Brush never returned to the electric industry.

In 1884, Brush built a mansion on Euclid Avenue in Cleveland that showcased many of his inventions. There he raised his family and lived the remainder of his life. The basement housed Brush's private laboratory.<sup>[12]</sup> In 1888, he powered the mansion with the world's first automatically operated wind turbine generator which charged the home's 12 batteries. It was the first home in Cleveland to have electricity.<sup>[12]</sup> Over its 20 year life, the turbine never failed to keep the home continuously powered.<sup>[10]</sup> In 1926, Brush pioneered the first piezo-electric featherweight stylus.<sup>[13]</sup>

Between 1910 and 1929 he wrote several papers on his version of a kinetic theory of gravitation, based on some sort of electromagnetic waves. He died on June 15, 1929.<sup>[14]</sup>



The world's first automatically operated wind turbine was built

## Legacy

- Charles F. Brush High School in Lyndhurst, Ohio is named after Brush, whose sports teams and other groups are named the "Arcs," after Brush's lamp.
- Metro Parks, Serving Summit County's Furnace Run Metro Park in Richfield, Ohio, received a donation of land from the Family of Charles F. Brush. The donated tract is known as Brushwood.
- USS Brush (DD-745) 1943-1969 (then Taiwan's *Hsiang Yang* until scrapped in 1993) was named after Brush, sponsored by his great-granddaughter.<sup>[15]</sup>

in 1888 by Charles F. Brush. It was 60 feet tall with a diameter of 56 feet, weighed 80,000 pounds and had a 12kW dynamo.  
[10][11]

## Honors

- Rumford Prize of the American Academy of Arts and Sciences (1899).
- French Legion of Honor (1881)
- Edison Medal (1913)
- Franklin Medal

## Patents

- Generator:U.S. Patent 189,997
- Arc light (automatic control of spark gap) 1878 U.S. Patent 203,411
- Arc light (double-carbon lamp regulation system) 1879 U.S. Patent 219,208
- Arc light (Automatic shut off for Electric Lights or Motors) 1880 U.S. Patent 234,456
- Arc light (improved regulator for the carbon arc) 1885 U.S. Patent 312,184

## References

1. ^ Jeffrey La Favre, *Charles Brush and the Arc Light*, <http://www.lafavre.us/brush/brushbio.htm>, retrieved 2009-01-04
2. ^ *<sup>a</sup> <sup>b</sup> <sup>c</sup> Charles Francis Brush*, Hebrew University of Jerusalem, <http://chem.ch.huji.ac.il/history/brush.html>, retrieved 2009-01-04
3. ^ Charles William Calhoun (2006), *The Gilded Age*, Rowman & Littlefield, p. 40, ISBN 0742550389, <http://books.google.com/?id=XrZTTCaCRAUC&pg=PA40>, retrieved 2009-01-04
4. ^ *<sup>a</sup> <sup>b</sup> Richard Shelton Kirby; Frances A. Davis (1990), Engineering in History*, Courier Dover Publications, p. 358, ISBN 0486264122, [http://books.google.com/?id=AVn\\_Sm56OCcC&pg=RA1-PA357](http://books.google.com/?id=AVn_Sm56OCcC&pg=RA1-PA357), retrieved 2009-01-04
5. ^ Mel Gorman, "Charles F. Brush and the First Public Electric Street Lighting System in America", *Ohio History:the Scholarly Journal of the Ohio Historical Society* (Kent State University Press) **70**: 142, <http://publications.ohiohistory.org/ohstemplate.cfm?action=detail&Page=0070142.html&StartPage=128&EndPage=144&volume=70&newtitle=Volume%2070%20Page%20128>
6. ^ Supreme Court of California (1905), "California Electric Light Company v. California Safe Deposit & Trust Co. et. al.", *The Pacific reporter*, **78**, West Pub. Co, pp. 372â–376  
Note legal title. Roe, born circa 1852, died December 10, 1894.
7. ^ Roth, Charles B. (19 December, 2009). "PG&E of California, The centenial story of pacific gas and electric company 1852-1952". *electrifications.net*. <http://www.electrifications.net/?q=node/23>. Retrieved 30 June 2010.  
"In June 1879 [young Canadian broker] Roe [and other investors] incorporated the California Electric Light Co., he serving as secretary and manager. J. R. Hardenbergh was the first president.... In July 1880 PIERRE

- B. CORNWALL was elected vice president and treasurer. Next year he became president..."
8. ^ PG&E passage no longer available quoted in blog, *PG&E: Our History*, [http://nodhimmitude.blogspot.com/2007\\_11\\_18\\_archive.html](http://nodhimmitude.blogspot.com/2007_11_18_archive.html), retrieved 2009-01-04, "At 27, George Roe had founded the first electric company in the PG&E family tree. By September [1879] a little building at Fourth and Market was completed and two tiny Brush arc-light dynamos were installed. Together they could supply 21 lights. Customers were lured by the unabashed offer of service from sundown to midnight (Sundays and holidays excluded) for \$10 per lamp per week. Yet in light-hungry San Francisco, customers came clamoring. By the first of the next year, four more generators with capacity of more than 100 lights had been added. Electricity had come to the West."
  9. ^ Richard Dennis (2008), *Cities in Modernity: Representations and Productions of Metropolitan Space, 1840-1930*, Cambridge University Press, p. 132, ISBN 0521464706, [http://books.google.com/?id=Gq9\\_uNNkmKUC&pg=PA131](http://books.google.com/?id=Gq9_uNNkmKUC&pg=PA131), retrieved 2009-01-04
  10. ^ ***a b*** A *Wind Energy Pioneer: Charles F. Brush*, Danish Wind Industry Association, <http://www.windpower.org/en/pictures/brush.htm>, retrieved 2008-12-28
  11. ^ Robert W. Righter (1996), *Wind Energy in America: A History*, University of Oklahoma Press, p. page44, ISBN 0806128127, <http://books.google.com/?id=kGnGw7AEkAEC&pg=PA44>, retrieved 2008-12-27
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  13. ^ Steven Schoenherr, *Electrical recording replaces acoustic*, <http://history.sandiego.edu/gen/recording/notes.html#electric>, retrieved 2009-07-23
  14. ^ "Charles F. Brush, Scientist, Dead. Inventor of Arc Light, 80 Years Old, Succumbs at Home in Cleveland. He Established Foundation for the Betterment of Man, Was Active in Philosophical Society.", *Associated Press in New York Times*, June 16, 1929, <http://select.nytimes.com/gst/abstract.html?res=F1091FF73C55127A93C4A8178DD85F4D8285F9>, retrieved 2009-01-07, "Charles Francis Brush, 80, inventor of the arc light and an outstanding figure as a scientist, humanitarian and philanthropist, died at his home here tonight."
  15. ^ DANFS entry on USS Brush

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Categories: 1849 births | 1929 deaths | American inventors | American electrical engineers | American manufacturing businesspeople | National Inventors Hall of Fame inductees | People from Cleveland, Ohio | IEEE Edison Medal recipients | Burials at Lake View Cemetery, Cleveland | People from Euclid, Ohio

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