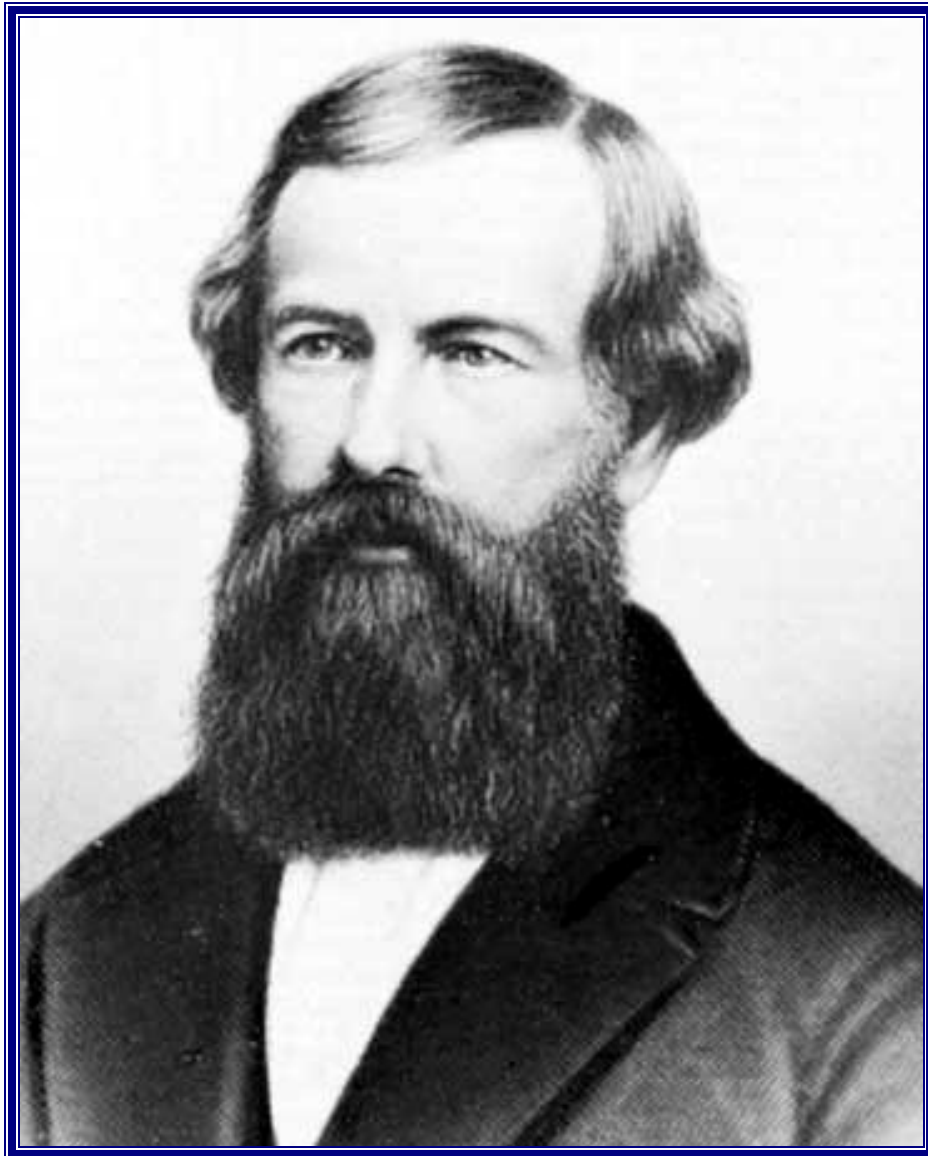


# ELISHA GRAVES OTIS

*By EurIng Brian Roberts, CIBSE Heritage Group*

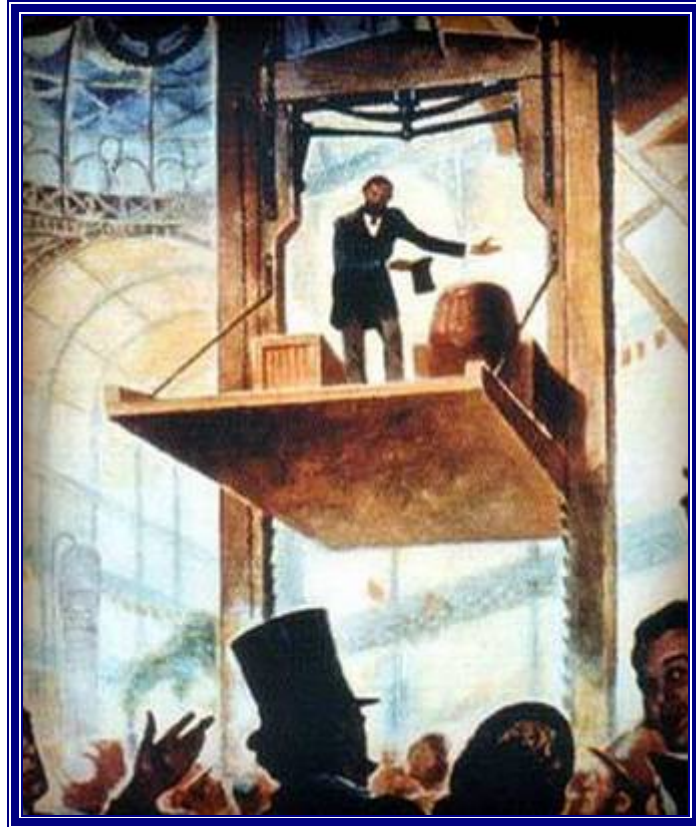
## The 19<sup>th</sup> Century



**Elisha Graves Otis 1811-1861, Founder of the Company**

While working at a bedstead factory in Yonkers, New York, in 1852, Elisha Otis invented a safety mechanism for the standard hoisting systems of his day. His safety device was simple, consisting of a spring on top of the elevator platform held taut by the hoisting rope and with ratchets along the walls of the hoistway. If the rope broke the spring would be released and force the pawls (ends of the spring) into the ratchets, stopping the elevator from falling. The name Otis would soon become associated with “safety elevators.”

In 1853 Otis established his works to manufacture elevators for the existing freight market. At the 1854 World’s Fair in New York City Otis dramatically demonstrated his safety elevator by riding on the platform while the rope was cut. The elevator did not crash.



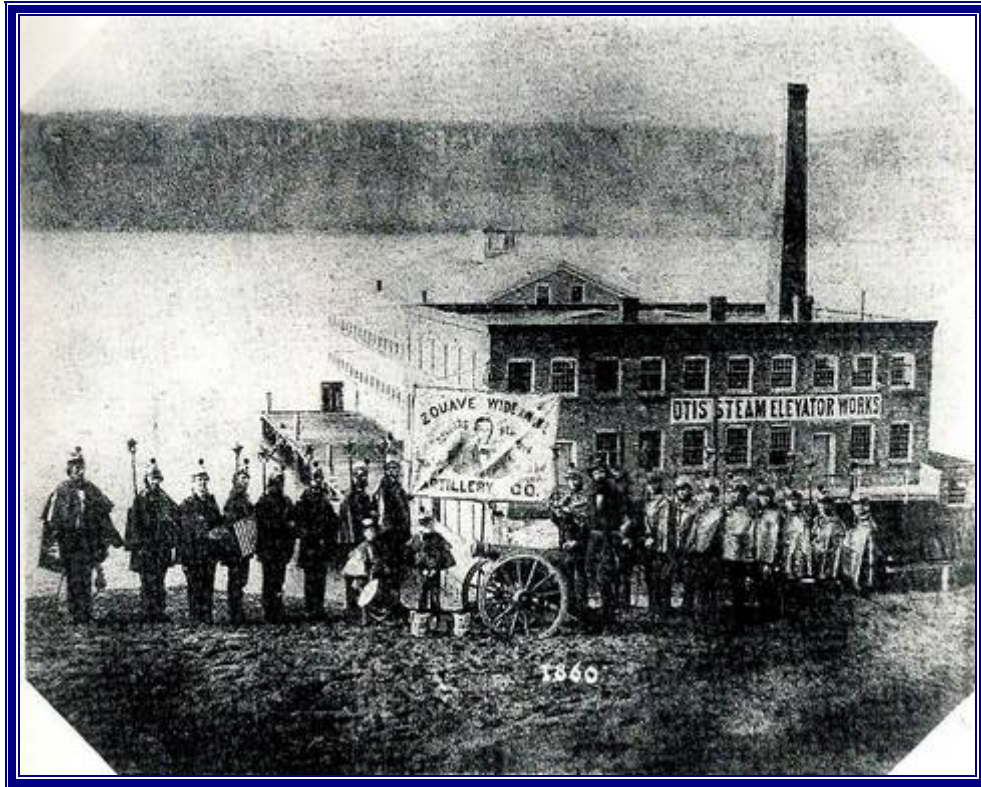
**Elisha Otis demonstrates his safety elevator**

The first customers of the Otis Company bought freight elevators but Otis and his sons soon discovered a new market –for the passenger elevator. He sold and installed his first commercial passenger elevator in 1857 for a department store, the Haughwout building in New York City.



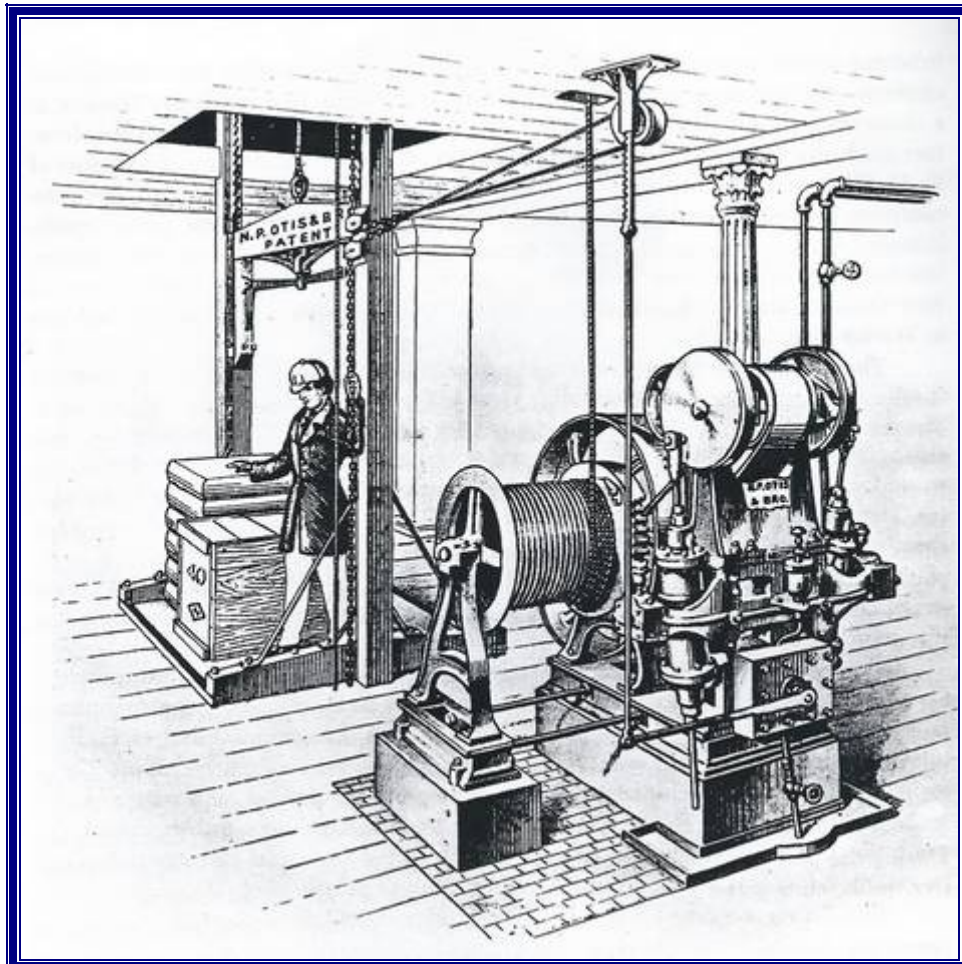
**The Haughwout building**





Elisha Otis, with hand on gun, in front of his Steam Elevator Works in 1860

Elisha Otis sold steam engines to power his elevators and invented and patented a number of improvements.



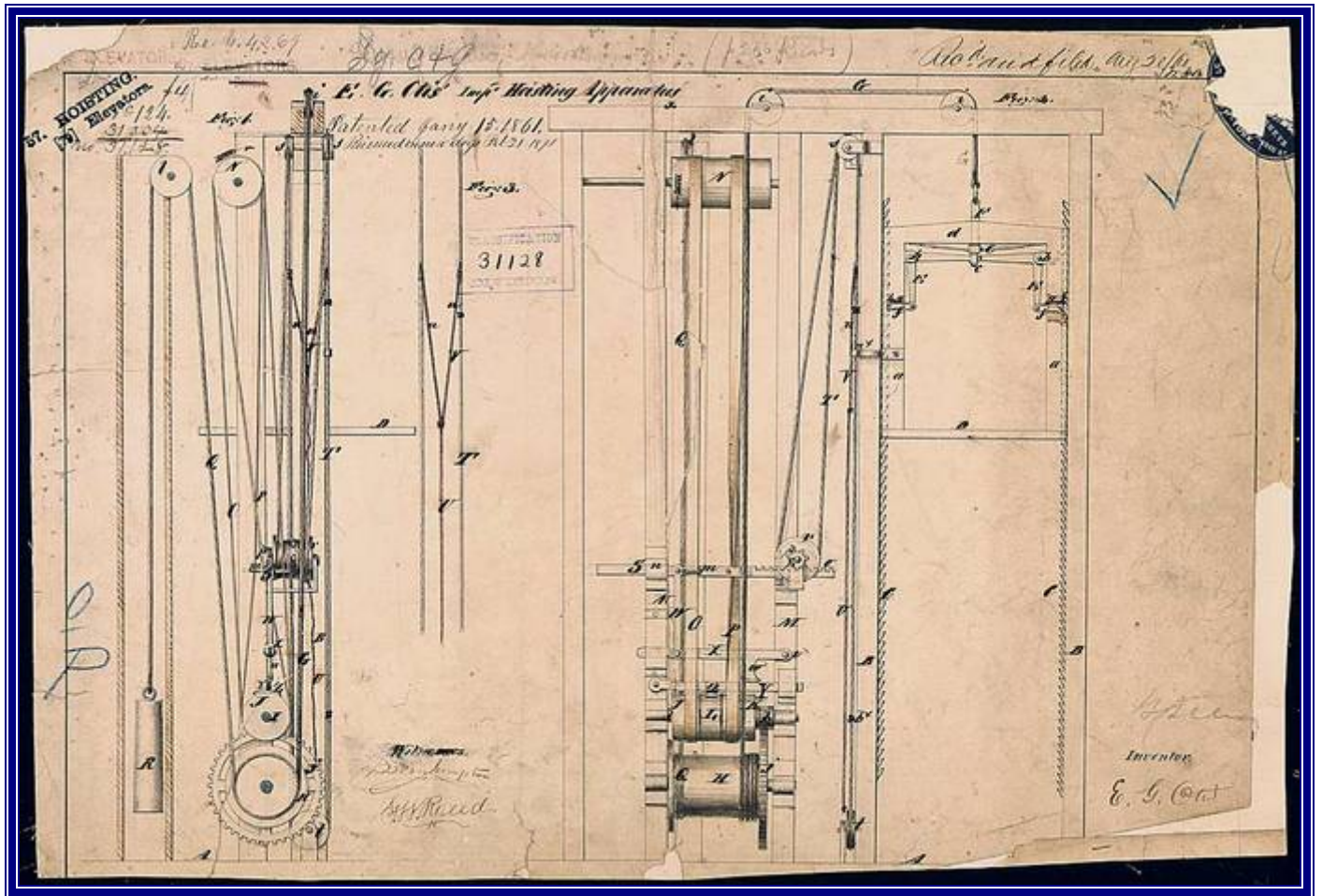
An Otis steam-powered freight elevator, 1861



Charles R Otis 1835-1927



Norton P Otis 1804-1905



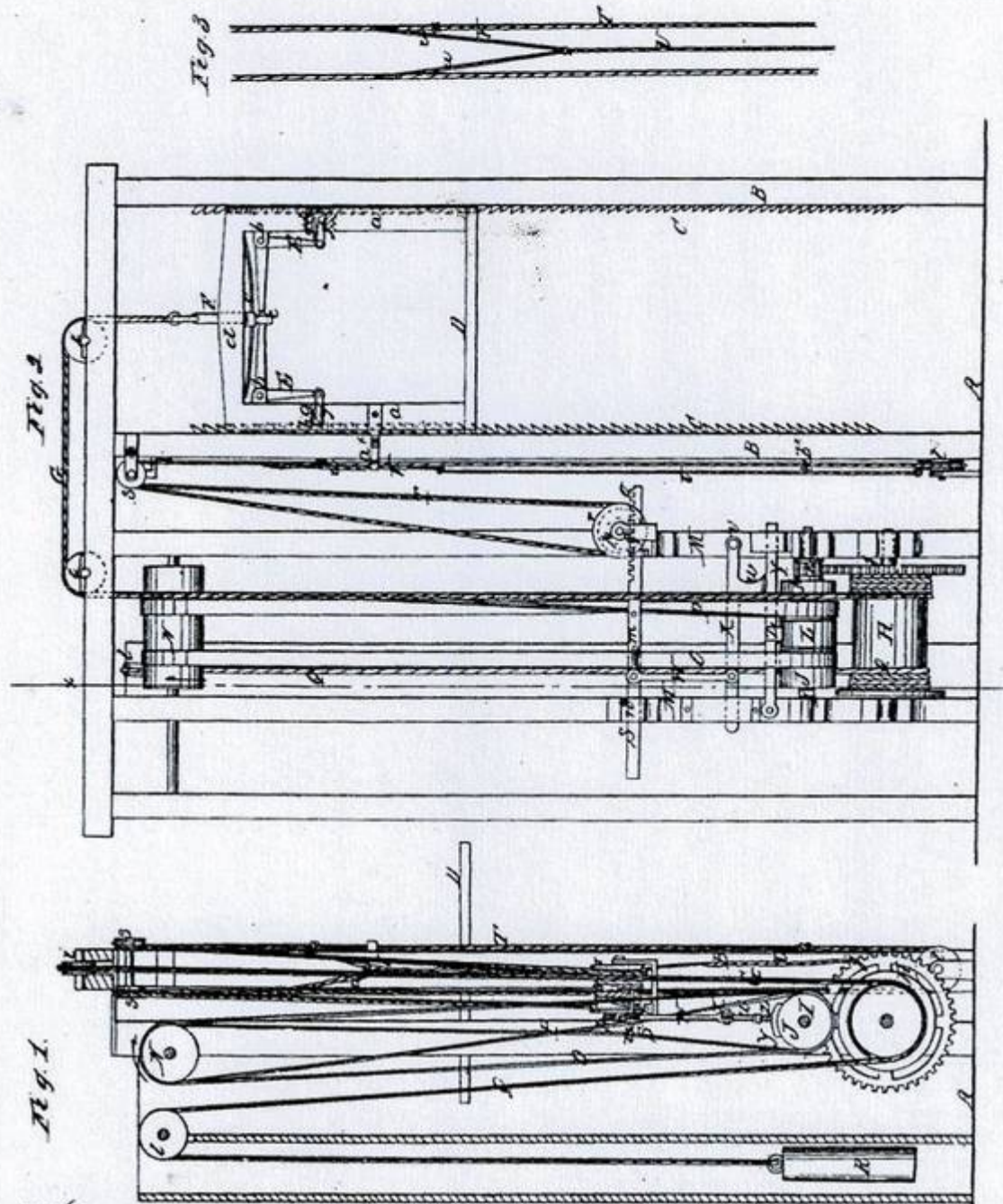
Patent drawing of 1861 for the E G Otis Hoisting Apparatus



E. G. OTIS.  
HOISTING APPARATUS.

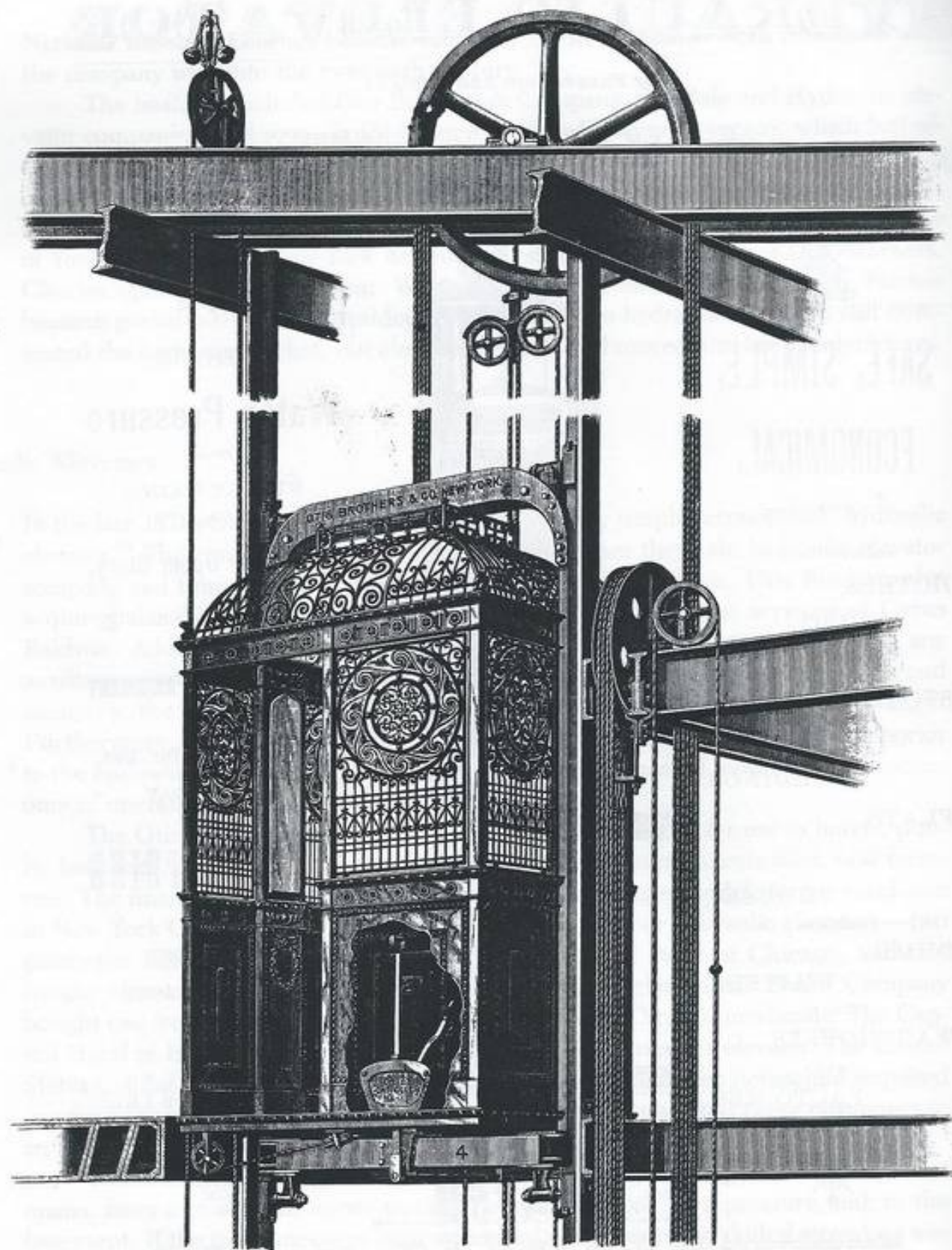
No. 31,128.

Patented Jan. 15, 1861.



Witnesses  
Wm. H. ...  
J. S. Reed

Inventor  
E. G. Otis



—THE OTIS—  
PASSENGER ELEVATOR CAR  
WITH  
TOGGLE GRIP SAFETY AND STEEL SAFETY FRAME AND GIRDE.

OTIS BROTHERS & CO.,  
36 & 38 PARK ROW,  
NEW YORK.

Cutaway drawing of elevator cage showing the Otis lever controller



# OTIS, BROTHERS & CO.,

Sole Manufacturers of  
**OTIS' PATENT LIFE AND LABOR SAVING  
 HOISTING MACHINERY**

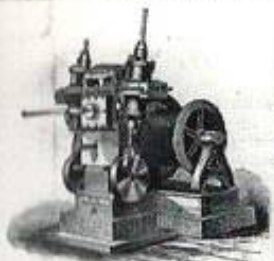
MANUFACTORY AT YONKERS, N. Y.

Office Hours, from 12 to 2 o'clock.

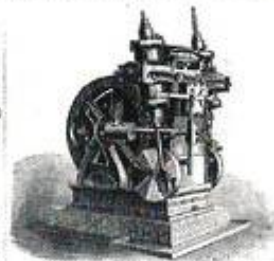
OFFICE, 307-9 BROADWAY, New York.

For the use of Stores, Hotels, Commission Houses, Storage Warehouses,  
 Sugar Refineries, Packing Houses, Livery Stables, Factories,  
 Bakeries, Mills, Shipping, Docks, Mines, &c.

A GREAT VARIETY OF SUPERIOR HOISTING MACHINERY, ADAPTED TO EVERY CLASS OF BUSINESS,  
 AND POWER, CONSTANTLY ON HAND AND IN PROCESS OF MANUFACTURE.



Union Hoisting Engine. Cut A.  
 Old Patent Double Gear Hoisting Engine, adapted for use in connection with Safety Platforms for Storage Warehouses, Packing Houses, Shipping, Docks, Mines, &c. Motion of Platform as will be explained, up to 300 feet per minute.



Union Hoisting Engine. Cut B.  
 Old Patent Double Gear Hoisting Engine, showing application of Patent Invention of up the barrels, by which the rope is substantially stopped after making any desired number of revolutions. Motion of Platform as will be explained, up to 300 feet per minute.



Automatic Safety Drum. Cut C.  
 Old Patent Safety Platform for stores and high buildings where the excessive weight of the Wire Lifting Boys tends to prevent the Safety Spring from acting at the critical moment. Securely mounting a safety device immediately between the Hoisting Engine and Safety Platform necessary. This "Safety Drum" is secured directly onto the hookway and acts as a counter to the entire machine, instantly stopping the Platform upon any approach to its steady position.

DEALERS in all kinds of Machinery required in the application of Steam for Hoisting Purposes.

STEAM BOILERS, STEAM PUMPS, STEAM & WATER GAUGES, STEAM & WATER PIPES, DAMPER REGULATORS, SHAFTING, IRON CASTINGS, FOLLIES, &c.

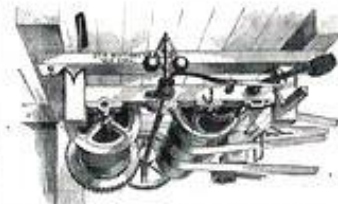
## WIRE ROPE

Of the best quality, manufactured expressly for Hoisting, constantly on hand and supplied to Order.



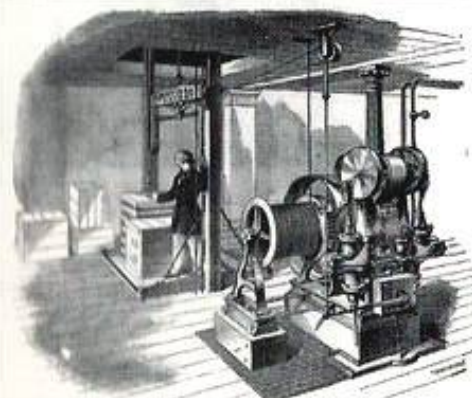
Lifting Power-screw combination. Cut D.

For Manufacturers and all general purposes of hoisting by belts. A strong, compact machine, simple in construction, and readily attached to work with or without Safety Platforms.



Lifting Power-gear combination. Cut E.

Old Patent Hoisting Machine, as illustrated below, showing "The Belt Attachment," by which the machine is instantly stopped to raise the platform to any desired position from any room, as in the hoisting of a ball, while the machine is in motion.



Metropolitan Hoisting Engine. Cut F.

Old Patent Standard Belt and Gear Hoisting Engine, Safety Platform and accessories, for Mills, Manufacture Houses, &c. Platform or Car moves any speed, as will be explained, up to 300 feet per minute.

DESCRIPTIVE CIRCULARS  
 Of our Machinery, with any information required, will be furnished on application by Mail or in person.



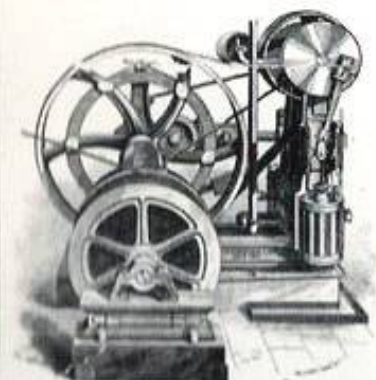
Relief Hoisting Engine. Cut G.

Old Patent Standard Screw Hoisting Engine, adapted for use in connection with Safety Platforms, also especially fitted and readily attached for working the ordinary overhead Hoisting Machine, giving the best performance obtainable, of Platform.



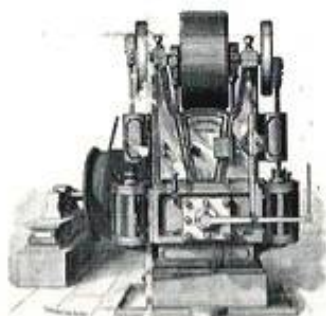
Universal Hoisting Machine. Cut H.

Old Patent Lifting Power, Safety Platform and accessories, for Factories, Mills, Hotels, Bakeries, and all general business purposes where steam, water or other power is in constant use. Motion of Platform 50 feet per minute.



Cut I.

Old National Stationary Cylinder Hoisting Engine. Side View. See Cut 2.



National Hoisting Engine, Front View. Cut J.

In this Hoisting Engine are combined many good and useful features, which will commend it to work in public and private buildings. It is very strong, and compactly built, provides a safe and reliable appearance, and runs without noise. The equipment is constructed upon an entirely new principle, by which a direct-acting and very simple machine is obtained, which has less friction than in any other mechanism for the purpose in use.



Metropolitan Hoisting Machine, showing Corner Platform. Cut K.

This "Corner Platform" is adapted to hoistage where it is necessary to hoist goods to and from the platform on all sides or on any two sides at right angles to any of the different floors.

Otis advertisement, 1868

Charles Otis, the elder son, and his father did not get on and there were many arguments. In 1861, Elisha Graves Otis died. Had not Charles and Norton been sharing responsibilities with their father at the time of his death, the business would have likely gone under. For a few years the brothers managed the firm as a partnership. In 1867 the firm became Otis Brothers & Company. In 1878 they purchased a large interest in the Hydraulic Elevator Company of Chicago thus acquiring important hydraulic technology.

# STANDARD HYDRAULIC ELEVATOR

*For Passengers and Freight.*

ADOPTED BY U. S. GOVERNMENT.

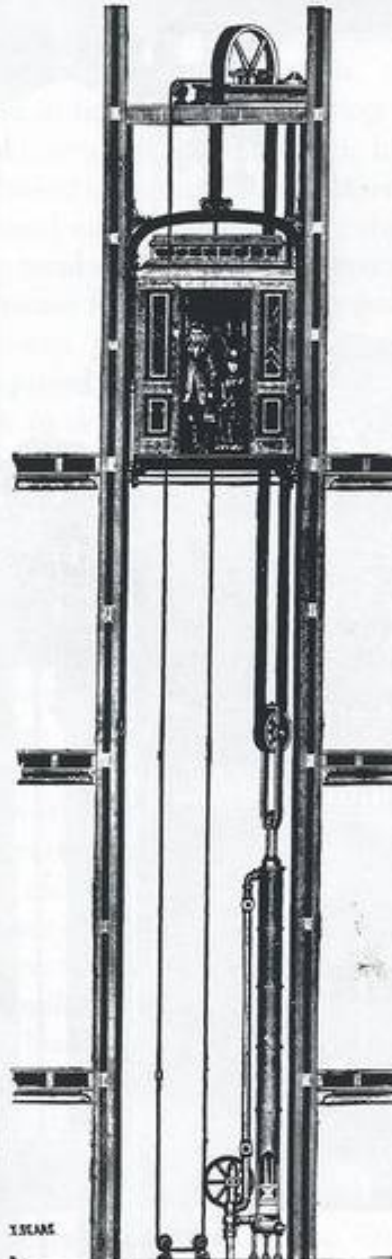
Upon Report of Eminent Experts appointed by the Secretary  
of the Treasury.



SAFE, SIMPLE,  
ECONOMICAL.

ADAPTED TO USE IN

HOTELS,  
PUBLIC  
BUILDINGS,  
STORES,  
OFFICE  
BUILDINGS,  
FLATS,  
PRIVATE  
HOUSES,  
AND FOR  
DUMB  
WAITERS,  
ALSO IN  
WAREHOUSES  
AND  
FACTORIES.



OPERATED BY

Water Pressure

FROM

STREET MAINS,

OR FROM

A TANK in Upper Story,

or on Roof of Building,

OR

PRESSURE TANK IN BASEMENT

Always Ready for Use,

NIGHT OR DAY.

COSTS NOTHING

WHEN

NOT IN USE.

CAN BE MANAGED

BY ANY

LADY OR YOUTH.



Manufactured by OTIS BROS. & CO., Yonkers, N. Y.

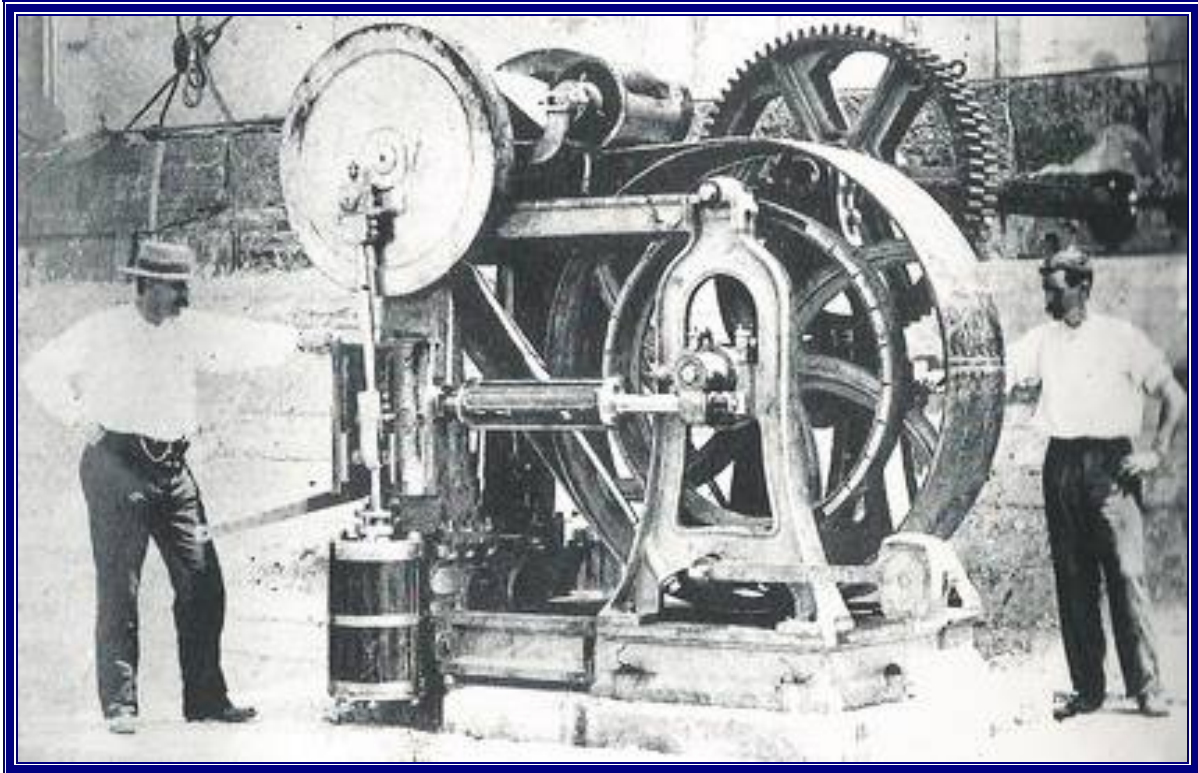
Q. N. EVANS & CO., Agents for New England; also, makers and designers of Steam and  
Water Heating Apparatus for public and private buildings.

N. Y. Office, 60 DUANE STREET.

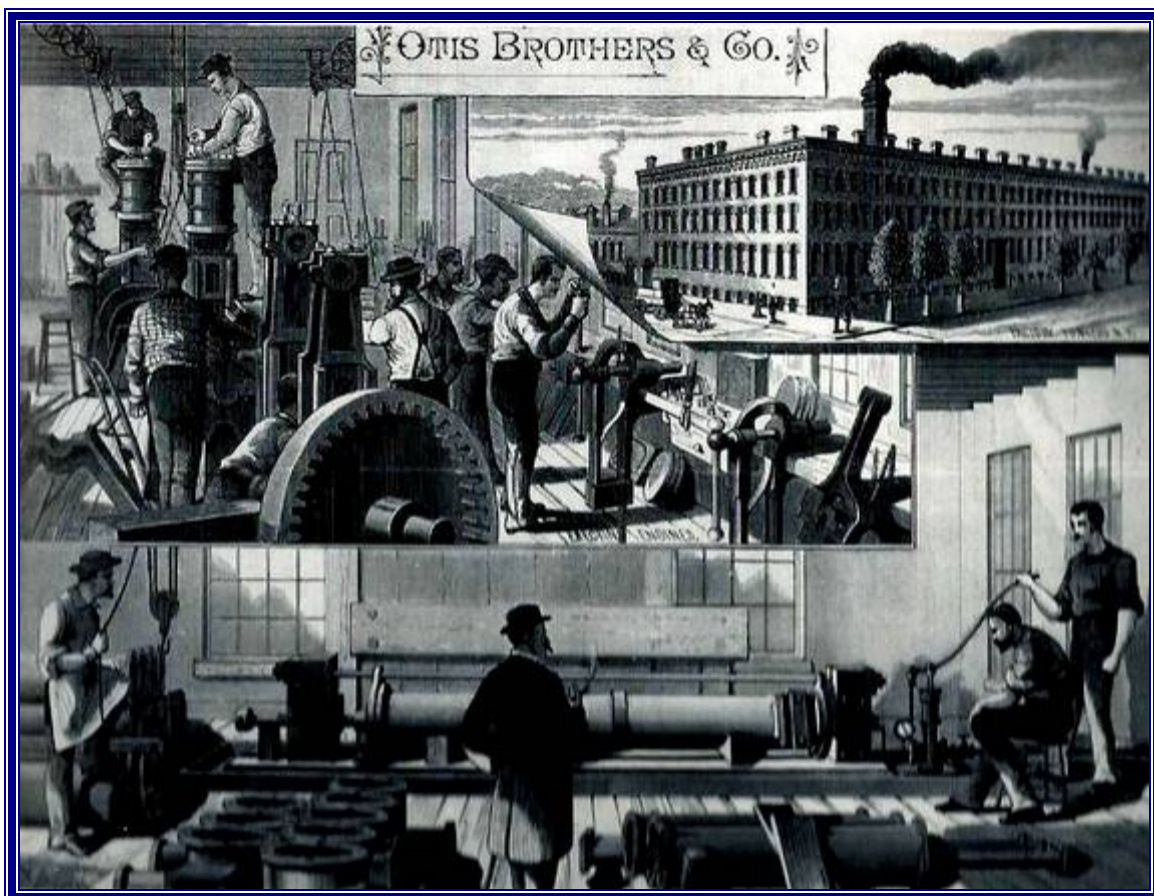
Office, 72 SUDBURY STREET, BOSTON.

The Otis Standard Hydraulic Elevator, which operated by water under pressure, was  
introduced in the 1870's. The advertisement dates from 1882.



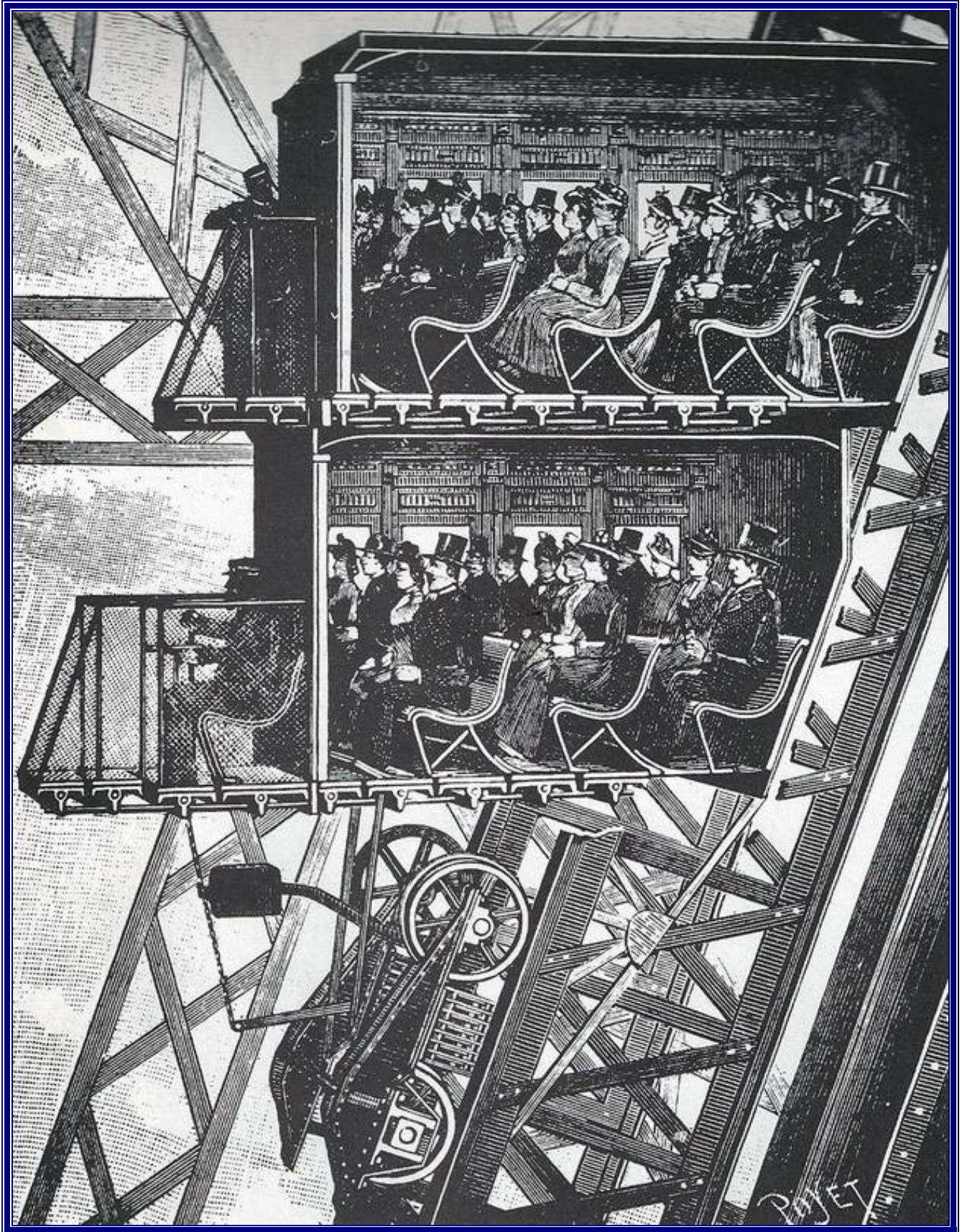


Washington Monument Elevator Engine, 1880



Engine construction at the Yonkers Works, 1878





The two Otis hydraulic elevators serving the Eiffel Tower operated from ground floor level at the North and South piers to reach the 2<sup>nd</sup> Platform at 380 feet. Each elevator car was of double-deck design holding 50 seated passengers and travelling at a speed of 394 feet/minute.



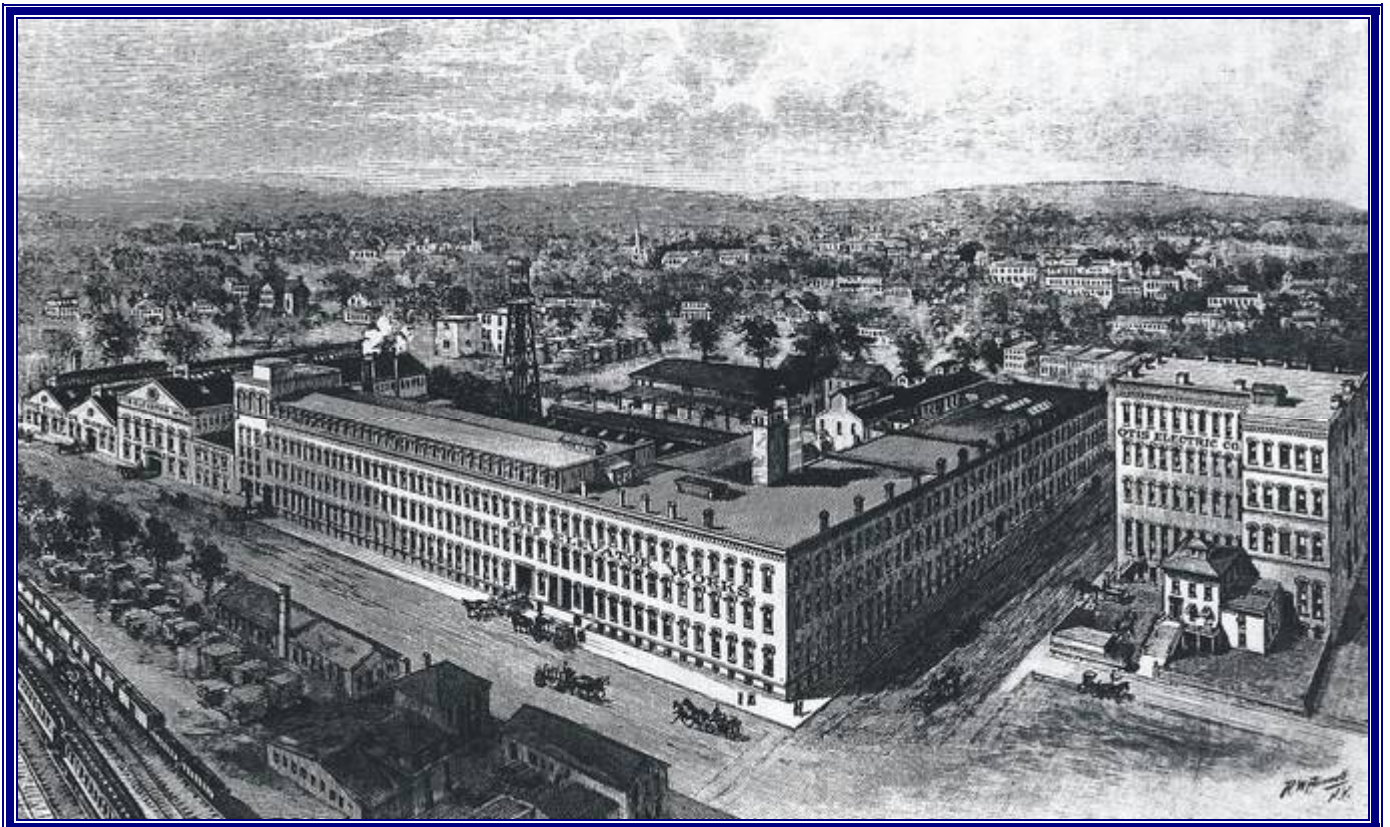
In 1880, the American Elevator Company was formed to market Otis' elevators in London and Paris. When the Eiffel Tower was planned "it was unthinkable that the tallest building (structure) in the world should not be equipped with Otis elevators." Against French opposition and reluctance, three years of preparatory work paid off, for in July 1887 Otis was awarded the contract for the most awkward section of the tower: two of the curved legs (other tower elevators were to be provided by French companies.)

However, the tower's designer Gustave Eiffel changed the design parameters insisting that Otis should incorporate a rack-and-pinion safety device and a manual lowering facility. Long and bitter arguments followed. Eiffel threatened to stop payments. Otis threatened to stop work. As the planned opening Exposition day of 1 May 1888 drew closer and closer, Otis won all its arguments and the tower opened on schedule to glowing reports.

## The Electric Elevator

The introduction of electricity gradually changed the elevator industry. Initially, electric motors were used to provide power for operating belt-driven freight elevators. Soon direct-drive electric motors were introduced. Otis Brothers sold its first electric elevators in 1889, providing two worm-drive machines to the Demarest Carriage Company building in New York City. To start with the Otis Company bought a "very ingeniously constructed motor from Rudolf Eickemeyer, a German immigrant, inventor and manufacturer."

In 1892 Otis Brothers and the new General Electric Company joined forces to set up the Otis Electric Company. The new Company employed about 100 people at its plant next to the Otis Brothers factory in Yonkers. By comparison, Otis Brothers then employed about 500 in its factory and another 150 in the field. Otis displayed their new electric elevator at the Columbian Exposition (World's Fair) held in Chicago in 1893.



The Otis Elevator Works and the separate Otis Electric Company building (right), Yonkers, 1896



# OTIS AUTOMATIC ELECTRIC ELEVATOR FOR USE IN RESIDENCES

is an addition to the comfort of every member of the household; and at the same time increases the value and salability of property more than cost of installation. No house of pretension should be without one. We frequently install elevators in houses already built. It is not as much of an undertaking as one might think to thus bring an old house up-to-date. Write for blanks and specifications.

**OTIS ELEVATOR COMPANY,**

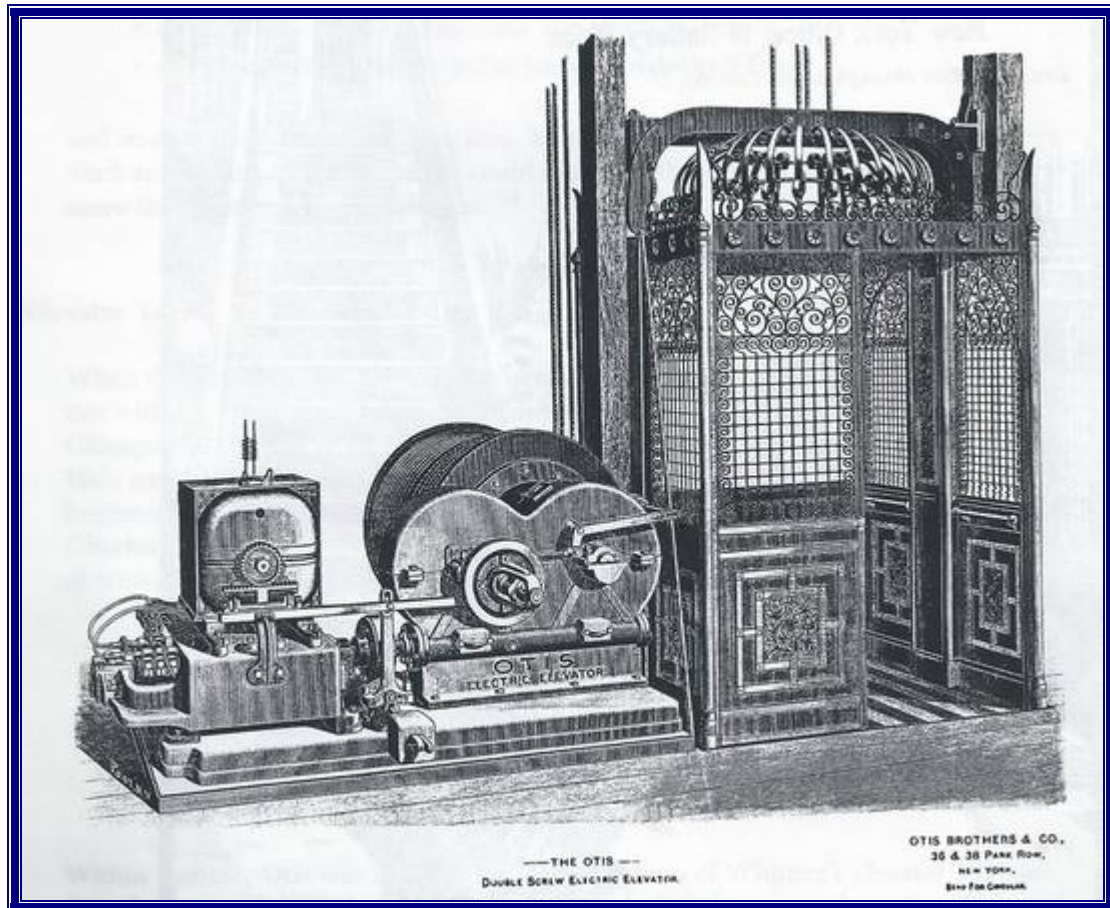
**New York Office, 17 Battery Place**

*Branch Offices throughout the Country*



The Automatic Electric Elevator introduced in the 1890's





**Otis Double Screw electric elevator with worm gears and drum for use in low-rise buildings, 1890's**

Compared to steam engines and hydraulic motors, the electric motor was compact and efficient but at this time the electric elevator could not compete with hydraulic systems for tall building applications. The use of worm gearing limited the height of the lift and the drums could not hold enough rope.

In the 1890's Otis introduced its automatic electric elevator for use in residences, complete with push-button control.

Around this time, Otis joined in an Elevator Trust, a group of companies co-operating to limit competition and control prices. In 1898, after a number of mergers and acquisitions a holding company styled the Otis Elevator Company was established and soon controlled 65% of the market and continued to grow.



## References

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*Victorian Inventions*, Leonard de Vries, (from the Dutch), John Murray, London, 1973

*The Technology of Man*, Derek Birdsall & Carlo M Cipolla, Wildwood House, 1980

*The Skyscraper*, Paul Goldberger, Allen Lane, 1982

*Technics and Architecture: Chapter 13 Elevators and Escalators*, Cecil D Elliot, MIT Press, 1993

*Technological Systems Compete at Otis: Hydraulic Versus Electric Elevators*, Anne Millbrooke, Institute of Electrical & Electronics Engineers, USA, 1993

*Rise of the New York Skyscraper 1865-1913*, Sarah Bradford Landau & Carl W Condit, Yale UP, 1996

*Otis: Giving Rise to the Modern City*, Jason Goodwin, Ivan R Dec, Chicago (for United Technologies Corp), 2001

## Further Reading

*Electronic Books/Systems & Equipment/Elevators & Escalators*, [www.hevac-heritage.org](http://www.hevac-heritage.org)  
Includes copy of the Ansaloni paper on the Eiffel Tower with full engineering drawings