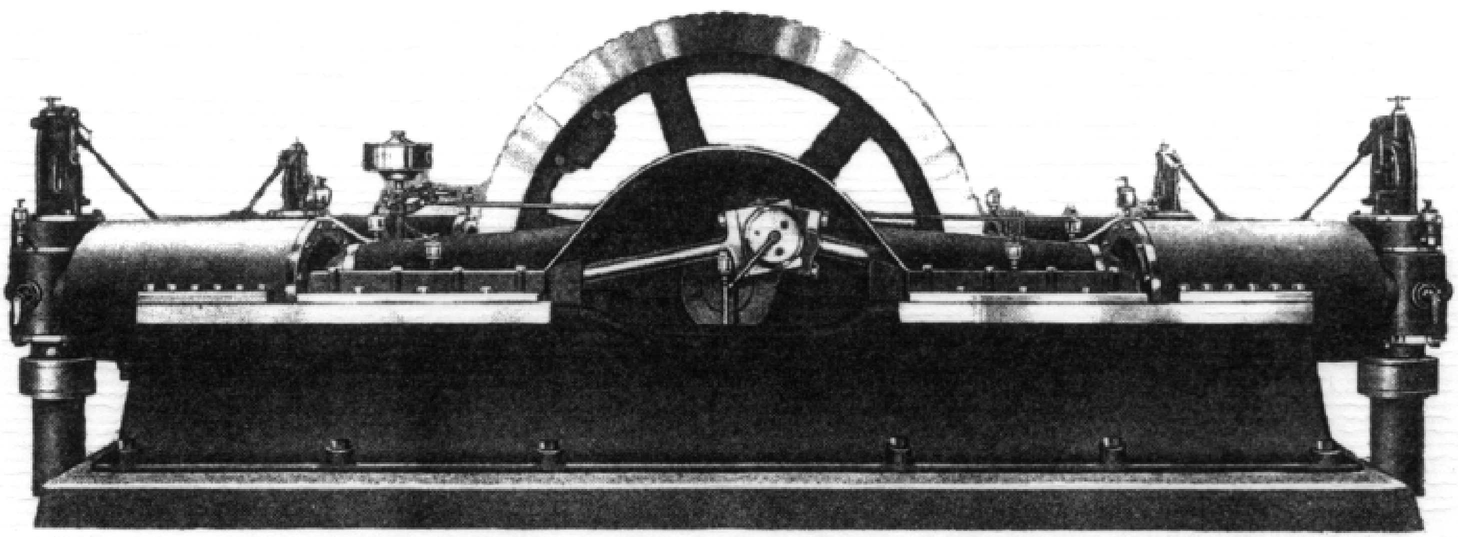
ASME International

THE COOLSPRING POWER MUSEUM COLLECTION OF STATIONARY INTERNAL COMBUSTION ENGINES

MECHANICAL ENGINEERING HERITAGE COLLECTION

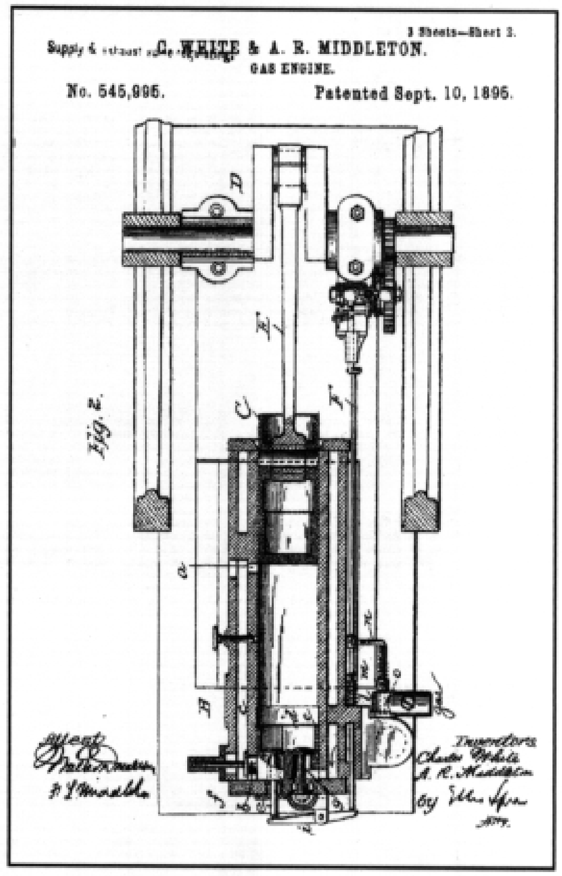


Coolspring Power Museum
Coolspring, Pennsylvania
June 16, 2001

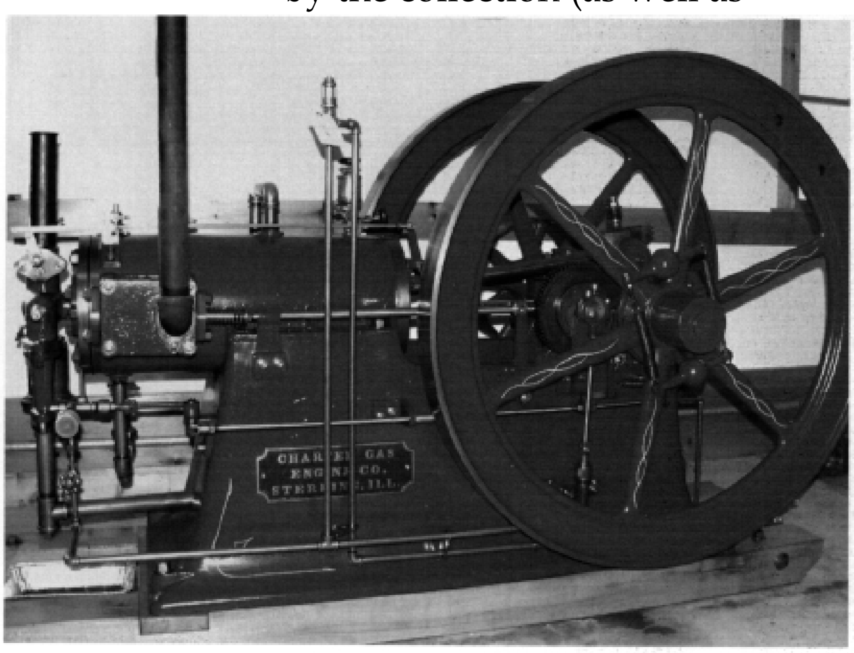
The Coolspring Power Museu

Internal combustion engines revolutionized the world around the turn of th 20th century in much the same way that steam engines did a century before. One has only to imagine a coal-fired, steam-powered, airplane to realize how important internal combustion was to the industrialized world. While the early gas engines were more expensive than the equivalent steam engines, they did not require a boiler and were cheaper to operate.

The Coolspring Power Museum collection documents the early history of the internal-combustion revolution. Almost all of the critical components of today's engines have their origins in the period represented by the collection (as well as hundreds of innovations that are no longer used). Some of the engines represent real engineering progress; others are more the product of inventive minds avoiding previous patents; but all tell a story. There are few duplications in the collection and only a couple of manufacturers are represented by more than one or two examples.



1897 Charter Gas Engine

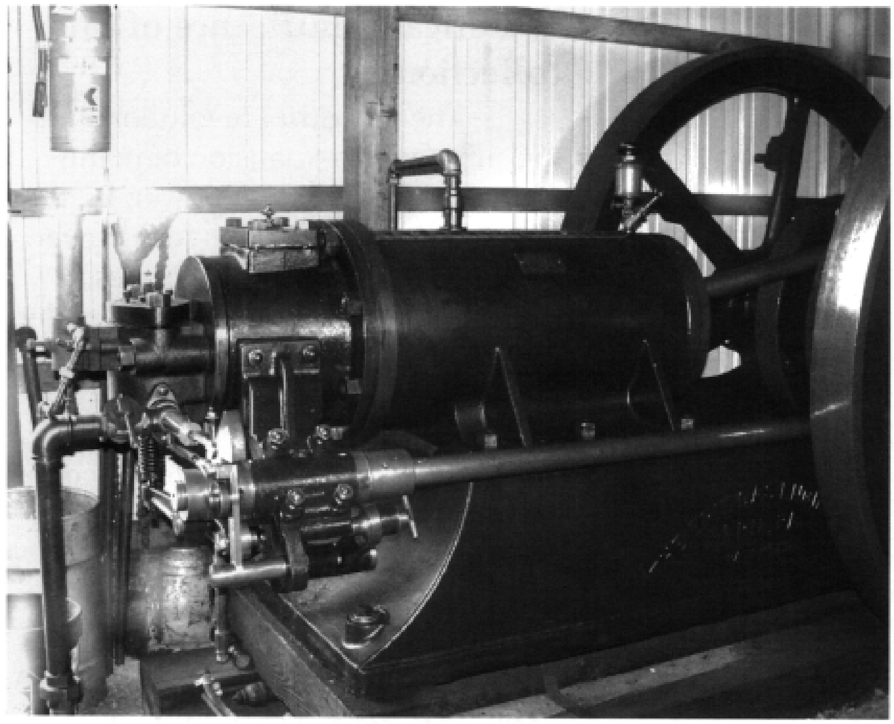


The Coolspring Power Museum contains the largest collection of historically significant, early internal combustion engines in the country, if not the world. With the exception of a few items in the collection that were driven by the engines,

m Collection

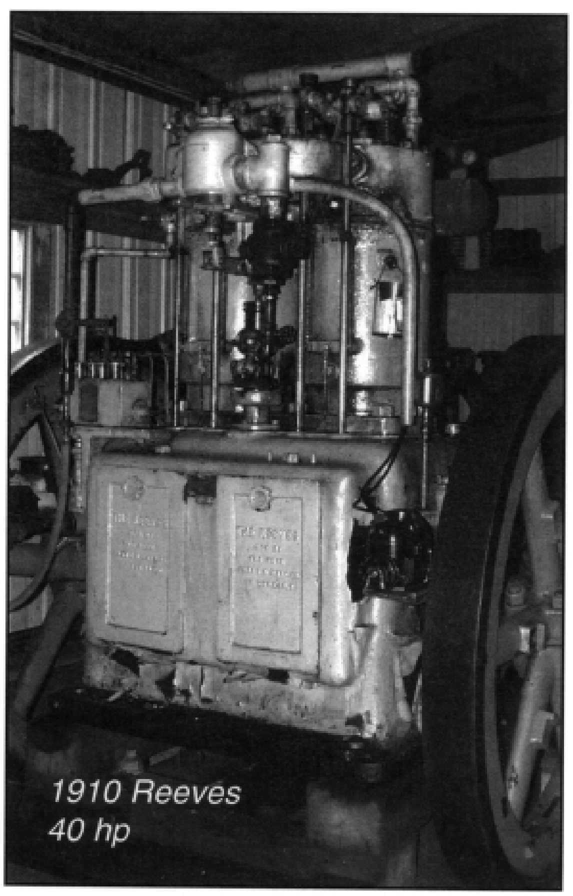
such as compressors, pumps, and generators, and a few steam and hot air engines shown for comparison purposes, the collection contains only internal combustion engines.

The collection consists mainly of stationary engines used in industrial applications. There are only a few marine, automotive, and farm engines in the collection and the Museum does not plan to expand its focus into those areas. Most of the Museum's acquisitioning efforts (those that involve substantial expenditure of funds and volunteer time) have been focused on collecting important large stationary engines that most likely would be scrapped if the Museum did not acquire them.



1895 Climax
50 hp

The Museum's passive collecting efforts are directed at filling technological gaps in the collection by accepting donations from private collectors and occasionally other museums. The Museum also maintains a substantial library and archive related to the objects in the collection and to the internal combustion engine in general. The collection consists primarily of engines built in America because that is what was available to the Museum. However, the technology on which they are based comes from both sides of the Atlantic.

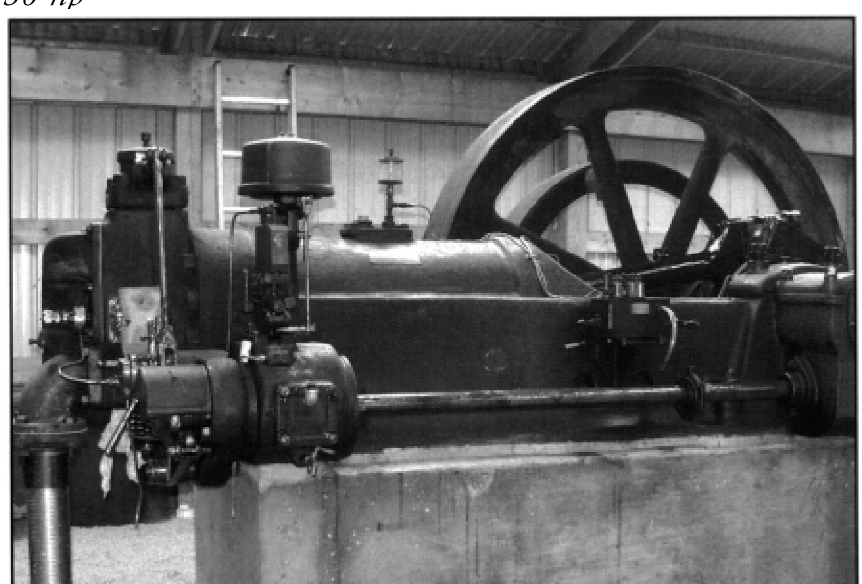


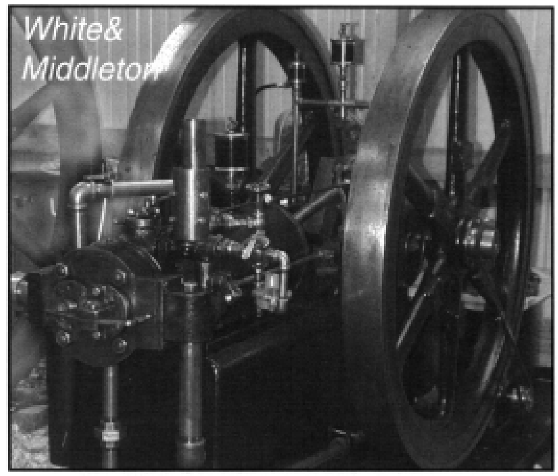
1910 Reeves
40 hp

Historical significance of this collection

The industrial revolution and the subsequent expansion of manufacturing depended on power. By the 1830s most of the good hydro power sites in the eastern United States, Great Britain, and Europe were under development. Steam power provided the energy for further industrial expansion. Steam, however, besides being perceived as dangerous, was expensive and not well suited to portable and small applications. By the 1850s several people were experimenting with engines that ignited a combustible mixture of air and fuel in a confined space. Lenoir in France produced the first practical internal combustion engine in 1860. It drew in the fuel-air mixture during the first half of the stroke, then ignited the mixture which expanded during the second half of the stroke. By firing on both sides on the piston it could provide power on every stroke like a steam engine. Lenoir-cycle engines were not very efficient and because the piston was double acting, and therefore was heated from both sides, they were limited to relatively small

1928 Otto Diesel 50-hp





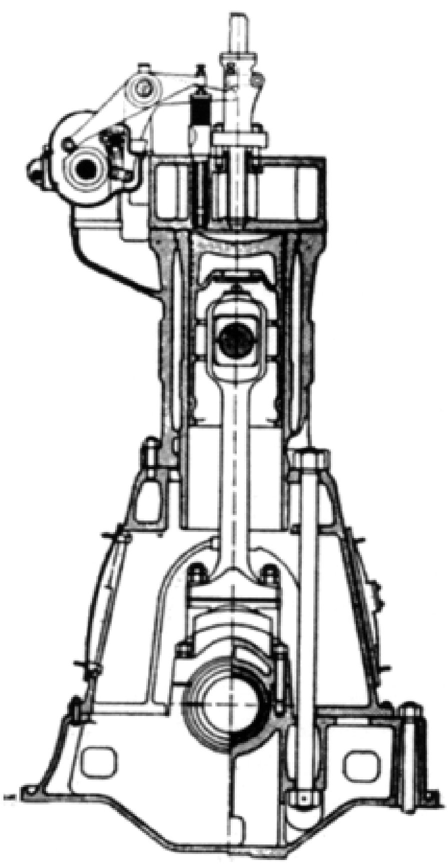
sizes that could be cooled by the cylinder water jacket.

In 1861 Nikolas August Otto in Germany conducted experiments with a four-stroke-cycle engine but for reasons that are not entirely clear dropped that design in favor of a free-piston atmospheric engine that he would improve and manufacture from 1866 to 1876 with his partner, Eugen Langen. Their engine also fired part way through the intake stroke but was far more efficient than Lenoir's which gave up much of its energy to the cooling water that kept the engine from overheating. Otto and Langen's engines were graceful looking but were much noisier than the steam engines of the time and could produce only a couple of horsepower.

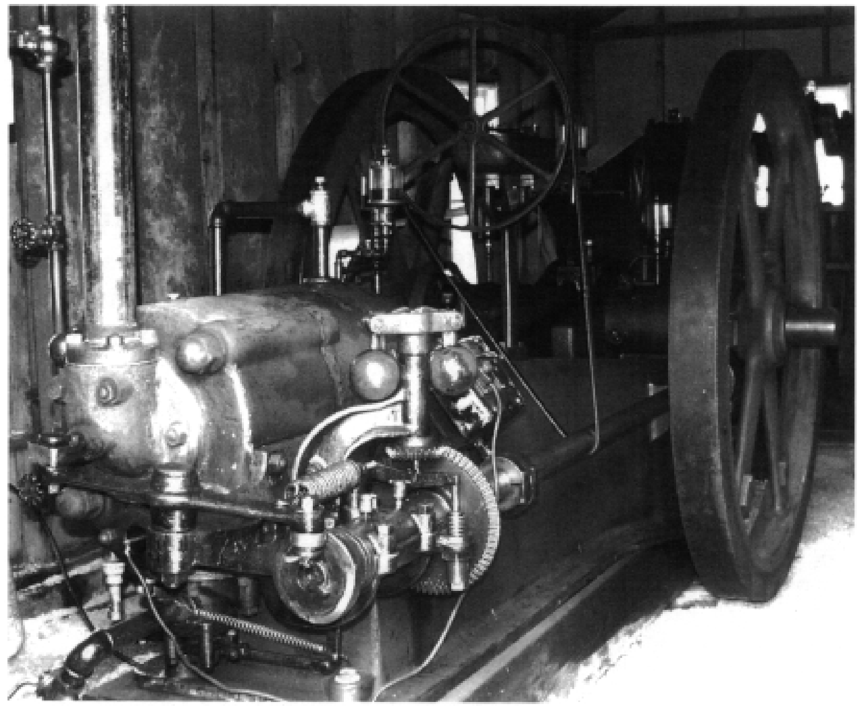
In 1876 Otto, who had given up active management of the firm (Otto & Langen), went back to his 1861 design and perfected the first four-stroke-cycle internal combustion engine. His design represented such an improvement that when William Crossley, Otto & Langen's English licensee, saw the new engine he immediately wired his factory to stop production of the atmospheric engines.

Otto's new engine fired the charge of air and gas under compression and while it produced no power during the next three strokes it was much more efficient and could be made in much larger sizes.

Otto was unable to defend the major parts of his four-stroke-cycle patent and soon many manufacturers were producing four-stroke engines. Despite the success of the the 'Otto Cycle' a number of inventors continued work on two-stroke-cycle engines but now they too fired under compression. Some of them used separate cylinders to draw in the air-fuel mixture and then transfer it to the main cylinder for combustion. Hundreds of individuals and companies developed variations on these two basic designs and sought patents. Most of the basic elements found in today's internal combustion engines were invented before 1900, and although they have been greatly refined over the years, no one would claim that today's engines have reached perfection.



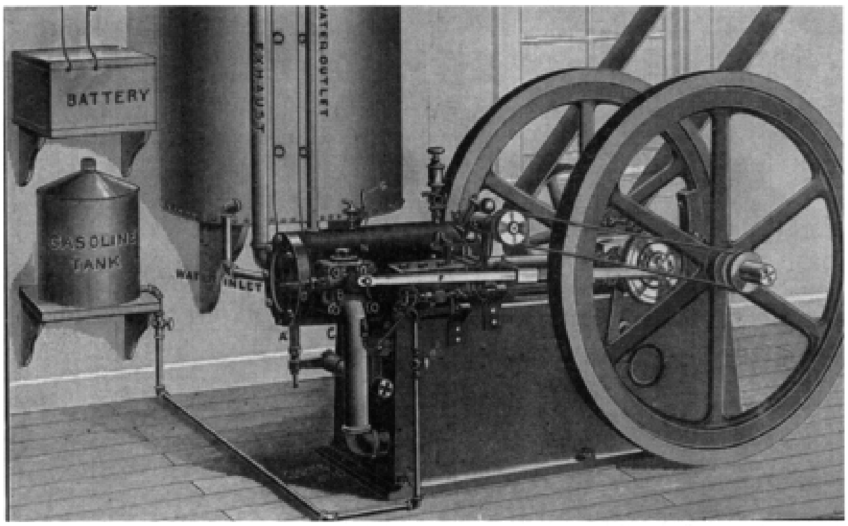
Sectional view of a Busch-Sulzer Diesel engine



National Transit Klein (Model 3)

Igniting the charge was a problem for early engine builders. Low-tension electric ignition had been introduced by Lenoir, and Otto used it in his 1861 experimental model. Various systems of "make-and-break" ignition were used until 1910. For his atmospheric engine Otto used a flame-ignition system that introduced an open flame into the combustion chamber. It was mechanically cumbersome and would work with only a limited range of hydrogen rich fuels, but was probably more reliable than electric ignition at that time. Few if any flame-ignition engines were built after 1900. Other early manufacturers used a system in which a tube that was open to the combustion chamber was heated with a gas flame until its closed, outer end was cherry red. When a fresh charge of fuel was compressed it would ignite when it reached the hot end of the tube. Hot-tube ignition was displaced by high-tension electric ignition with spark plugs by the 1920s. Rudolf Diesel introduced in 1893 an engine in which the high compression of the air produced enough heat to ignite when fuel was injected.

Controlling the speed of the engines was another area where early inventors used a number of different systems. The throttling governors used on steam engines were adapted to control the intake of the air-fuel mixture. Various systems were developed to control the action of intake and exhaust valves and many ways of controlling the ratio of fuel to air were devised.



Foos gas and gasoline engine

The early internal combustion engines produced only a few horsepower and could not replace steam engines in most applications, but by 1890 they were powerful enough for most portable or remote operations as well as many small manufactures. By 1900 they were replacing reciprocating steam engines for electric generation and by 1915 they were being considered for all but the largest installations where steam turbines have dominated for most of this century. Large reciprocating steam engines were limited to those applications were instantaneous reversal was required, such as rolling mills, locomotives, and marine service.

The collection at Coolspring contains examples of most of the early solutions to the basic problems as well as many innovations that were less critical to the operation of the engines but which greatly affected their marketability. There are even a number of engines in the collection that started their life as steam engines and were converted to internal combustion.

A brief history of the Coolspring Power Museum

The museum's origins go back to the early 1950s and the efforts of two collectors: John Wilcox and Paul Harvey. As their collections grew, significant pieces were gathered in a series of buildings in Coolspring, Pennsylvania. Through the years, and with the help and encouragement of many other individuals, this became the Coolspring Power Museum. The Museum was formally chartered in June 1985 as a registered, tax exempt, non-profit, corporation. During the years since the founding, membership has grown steadily. So have the collections housed at Coolspring. Many other engine enthusiasts have placed significant pieces at Coolspring for display. The grounds, as well as semi-annual shows, have expanded with visitors from Maine to California, as well as from Canada and England.

The Coolspring Collection of historic internal combustion engines is the largest, mechanically most interesting, and historically significant in the entire country.

At this time, the museum is housed in 13 buildings that, besides its own large collection, contain many pieces placed there on loan. Total inventory is about 250 engines with a significant number permanently mounted and operational. The Museum acquires most of its collection by gift, however a substantial part of its operating budget has been spent on moving and other acquisition costs.

A listing of some of the more significant engines in the Coolspring Power Museum Collection by year of manufacture follows. Unless indicated otherwise they used gas (either natural or producer) as a fuel although most of the smaller gas engines could also be fitted with a carburetor.

1885

Schleicher-Schumm Built in Philadelphia, PA by the American licensee of Otto and the second oldest American, operating internal combustion engine. Two-horsepower at 180 rpm, single-cylinder, horizontal design.

J. P. Connelly Manufactured in New York, NY. It uses a unique design featuring second cylinder that scavenges the exhaust and draws in a fresh charge. Five horsepower at 200 rpm

1895

Climax Made in Erie, PA, this large 50-horsepower at 200 rpm, single-cylinder engine features a disc crank, side shaft, and a pendulum governor. It powered a flour mill.

1896

Reid Type A Built in Oil City, PA. Reids were the only commercially successful engines using the 'Clerk' cycle, employing a separate charging cylinder. This two-cylinder horizontal was used in the oil fields.

1897

Charter A 12-horsepower at 210 rpm, single, horizontal engine built in Sterling, IL. Charter demonstrated fuel injection in 1893.

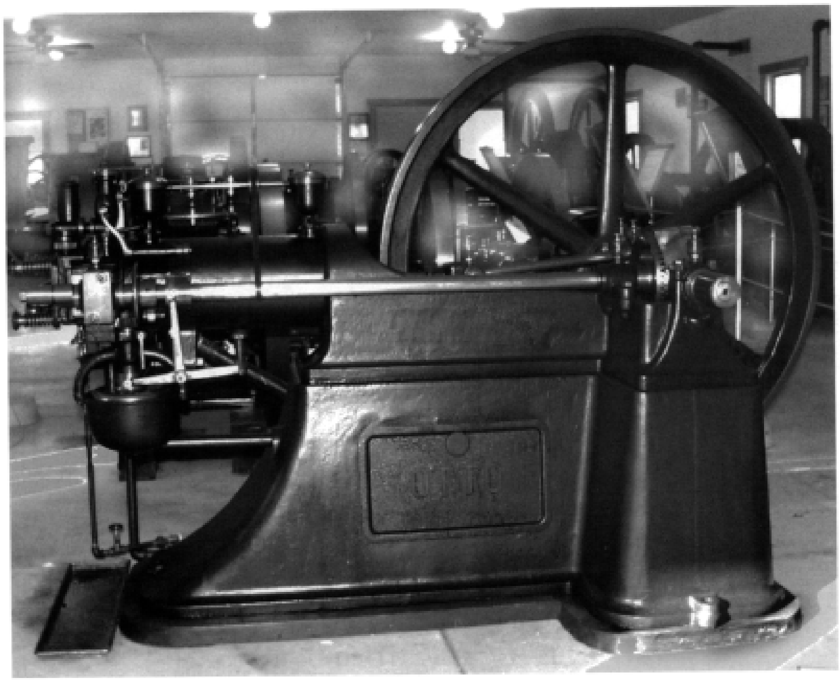
1899

National Transit Klein (Model 1) Built in Oil City, PA, this was the first of a series, manufactured by Standard Oil's pipeline division for its own use. It is a 35 horsepower at 160 rpm, single-cylinder engine with a "pull rod" exhaust and disc crank.

National Transit Klein (Model 2) Is a smaller engine with a side shaft and vertical governor producing 10 horsepower at 240 rpm.

1900

National Transit Klein (Model 3) A 20-horsepower at 160 rpm, single-cylinder with side shaft. Only 50 of this model were built.



1885 Schleicher-Schumm

Callahan Built in Dayton, OH. A single horizontal cylinder produced 6 horsepower at 260 rpm. The governor stops the side camshaft.

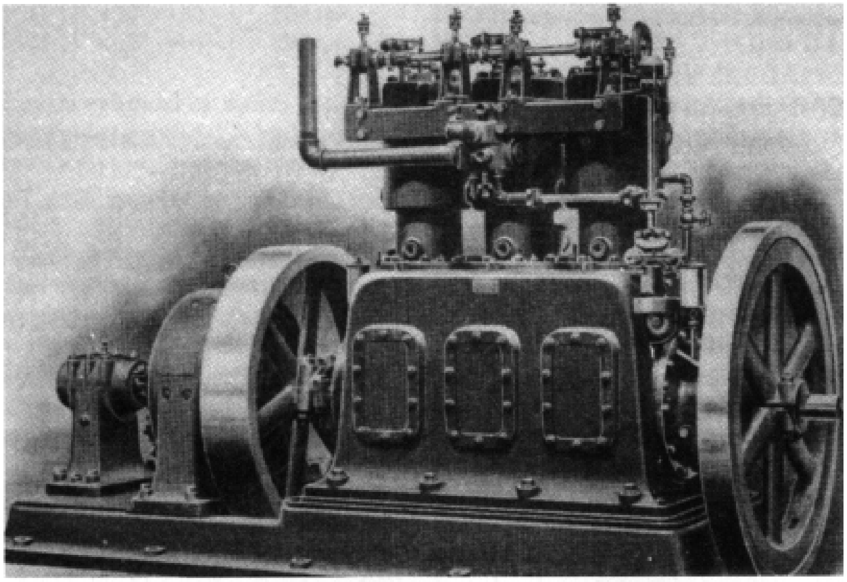
Lambert Made in Anderson, IN. This 20-horsepower at 225 rpm, single-cylinder horizontal engine features a one-piece cylinder and head casting and an unusual governor motion.

1901

National Transit Klein (Model 4) This was John Klein's last design and was a masterpiece using a pneumatically controlled variable-cut-off governor. It produced 40 horsepower at 240 rpm.

Palm A 12-horsepower at 120 rpm convertible engine built in Butler, PA. The only known four-stroke-cycle engine that could run on either steam or gas or both simultaneously.

Westinghouse A three-cylinder vertical engine built in Pittsburgh, PA for use in small electric generating plants. It produces 90 horsepower at 281 rpm.



Westinghouse three cylinder engine, direct connected to a generator

1902

Gardner Manufactured in Washington, PA, it produced 12 horsepower. Gardner was the first to build an engine that could be run on either steam or gas, for use in the oil fields.

Harvard-Stickney Made in St. Paul, MN. This 3-horse at 280 rpm, single-cylinder vertical engine was the first internal combustion engine to be sold by Sears & Roebuck in their catalogue.

1905

Either Built in Washington, PA. Another convertible, steam-to-gas engine designed for use in the oil fields. Twelve horsepower at 120 rpm.

Fairchild & Betts Manufactured in Warren, PA, is a single-horizontal-cylinder engine with an unusual vertical governor, for use in the oil fields.

Lima Built in Lima, OH for powering a rod-line pumping system. It is a four-stroke-cycle, single-cylinder horizontal engine with a crosshead.

1906

Foos Made in Springfield, OH. It has a single horizontal cylinder with rotary wipe ignition, disc crank and produced 40 horsepower at 200 rpm.

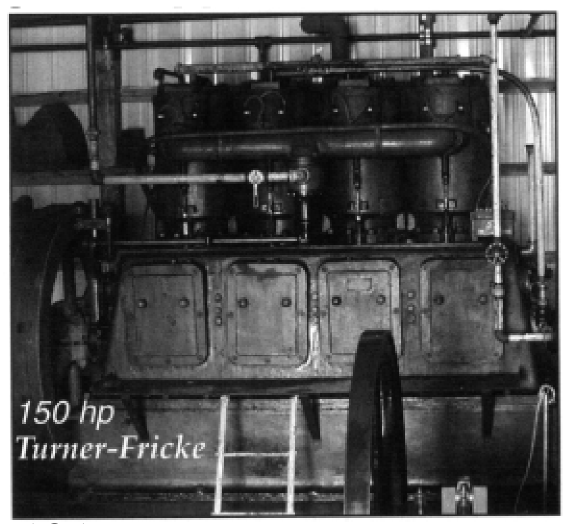
White & Middleton Manufactured in Baltimore, MD. A typical East Coast design with an atmospheric intake valve, a front powered-exhaust and a rear auxiliary-exhaust port. The single horizontal cylinder produces 7 horsepower.

Williamsport Gas Engine Made in Williamsport, PA. A single-cylinder horizontal engine with a pendulum governor that controls the fuel. It is rated at 6 horsepower at 325 rpm and was used to power a small telephone exchange.

1908

Hornsby-Akroyd Built in New York, NY. The first American four-stroke oil engine. It is a single-cylinder horizontal design and was used on an oil pipe line. It produces 35 horsepower at 220 rpm.

Turner-Fricke Manufactured in Pittsburgh, PA. An early, heavy vertical engine with four cylinders designed for continuous use. It produces 150 horsepower at 277 rpm and was used to produce A.C. electric power in a pipeline pumping station.



1910

Flickenger Made in Bradford, PA. Uses a single cylinder with the combustion in front of the piston and air compression behind it. It provided compressed air to power steam engines used to pump oil in the field. It is rated at 60 horsepower at 180 rpm.

Reeves Built in Mt. Vernon, OH. A 40-horsepower at 300 rpm engine with twin vertical cylinders designed for continuous use driving a generator.

1912

National Transit Twin Klein The heavy horizontal twin cylinders and frame were cast 'en bloc.' It produces 125 horsepower at 120 rpm.

Snow Manufactured in Buffalo, NY. An air-injected diesel with single massive horizontal cylinder. Its 200 horsepower at 120 rpm was used to power a pump on the Tidewater pipeline.

1913

Miller Built in Springfield, OH. Has four horizontal cylinders arranged in an "H" around a central flywheel. Rated at 300 horsepower at 180 rpm, it drove an Ingersoll Imperial air compressor. The compressed air was distributed to old steam engines to pump oil wells.

1915

General Electric Manufactured in Schenectady, NY. Direct connected to a D.C. generator. This 50-horsepower at 550 rpm, four-cylinder vertical engine was used on the Erie Barge Canal.

1916

Blaisdell Made in Bradford, PA Was also used to supply compressed air for pumping oil. A single horizontal power cylinder is directly in front of the compressor, which features Corliss-type valves. It produces 65 horsepower at 180 rpm.

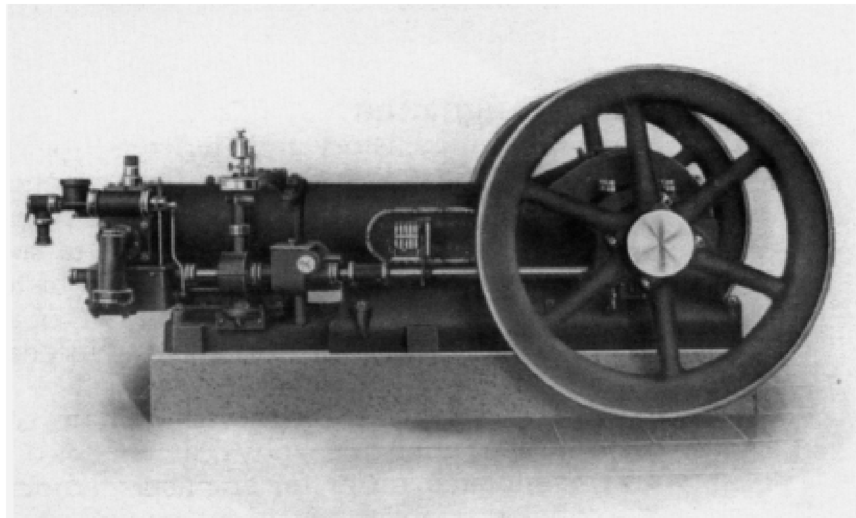
Blaisdell A smaller version of the previous entry and was used to start it. It features a figure-eight cam design that eliminates the use of reduction gears.

1917

Snow Built in Buffalo, NY, It is the largest engine in the collection. Its twin tandem cylinders are direct-connected to a compressor behind the crankshaft. Rated at 600 horsepower, at 95 rpm, it was used to pump natural gas at Roystone PA.

1920

Evans Manufactured in Butler, PA. It powered an oil-field pressure plant. This single-cylinder horizontal has a powered intake valve and produced 25 horsepower at '180 rpm.



Flickinger straight line self oiling single cylinder gas driven air compressor

1925

Bovaird Titan Made in Bradford, PA. Rated at 25 horsepower at 225 rpm, this single-cylinder horizontal engine had an intake valve controlled by an eccentric like used on steam engines.

Buffalo-Springfield Made in Springfield, OH. This 40-horsepower, horizontal twin-opposed still powers a road roller.

1927

Busch-Sulzer Made in St. Louis, MO. This is a 400-horsepower at 177 rpm, four-cylinder, vertical air-injected diesel made by the first American manufacturer of diesels. It generated electricity in Greenport, Long Island.

1928

Otto Diesel Manufactured in Philadelphia, PA. This 50-horsepower at 230 rpm, single, horizontal diesel is believed to be the last engine built by Otto in America. It drove an ammonia compressor at an ice plant in Lewisburg, PA.

The History and Heritage Program of ASME International

The History and Heritage Landmarks Program of ASME International (the American Society of Mechanical Engineers) began in 1971. To implement and achieve its goals, ASME formed a History and Heritage Committee initially composed of mechanical engineers, historians of technology and the curator (now emeritus) of mechanical engineering at the Smithsonian Institution, Washington, D.C. The History and Heritage Committee provides a public service by examining, noting, recording and acknowledging mechanical engineering achievements of particular significance. This Committee is part of ASME's Council on Public Affairs and Board on Public Information. For further information, please contact Public Information at ASME International, Three Park Avenue, New York, NY 10016-5990, 1-212-591-7740.

Designation

Since the History and Heritage Program began in 1971, 214 landmarks have been designated as historic mechanical engineering landmarks, heritage collections or heritage sites. Each represents a progressive step in the evolution of mechanical engineering and its significance to society in general. Site designations note an event or development of clear historic importance to mechanical engineers. Collections mark the contributions of a number of objects with special significance to the historical development of mechanical engineering.

The Landmarks Program illuminates our technological heritage and encourages the preservation of the physical remains of historically important works. It provides an annotated roster for engineers, students, educators, historians and travelers. It helps establish persistent reminders of where we have been and where we are going along the divergent paths of discovery.

The 125,000-member ASME International is a worldwide engineering society focused on technical, educational and research issues. ASME conducts one of the world's largest publishing operations, holds some 30 technical conferences and 200 professional development courses each year, and sets many industrial and manufacturing standards.

MECHANICAL ENGINEERING HERITAGE COLLECTION
COOLSPRING POWER MUSEUM

THIS IS THE LARGEST COLLECTION OF HISTORICALLY SIGNIFICANT STATIONARY INTERNAL COMBUSTION ENGINES IN THE UNITED STATES. A MAJORITY OF THESE MECHANICALLY INTERESTING ENGINES WERE BUILT BETWEEN 1890 AND 1920 AND USED IN INDUSTRIAL APPLICATIONS.

THIS COLLECTION DOCUMENTS THE EARLY HISTORY AND EVOLUTION OF THE INTERNAL COMBUSTION ENGINE, MANY COMPONENTS OF TODAY'S ENGINES HAVE THEIR ORIGINS IN THE PERIOD REPRESENTED BY THIS COLLECTION.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS – 2001

ASME International

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This brochure was written and designed by Vance Packard with help from Peston Foster, Clark Colby and Robert Vogel

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