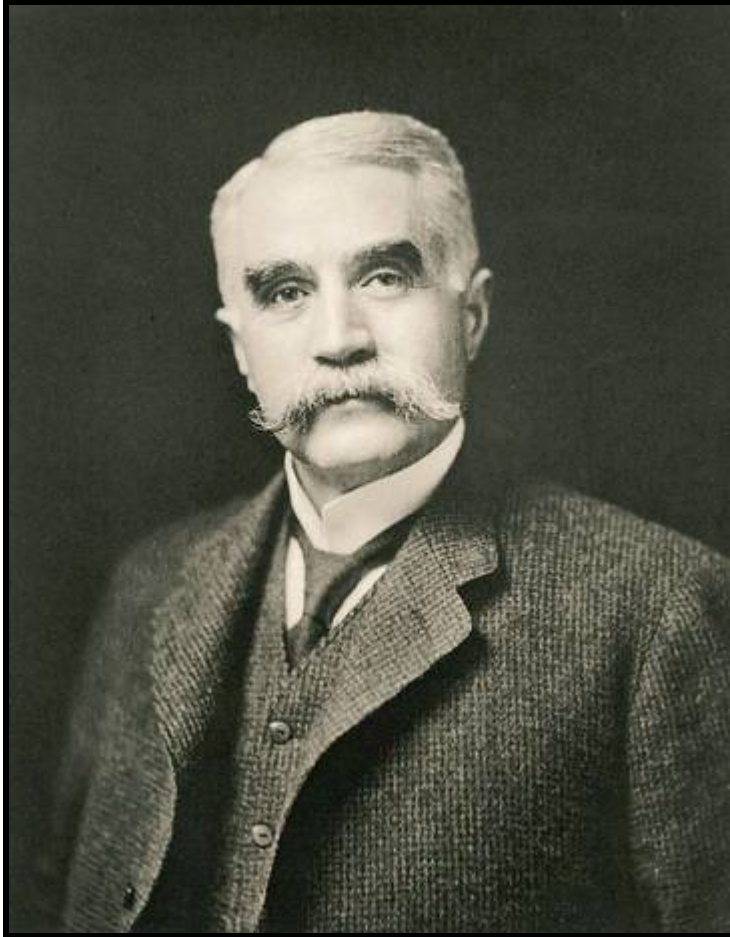


# CHARLES FRANCIS BRUSH ELECTRIC LIGHTING PIONEER

by Brian Roberts, CIBSE Heritage Group

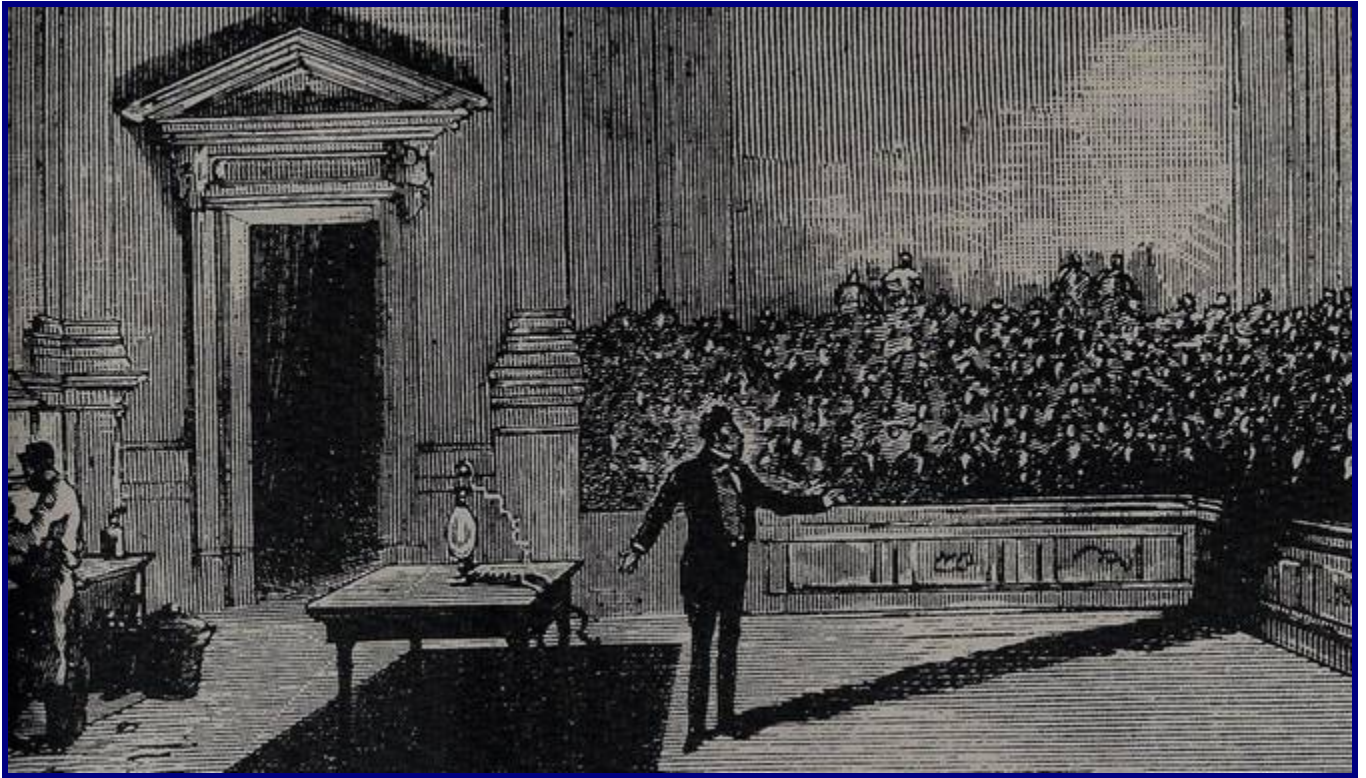


*Charles Francis Brush, 1849-1929*

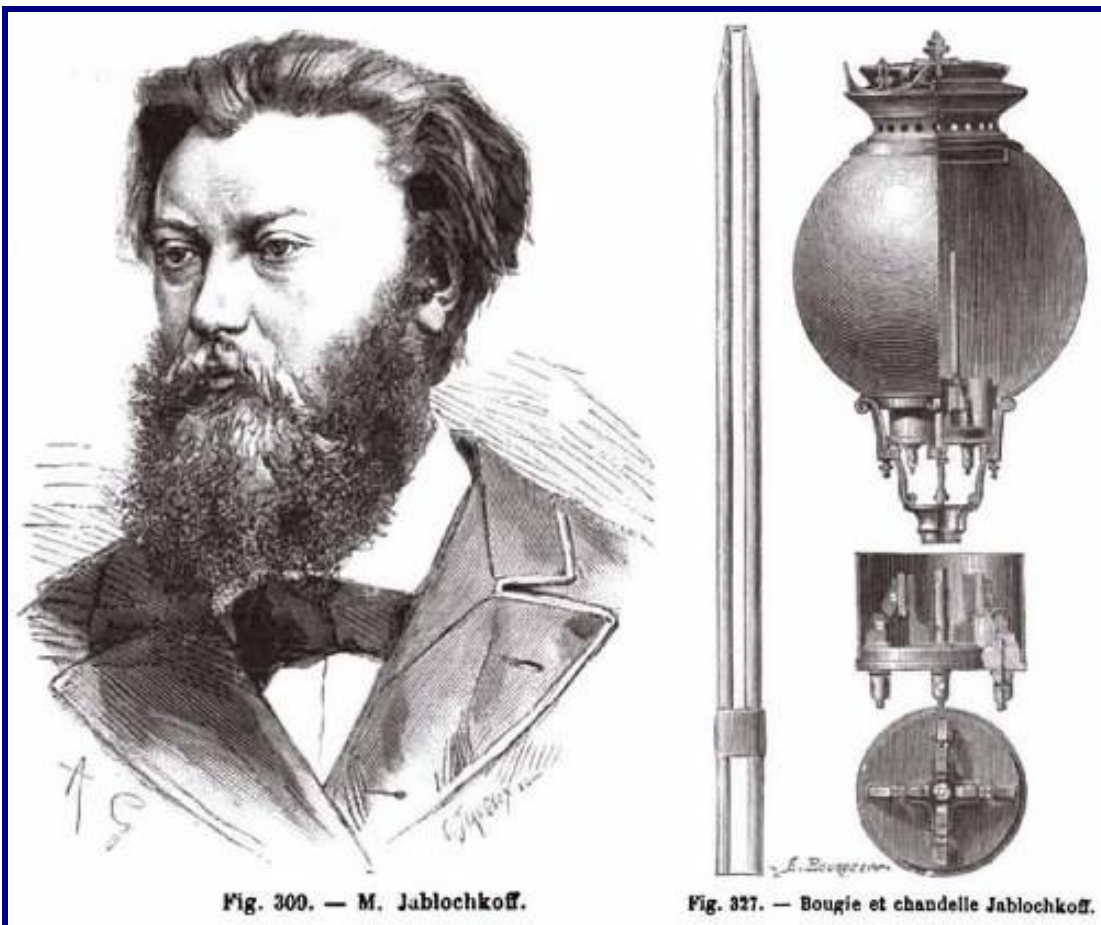
Charles Brush was born on the 17<sup>th</sup> March, 1849, in Euclid, Ohio, near the town of Cleveland, where he grew up on his parent's farm. From about the age of 12, Brush had a great interest in science, particularly with the experiments of Humphry Davy and the arc lamp. He went to the Central High School in Cleveland where he built his first arc lamp, before attending the University of Michigan where he studied mining.

In 1876, Brush received the backing of the Wetting Supply Company in Cleveland to design his dynamo, which he based on the designs of Gramme and Pacinotti with his own improvements and for which he received US Patent 189,997. His work was recognised by the Franklin Institute of Philadelphia when in 1878 they judged his "dynamo superior due to its simpler design and maintainability."

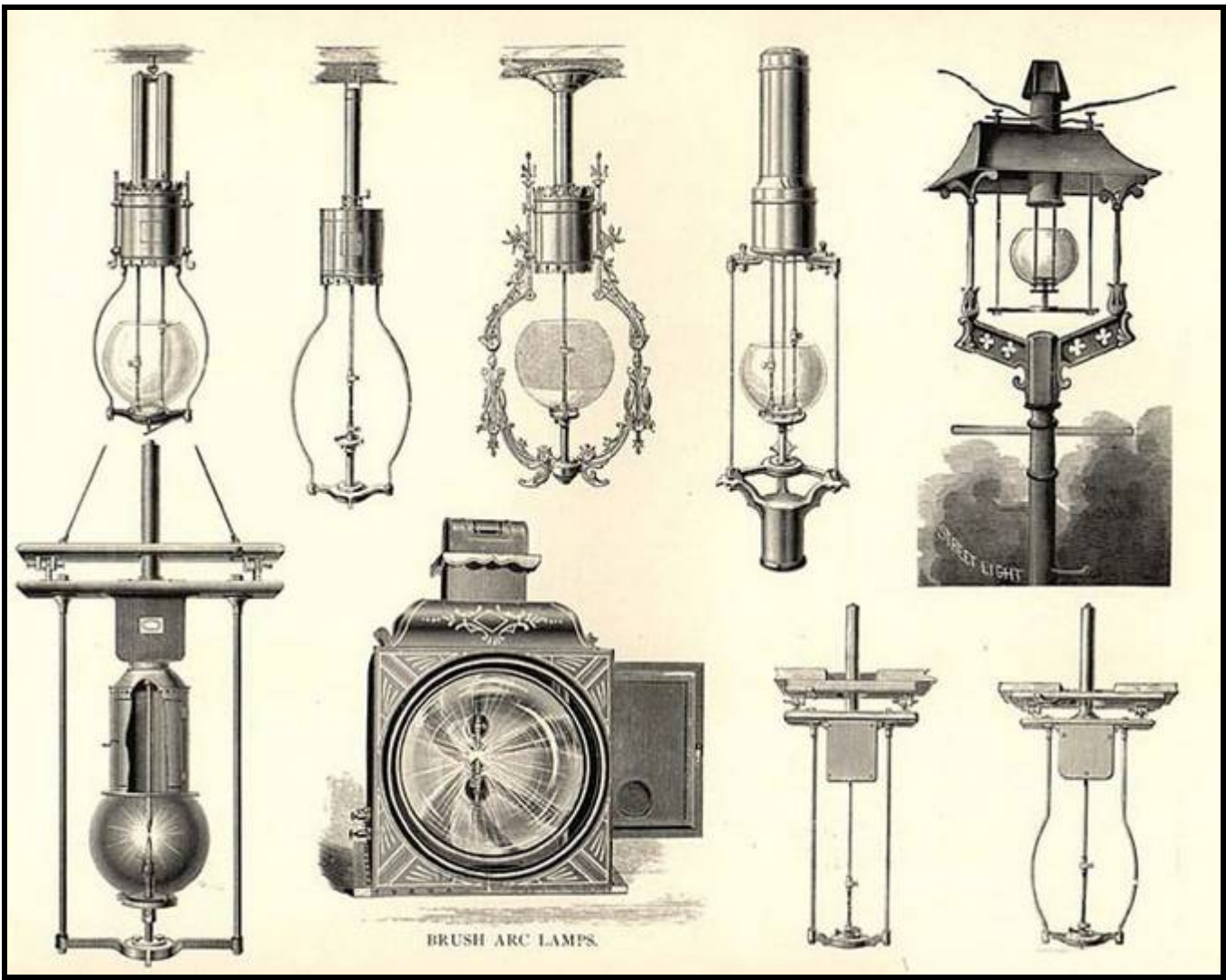
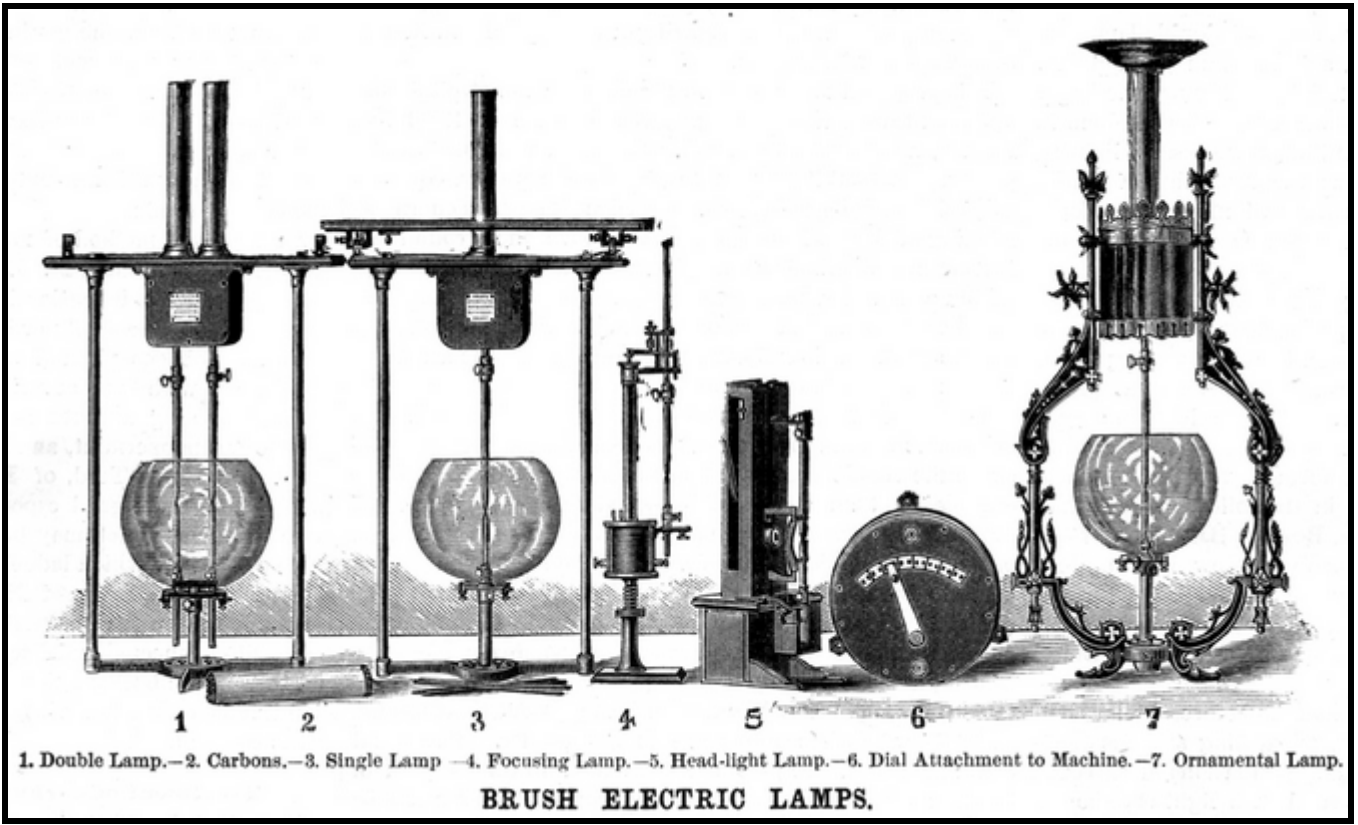
## EARLIER ARC LAMP PIONEERS



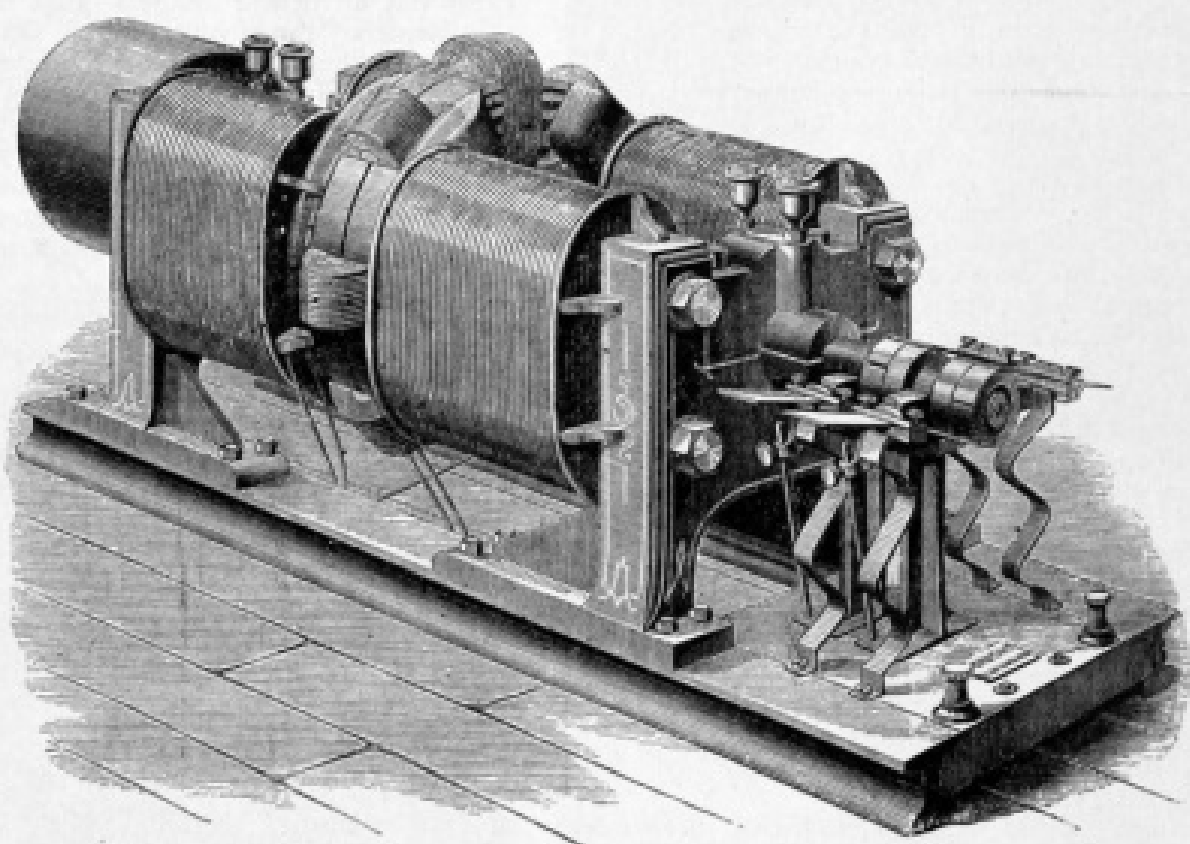
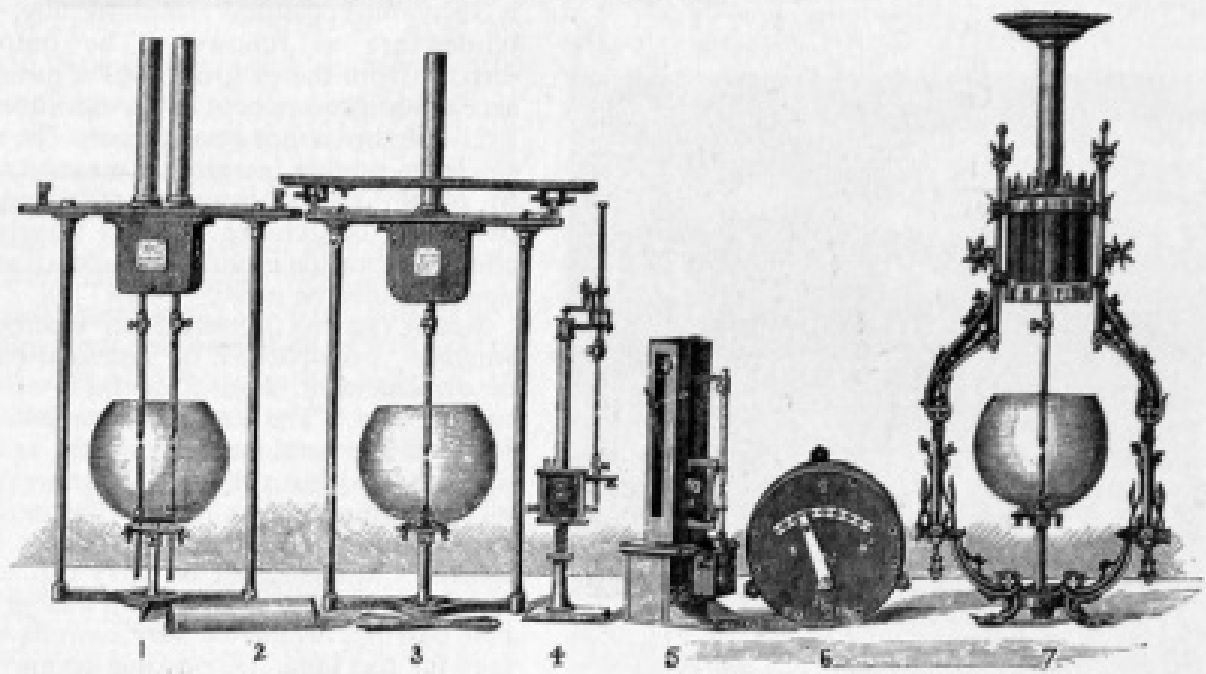
Humphry Davy demonstrated the first electric arc lamp before the Royal Society in 1808.



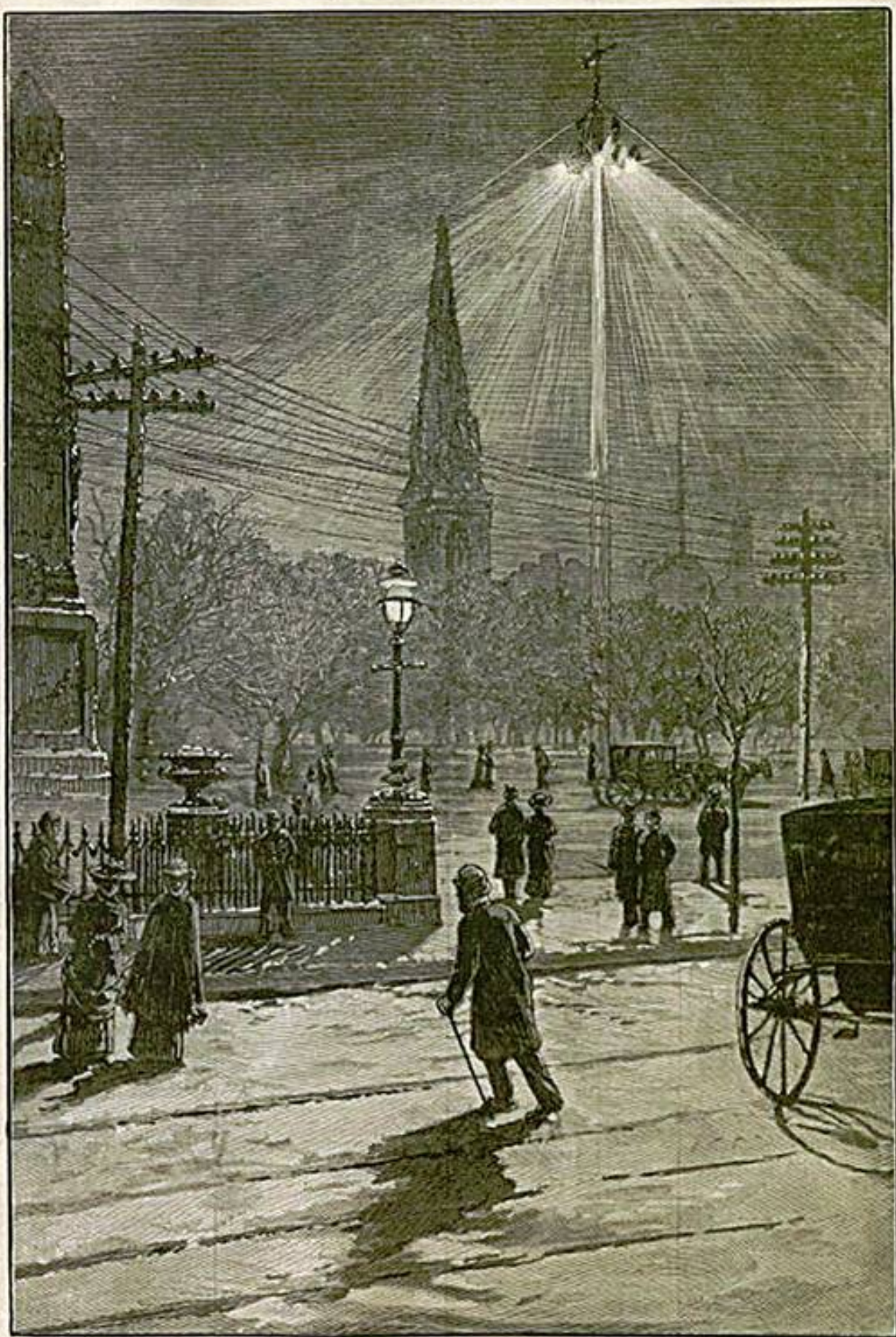
The Russian engineer, Paul Jablochkoff, eliminated the mechanical complexity that required a regulator to manage the voltaic arc, receiving a French patent in 1836



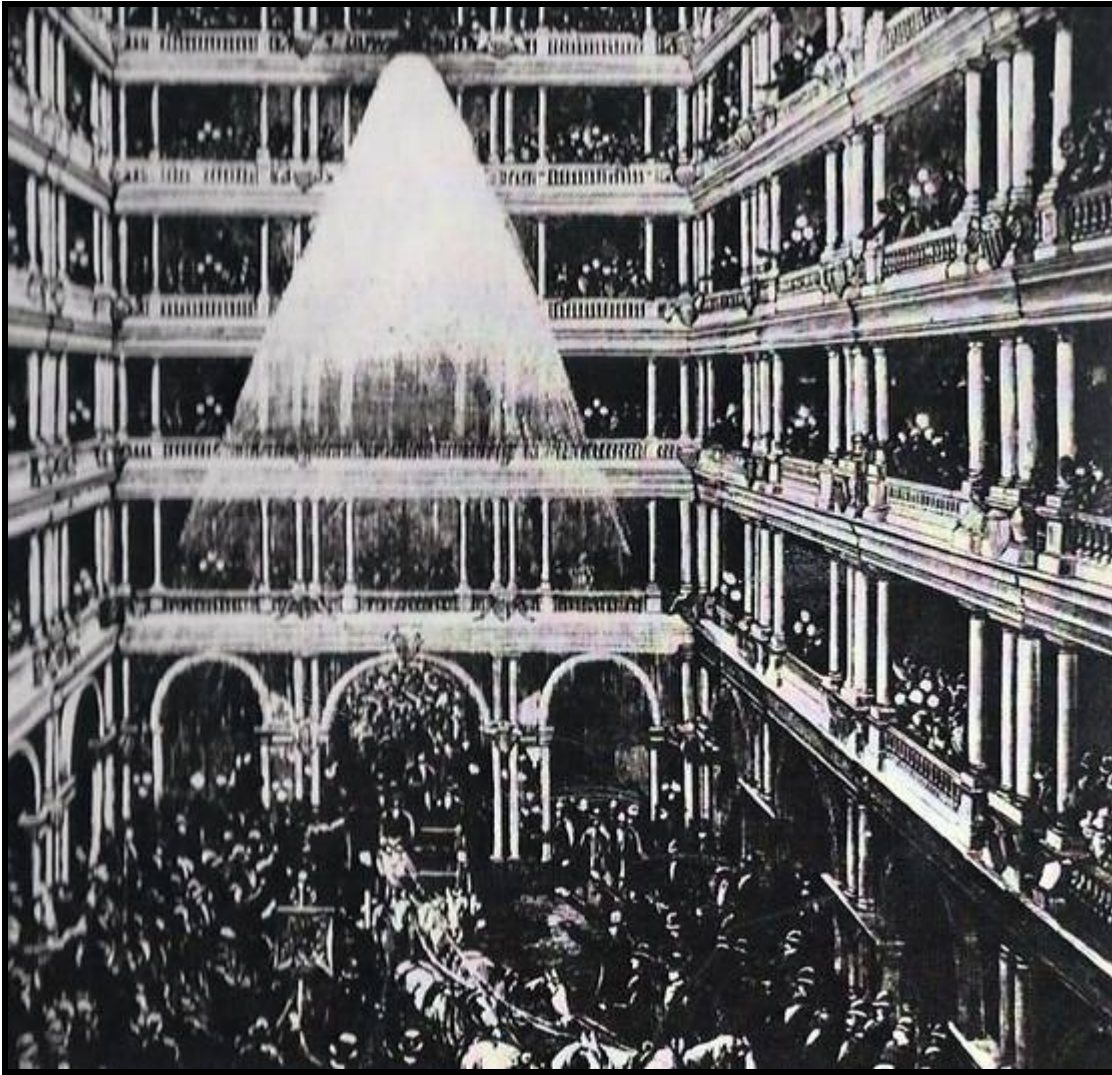
In our issue of January 7, 1881, there appears some account of the introduction of electric lighting to Broadway, New York. The work was done by the Brush Electric Light Company, and the right-hand engraving illustrates the construction of the lamps and also the "dynamo-electric machine requiring 14 horsepower to drive it"



Brush received additional patents covering arc lamps, selling systems incorporating his generators to a number of cities for public lighting. By 1881, these included New York where Brush's system was lighting Broadway before Edison's Pearl Street Station went into operation.



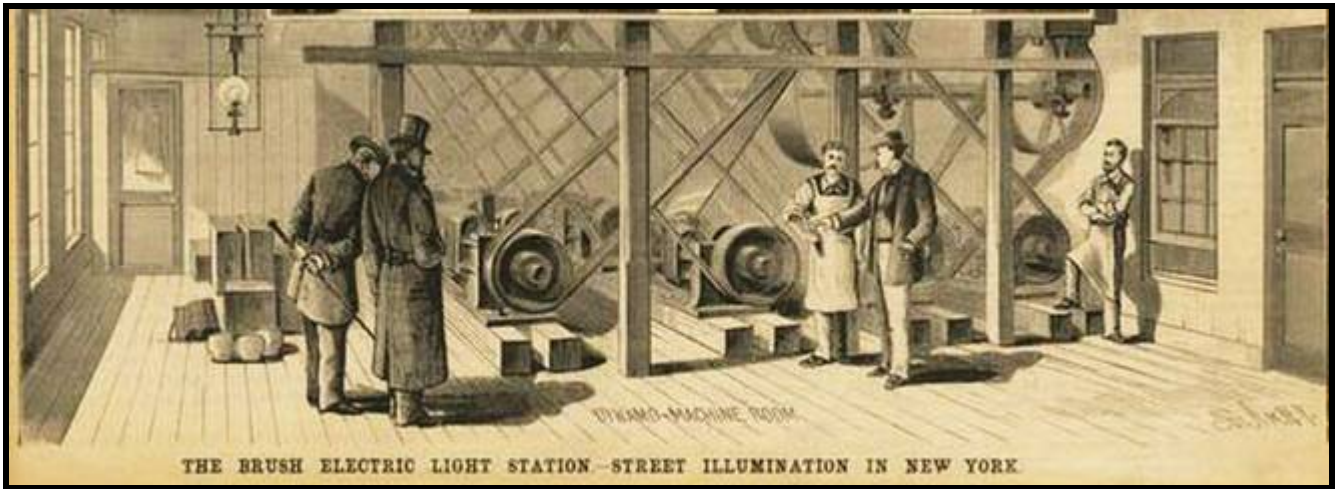
THE ELECTRIC LIGHT IN MADISON SQUARE, NEW YORK.—DRAWN BY CHARLES GAZDAR.—[SEE PAGE 24.]



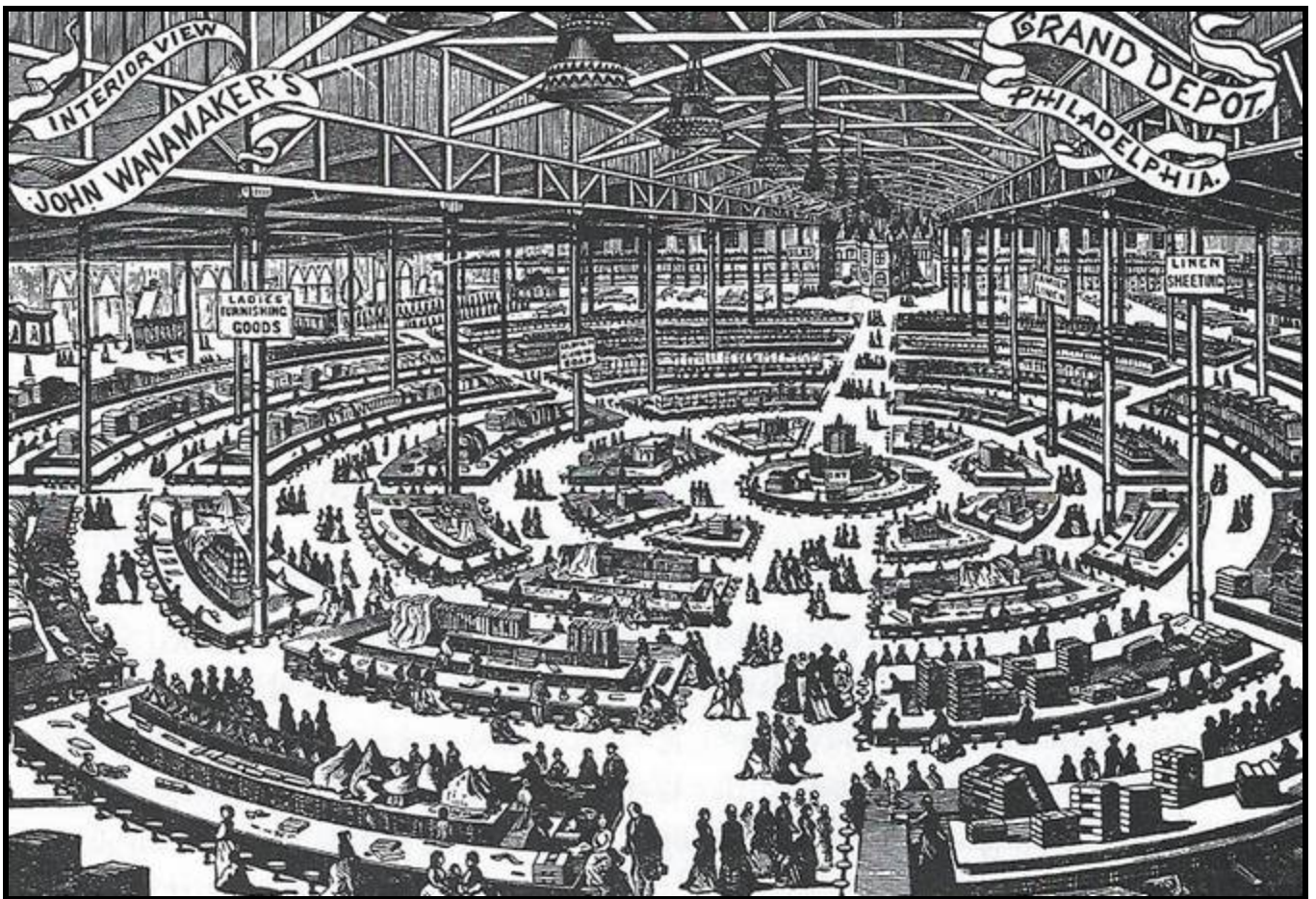
*On the 20<sup>th</sup> September, 1879, two arc lamps powered by a Brush generator illuminated a gala reception for former President Uylsses S Grant in the Courtyard of the Palace Hotel in San Francisco*



*Charles Brush*



Brush also lit Boston, Philadelphia, Baltimore, Cleveland and San Francisco and equipped John Wanamaker's Grand Depot (Department Store) in Philadelphia with a system.



*The Wanamaker Grand Depot in 1877, formerly a Railway Freight Depot*

In 1879, the Anglo-American Brush Electric Light Corporation, using Brush's inventions, was formed in London, later becoming Brush Electrical Engineering Company Ltd and moving to Loughborough.

**The Anglo-American Brush Electric Light Corporation, Ltd.**  
**REDUCTION IN PRICES OF BRUSH DYNAMOS FOR ARC LIGHTING.**

THE REDUCTION in the case of the largest Machine IS EQUAL TO ABOUT 30% upon the prices now ruling, and renders the Brush Machine *THE CHEAPEST ARC MACHINE IN THE MARKET.*

The Machines are all provided with the new improved armatures, by which their efficiency is greatly increased; and they are all of the LATEST DESIGN AND MANUFACTURE.

**GROUPS OF INCANDESCENCE LAMPS** may be successfully run in multiple series on the same circuit with Arc Lamps.

A wide application also exists in the suitability of these Machines **FOR CHARGING SECONDARY BATTERIES OR ACCUMULATORS** over long distances, thus permitting a single Dynamo placed in a central station to charge a large number of secondary batteries placed in cellars or discharging stations in various parts of a town. The Brush Dynamo is also very serviceable as a generator in the **TRANSMISSION OF POWER**, and is used in connection with Victoria Motors.

For the **LIGHTING OF RAILWAY TRAINS**, Brush Dynamos are being successfully employed on several Railways.

The ARC LIGHTING of the ROYAL JUBILEE EXHIBITION, MANCHESTER, was exclusively carried out by means of Brush Arc Machines, Lamps, and Carbons; and the Anglo-American Brush Electric Light Corporation, Limited, have been entrusted with the Contract for the ARC LIGHTING of the GLASGOW EXHIBITION, 1888, by means of Brush Arc Machines and 516 Brush Arc Lamps.

**APPARATUS OR COMPLETE INSTALLATIONS SUPPLIED ON THE PURCHASE-HIRE SYSTEM.**

*For Price Lists and further information apply to the SECRETARY, 112, BELVEDERE ROAD, LAMBETH, S.E. (opposite Charing Cross Foot Bridge).  
 Telegraphic Address, "MAGNETO, LONDON;" Telephone, 4364.*

**THE MORDEY ALTERNATE CURRENT DYNAMO.**  
 CONSTRUCTED BY THE ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION, LIMITED, LONDON.

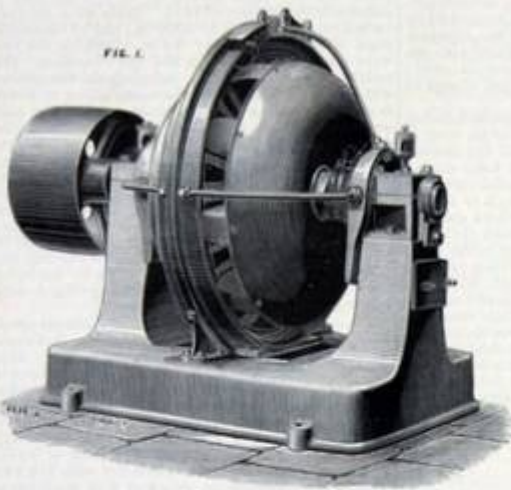


FIG. 1.

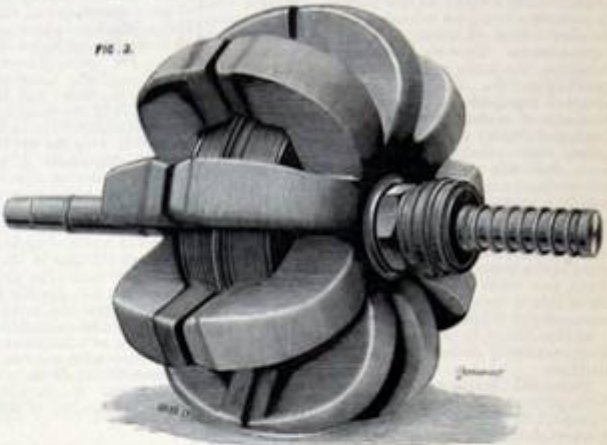


FIG. 2.




FIG. 5.




FIG. 6.




FIG. 7.

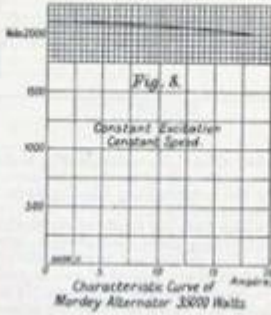


FIG. 8.


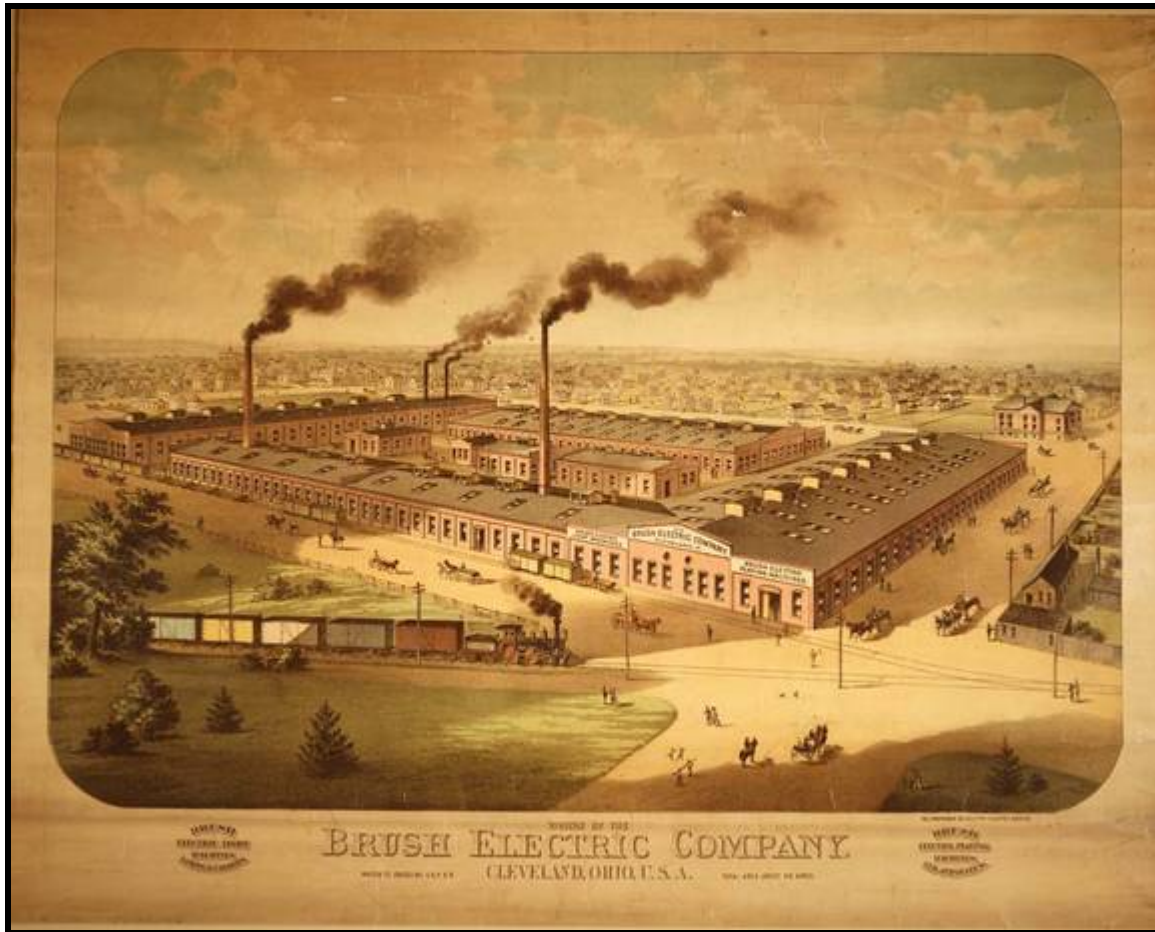


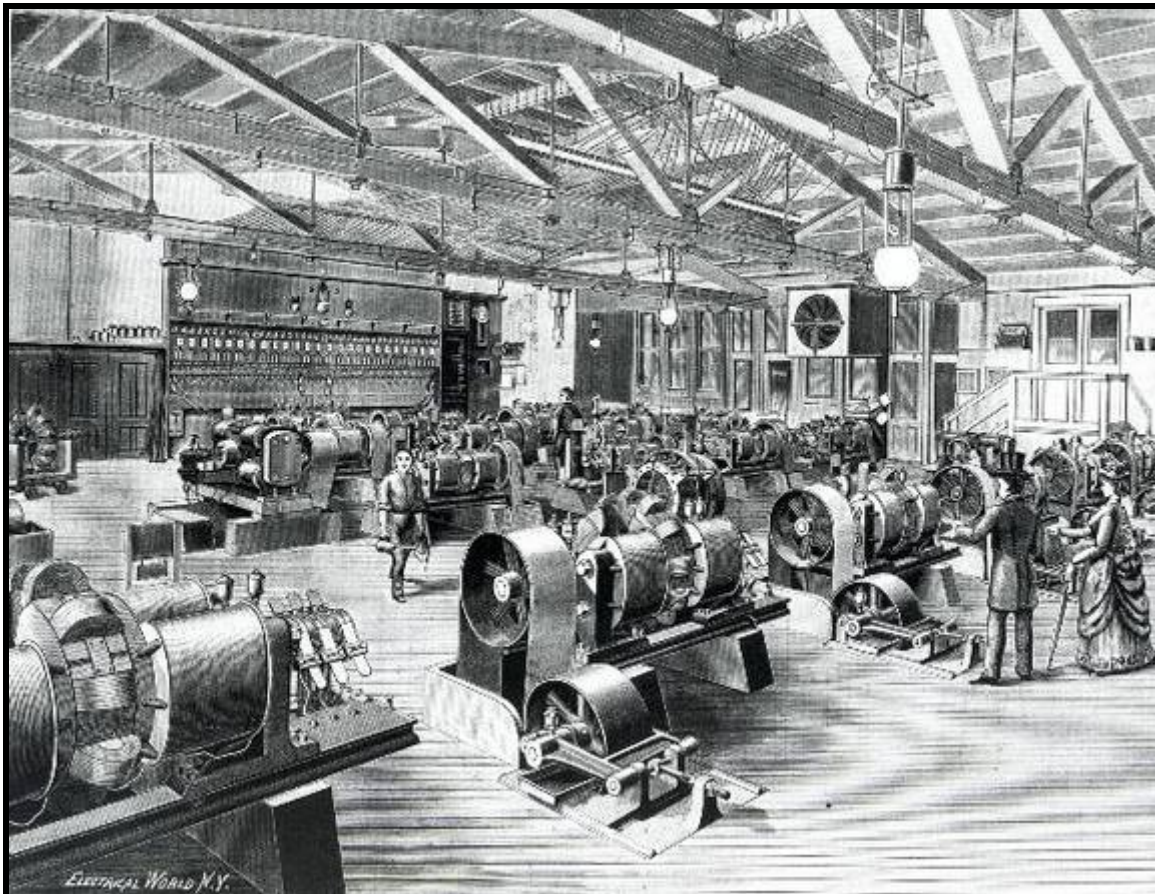
FIG. 9.



In 1880, Brush set up the Brush Electric Company in Ohio.



*The Brush Electric Factory in Cleveland, 1882*

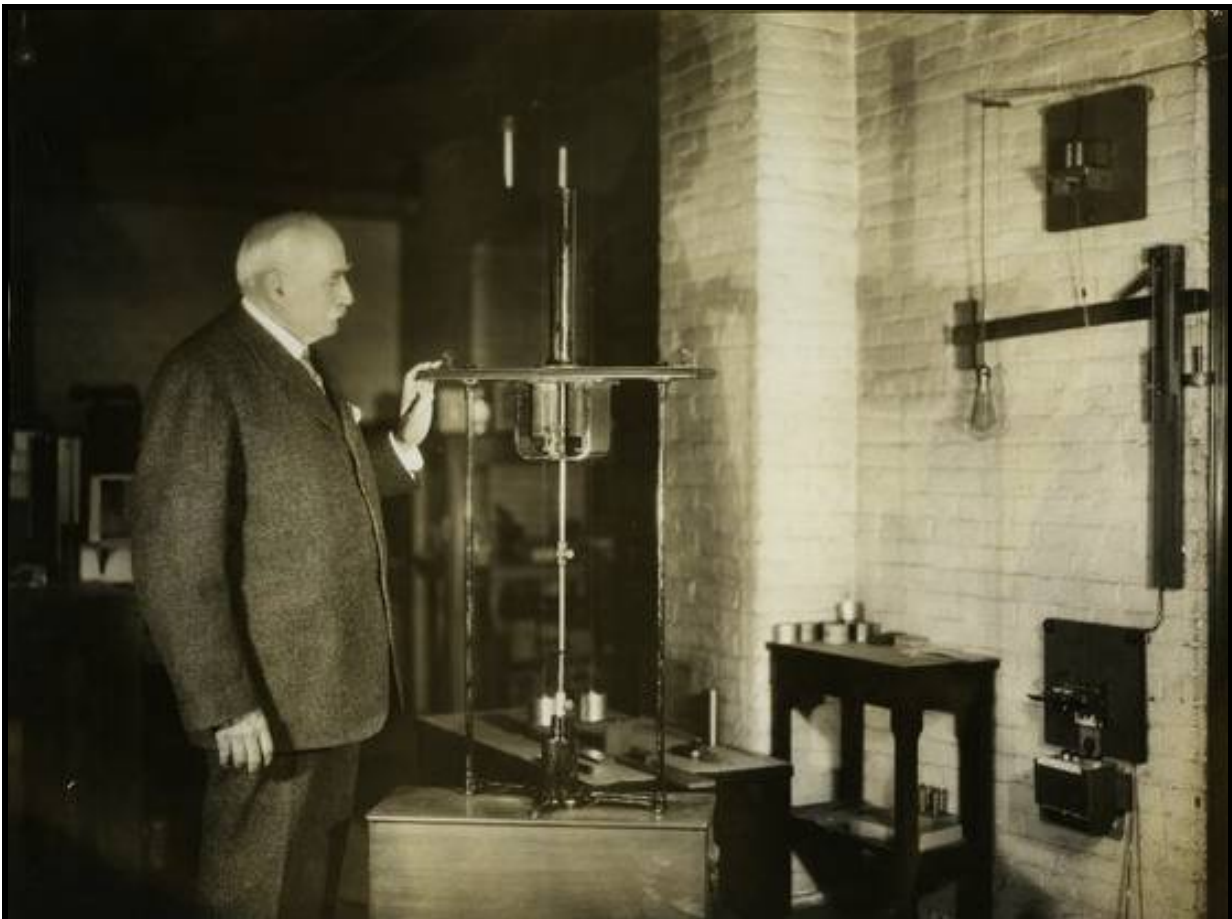


*Inside the Brush Electric factory*

In 1884, Brush built a mansion on Euclid Avenue in Cleveland where he lived the rest of his life. He kept a private laboratory in the basement and in 1888 he powered the mansion with the world's first automatically operated wind turbine generator.



*The Brush Mansion*



*Brush in his basement laboratory*

# SCIENTIFIC AMERICAN

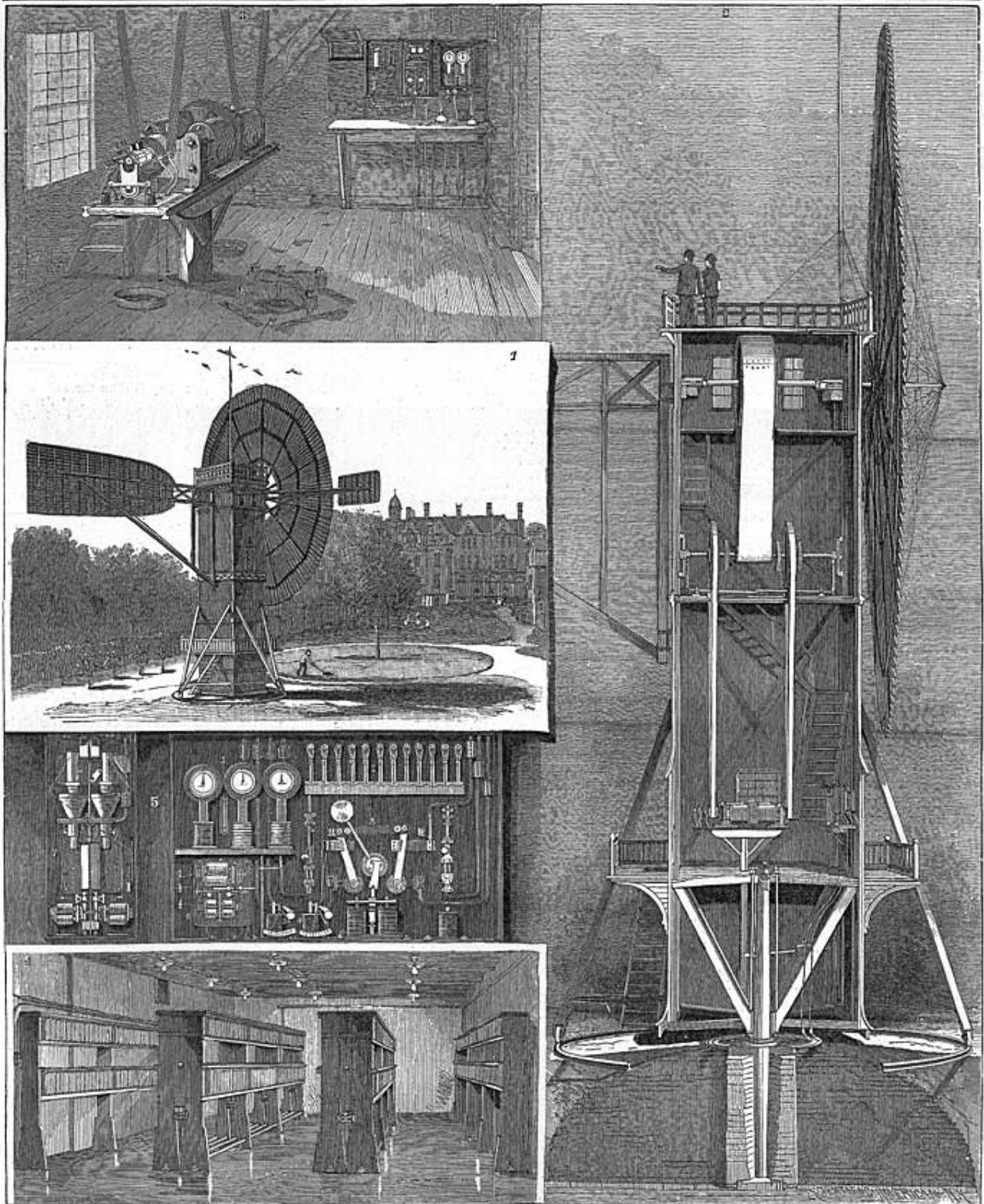
[Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyrighted, 1890, by Mann & Co.]

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

Vol. LXIII.—No. 25.  
ESTABLISHED 1845.

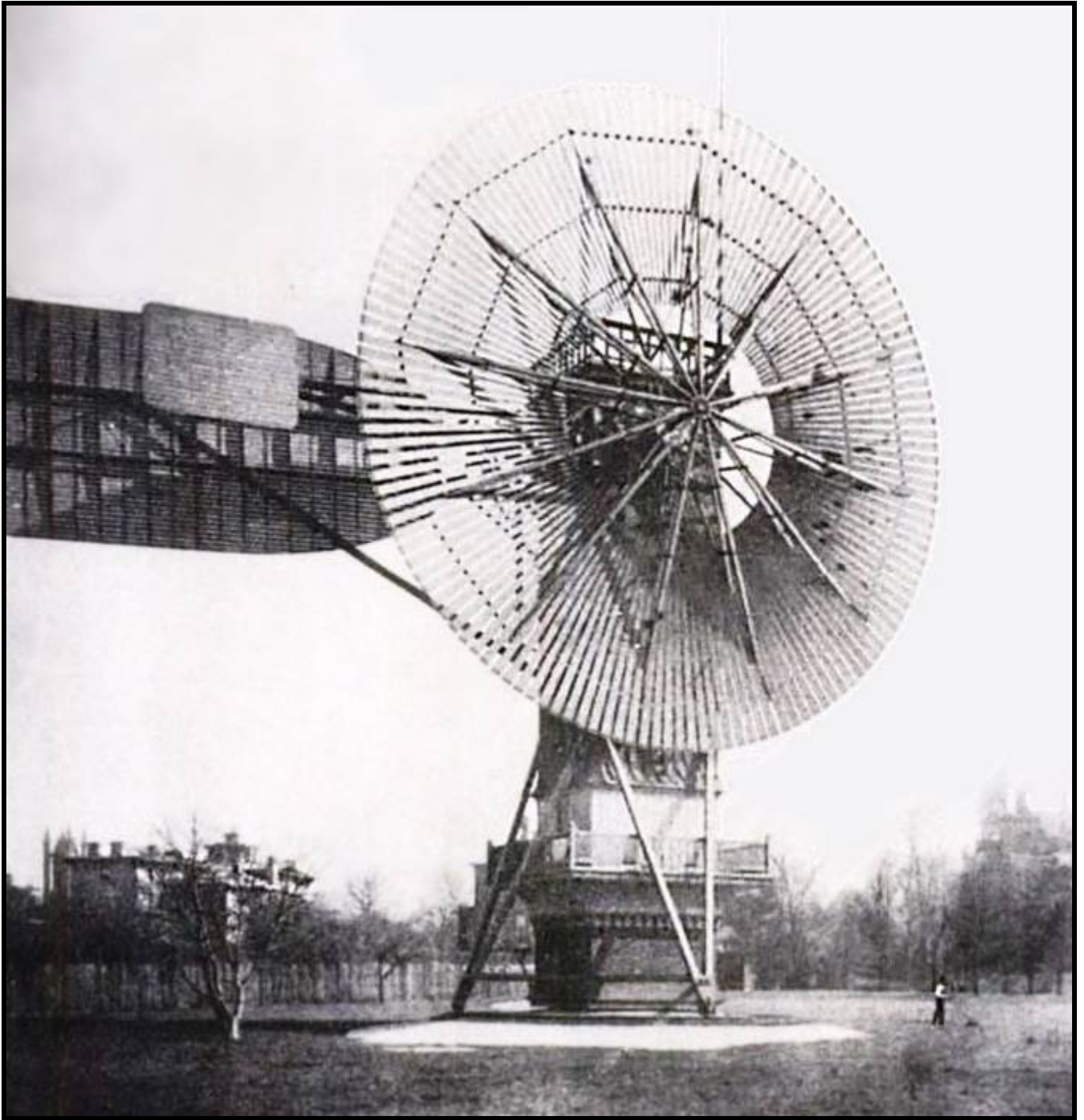
NEW YORK, DECEMBER 20, 1890.

[\$3.00 A YEAR.  
WEEKLY.]



1. Windmill in the park. 2. Vertical section of the tower. 3. Dynamo. 4. Storage batteries. 5. Regulating apparatus.

THE WINDMILL DYNAMO AND ELECTRIC LIGHT PLANT OF MR. CHARLES F. BRUSH, CLEVELAND, O.—[See page 389.]



*Bush's Windmill Dynamo standing 60 feet tall with a diameter of 56 feet.  
It weighed 80,000 pounds and incorporated a 12 kW dynamo*

The American Company faced stiff opposition from Edison and his incandescent lamps, and from the Thomson-Houston Electric Company and their superior on/off switching arrangements. In 1889, this resulted in Thomson-Houston buying out Brush and eventually merging to become part of General Electric. After selling his interests, Brush never returned to the electrical industry.

The British Company continued to operate as Brush Electrical Engineering.

VICTORIA DYNAMO  
AND  
BRUSH ENGINE.

RAWORTH'S PATENT FRICTION GRIP  
FLEXIBLE COUPLING.

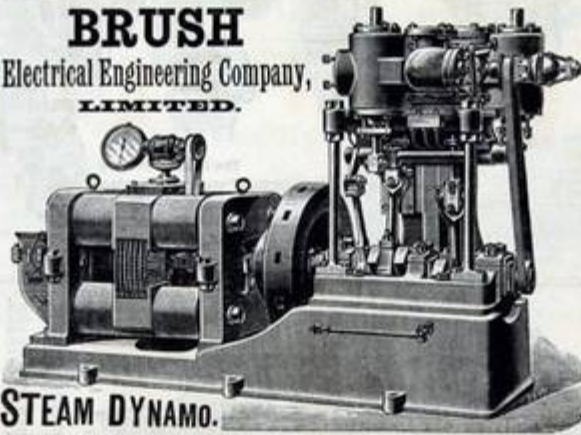
200 to 300 Revolutions per Minute.

Address:

THE SECRETARY,  
112, Belvedere Road,  
Lambeth, LONDON.

**BRUSH**

Electrical Engineering Company,  
**LIMITED.**



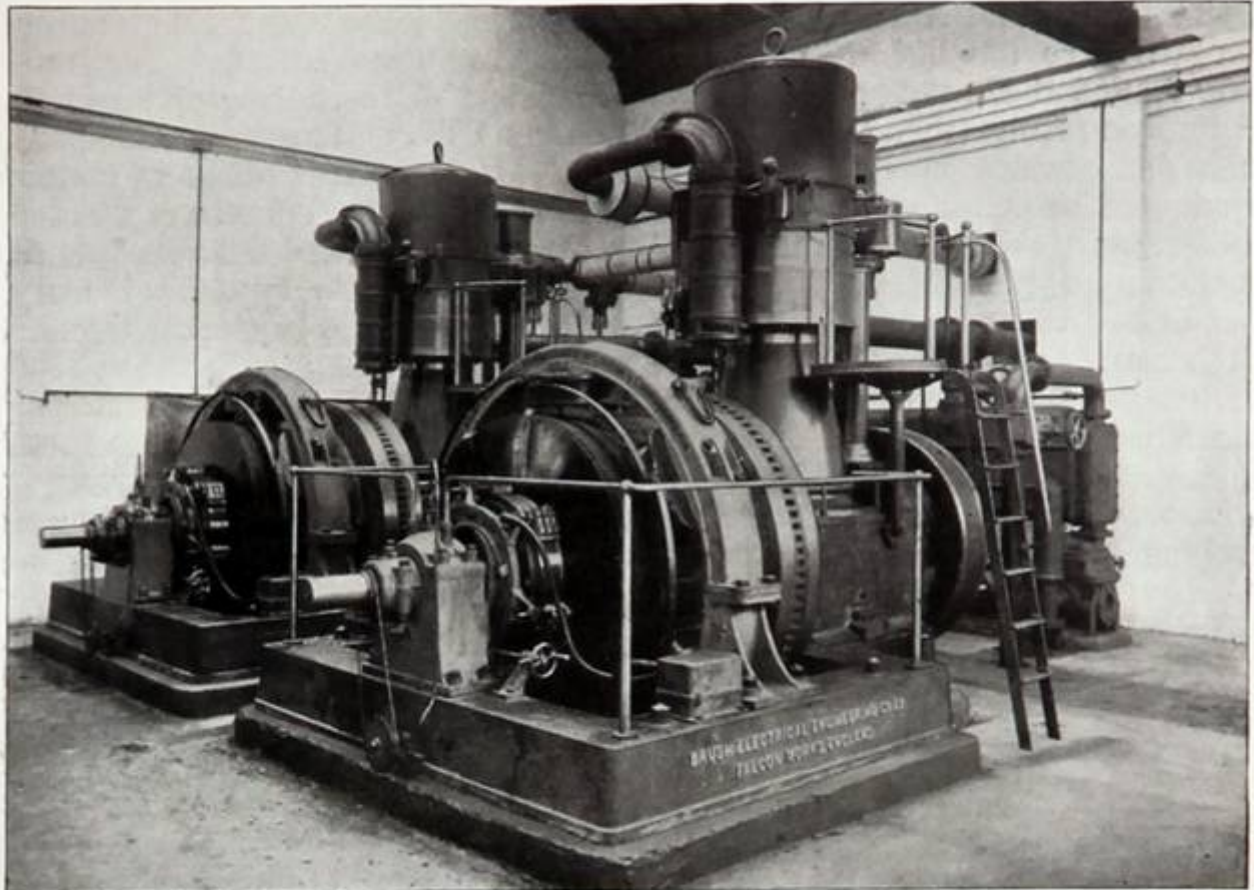
**STEAM DYNAMO.**

USED BY  
PRINCIPAL LINES OF STEAMSHIPS  
AND  
FOREIGN GOVERNMENTS.

Address:

THE SECRETARY,  
112, Belvedere Road,  
Lambeth, LONDON.

7909

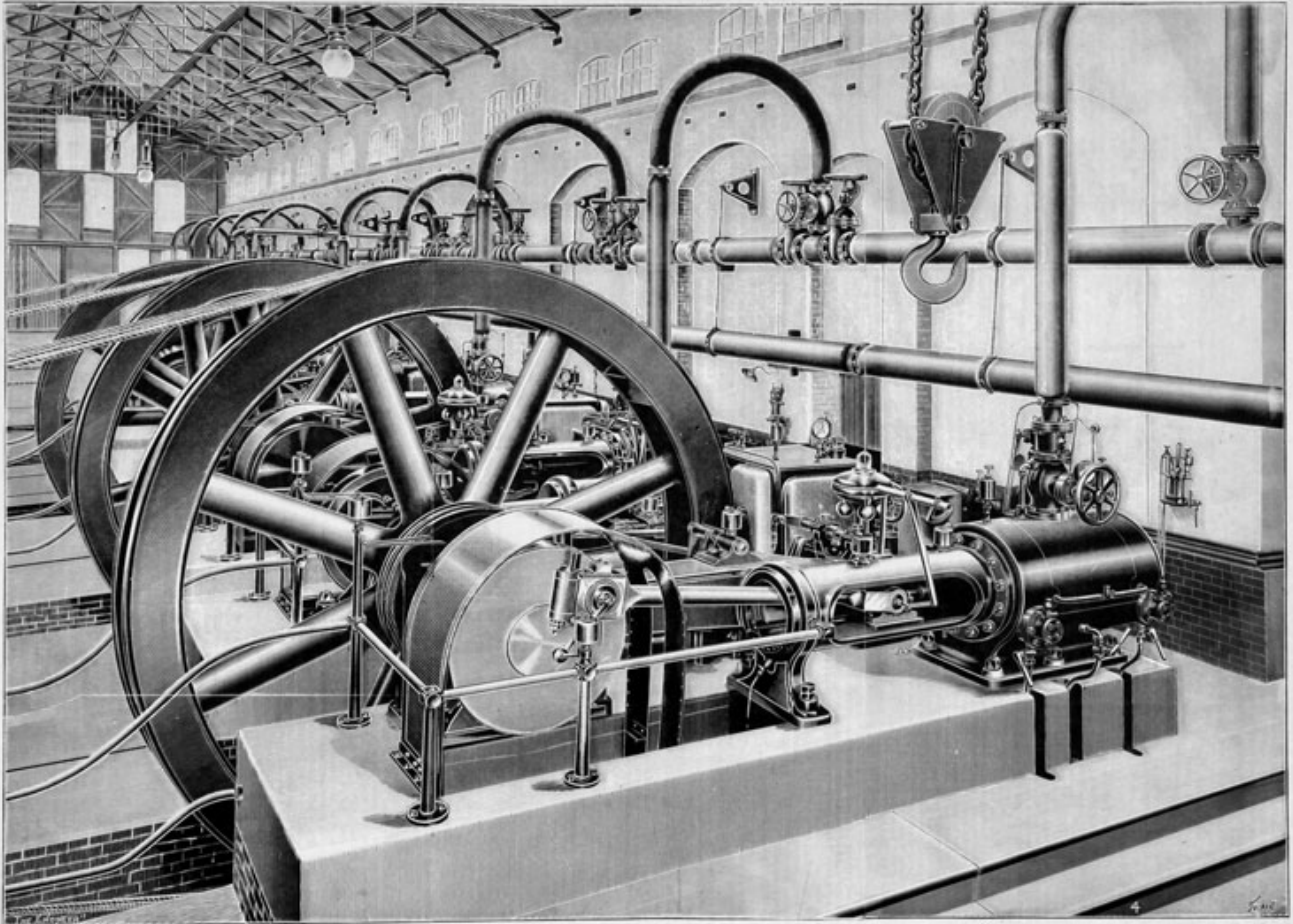


A GENERATING SET FOR THE KIDDERMINSTER & STOURPORT ELECTRIC TRAMWAY. BUILT BY  
THE BRUSH ELECTRICAL ENGINEERING CO., LTD.

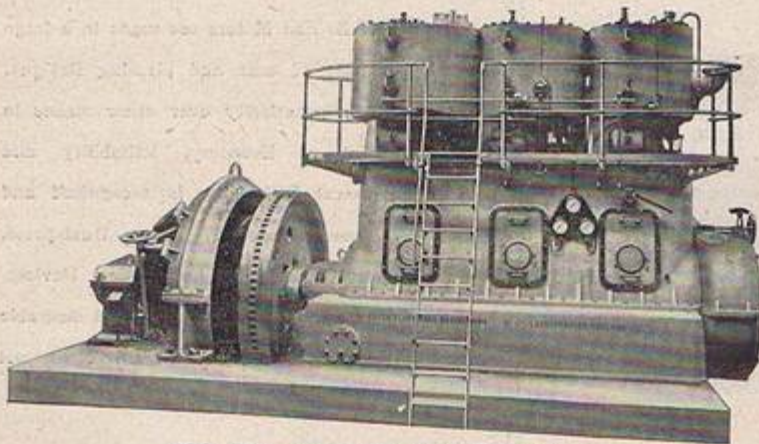
ENGINE AND DYNAMO ROOM, HOLLOWAY ELECTRIC LIGHT STATION

MESSES FOWLER AND CO., AND THE BRUSH COMPANY, ENGINEERS

(For description see page 353)



# BRUSH STEAM SETS



500 Kilowatt Steam Dynamo

Described in Bulletin No 1

built at

**Falcon Works**

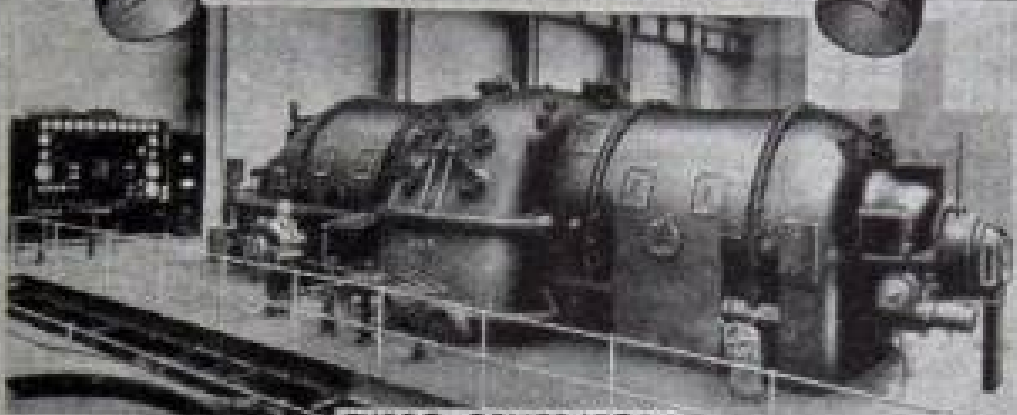
**Loughborough, Leicestershire.**

**The BRUSH ELECTRICAL ENGINEERING CO Ltd**

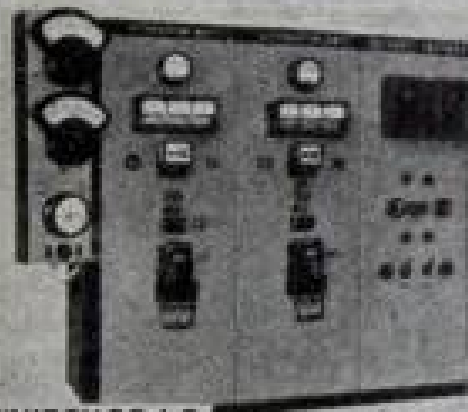
Head Offices: 106 to 112, Belvedere Road, LONDON, S.E.

# BRUSH

PRODUCTS



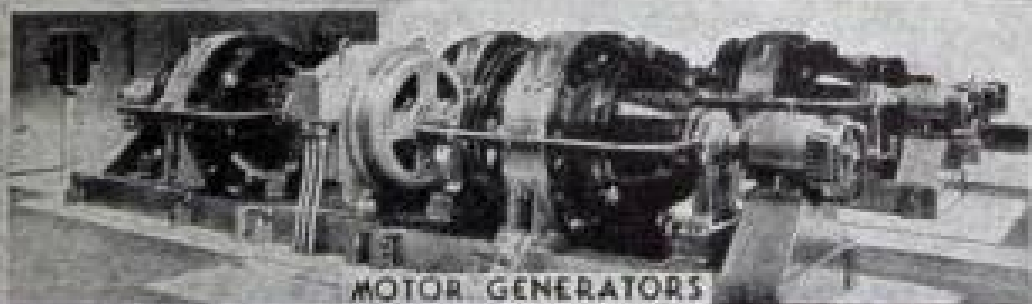
TURBO-GENERATORS



SWITCHGEAR



TRANSFORMERS



MOTOR GENERATORS

*For Quality, Dependability and outstanding Efficiency*

**BRUSH**  
ELECTRIC CORPORATION  
LOW VOLTAGE  
1943

APPENDIX: SOME BRUSH AMERICAN PATENTS

4 Sheets—Sheet 1.

C. F. BRUSH.

MAGNETO ELECTRIC MACHINE.

No. 189,997.

Patented April 24, 1877.

Fig. 1.

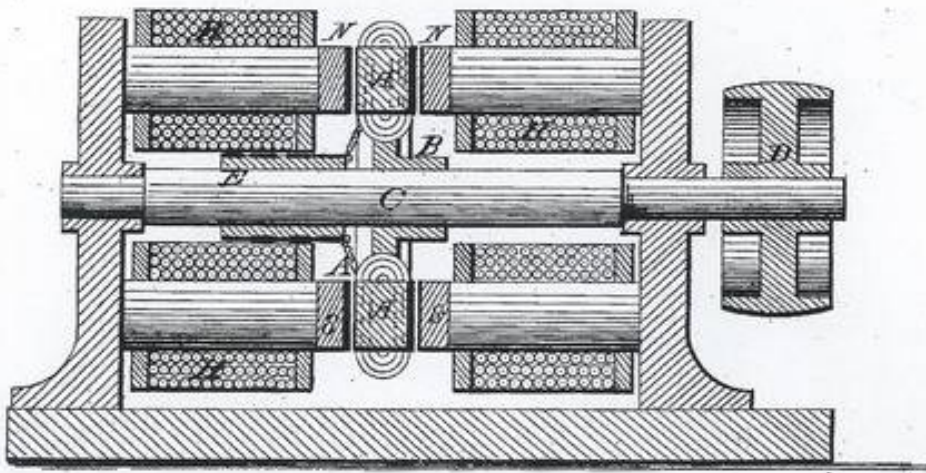
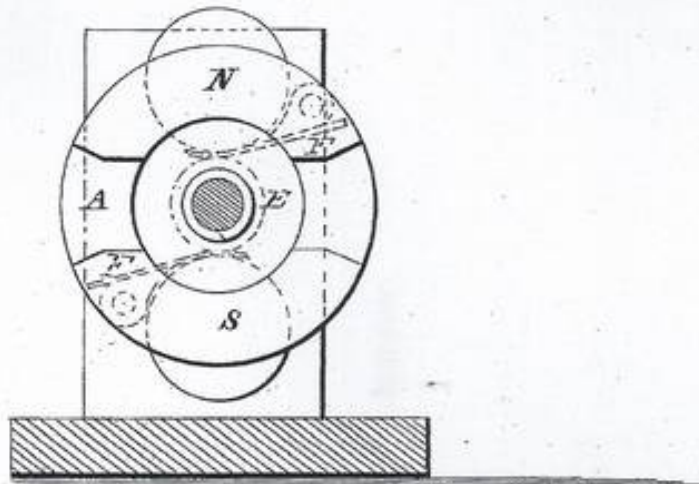


Fig. 2.



WITNESSES

*Edw. Spottiswood*  
*A. M. Bright*

INVENTOR

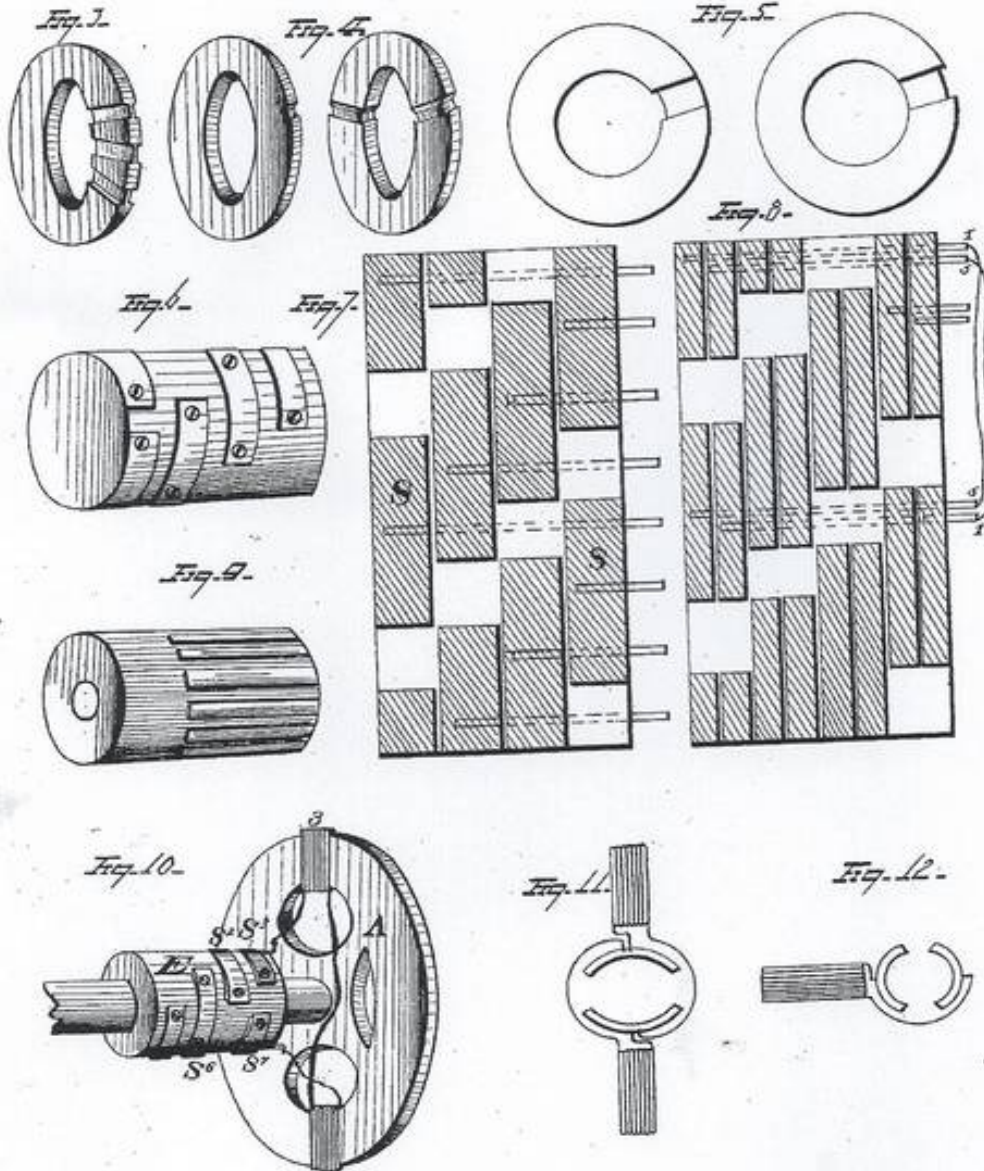
*Charles F. Brush*  
By *Sequett and Sequett*  
ATTORNEYS



C. F. BRUSH.  
MAGNETO ELECTRIC MACHINE.

No. 189,997.

Patented April 24, 1877.



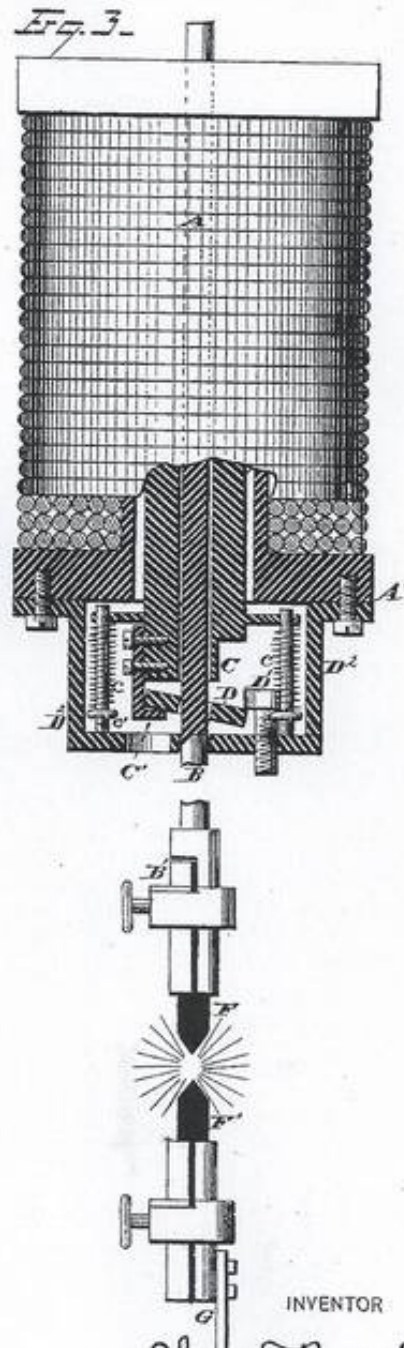
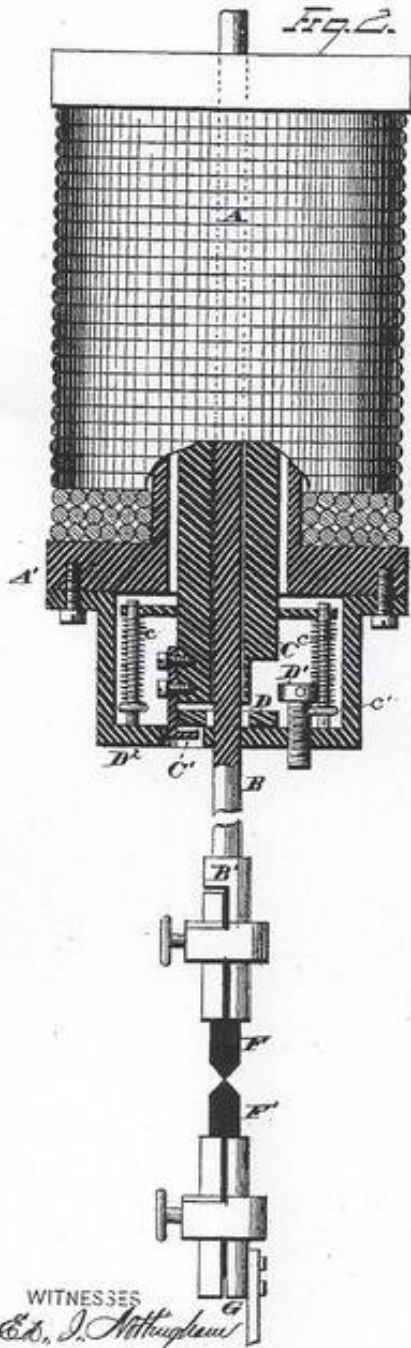
WITNESSES  
*Edw. Tottenham*  
*A. W. Bright*

INVENTOR  
*Charles F. Brush,*  
*Seaggett and Seaggett,*  
ATTORNEYS

C. F. BRUSH.  
Electric Lamp.

No. 203,411.

Patented May 7, 1878.



WITNESSES  
*Ed. J. Attkins*  
*A. W. Bright*

INVENTOR  
*Chas. F. Brush*  
*By E. Eggett & E. Eggett*  
ATTORNEYS

C. F. BRUSH.  
Electric Lamp.

No. 203,411.

Patented May 7, 1878.

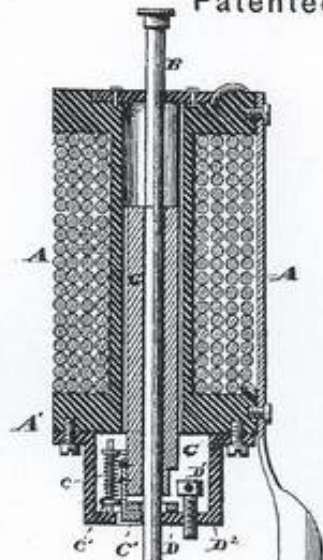
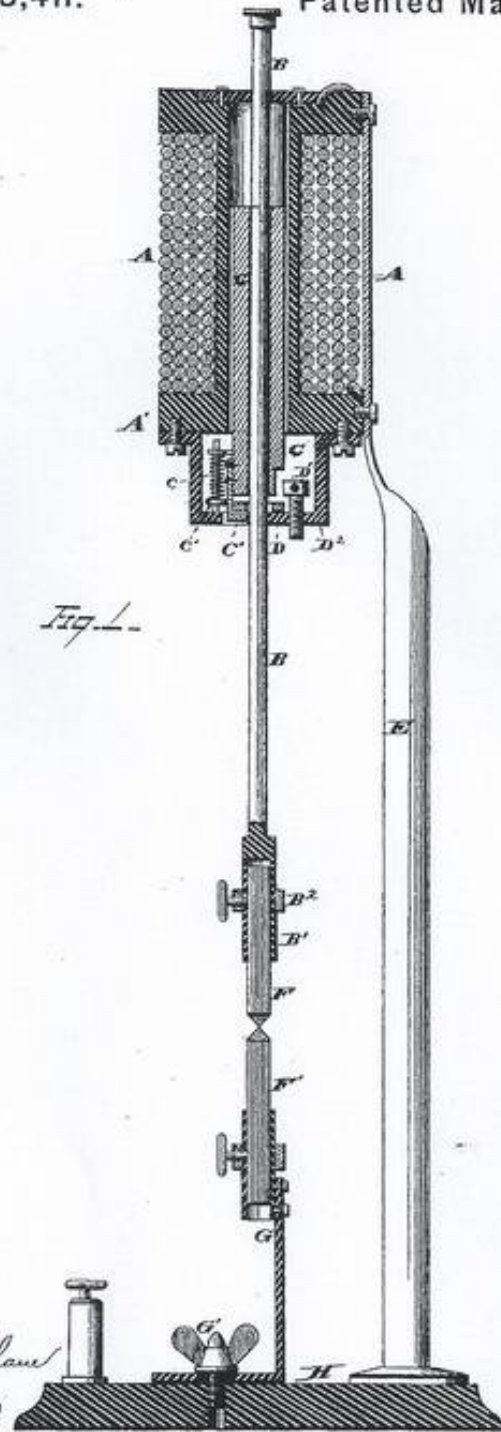


Fig. 1.



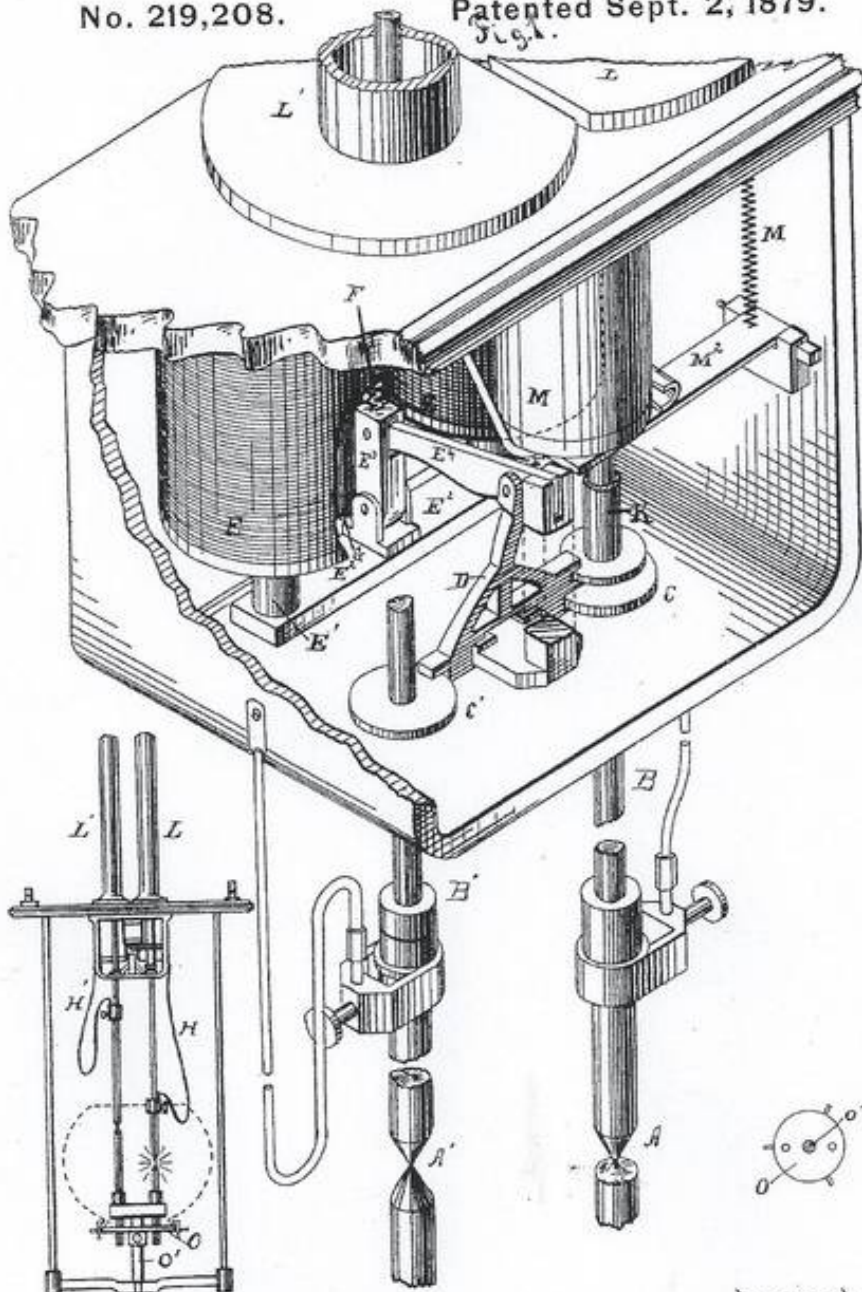
WITNESSES  
*Edw. Nottingham*  
*A. W. Bright*

INVENTOR  
*Chas. Brush*  
By *Leggett & Leggett*  
ATTORNEYS.

C. F. BRUSH.  
Electric-Lamp.

No. 219,208.

Patented Sept. 2, 1879.



Witnesses.  
 Frank M. Taylor.  
 W. E. Donnelly

Inventor.  
 Charles F. Brush  
 By Leggett & Leggett  
 Attorneys

C. F. BRUSH.

Automatic Cut-Out Apparatus for Electric Lights or Motors.

No. 234,456.

+ BATTERY Patented Nov. 16, 1880.

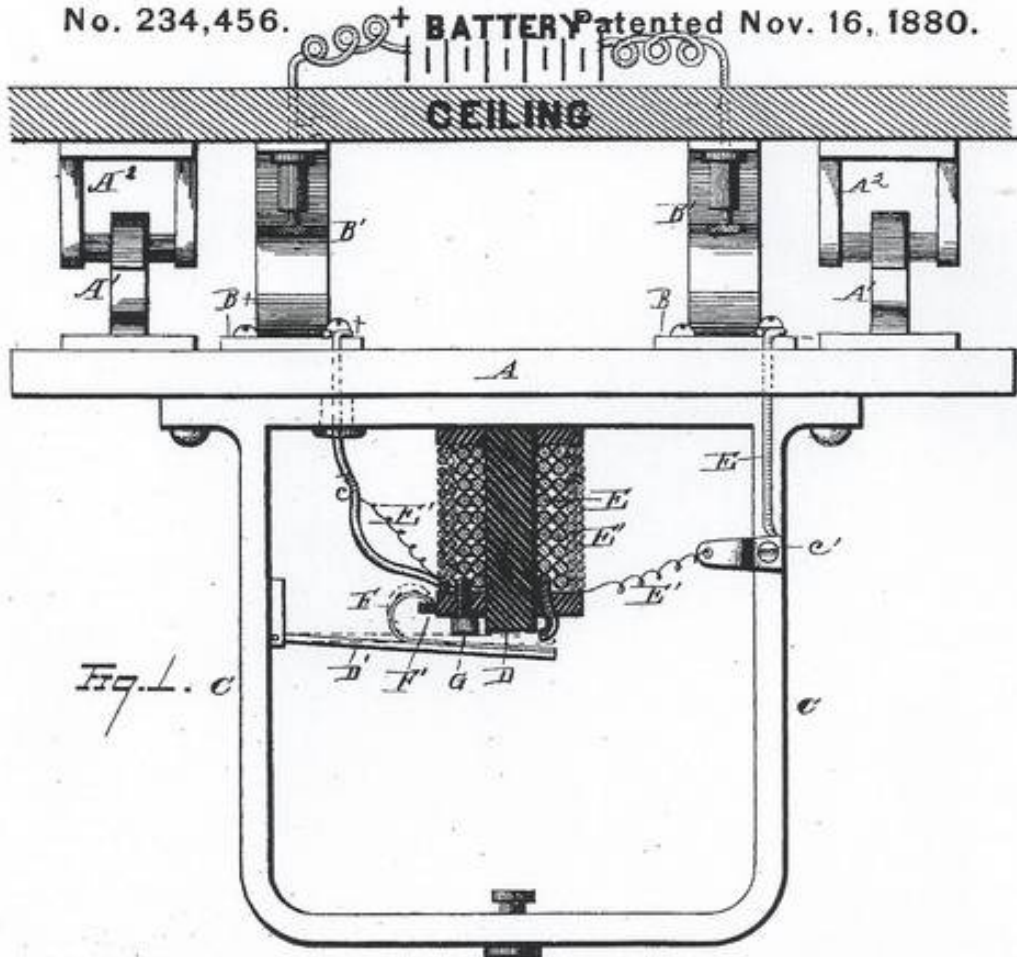
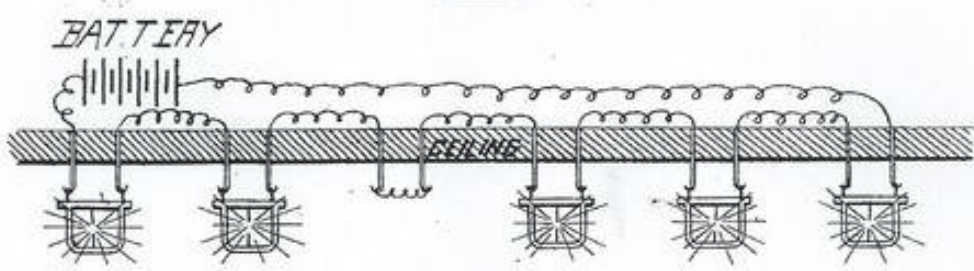


Fig. 1. c



WITNESSES  
*E. S. Nottingham*  
*Am. Bright*

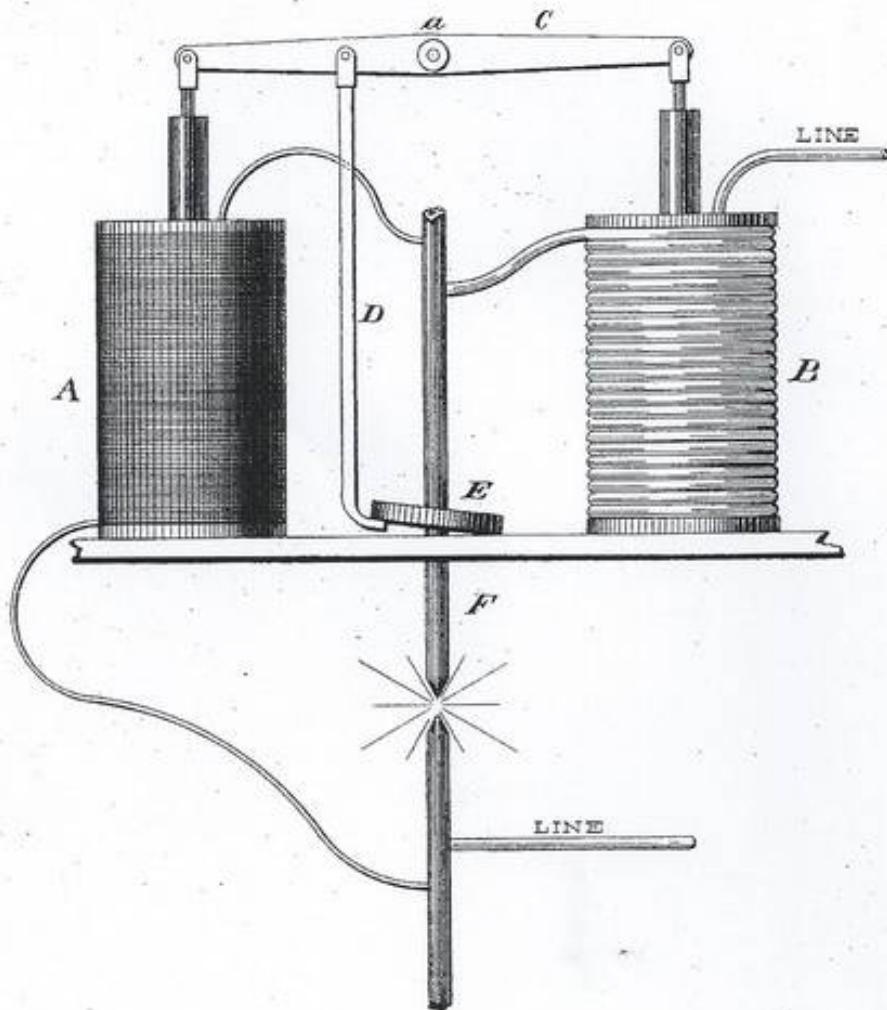
INVENTOR  
*Chas. F. Brush.*  
 By *Dequett & Dequett.*  
 ATTORNEYS

(No Model.)

C. F. BRUSH.  
ELECTRIC ARC LAMP.

No. 312,184.

Patented Feb. 10, 1885.



WITNESSES

*P. M. Felt*  
*Jno. Cornell Jr.*

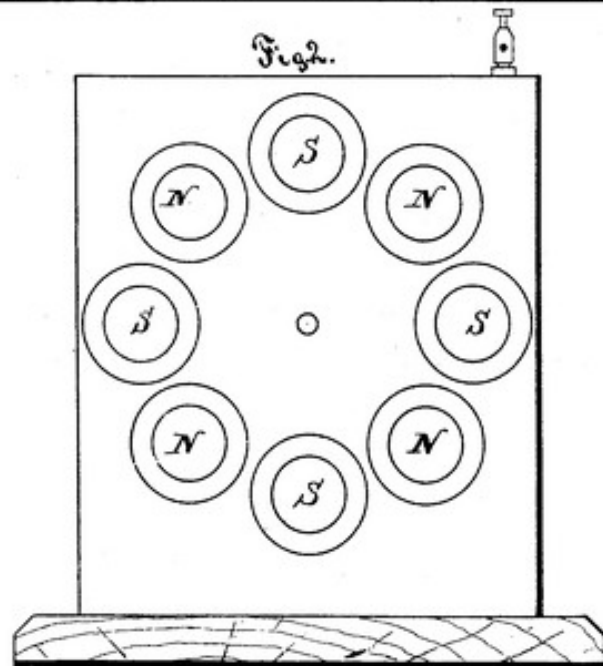
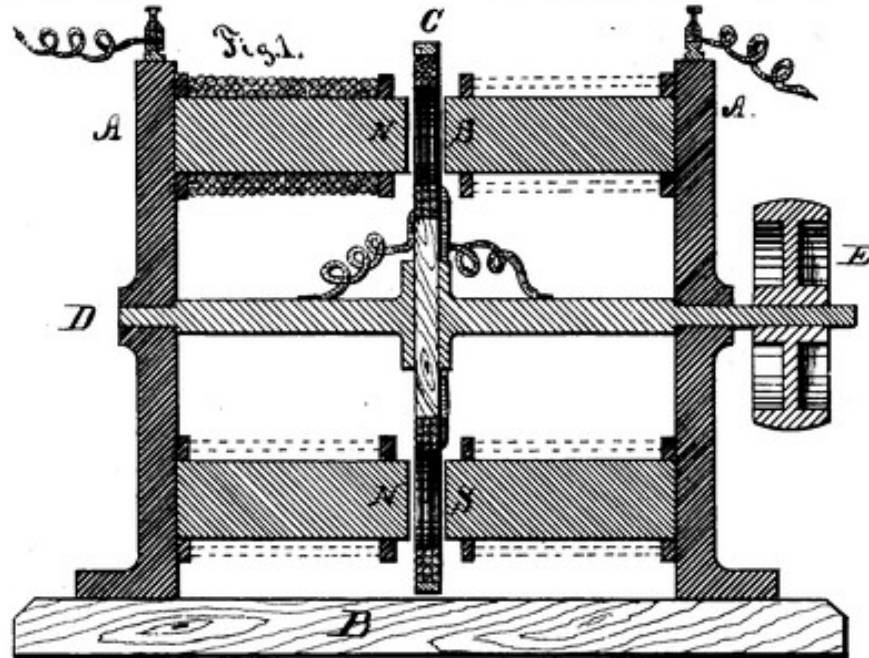
INVENTOR

*Chas. F. Brush*  
By *Leggett & Leggett*, ATTORNEYS

C. F. BRUSH.  
DYNAMO ELECTRIC MACHINE.

No. 514,907.

Patented Feb. 20, 1894.



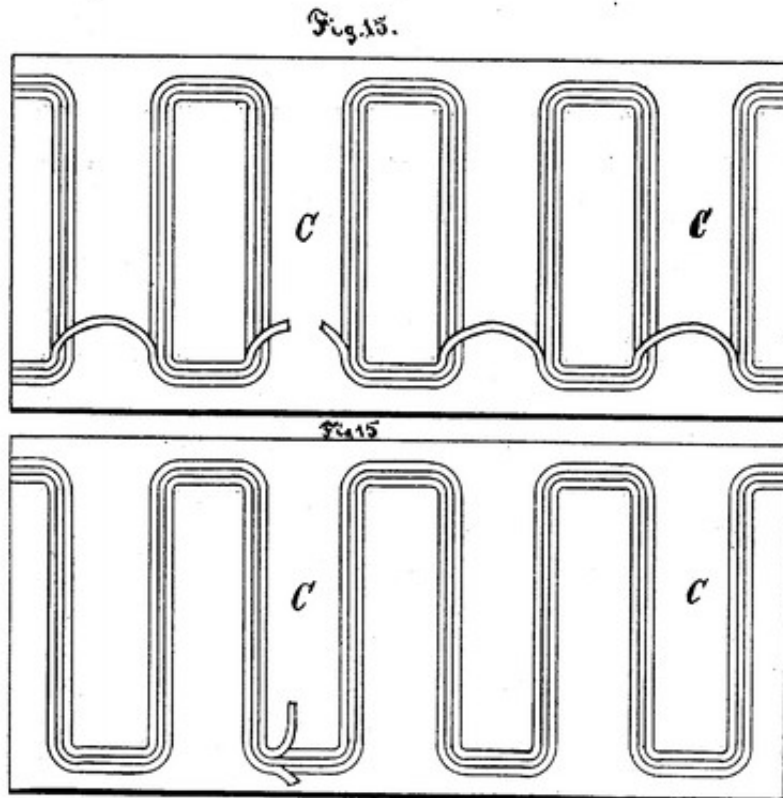
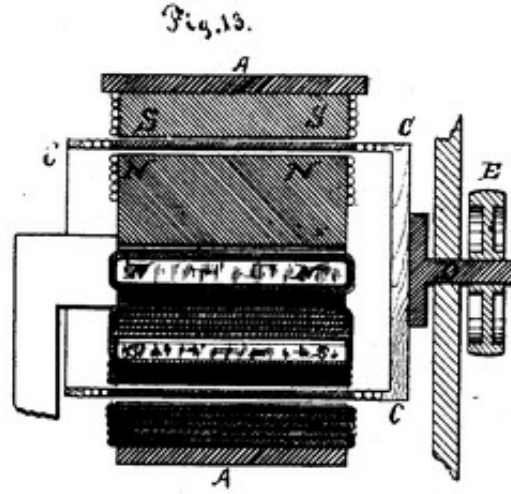
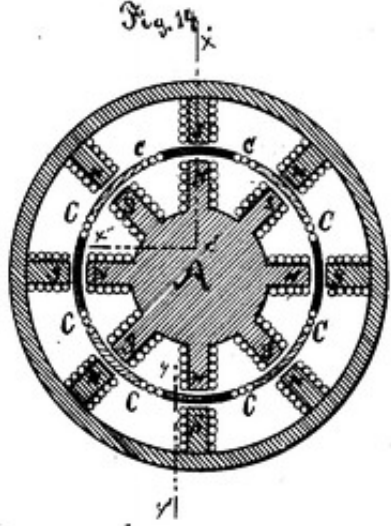
Witnesses.  
Frank M. Taylor  
Llewellyn L. Lippitt

Inventor.  
Charles F. Brush  
By Lippitt & Lippitt  
Attys.

C. F. BRUSH.  
DYNAMO ELECTRIC MACHINE.

No. 514,907.

Patented Feb. 20, 1894.



Witnesses.  
 Frank M. Haber  
 Lewis L. Lippitt

Inventor  
 Charles F. Brush  
 By Lippitt & Lippitt  
 Attys.



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1949 *ibid*, *A Pioneer in the Electric Age*, Benjamin F Bailey

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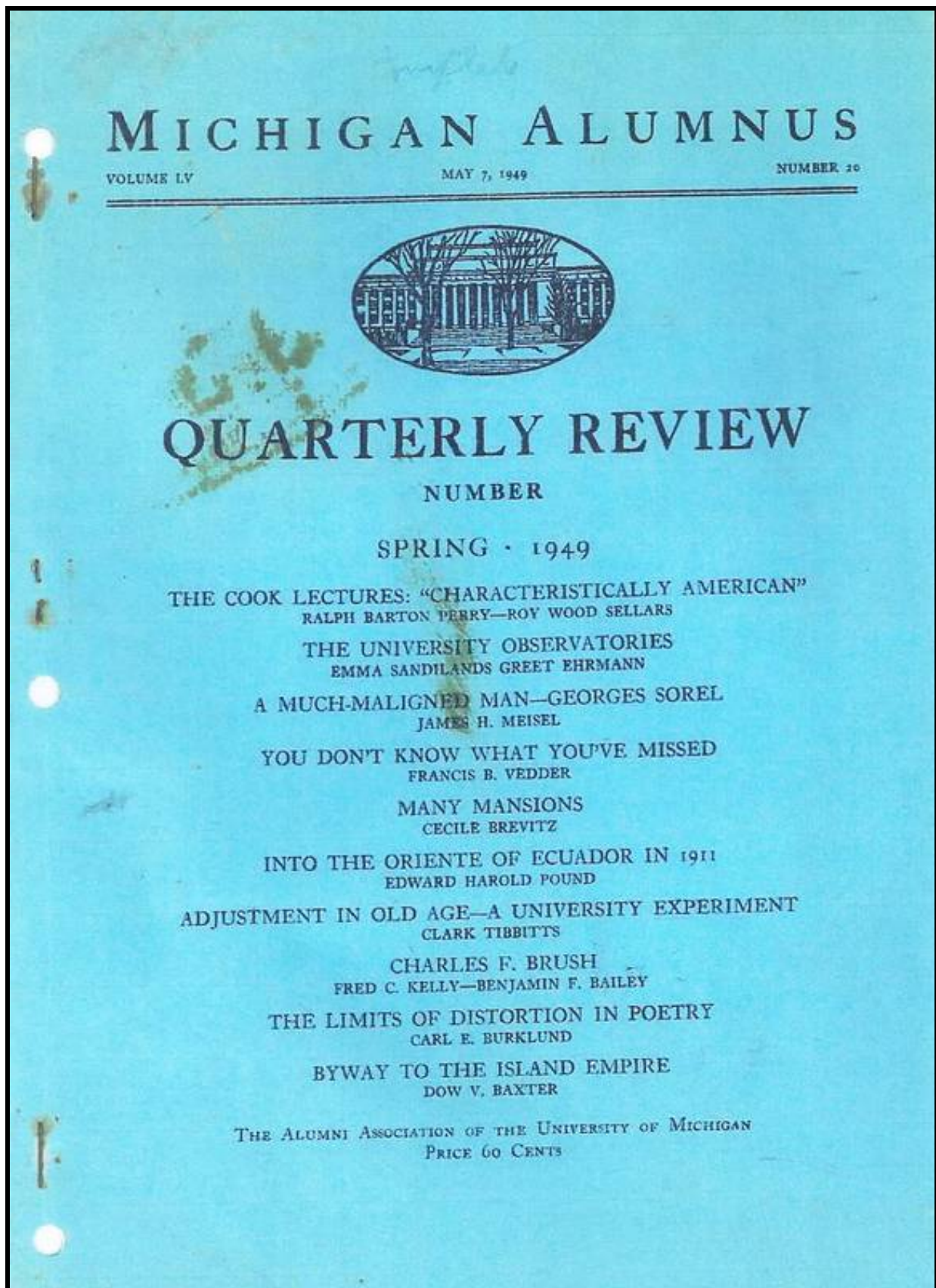
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<http://ethw.org/Charles-F-Brush>

<http://www.britannica.com/biography/Charles-Francis-Brush>





## EPILOGUE



*Medallion of Charles F Brush in the Cleveland Arcade*

Charles Francis Brush died at the age of 80 on the 15<sup>th</sup> June, 1929, in Cleveland, Ohio. His honours included the French Legion of Honour (1881), the Rumford Medal (1899), the Edison Medal (1913) and the Franklin Medal (1928).



*Brush Memorial and Grave in Cleveland, Ohio*