STEAM ENGINE COLLECTION

The New England Museum of Wireless And Steam
Frenchtown Road ~ East Greenwich, R.I.

International Mechanical Engineering Heritage Collection
Designated September 12, 1992

The American Society of
Mechanical Engineers

INTRODUCTION

It has been said that an operating steam engine is 'visual music'. The New England Museum of Wireless and Steam provides the steam engine enthusiast, the mechanical engineer and the public at large with an opportunity to experience the 'music' when the engines are in steam. At the same time they can appreciate the engineering skills of those who designed the engines.

The New England Museum of Wireless and Steam is unusual among museums in its focus on one aspect of mechanical engineering history, namely, the history of the steam engine. It is especially rich in engines manufactured in Rhode Island, a state which has had an influence on the history of the steam engine in the United States out of all proportion to its size and population. Many of the great names in the design and manufacture of steam engines received their training in Rhode Island, most particularly in the shops of the Corliss Steam Engine Co. in Providence.

George H. Corliss, an important contributor to steam engine technology, founded his company in Providence in 1846. Engines that used his patent valve gear were built in large numbers by the Corliss company, and by others, both in the United States and abroad, either under license or in various modified forms once the Corliss patent expired in 1870. The New England Museum of Wireless and Steam is particularly fortunate in preserving an example of a Corliss engine built by the Corliss Steam Engine Company. This is one of four known engines of this type in the United States. The museum also has in its collection two other steam engines that employed the Corliss valve gear, but were made by the William A. Harris Steam Engine Co. in Providence. This conjunction of engines gives the visitor an unusual opportunity to study and appreciate different versions of this uniquely American engine, which was also used in substantial numbers outside the United States, particularly in Britain.

The various engines on display at the museum represent machines constructed between 1868 and about 1911. This was the heyday of the stationary engine before the arrival of the steam turbine and the ready availability of electric power provided by a utility company. During this time businesses of all kinds from engineering companies, to textile manufacturers, to printing plants, and so on, employed steam engines to provide the power for their operations. The larger plants would have engines capable of providing several hundred horsepower and requiring the full-time attention of several enginemen and attendants. Smaller plants needed engines that could operate safely and reliably for the duration of the working day with only minimal attention. Those requirements influenced the design of steam engines. The operators of larger plants were particularly concerned with efficiency. Engine efficiency is particularly dependent on the design of the valve gear that controls the admission of steam to the engine cylinder and its release from the cylinder once its energy has been extracted. Numerous forms of valve gear have been invented, in fact it has been said that at one stage in the nineteenth century the U.S. Patent Office received applications for steam engine valve gears at the rate of about one a week.

With the application of the steam engine to electrical generation after 1881, substantial attention was devoted to ensuring satisfactory speed regulation. Speed control is a function of the governor. A number of varieties of governors - not nearly as many as the varieties of valve gear - have been invented, and the New England Museum's exhibits provide a number of interesting examples of both valve gear and governor mechanisms.

While the visitor to the museum will undoubtedly pay particularly close attention to such things as the overall form of the engine, the details of its operation, and its various design features, a sense of the role of the steam engine both in mechanical engineering history and general history should be kept in mind.

The steam engine in some sense may be said to have 'made' the mechanical engineer. It required levels of workmanship beyond those of the millwrights who built the early wind and water mills. It led to the development of manufacturing methods, and it improved the quality of engineering materials. Studying the engines in the New England Museum's collection should stimulate the visitor to think about how the parts for the engines were made and how those parts were made sufficiently strong to withstand the forces they experienced. This is the essence of mechanical engineering, and those nineteen century mechanical engineers who solved those problems laid the foundations of the modern profession.

Rhode Island was a particular contributor to the development of the mechanical engineering profession. A number of important steam engine manufacturers, including the Corliss Steam Engine Co., Thurston, Greene & Co., Fairbanks, Bancroft Co. (later the Corliss Steam Engine Co.), Rice and Sargent Co., Armington & Sims Co., Providence Steam Engine Co., and William A. Harris Steam Engine Co. had their plants in Providence. The Corliss Company was an especially important incubator of engineers who subsequently made important contributions to engineering. Early in their careers Corliss employed such men as William Sellers, founder of the William Sellers Co., machine tool builders, Alexander Holley, who brought the Bessemer steel making process in the United States, Edwin Reynolds, who became chief engineer for the Allis-Chalmers Co. in Milwaukee, and Nathanael Herreshoff, who probably designed more types of steam engines than any other engineer.

The American Society of Mechanical Engineers also has strong links to the mechanical engineering tradition of Rhode Island. Two of the leading founders of the Society had Rhode Island connections. Robert H. Thurston, the first president of the Society was born in Providence and worked at his father's factory, Thurston, Greene & Co. Alexander L. Holley was not born in Rhode Island, but was educated at Brown University and received his practical training with the Corliss Steam Engine Co.

The importance of the steam engine engine in bringing about the industrialization of a rural world is surely too well known to be worthy of such comment. It was first used for mine drainage in Britain in 1712. These early engines provided a reciprocating motion that was well adapted to operating pumps. It was not until Watt patented his sun-and-planet gear in 1781 that the steam engine was introduced into textile manufacture. This industry has been dependent on water power up to that time, which was limited in quantity and variable in amount. The steam engine provided large amounts of power at any season of the year.

The earliest steam engines in British America arrived in 1755 to pump out the Schuyler mine in New Jersey. This was about fifty years before the steam age can be said to have come to North America. Steam navigation was the beginning of the American Steam Age. Robert Fulton operated his *Clermont* on Hudson River in 1807. Steam water pumps were built in Philadelphia in 1802. However it was the application of the steam engine to textile manufacture that resulted in the initiation of the steam age in the United States. Water power has been the original impetus for the establishment of textile manufacture in New England. However with the establishment of very large mills, which were attracted to New England by its access to water-borne transport and cheap fuel from the coal regions, water power was no longer adequate and steam power was essential. Rhode Island became an important center for textile manufacture and engineering. By 1860 Providence was one of the leading manufacturing centers for steam engines.

The steam engine did not last forever. Ultimately it was found that engines producing more than about 3000 horsepower were so massive that their first cost was exorbitant. The invention, by Charles Parsons in England, of the steam turbine in 1883 resulted in the eventual demise of the steam engine. The steam turbine can produce very large amounts of power in a space much smaller than an equivalent steam engine, if it could be built and operated. They are also much more efficient than steam engines and they can be balanced perfectly. However, without the experience of building steam engines it is unlikely that mechanical engineers could have built steam turbines.

THE CORLISS ENGINE

The three examples of the Corliss engine are undoubtedly the jewels in the New England Museum's collection. The Corliss valve gear in one step reduced the fuel consumption of the steam engine by about 30 percent. This is comparable to the 60 percent improvement produced by James Watt (1736-1819) in his application in 1765 of the separate condenser to the Newcomen engine. In fact, probably for this reason, Corliss has been called the American James Watt.

Significance to steam engine history

The Corliss engine incorporated two significant advances in steam engine technology. Firstly, engine power and speed were controlled by varying the period of steam admission during each working stroke of the piston (previously this had been accomplished by opening or closing the throttle valve located between the boiler and the engine). This greatly improved the efficiency of the engine because it made use of the energy released as the steam decreased in pressure in the cylinder after the point of steam cut-off. The decrease in pressure resulted from the increase in the volume occupied by the steam in the cylinder as the piston continued its outward stroke after the cut-off point,

Corliss, furthermore, designed his valve gear, which determined the point of steam cut-off, so that the cut-off point was controlled automatically by the power demanded from the engine.The variations in power demand were sensed by the governor, which responded to changes in engine speed as load was removed from or added to the engine crankshaft. This resulted in much closer regulation of engine speed than was possible with hand or governor control of the main steam throttle valve. Good speed regulation was especially important in driving textile machinery.

The Corliss engine and its history

On March 10, 1849 George Corliss was awarded U.S. Patent No. 6162 for a form of valve gear that controlled steam admission and exhaust in reciprocating steam engines. Four valves were provided, two at each end of the cylinder (See Fig. 1). One of each pair controlled steam admission, while the other pair controlled steam exhaust. The valves were flat and moved backward and forwards on flat surfaces. The valve travel was small, being about equal to the steam port opening. The valves were driven by oscillating arms, and these derived their motion from rods that were connected to an oscillating 'wrist plate' located outside the cylinder at about its mid-point. A very particular feature of this valve gear was the operation of the steam admission valves. These were opened against the pressure of a spring and at the point of cut-off the valve was released from its connection to the wrist plate, in consequence the valve was closed very rapidly under the action of the spring. To minimize the shock to the mechanism on the closure of the valve, an air-filled dash-pot served to cushion the closing motion of the valve gear.

Apparently in the early 1850's Corliss replaced the flat valves by the cylindrical valves that are now commonly associated with the Corliss engine. It is interesting to note that this modification to the valve gear was never patented. The rapid closure of the steam admission valve assisted the improvement in economy of engines fitted with this type of valve gear compared to engines using the more usual contemporary flat slide valves that controlled both steam admission and release. The slowly closing valves of the latter type led to throttling of the steam, which constituted a loss of energy that might otherwise have been available for doing work at the engine crank shaft.

The use of separate admission and exhaust valves, instead of the single slide valve in use at that time, meant that the incoming steam was not exposed to steam passages and ports that had been cooled by the lower temperature exhaust steam that had passed through these passages on the immediately preceding piston stroke. If the incoming steam was cooled before it entered the cylinder it had less energy available to supply to the engine load. The Corliss valve arrangement avoided this undesirable phenomenon.

GEORGE HENRY CORLISS (1817-1888)

Corliss was born in Easton, New York which is located about 35 miles north of the state capital, Albany. In 1843 he patented a machine for stitching shoes, which was a consequence of his working in a country store. He migrated to Providence, Rhode Island, which was at that time the leading center of manufacturing technology. He was employed as a draftsman by Bancroft, Nightingale and Co., but he quickly rose in the firm and by 1846 he was a partner in the new company of Corliss, Nightingale and Co. His rapid elevation is a clear indication of his technical and commercial capabilities. Apparently he conceived the idea for his valve gear in 1846 and in July 1847 his company started construction of the first Corliss engine for use by a Providence textile finishing company. This was a 260 HP engine with a vertical cylinder that drove the output shaft through an oscillating overhead beam. The engine was a success and business grew very rapidly, so that 481 engines had been built in the fifteen years up to 1863.

Corliss used a very similar business practice to that employed more than half a century earlier by Boulton and Watt in England. Customers could either pay a fixed price for the engine or a fee for a certain number of years, where that fee depended on the fuel saving compared to that with the engines they used previously.

In 1849 the Corliss company was sued by the Providence firm of engine builders of Thurston, Greene and Co. They were the users of a valve gear that had been patented by Frederick E. Sickles in 1842. This contained certain features that were present in Corliss' valve gear patent. The various legal actions associated with this controversy persisted until 1869, and resulted in the expenditure by the Corliss company of more than $100,000. Corliss' position was sustained, and on the basis of the costs incurred in the legal actions Corliss obtained in 1863 a seven year extension of his patent. Following the final expiration of the patent in 1870, Corliss engines with many modifications, were built by various manufacturers both in the United States and elsewhere.

In spite of his demonstrated engineering talents and business ability, it has been reported that manufacturing methods in the Corliss factory were very much of the 'one off' variety. Interchangeability of parts and standardization of components were unknown. However, just prior to his death in 1888, he initiated a complete revamping of production methods so that more up to date techniques could be used.

THE STEAM ENGINE COLLECTION

The steam engine collection of the New England Museum of Wireless and Steam comprises 15 larger engines and numerous smaller engines. Details of the former are summarized in the table at the end of this section. This section will concentrate on the group of larger engines and will attempt to provide historical and technical details of each one, so that the visitor can have a sense of what to look for in each exhibit and be able to appreciate its importance to the history of the steam engine.

CORLISS ENGINE

Corliss Steam Engine Company, Providence, Rhode Island (1892)

This engine (see Fig. 2) is an extremely rare specimen among preserved steam engines. It is one of four Corliss engines that were built by the Corliss Steam Engine Co. that probably survive in the United States. At the time of writing (summer 1992) this engine is being repaired, but when the work is completed it will be operated under steam. It will then probably be unique in being the only surviving engine of the Corliss type, produced by the Corliss Company, that is still operated.

This is a girder frame engine constructed in 1892. A noteworthy feature is the wrist plate that drives the valves. This consists of a cast 'spider' instead of the more commonly encountered disc or spoked wheel. The use of bold curves in the various parts of the engine is also a characteristic of engines produced by the Corliss Steam Engine Co. A careful study of this engine suggests that its original crank-shaft was replaced by a 'disc crank' by its owners, the Stratton Co., Maine. The Disc must have been heated in a furnace and then shrunk on the crankshaft with two compression collars; a remarkable achievement by mechanics working in the remote areas of Maine.

Corliss Engine: William A. Harris Steam Engine Co., Providence, Rhode Island (1892)

This is the older of the two Corliss type engines in the collection that were not manufactured by the Corless Steam Engine Co. Corliss engines manufactured by the Harris Company are commonly known as Harris Corliss engines, and they were widely used both nationally and internationally (see Fig. 3).

Corliss Engine: William A. Harris Steam Co., Providence, Rhode Island (1911).

This is a heavy duty type with Tangye bed using Brown Valve gear.

Armington & Sims Co., Providence, Rhode Island (1888)

The application of the steam engine to the generation of electric power from about 1881 onward required the development of engines capable of operating at much higher speeds than the 80 RPM of the long stroke engines typified by the three examples of Corliss engines in this museum. "Furthermore, close control of engine speed is needed to avoid "flickering" of electric lights which receive power from engine driven generators.

The Armington & Sims is an example of a single cylinder, horizontal high speed automatic engine (see Fig. 4). High speed because it operates at about three times the speed of its larger predecessors. It is called an automatic engine because of the sensitivity of its flywheel mounted inertia governor. This governor detects the speed as well as the rate of change of speed, which results in a much more rapid response to sudden variations in the engine's load. This governor consists of heavy weights mounted on pivoted arms held inward by stiff coil springs in tension. The pivot points are offset and on the opposite side of the shaft center from the weights rather than at the shaft center as in the Watt governor. The mass of the arm is so distributed that when engine load changes gradually the governor acts as a centrifugal governor, but with a sudden change in load the inertia of the arm augments the centrifugal action resulting in a very high response speed. Edison came to Providence and contributed suggestions to Gardner Sims on this design. Edison had previously studied centrifugal governors to get more exact speed control in his photographs. Edison replaced the Porter Allen engines in the Pearl Street station with Armington & Sims and for many years preferred them.

William Baxter Engine, Manufactured by Colt Fire Arms Co.(c.1868)

This engine is an example of a semi-portable engine in which the boiler and engine are combined in a unit. The cylinder is placed in the top of a three pass vertical fire tube boiler. This minimizes heat loss in delivery pipes and in the engine itself. Also no cylinder drain cocks are necessary, the unit is compact, and its efficiency, compared to other types of small engines, is exceptionally good. The crankshaft is mounted above the cylinder. The crankshaft carries three eccentrics; one for the the feed pump, one for the usual slide valve and one which optionally may be used to control cut-off.

Fitchburg Steam Engine Co., Fitchburg, Massachusetts (c 1905)

This is another example of a girder frame, horizontal, mill engine. It is a later design than the Corliss engine (see Fig. 5). The valve gear is particularly noteworthy. The admission valves are operated by quick acting cams driven by the reciprocating eccentric rod. The exhaust valves are directly driven by a second eccentric rod. The eccentrics are controlled by a shaft governor which is mounted next to them. The surface of the piston valves can be expanded to make up for wear. This is done by tightening nuts which drive gradually tapered cones inside the valves. The range of this expansion is 1 1 / 16 of an inch.

New York Safety Steam Power Co. (1870) manufactured by Nichols and Langworthy, Hope ValleY, Rhode Island

The New York Safety Steam Power engine represents a marked advance in size reduction, one piece ruggedness, and simplicity of manufacture. It is a vertical, single cylinder engine producing 15 horsepower at 150 RPM on 80 psi. A distinguishing feature of the vertical NYSSP engine is its widely copied bottle shaped frame. The cross head guides are arcs of a cylinder. They are machined by the insertion of a boring bar through the lower end of the frame (see Fig. 6).

The NYSSP engine was designed by Stephen Wilcox in 1869. Stephen Wilcox and George Babcock shared an office in New York on Cortlandt Street (engine makers row) where they sold Nichols and Langworthy products and began the Babcock and Wilcox boiler manufacturing company.

New York Safety Steam Power Co. (c 1870-1880) Manufactured by Nichols and Langworthy, Hope Valley, Rhode Island.

This is a smaller version of the previous bottle engine. It is distinguished by its walnut cylinder lagging for insulation.

New York Safety Steam Power Co. (1892) Manufactured by Nichols and Langworthy, Hope Valley, Rhode Island.

This is a horizontal, piston valve, automatic cut-off engine showing strong influence of the Armington & Sims (See Fig. 7).

Herreshoff Manufacturing Co., (1904) Bristol, Rhode Island

This is a 385 horsepower, triple expansion engine originally designed for torpedo boat use. It exhibits many ingenious techniques to reduce weight and size; for example the split connecting rods and the side mounted valves. In the triple expansion engine thermal loss is reduced by expanding the steam in three stages from boiler pressure to condenser pressure. The total temperature drop is divided into three parts so that the temperature difference across any cylinder is one third that of a single cylinder engine. Heat loss is correspondingly reduced. Triple expansion engines often operated with superheated steam, further improving efficiency.

The engine on display was used for 80 years at the Phelps Dodge copper refinery in Maspeth, Long Island, New York. It along with three others drove low voltage DC generators to supply current to the electrolytic refining cells. The cylinders are pressure lubricated but the connecting rods and crankshaft are splash lubricated. For display purposes the crankshaft is open. Normally it would be closed, much as a modern automobile engine.

Herreshoff Manufacturing Co., Bristol, Rhode Island (c 1905)

This engine is similar in principle to the triple except only two stages of expansion are used. The engine is simpler than the triple while still being a good performer. The compound was the preferred engine for tug boats, small yachts, small excursions steamers and fishing boats.

Herreshoff Manufacturing Co., Bristol, Rhode Island (c 1900)

This small vertical, splendidly built, bronze single cylinder, non reversing engine was probably used to drive a pump. The bronze construction was characteristic of Captain Nathaniel Herreshoff.

Granger Foundry and Machine Co., Providence, R.I. (c 1880)

This unusual two cylinder, inverted VEE, simple, slide valve engine was designed to drive textile printing machinery. The arrangement allowed direct connection to the load and the 90 degree positioning of the cylinders resulting in positive starting.

American Engine Co., Bound Brook, New Jersey (c 1905)

The American Ball Engine is a later version of the Armington & Sims automatic cut-off engine with flywheel-mounted Rites inertia governor. This engine is designed to run at 240 RPM driving a 30 pole, 100 kw three phase General Electric alternator (see Fig. 8).

Eddy Co., Windsor Locks, Connecticut (c 1890)

This unusual triple expansion engine was designed and built to power a racing boat to compete in the Vanderbilt Cup Races held in the nineties on the Connecticut River. A coil boiler designed for 1,000 psi supplied the steam. For strength reasons and also for compactness the high pressure cylinder is surrounded by the intermediate pressure cylinder which assume the form of an annulus. In a quick glance this engine looks like a compound but in fact it is a triple. The three pistons are coupled to the crankshaft by scotch yokes.

Major Engines in the Collection of the New England Museum of Wireless and Steam

Builder	Date	Type	Arrangement	Cylinder Dimensions*	Speed (RPM)	Power (BHP)	Steam Pressure (psig)	Source
Corliss Steam Engine Co., Providence, RI	1892	4 valve	Horizontal Mill	B: 16" S: 42"	80		100	Stratton Co., Stratton, ME, c 1978,
William A. Harris Steam Engine Co., Providence, RI	1892	Corliss type	Horizontal Mill	B: 15" S: 42"			100	Pond Lily Co., Westville, CT, c. 1977. Donated by Evelyn Moulton
William A. Harris	c1911	Corliss type	Horizontal Mill	B: 16" S: 30:		150	150	National Laundry Co., Dorchester, MA, 1969
Baxter Manufacturing Co.	c1868	Slide valve	Vertical, cylinder in boiler	B: 7" S: 8"		10	80	Faxon Co., Quincy, MA.
American Engine Co., Bound Brook, NJ (American Ball engine)	c1905	Piston valve	Horizontal Direct Connected Alternator	B: 14" S: 12"	150	125	150	National Laundry Co., Dorchester, MA, 1969
Herreschoff Manufacturing Co.	1904	Triple expansion piston valves	Vertical, marine type	B: 10" 15" 20" S: 14"	300	385	200	Phelps Dodge Co., Brooklyn, NY
Fitchburg Steam Engine Co., Fitchburg, MA	c1905	piston valve	Horizontal Mill	B: 14 1/2" S: 28"	150		130	Noone Mill, Peterboro, NH, date unknown.
M. Eddy, Windsor Locks, CT	c1890	Triple expansion IP cylinder concentric to HP cylinder	Vertical Marine			100	1000?	

Major Engines, continued

Builder	Date	Type	Arrangement	Cylinder Dimensions*	Speed (RPM)	Power (BHP)	Steam Pressure (psig)	Source
Nicols & Langworthy Machine Shop, Hope Valley, RI (New York Safety Steam Power Co)	c 1870	Slide Valve	Vertical	B: 8" S: 9"	150	15	80	Gift of Charles A. Moore 1992 "Bottle" engine
Nichols & Langworthy	c 1869	Simple Auto Cut Off	Horizontal	B: 8" S: 9"	250	25	100	Gift of Norman D. Fay, Northboro, MA, 1992
Nichols & Langworthy		Slide Valve	Vertical	B: 3 1/2" S: 5"	150	5	80	
Granger Foundry and Machine Co., Providence, RI	c 1880	Slide Valve	Inverted	B: 5 1/2" S: 8"	100		80	
Herreshoff Manufacturing Co.	c 1905	Compound Marine	Vertical	B: 3 1/2" 5" S: 6"	150	25	175	
Herreshoff Manufacturing Co.		Piston Valve	Vertical	B: 2" S: 3"	200	2	110	
Armington & Sims, Providence, RI	1888	Auto Cut Off	Horizontal	B: 12" S: 12"	250	75	150	Donated by Henry Ford Museum, 1991

THE NEW ENGLAND WIRELESS & STEAM MUSEUM

The museum began in 1964 with a collection of early wireless and radio equipment brought together by Robert W. and Nancy A. Merriam. A formal but private organization was established when a group of interesting historians and important early radio design engineers opened a 35 x 65 foot building to house the collection.

The quality and scope of the collection improved rapidly when several private collections of senior engineers were given to the museum. From the beginning Nancy Merriam, who has served as librarian, appreciated the importance of preserving documents and as a consequence the museum has an outstanding reference library of mechanical and electrical engineering history.

In 1966 the museum was incorporated as the New England Wireless & Steam Museum with R.W. Merriam as its Director and with a distinguished board consisting largely of engineers and businessmen. Merriam's interest in steam developed naturally, being a native Rhode Islander and being the son of Paul Merriam who taught steam engineering as Lionel S. Mark's assistant at the Harvard Engineering School 1910-1912.

In 1966 the museum's board decided to include stationary steam engines, with a special emphasis on Rhode Island built engines, to insure that this record be preserved. In 1972 a a 40 by 80 foot building was erected entirely by volunteers to house the growing collection of large steam engines. Every engine in the steam building was a donation. Some have come from great distances and all had to be rigged, shipped and re-erected with the effort of volunteers. Each of these exercises brought to light long forgotten facts. Today, with the engines connected to boilers, many can appreciate the great work that was done in Rhode Island more than 100 years ago when its engines were shipped all over the world.

Also in 1972 an 1822 New England meeting house was saved from the wrecker and moved to the museum. This building is now on the National Register. It is used for engineering society meeting, seminars, club meetings, and even weddings. The lower floor houses the electrical engineering reference library.

In 1982 the museum received a remarkable gift in the form of the complete 2 1/2 story coastal Massie Wireless Telegraph Company station from Point Judith, R.I. This is one of the oldest surviving wireless stations in the world and it has been very little altered since being built in 1907 It is complete with all its original wireless telegraph equipment. It also houses the Arthur C. Goodnow collection of spark transmitters.

Currently the museum is completing work on the Mayes building named for former director, Thorn L. Mayes, a registered PE in both mechanical and electrical engineering and a generous benefactor of this museum. The Mayes building will house the mechanical engineering reference library and the collection of small antique steam engines, models and the extensive collection of engineering drawings which came from former steam engine manufacturers in Rhode Island. It will also be the location of the museum's office.

The museum is a public IRS (501C) corporation and all contributions to it are tax exempt. The museum has no paid staff. From the beginning it has strictly adhered to a policy neither to seek government grants nor to accept them. It is funded entirely by private gifts, grants from private foundations, by admissions, and by the sale of publications and other items. Its purpose is to preserve engineering history, the record of great innovators and business creators to show the immense value to society of their work.

PLAQUE

NATIONAL MECHANICAL ENGINEERING HERITAGE COLLECTION
THE NEW ENGLAND WIRELESS AND STEAM MUSEUM

By the middle of the nineteenth century American industry - especially in New England - was rapidly outgrowing the capacity of the water power that had been its principal prime mover. The need for a new power source inspired an intense development of the steam engine, the work of inventors directed mainly at improving fuel efficiency by reducing steam consumption. The leader in this effort was George H. Corliss, whose improvements in efficiency and mechanical detail earned him the title "The American James Watt."

By the 1870's Corliss' Providence Engine Works was the world's largest and drew to the state a number of other important builders, Rhode Island becoming the steam-engine capital of the nation.

This museum contains the finest collection of Rhode Island engines, including one of the three built at the Corliss Works known to survive.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS - 1992

ACKNOWLEDGEMENTS

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FURTHER READING

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2. Hunter, L.C., A History of Industrial Power in the United States 1780-1930. Volume Two: Steam Power. Charlottesville, VA: University Press of Virginia for the Hagley Museum and LIbrary, 1985.

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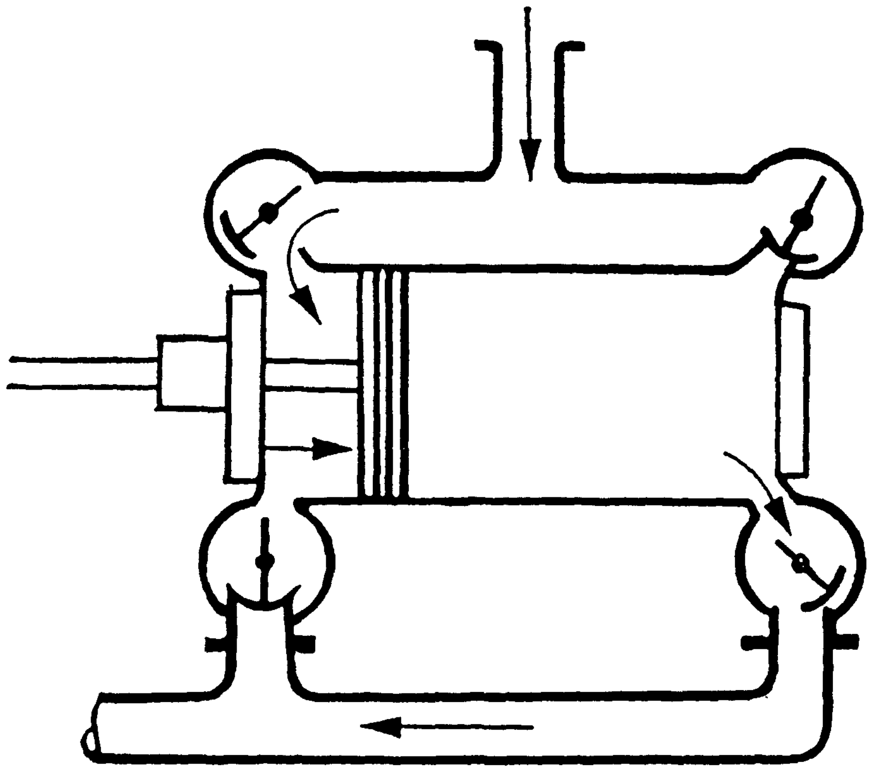


Figure 1.

Schematic arrangement of Corliss valves. The valve is slotted, machined cast iron cylinder rocking about an axis at right angles to the piston motion. The upper valves control steam admission and the lower valves control exhaust.

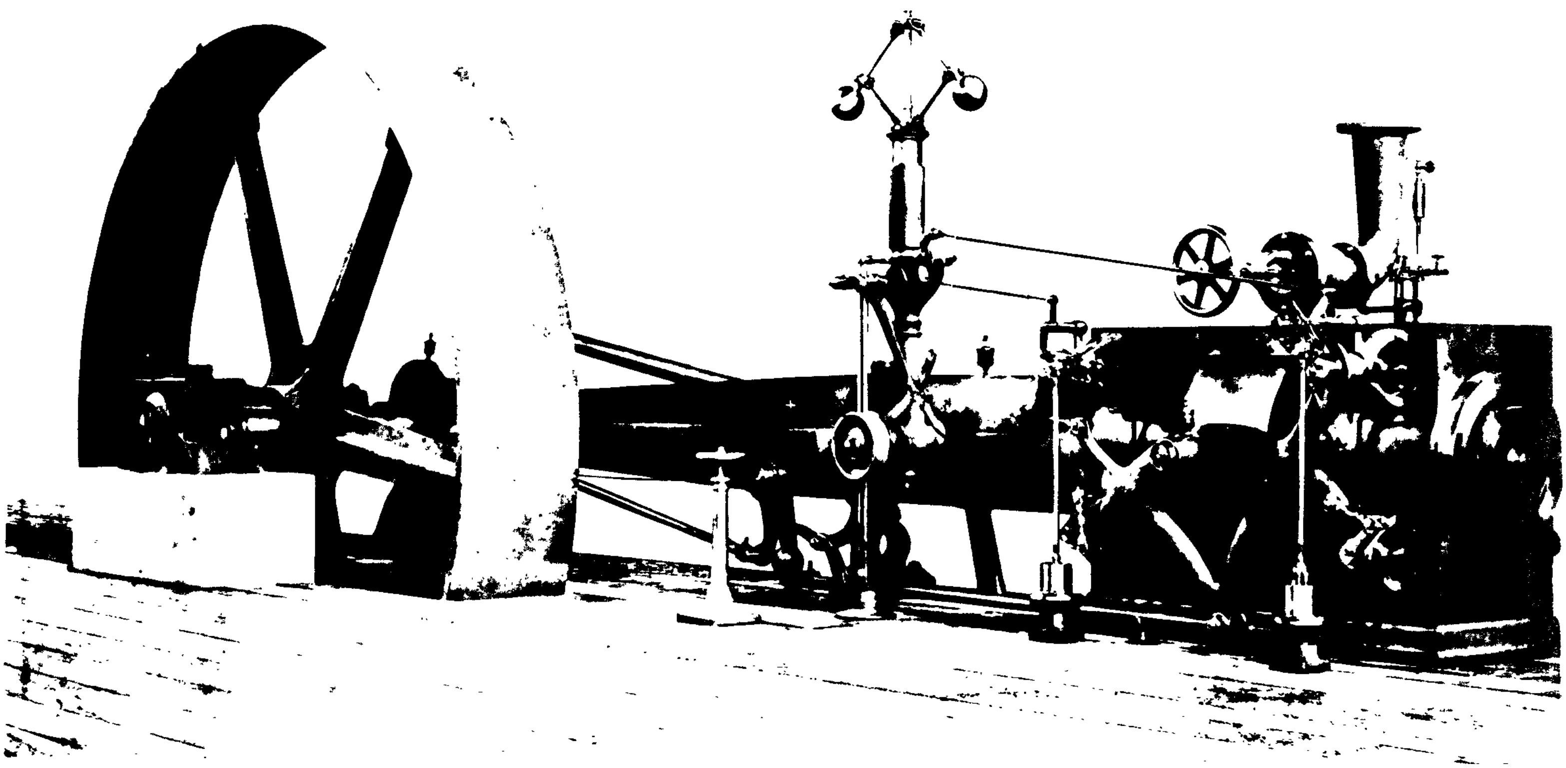


Figure 2.

Corliss engine manufactured by the Corliss Steam Engine Company, Providence, Rhode Island, in 1892. The unique spider form of wrist plate should be noted.

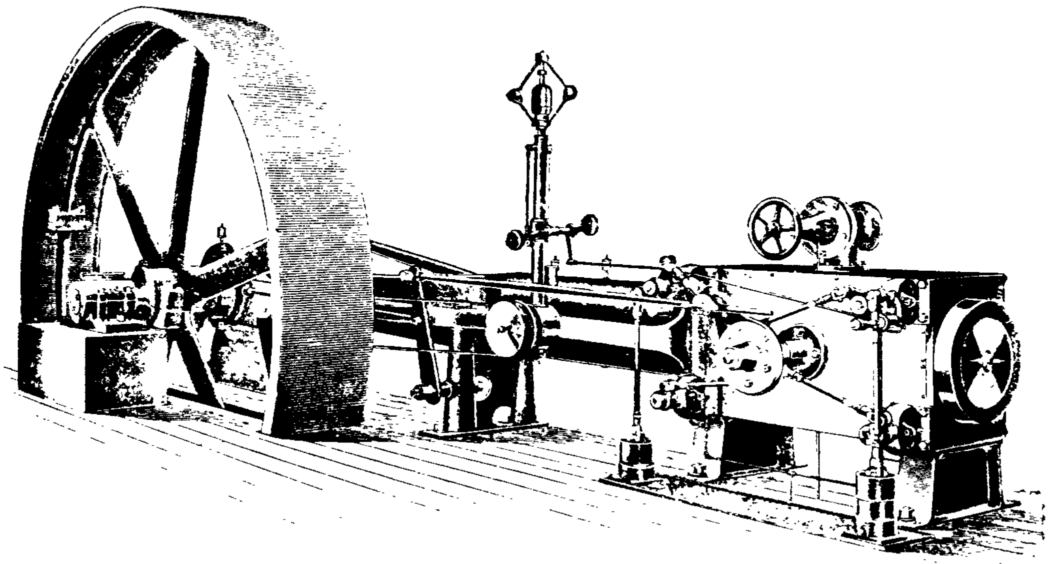


Figure 3.

Harris Corliss engine showing Corliss valve gear. The circular disc wrist plate is centrally located on the side of the cylinder. It is driven by a rod which extends to the eccentric on the crank shaft. The ends of the four valves protrude from the four corners of the cylinder casing. The upper valves control the steam admission and the lower valves control its exhaust. The dashpots are on the floor at the front and rear of the cylinder. Vertical rods tie them to the admission valves. Rods connect the governor to the admission valves to control the time of steam cut-off.

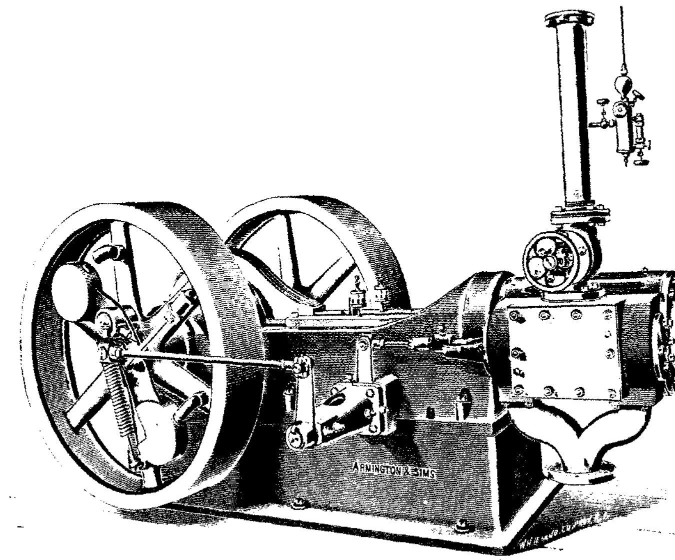


Figure 4.

Armington & Sims engine. This is high speed single cylinder automatic engine. The valve is controlled directly by the flywheel mounted inertia governor. The great simplicity of the valve gear and the attention to dynamic balancing compared to the Corliss and Fitchburg engines should be noted.

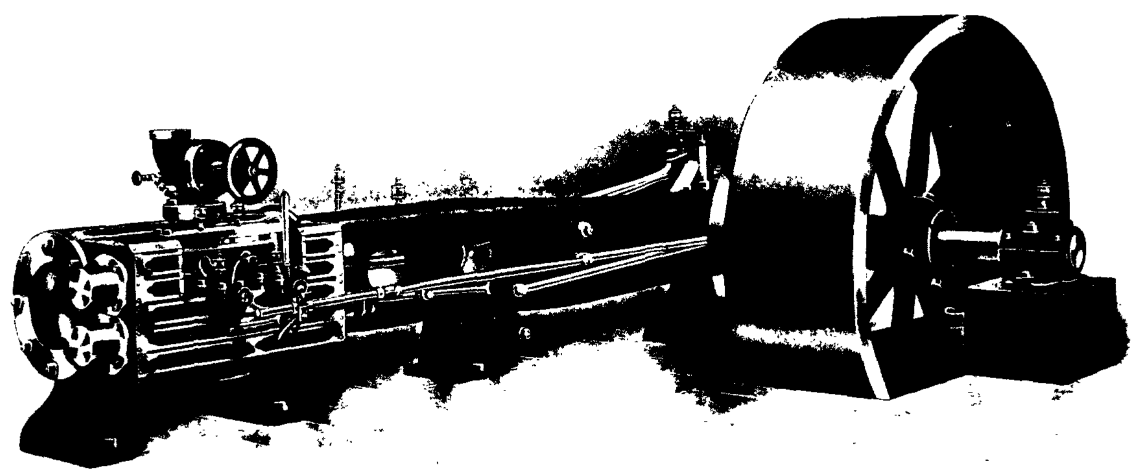


Figure 5.

Fitchburg engine. This is a girder frame engine. Note the double rods that connect the valve gear to the valve eccentrics which are mounted on the main shaft behind the flywheel and governor.

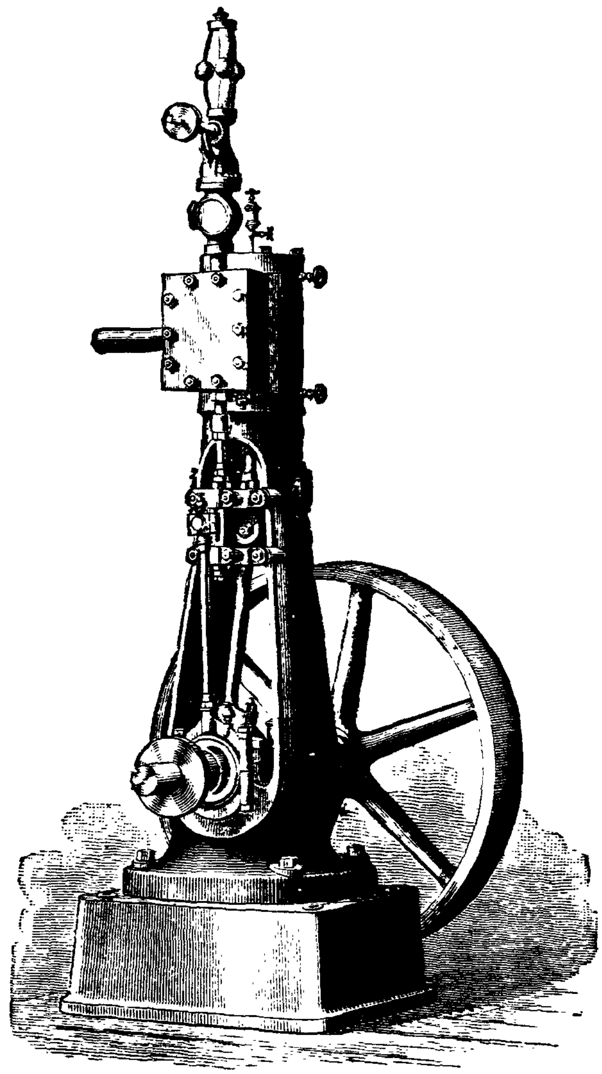


Figure 6.

New York Safety Steam Power Company vertical bottle engine manufactured by Nichols and Langworthy, Hope Valley, Rhode Island. The slide valve controls steam admission and exhaust. It is driven by the eccentric seen on the end of the crankshaft at the lower end of the engine. The speed of these engines is typically controlled by a Pickering throttling governor. This method is inefficient but practical in small engines where simplicity is an overriding concern.

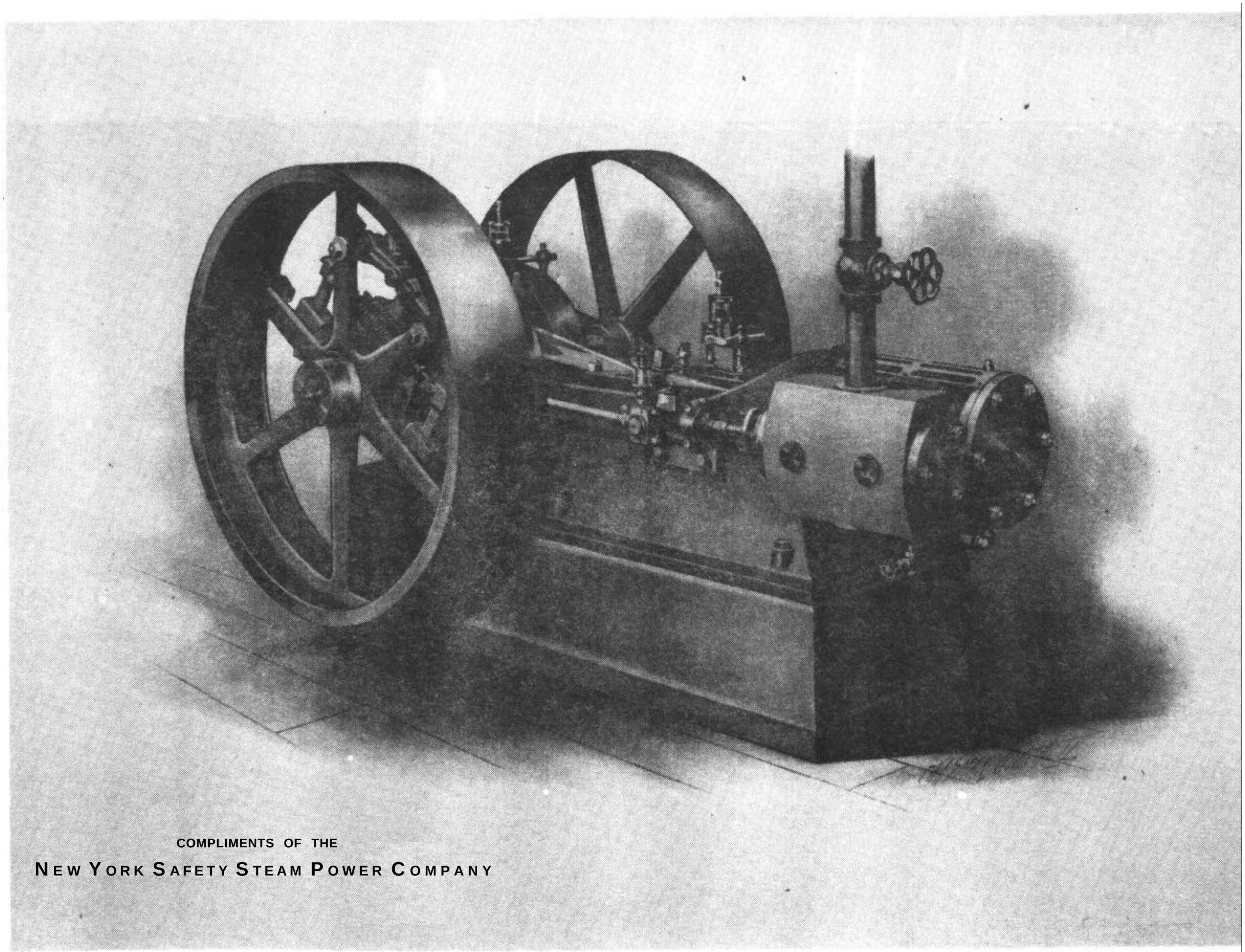
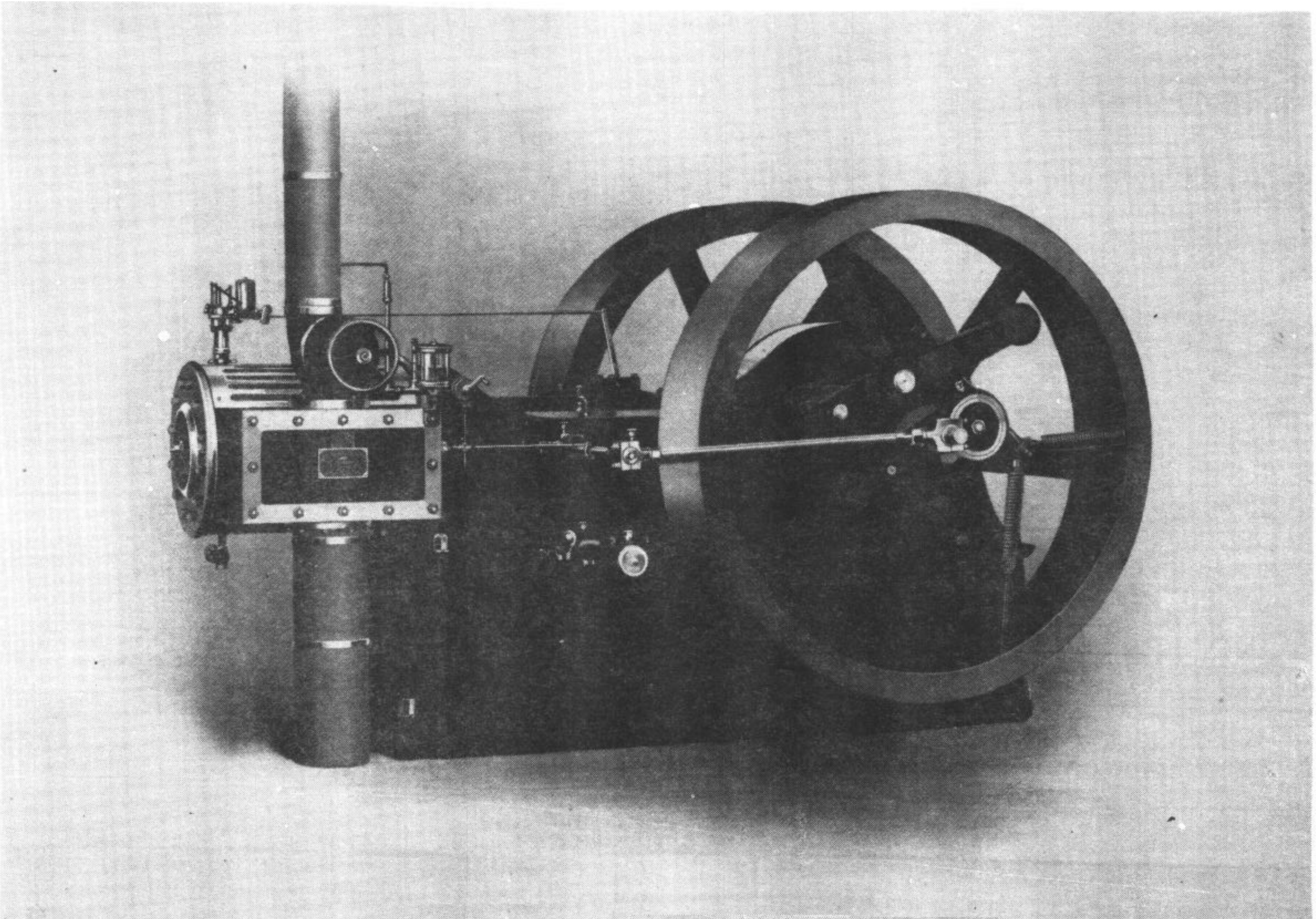


Figure 7.

New York Safety Steam Power Company, manufactured by Nichols and Langworthy, Hope Valley, Rhode Island, horizontal high speed, automatic engine for dynamo drive. This uses the inertia governor for accurate speed control.



THE FAMOUS AMERICAN-BALL SIMPLE ENGINE—GOVERNOR SIDE

Figure 8.

The American Ball engine, built in Bound Brook, New Jersey, is a later version of the high speed, automatic engine designed for direct alternator drive.

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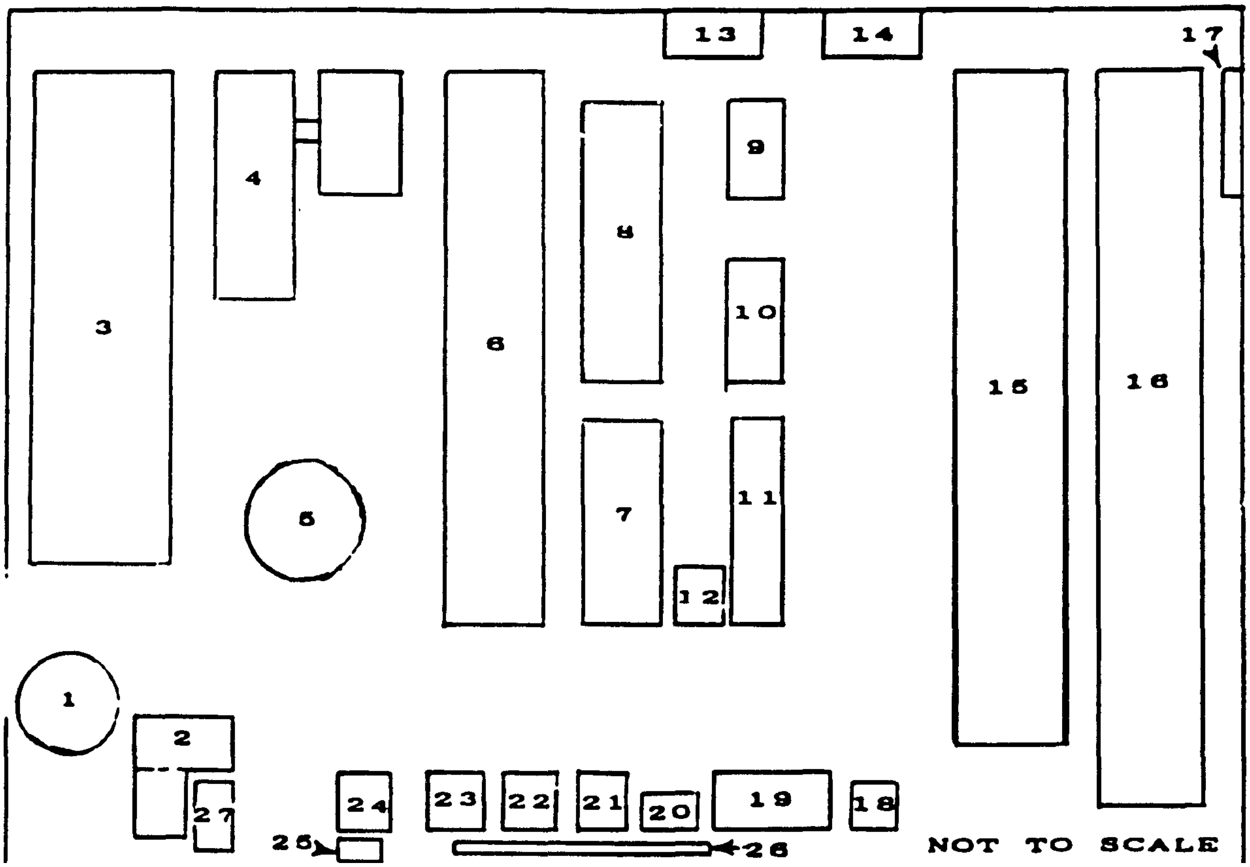

STEAM BUILDING EQUIPMENT LAYOUT

1. 5 hp Vertical Fire Tube Boiler. Built in 1950
2. 20 HP Dry Back Scotch Boiler. Built in 1976
3. 150 hp Horizontal Engine. Built circa 1900
4. 150 hp High Speed Engine, Direct Electric Dynamo Drive. Built circa 1900
5. 10 hp Baxter Engine/Boiler. Built circa 1868
6. 150 hp Harris Engine. Heavy duty Frame. Built in.1911
7. 25 hp Automatic cut off Engine. Built in 1892 for R.I. State College
8. 75 hp Automatic Cut Off Horizontal Engine. Built in 1888
9. 5 hp Horizontal Side Crank Engine. Built circa 1890
10. 15 hp Riding Cut Portable Farm Engine. Built circa 1870
11. 20 hp Horizontal Engine. Built circa 1870
12. 5 HP Vertical Bottle Engine. Built circa 1869
13. 25 hp, 2 Cylinder, Textile Printing Machine Engine. Built circa 1870
14. Hydraulic Turbine Governor. Built in 1904
15. 150 hp Girder Frame Horizontal Mill Engine. Built in 1892
16. Horizontal Mill Engine, Designed circa 1887, Built in 1892
17. Boiler Face from Bay Mill East Greenwich. Built circa 1900
18. 25 hp Enclosed Vertical Engine. Built about 1920 for BP1
19. 385 hp Triple Expansion Vertical Engine. Built 1904
20. Noiseless Right Angle Drive. Built 1884
21. 15 hp Vertical Bottle Engine
22. 15 hp Engine with Riding Cut Off. Built circa 1885
23. 25 hp Coal Stoker Engine. Built circa 1910
24. Sears Roebuck Engine. Built circa 1899
25. 2 hp Bipolar DC Generator. Built in 1891
26. Overhead Line Shafting
27. Hot Air Doaestic Water Pumping. Enqine. Built Circa 1890

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