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SMITHSONIAN INSTITUTION
WASHINGTON 1846

Photo by Henry Austin Clark, Jr

The Simplex automobile was the American luxury car of the early 20th century. This racing type shown here, now in the Long Island Automotive Museum, Southampton, Long Island, N. Y., is almost identical with the Simplex in the U. S. National Museum. *(Color plate contributed by Henry Austin Clark, Jr.)*

United States National Museum
Bulletin 213

AUTOMOBILES AND MOTORCYCLES

in the U. S. National Museum

By SMITH HEMPSTONE OLIVER

SMITHSONIAN INSTITUTION • WASHINGTON, D. C. • 1957

PUBLICATIONS OF THE U. S. NATIONAL MUSEUM

The scientific publications of the National Museum include two series, known, respectively, as *Proceedings* and *Bulletin.*

The *Proceedings* series, begun in 1878, is intended primarily as a medium for the publication of original papers, based on the collections of the National Museum, that set forth newly acquired facts in biology, anthropology, and geology, with descriptions of new forms and revisions of limited groups. Copies of each paper, in pamphlet form, are distributed as published to libraries and scientific organizations and to specialists and others interested in the different subjects. The dates at which these separate papers are published are recorded in the table of contents of each of the volumes.

The series of *Bulletins,* the first of which was issued in 1875, contains separate publications comprising monographs of large zoological groups and other general systematic treatises (occasionally in several volumes), faunal works, reports of expeditions, catalogs of type specimens, special collections, and other material of similar nature. The majority of the volumes are octavo in size, but a quarto size has been adopted in a few instances in which large plates were regarded as indispensable. In the *Bulletin* series appear volumes under the heading *Contributions from the United States National Herbarium,* in octavo form, published by the National Museum since 1902, which contain papers relating to the botanical collections of the Museum.

The present work is a revision and expansion of Bulletin 198, "Catalog of the Automobile and Motorcycle Collection of the Division of Engineering, United States National Museum." It forms No. 213 of the *Bulletin* series.

Remington Kellogg,
Director, United States National Museum

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FOREWORD

At present a large number of collections of antique automobiles exist in the United States. Most are small, reflecting the discoveries of private collectors; but more than a few are large, representing considerable effort by either individuals or organizations. None contains so many actual automotive milestones, however, as that housed in the U. S. National Museum, at the Smithsonian Institution in Washington, D. C.

This collection includes, for example, the Duryea car, built in Springfield, Massachusetts, which is universally considered to be the first American automobile driven by an internal-combustion engine. For those who endorse the claim of Elwood Haynes and the Apperson brothers, it also includes the first vehicle produced as a result of their genius. Neither of these cars would be of much use to the collector who might wish to operate them, but they are the two most important very early gasoline vehicles built in this country.

As most of us know, the internal-combustion-engined vehicle was not the first self-propelled vehicle to travel the public road. Long before the appearance of the first Daimler, Benz, or Duryea gasoline automobiles, steam wagons of various forms were built. Recent acquisitions of the Smithsonian's National Museum that come under this heading are the Roper steam velocipede of the late 1860's and the Long steam tricycle of 1879–1881. While much more recent than the Cugnot three-wheeled gun tractor of 1770, still preserved in Paris, these are very early as far as American development is concerned, and are of unusual interest in themselves.

Probably the most elusive of automotive treasures are the early racing cars, which were always few in number. The hazardous nature of their use saw to it that few remained for many years. It is astounding, therefore, that the Winton "Bullets" Nos. 1 and 2 both are to be found in the Smithsonian collection. These machines share with Henry

Ford's "999" and the Peerless "Green Dragon" the honor of writing the first chapters in the romance of automobile racing here, a story still being lived on the concrete of Sebring and the bricks of Indianapolis.

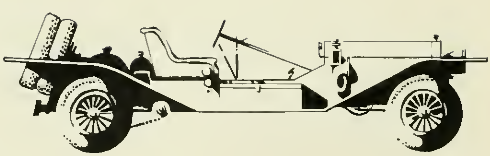
Less spectacular, but no less important, are the examples of the first models of such well-known American automobiles as the Oldsmobile, Franklin, Cadillac, and Autocar. These were among the very first cars offered to the buying public by their makers, and on their acceptance the industry was destined to rise or fall.

Ask any collector to choose which car in the Smithsonian collection he would like to own, and he would name the Simplex. With the Mercer Raceabout and the Stutz Bearcat, the chain-drive Simplex Speed Car is the most sought after of early automobiles. It represents all that is grand in the cars of the brassbound era—a truly mighty engine and beautiful, clean lines. Only a few of these cars remain today, and this is one of the best.

All collectors look forward to the day when this magnificent collection will be housed in the Smithsonian's new Museum of History and Technology. Then, it is to be hoped, there will be an opportunity for other important vehicles to be added to the group, as their owners seek the best eventual disposition for them. It would be satisfying to know that, regardless of the tides of human fortune, the really worthwhile early machines are being preserved. So many important relics from the dawn of the industry have already disappeared that now, more than ever, must those remaining be saved, to be marveled at by future generations.

Henry Austin Clark, Jr.

Long Island Automotive Museum
Southampton, New York
July 1, 1956



THE PIONEERS

THE AUTOMOBILE is one of the most important factors in our everyday life. To many persons it is a convenience and a means of recreation, but to many more it is an absolute necessity. Modern transportation is based in substantial part upon the services of the automobile, and a slight idea of what life would be like if the automobile suddenly ceased to exist can be recalled from the days of tire and gasoline rationing during World War II.

When we consider the number of people engaged in manufacturing, selling, operating, and maintaining passenger automobiles, trucks, and busses, and in incidental businesses such as those connected with oil-refinery products, accessories, insurance, and highway construction, it is apparent that our economic structure is most decidedly related to the automobile. Our living today is definitely geared to this form of conveyance, and its existence affords a livelihood to millions.

Few people, however, in a generation that has always known the automobile, realize how brief its history is. Not too many years ago the automobile was considered the work of madmen determined to upset the enterprises of the harnessmaker, the blacksmith, and the horse breeder; while even more recently it was looked upon merely as a plaything of the wealthy.

Only 40 or so years ago highways became seas of mud in rainy weather. Then the horse was still the master, extracting untold numbers of mired vehicles from muddy traps. But, with the continued lowering in cost of the automobile, bringing its purchase within the ability of more and more people, the demand increased for more and better roads and streets, resulting in the relatively excellent traffic arteries of modern times.

Today, because of fine roads, and the automobiles that travel upon them, it is possible to make in several hours trips which formerly took as many days. Workers are easily transported to and from their places of business, farmers carry goods to market with little effort, heavy construction material is swiftly delivered directly to the job, vacations are readily enjoyed, and emergencies are quickly met, all with a machine that two generations ago was in its infancy.

True, there were huge self-propelled road vehicles many generations earlier, but they were clumsy steam monsters which contributed little to the development of the lightweight, flexible, and more practical gasoline-engined vehicles that appeared in the last decades of the nineteenth century both here and abroad.

In addition, many unusual and less practical vehicles powered by sails, clockwork, pedals, treadmills, and various forms of human and animal power had been conceived, if not actually constructed. The majority of these probably were never built, but extant drawings of them remind us of the ingenuity of their designers. One of them was the jet-propelled steam vehicle said to have been suggested by Sir Isaac Newton toward the end of the seventeenth century.

Nicolas Joseph Cugnot

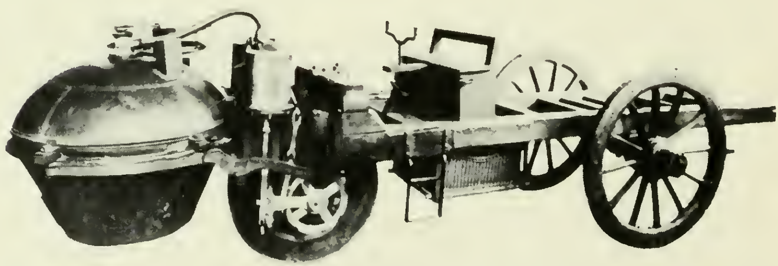


Figure 1.—Cugnot's steam-powered vehicle of 1770, now preserved in the Conservatoire National des Arts et Metiers at Paris.

One of the first known self-propelled road vehicles was constructed in 1769 by the French military engineer Nicolas Joseph Cugnot. Capable of carrying four passengers, it could attain a speed of about 2 miles an hour with a steam supply lasting a little over 10 minutes. Although hardly practical, it proved that the idea of self-propulsion by steam could be developed and led to the construction in 1770 by Brézin, after Cugnot's design, of another vehicle (fig. 1) intended for the transportation of artillery. It can be seen today in the Conservatoire National des Arts et Métiers at Paris, where it has been carefully preserved. Supported on three wheels, the machine is powered by a steam engine comprising two vertical, single-acting cylinders attached to the single front wheel. The front wheel is steered, the engine and copper boiler turning with it. This self-propelled vehicle is one of the oldest known to exist today.

Road Locomotives in England

Among the many early steam-propelled conveyances constructed in England were those of William Murdock, Richard Trevithick, Sir Goldsworthy Gurney, Sir Charles Dance, Walter Hancock, William Church, and Squire and Maceroni. Including both small operable models and full-sized vehicles used to transport passengers and freight over the highways, they were built in the period from 1786 to 1838. Some had three wheels, while others had four or six, and some of Gurney's used mechanically operated legs for propulsion, with wheels for support.

By 1786 Murdock had built a small 3-wheeled model, a copy of which is now in the Science Museum at South Kensington, and there is good evidence that he constructed other models. However, under pressure from his employers, Boulton and Watt, he ultimately abandoned his experiments.

Trevithick's full-sized steamers operated on the roads of Camborne in Cornwall in 1801 and on the streets of London in 1803. They were antedated by a small 3-wheeled model built about 1797, also in the Science Museum.

During the years 1825 through 1829 Gurney constructed several steamers, some of which were conventional carriages pulled by steam-propelled tractors. Gurney's conveyances were taken over and improved upon by Dance, who, from February to June 1831, ran a regular service with them four times a day between Gloucester and Cheltenham, a distance of 9 miles. The speed, including stops, was a little over 10 miles an hour.

Figure 2.—One of Walter Hancock's steam carriages, 1836.

Between 1827 and 1838 Hancock built nine steam carriages of various types, all of which were mechanically successful. One of these is shown in figure 2. In 1832 he started a regular steam omnibus service between Paddington and London. One of the best of his carriages weighed about 7,000 pounds and carried 16 passengers. There were two vertical cylinders, 9 inches in diameter with 12-inch stroke, driving a crankshaft connected by chain to driving wheels 48 inches in diameter. Steam was supplied by a sheet-flue boiler 2 feet square and 3 feet high, placed over a grate which had a closed ashpit and a fan draft.

In 1832 Church's steam carriages (fig. 3) ran between London and Birmingham, but they were subsequently given up because of the competition from the newly opened railroad.

The steam carriages of Squire and Maceroni, built about 1833, regularly ran at an average speed of 14 miles an hour, while their maximum speed was 20.

By 1836 steam road carriages were practically abandoned in England because of the heavy tolls imposed on mechanically propelled vehicles on the highways. Also, the rail-

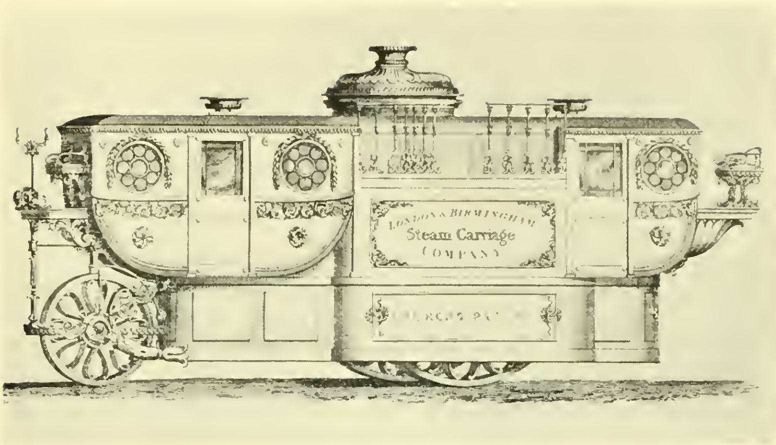


Figure 3.—Steam carriage of William Church, 1832.

roads were strong and successful competitors. Finally, an act of 1865 brought the road vehicles to an abrupt halt as it imposed on them a speed limit of 4 miles an hour in the open country and 2 miles an hour in the city. In addition, a man carrying a red flag was required to precede the vehicle. An amendment in 1878 removed the requirement that a flag be carried, and in 1896 the popularly called Emancipation Act eliminated this restriction and raised the speed limit, thus removing a major obstacle to the manufacture and use of the automobile in England. In 1903 the speed limit was raised to 20 miles an hour.

First Attempts in America

In America, Nathan Read, well-known inventor of Salem, Mass., obtained a patent in 1790 for a 4-wheeled, self-propelled vehicle, and built a small operable model. It was powered with a 2-cylinder steam engine. Because of lack of public interest Read's vehicle did not progress beyond the model stage.

The earliest known passenger-carrying, self-propelled land vehicle in the United States was that of Oliver Evans, American inventor and engineer. Although he had planned a "steam wagon" in 1801, it was not until July 1805 that the "Orukter Amphibolos," or "Amphibious Digger," was set in motion, up Market Street and around the Center

Square waterworks at Philadelphia. Built as a steam-operated dredge to be used in the harbor, the 40,000-pound craft was mounted upon axles and wheels (fig. 4) and propelled by its engine from its place of building to the water's edge, earning the present-day title of "America's first automobile."

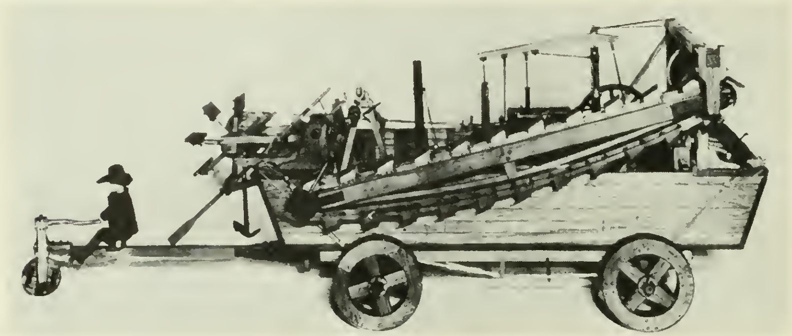


Figure 4.—Oliver Evans' "Orukter Amphibolos," 1805. Photograph of a model constructed by Greville Bathe.

It is stated that the Johnson brothers, proprietors of an engineering establishment in Philadelphia, built a 4-wheeled, 1-cylinder, steam-propelled wagon in 1828. If authenticated, this vehicle would be America's first full-sized automobile built for the specific purpose of operating on the highway.

It is further stated that William James, stove manufacturer of New York City, built a full-sized steam carriage in 1830. Supported on three wheels, it was steered by the single front one, while a 2-cylinder horizontal engine drove the rear two. No relic of the machines constructed by Read, Evans, the Johnsons, and James is known to exist.

During the middle part of the nineteenth century steam-operated traction engines were built both in America and abroad. In a sense they could be called automobiles, as they moved under their own power, could be steered, and were capable of carrying passengers. They were, however, designed to perform work in the fields, and were usually equipped with broad, cleated wheels, or tracks, and so are not properly a part of the history of the automobile. Their modern counterparts are the often seen Diesel-powered tractors.

Richard Dudgeon

In New York, in about 1867, Richard Dudgeon built a steam-powered carriage capable of carrying 10 persons. It ran on four solid wooden wheels, the two rear ones connected to steam cylinders mounted at the front of the horizontal boiler, on each side. Veritably a "road locomotive," it differed from a rail locomotive in having its wheels unflanged and its front axle pivoted for steering.

This vehicle (fig. 5) is probably the earliest surviving self-propelled road conveyance in America. Still in good operable condition, it is the oldest specimen in the private collection of George H. Waterman and Kirkland Gibson at East Greenwich, R. I. It is currently to be seen at the Antique Auto Museum of Massachusetts, at Larz Anderson Park in Brookline, Mass., where it is on loan to the Veteran Motor Car Club of America. An earlier Dudgeon steamer was built in about 1853, but was destroyed in the Crystal Palace fire in New York City in 1858.

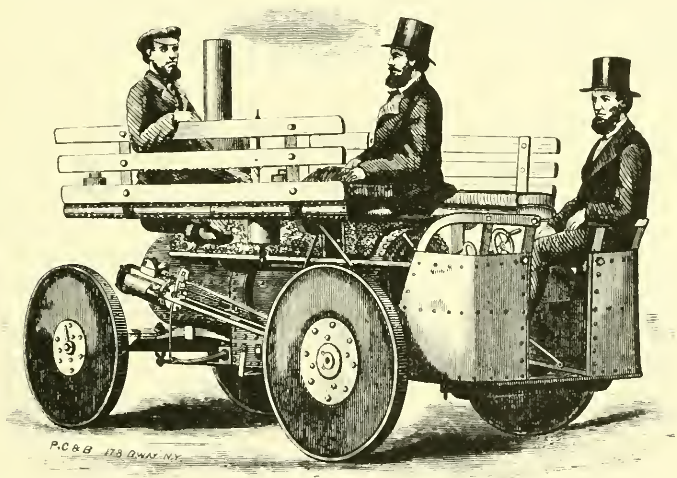


Figure 5.—Richard Dudgeon's steam vehicle of about 1867, as it appeared in an 1870 catalog of the Dudgeon Co., manufacturers of machinery. In this catalog Dudgeon reports that he had made two steam carriages, the first 17 years and the other only 4 years prior to the date of the catalog (the first was destroyed in the fire that consumed New York's Crystal Palace in 1858). He adds that the latter, of which this is the catalog illustration, was in perfect order after having run hundreds of miles on almost every kind of road. Dudgeon states, nevertheless, that after 17 years of effort, and despite his conviction of the utility of such a machine, he had learned that it was not fashionable, or that people were not ready for it.

Figure 6.—Early handbill publicizing Roper steam vehicles.

Sylvester H. Roper

At least one early inventor, Sylvester H. Roper, of Roxbury, Mass., constructed a steam-operated velocipede, and for some years his machine (see p. 33) appeared at fairs and circuses in New England, as a handbill of about 75 years ago (fig. 6) reveals. Resembling a Hanlon-type velocipede, with wooden wheels and iron-band tires, the machine was propelled through the rear wheel, the axle of which was fitted with cranks connected to two small steam cylinders, one on each side of the rear section of the frame. This velocipede, built in about 1869, is now in the collection of the National Museum.

Over a period of years, Roper also constructed several large steam-propelled wagons, one of which (fig. 7) is fortunately preserved in the Henry Ford Museum at Dearborn, Mich. This machine, as the handbill shows, was at one time exhibited with the velocipede. It has been erroneously referred to as an Austin steamer because of the fact that

Figure 7.—Roper steam carriage now preserved in the Henry Ford Museum at Dearborn, Mich.

years ago it was for a while exhibited by a "Professor" W. W. Austin. Its date of construction is not known.

Roper unfortunately met his death on June 1, 1896, while operating his most recent steam vehicle, another two-wheeler, on the Charles River bicycle track at Cambridge, Mass. This machine is today exhibited at "Horn's Cars of Yesterday," a museum at Sarasota, Fla.

Lucius D. Copeland

In 1883 or 1884 Lucius D. Copeland equipped a Star bicycle with a small 1-cylinder steam engine and a boiler (fig. 8), and successfully operated the machine. Two or three years later a tricycle (fig. 9) was similarly equipped for Copeland by the Northrop Manufacturing Co., of Camden, N. J. Articles on these machines appeared in many engineering magazines of that time, and Sandford Northrop's associates issued a number of advertising brochures, one of which is reproduced in figure 10, publicizing the

Figure 8.—Lucius D. Copeland and his steam bicycle of the mid-1880's.

Figure 9.—Photo, taken about 1888, showing Copeland at the controls of his steam tricycle outside the Smithsonian Institution. Sandford Northrop, with cane and derby, stands behind the small wheel. On the far right is J. Elfreth Watkins, onetime curator of transportation and engineering of the U. S. National Museum.

PHAETON MOTO-CYCLE

WEIGHT, 220 POUNDS.
SPEED, 10 MILES PER HOUR.
POWER, 2 HORSE.

MOTO-CYCLE MANUFACTURING COMPANY,

J. E. WATKINS, PRESIDENT,
W. H. TRAVIS, SECRETARY,
E. F. SMITH, TREASURER.

1529 ARCH STREET, PHILADELPHIA, PA.

Figure 10.—Advertising circular for the Copeland steam tricycle. Note the warning bells at front and rear. Such a bell appears at rear of machine in figure 9.

formation of their Moto-Cycle Manufacturing Co., but the venture proceeded no further—the fate of many another pioneer attempt to produce a commercially successful self-propelled road vehicle in America. Today, the only known relics of these Copeland machines are the boiler and engine of the Star bicycle, prized possessions of the Arizona Museum at Phoenix.

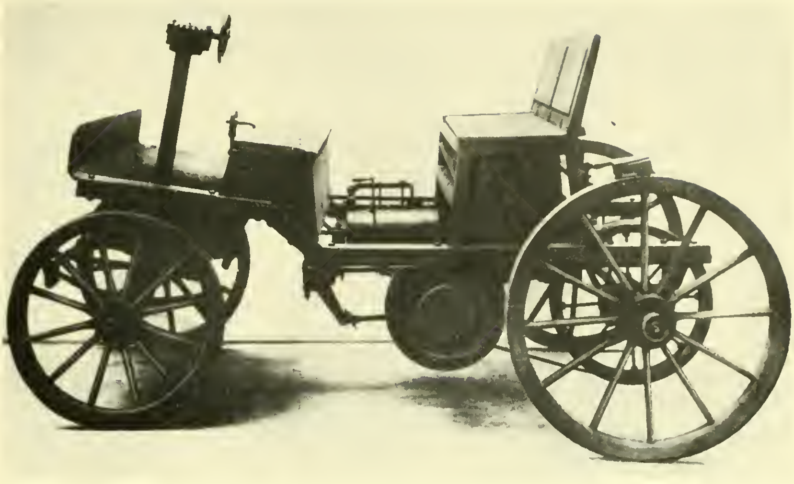


Figure 11.—Siegfried Marcus' gasoline-powered vehicle of 1875, now preserved in the Technisches Museum für Industrie und Gewerbe at Vienna. This is probably the earliest gasoline automobile in existence.

In France several men constructed steam automobiles of fairly advanced design, chief among them being Amédée Bollée, Albert de Dion, and Léon Serpollet. Bollée's first machine, completed in 1873, was followed by improved models of various sizes built by his son as well as himself. All were successful, and some of them attained considerable speed over the roads. Some of his steamers are to be seen today at the Conservatoire at Paris, and at the Musée de la Voiture at Compiègne.

Vehicles powered by internal-combustion engines came into the picture with the construction, about 1863, by Jean Joseph Étienne Lenoir of a vehicle employing a 1-cylinder engine of the type patented by him in 1860. Lenoir, a French citizen born in Belgium, wrote that the vehicle was clumsy, was powered with a 1½-horsepower motor making 100 revolutions per minute, yet was driven in an hour and a half to Joinville-le-Pont, some 6 miles from the starting point.

Shortly afterward, in 1864, Siegfried Marcus, of Vienna, built a vehicle with a vertical, 1-cylinder, modified-Lenoir gas engine, also using electric ignition, and a carburetor with liquid fuel. This 4-wheeled vehicle is said to have run satisfactorily. It is, unfortunately, no longer in existence.

Marcus' second automobile (fig. 11) was constructed in 1875 and is preserved at the Technisches Museum für Industrie und Gewerbe in Vienna. It is powered with a horizontal, 1-cylinder, 4-cycle, ¾-horsepower, internal-combustion engine using liquid fuel and electric ignition. Seating four passengers on two crosswise seats, it is supported on four wooden-spoked wheels and is guided by means of a steering wheel. It is reported to have been operated on the streets of Vienna in the spring of 1950, on its 75th anniversary.

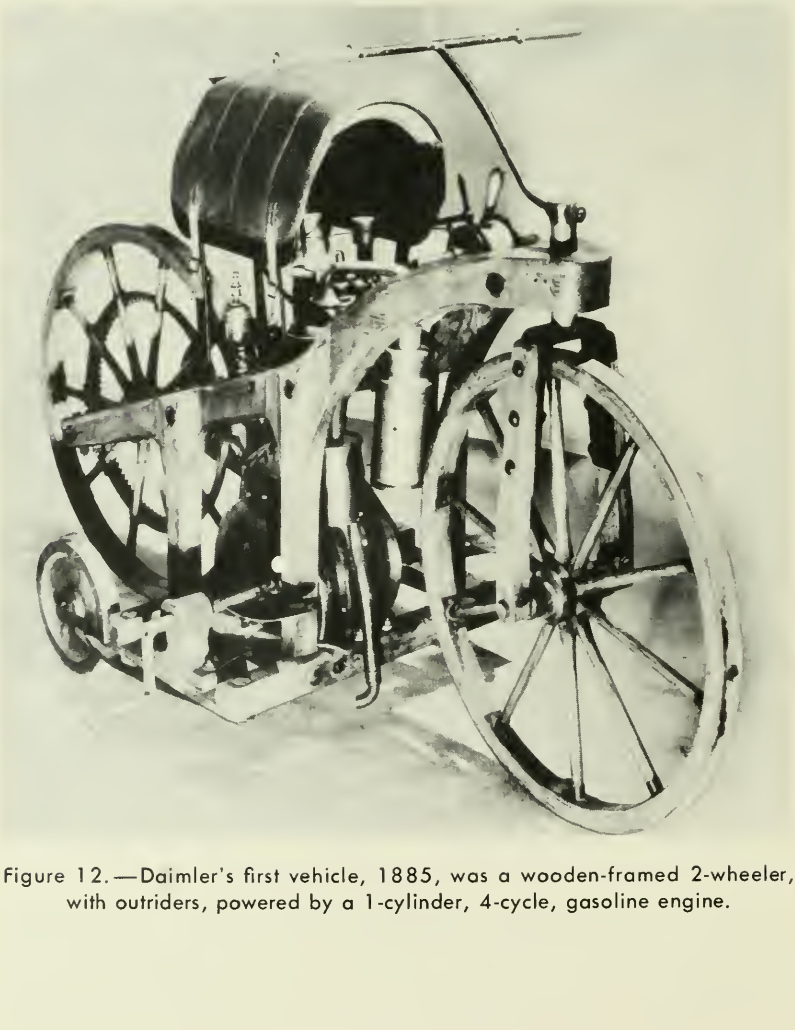


Figure 12.—Daimler's first vehicle, 1885, was a wooden-framed 2-wheeler, with outriders, powered by a 1-cylinder, 4-cycle, gasoline engine.

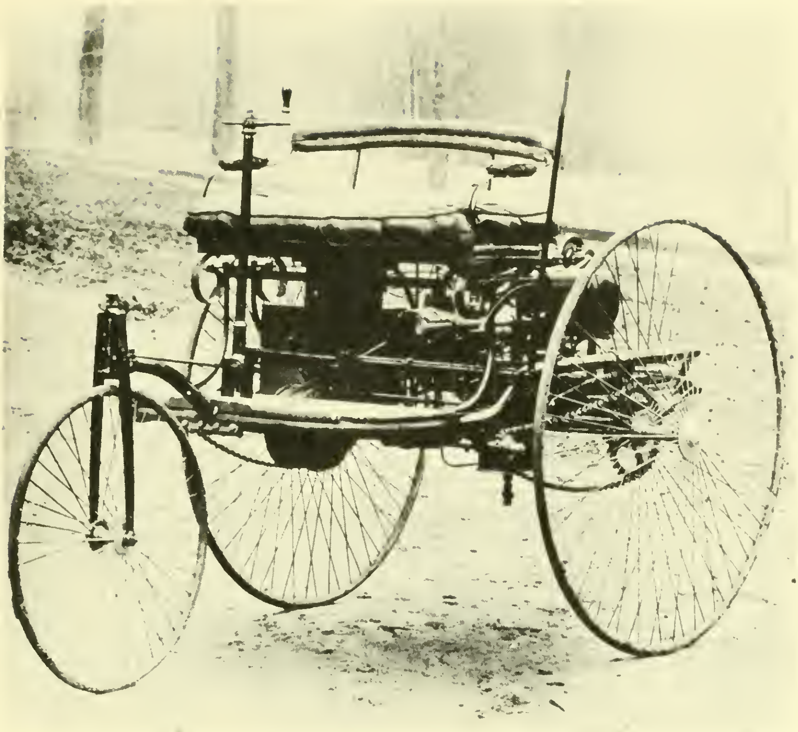


Figure 13.—First vehicle of Karl Benz, his tricycle of 1885, powered by a 1-cylinder, gasoline engine.

Further advancement with gasoline-powered vehicles came in 1885 with the simultaneous, though independent, construction of a 2-wheeled machine by Gottlieb Daimler (fig. 12) and a 3-wheeled machine by Karl Benz (fig. 13), both in Germany. The Daimler motorcycle was powered with a 1-cylinder, 4-cycle engine, and was the first automotive vehicle produced by the subsequently world-famous Daimler Motoren Gesellschaft, makers of the renowned Mercedes and, later, of the Mercedes-Benz automobiles. Daimler was aided through the years by his friend Wilhelm Maybach.

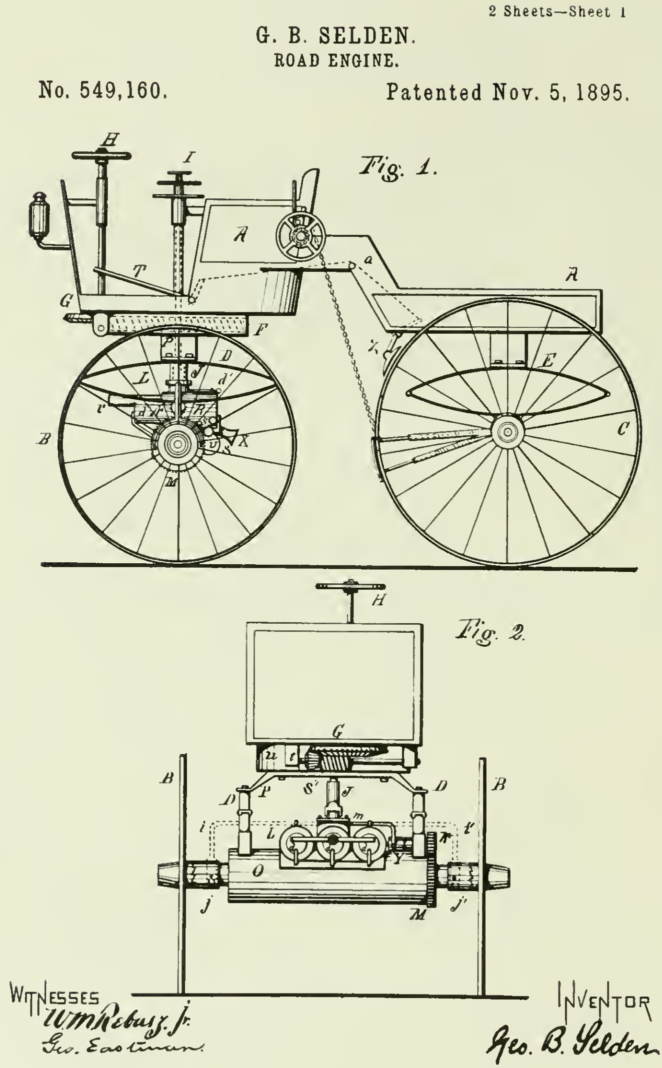


Figure 14.—Drawings from Selden's patent, showing outline of vehicle proposed by him in 1879.

In America, George B. Selden applied in 1879 for a patent for a motor vehicle with an internal-combustion engine. The patent (fig. 14) was not issued until 1895, after which it had a short-lived but great effect upon a young industry. The model submitted with the application for patent is in the National Museum collection (see p. 36).

Figure 15.—Early photo of the 1893–94 Duryea gasoline automobile, now in the National Museum.

Charles E. and J. Frank Duryea, whose work is represented in the National Museum by their 1-cylinder vehicle (fig. 15) of 1893–94, were notable among the American pioneers. A 2-cylinder, pneumatic-tired Duryea vehicle (fig. 16) was driven by J. Frank Duryea to victory in the Chicago Times-Herald automobile race from Chicago to Evanston and back on Thanksgiving Day, November 28, 1895. (This car was unfortunately destroyed through a workman's misunderstanding many years ago.)

Figure 16.—Charles E. Duryea seated in the Duryea car that won the Chicago Times-Herald race on November 28, 1895.

In 1896 the Duryea Motor Wagon Co. constructed 13 identical automobiles (fig. 17), the first instance of mass automobile production in America. The sale of the first of these cars constituted the first sale of a gasoline-powered automobile in America. Of these 13 cars, only one remains; it is in the private collection of George H. Waterman, at East Greenwich, R. I. A slightly different model, completed in October 1896, was taken to England and entered in the London-to-Brighton run on November 14 of that year. It was the first car to arrive at Brighton, for which performance a gold medal was awarded. This medal is in the National Museum.

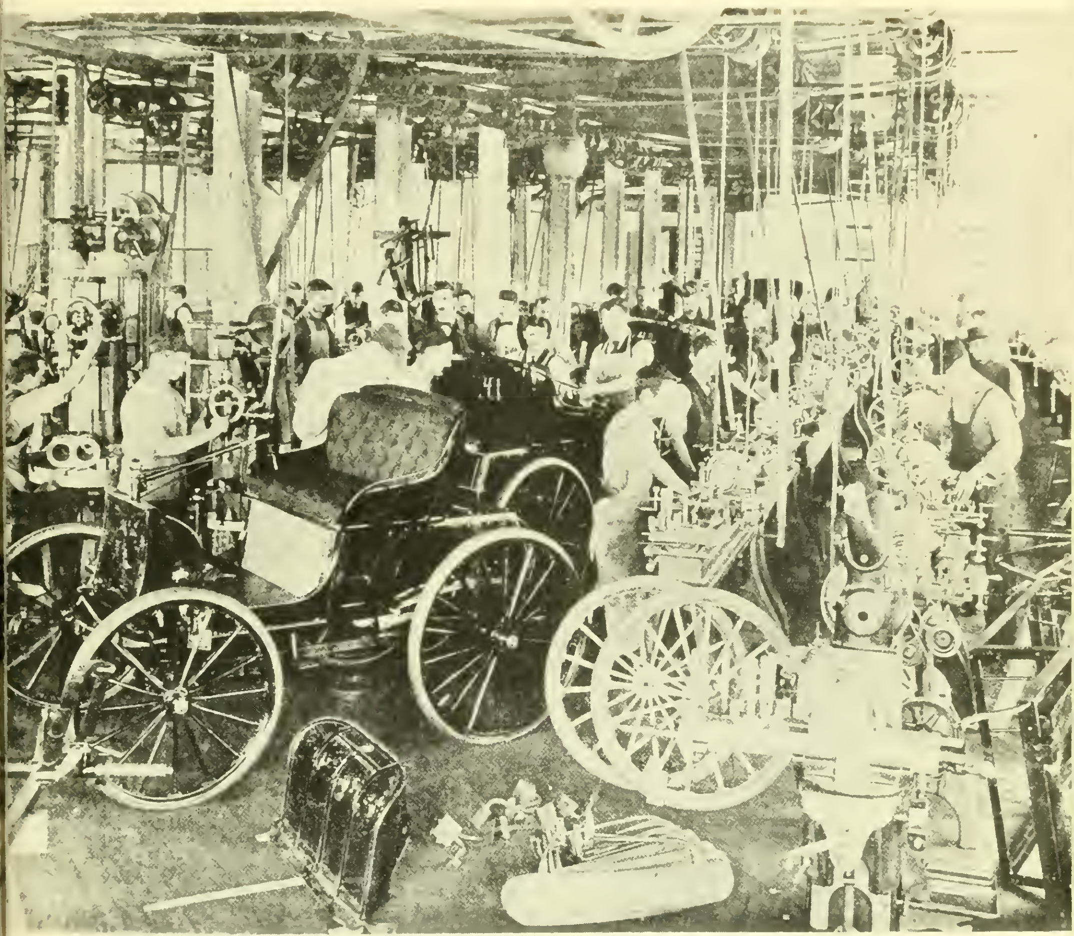


Figure 17.—Workmen in the Duryea factory at Springfield, Mass., in 1896, assembling part of a group of 13 identical cars. This is the first instance of "mass production" of automobiles in America.

Elwood Haynes, metallurgical engineer, worked for several years on the idea of a gasoline-powered vehicle after deciding that such a machine would be far more practical than one propelled by steam or electricity. On July 4, 1894, his first car (fig. 18) made a successful trial trip. This vehicle, now in the National Museum, is described on page 48.

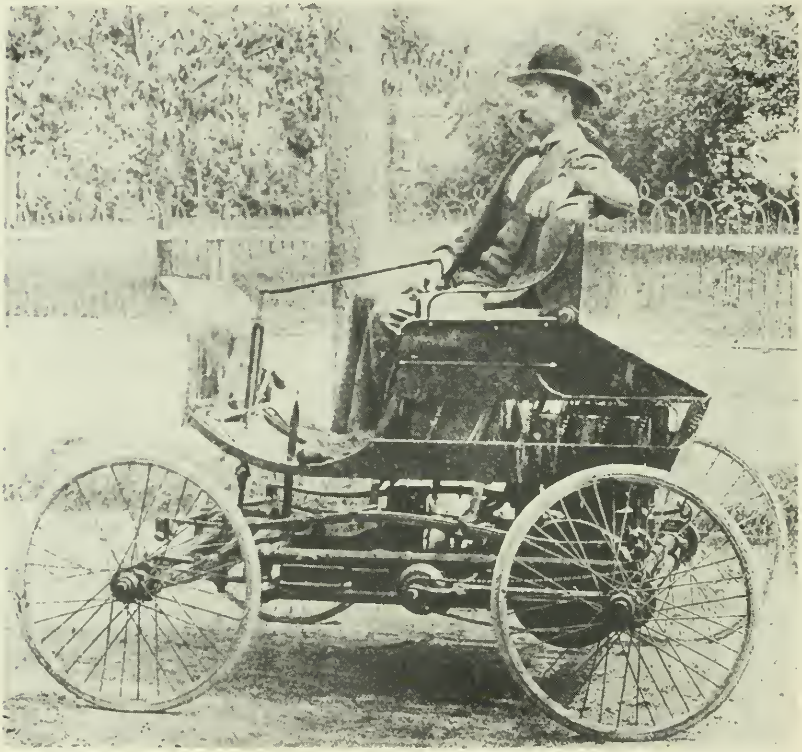


Figure 18.—Elwood Haynes seated in his first automobile, built in 1894 and now in the National Museum.

Stephen M. Balzer is another pioneer. He is represented in the National Museum by a small rotary-engined road carriage built in 1894 (see p. 50). This is the only one of those constructed by Balzer known to exist, although other slightly different models appear in the drawings and specifications of several patents obtained by him in the same period. Figure 19 shows Balzer with one of his larger vehicles.

Figure 19.—Stephen M. Balzer with one of his early rotary-engined experimental vehicles.

In Detroit, Mich., Charles Brady King planned a motor tricycle in 1893, and in that and the following year planned several 4-wheeled vehicles to be powered with Sintz, 1-cylinder, 2-cycle, gasoline engines. They were never built, but in 1895 he started the construction of an automobile powered with a 4-cylinder, 4-cycle, gasoline engine of his own design. This vehicle (fig. 20) was successfully put in operation on March 6, 1896, and is said to have been the first automobile ever driven on the streets of Detroit. The machine was dismantled shortly afterward. Several of the valves of this engine were subsequently given by King to Henry Ford and were used in the engine of Ford's first vehicle.

Figure 20.—Charles Brady King at the tiller of his experimental 4-cylinder automobile in Detroit in 1896.

Henry Ford, machinist and one-time farmer, had experimented with gasoline engines for a number of years before ultimately constructing in his little workshop on Bagley Avenue in Detroit a 4-wheeled, tiller-steered vehicle (fig. 21) powered with his own 2-cylinder, 4-cycle, horizontal, gasoline engine. This car, with Charles B. King as a passenger, had its first test run on the streets of Detroit on June 4, 1896. It is now on exhibition in the Henry Ford Museum. Several successful racing cars were later built by Ford, and in 1903 the first model-A Ford automobile, a 2-cylinder machine, was offered to the public by the then newly formed Ford Motor Co.

In Lansing, Mich., in 1886, Ransom E. Olds had constructed a 3-wheeled, steam-propelled, passenger vehicle. This was subsequently rebuilt into a 4-wheeled steamer, and in 1893 it was shipped to a purchaser in Bombay, India. Olds' first gasoline-engined automobile was not built until late in 1895 or early in 1896, and unfortunately was later destroyed by fire. In 1897 four similar gasoline automobiles are said to have been built, one of which is now in the National Museum collection (see p. 55). It is the oldest Olds vehicle surviving.

A few other makes and types of automobiles were also in evidence in this country before the close of the century, and untold numbers of experimental machines were built by mechanically minded men in the next few years. Many developed into successful enterprises, some doing business even today. Not to be overlooked were the autobiles powered with steam engines and electric motors. Each of these for a time appeared likely to become the ultimate type of power plant for the passenger automobile, but in the end gasoline won out.

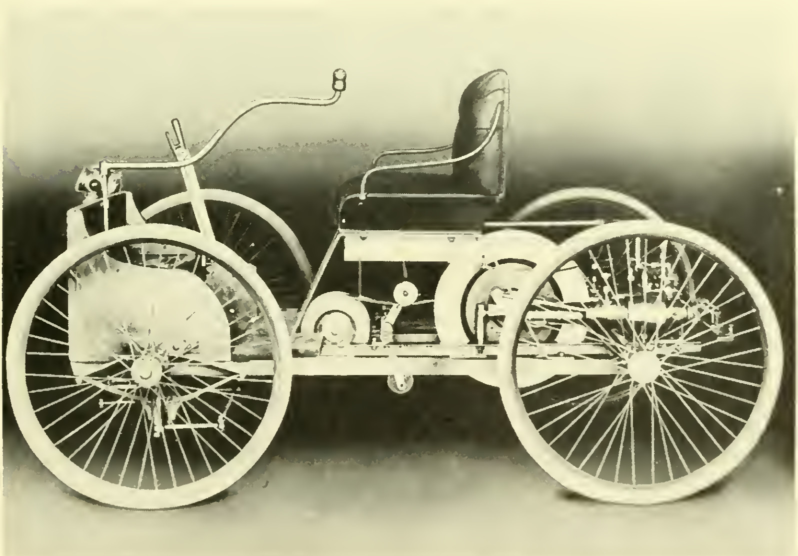


Figure 21.—Henry Ford's first automobile, his 2-cylinder machine of 1896, now preserved in the Henry Ford Museum.

In 1903 the first transcontinental automobile trip was completed when H. Nelson Jackson drove his 2-cylinder Winton from San Francisco, Calif., to New York City in 63 days. This car (fig. 22), now in the National Museum, is described on page 103. One month after the successful Winton trip a 1-cylinder Packard driven by Tom Fetch

Figure 22.—H. Nelson Jackson, with Sewall K. Crocker, in Jackson's 1903 Winton. The first car to be driven across the United States, it is now in the National Museum.

completed the transcontinental journey between the same two cities in a few days less time. Shortly afterward, Whitman and Hammond made the trip in a 1-cylinder Oldsmobile, about 10 weeks being required. It had become evident that long trips could be made with an automobile.

As time passed and manufacturing methods were improved, the automobile proved more and more reliable. Service facilities were more frequently to be found, and the brawny hand of the blacksmith was laid less often on the machine in need of repairs. Garages with mechanics and replacement parts appeared, and women took up the art of driving as the risk of breakdowns became less.

Interchangeability of parts, upon which ease of replacement and assembly-line manufacture both depend, was dramatically demonstrated when the Royal Automobile Club of Great Britain in 1908 presented the Sir Thomas Dewar trophy to Cadillac for the most meritorious performance in any trial held by the Club during the year. The trial consisted of completely disassembling three new 1-cylinder Cadillac automobiles, mixing all the parts, and reassembling the vehicles from parts picked at random. After the assembly the engines were started easily, and test runs of 500 miles were made.

This trial showed that the manufacture of parts to tolerances permitting assembling without slow, skilled hand fitting was a workable American practice. Assembly-line manufacture based on this practice has made possible the high production records of the automobile industry in peace and war since 1908.

Since November 28, 1895, the date of America's first automobile race, many speed contests and reliability trials have been held in this country, and both types of events have had a telling effect on the automobile. These contests, in which machines vied with one another, led the manufacturers and engineers to develop increasingly better tires, alloys, lubricants, and other components of the automobile, resulting in the long-lived and serviceable vehicle we know today.

THE COLLECTION

Automobiles and Motorcycles in the United States National Museum

ROPER STEAM VELOCIPEDE, about 1869
Lent by John H. Bacon in 1956 (USNM 314809)

The oldest self-propelled road vehicle in the National Museum collection is the steam-propelled velocipede (fig. 23) built in the late 1860's by Sylvester H. Roper of Roxbury, Mass.

Although the machine appears to be a converted velocipede, examination reveals that the frame is a forging made expressly for the purpose. It is mounted on two 34-inch-diameter wooden-spoked velocipede wheels having wooden felloes and iron-band tires. The front wheel is supported in a forged wrought-iron fork surmounted by a straight handle bar with wooden grips. Foot rests are placed at the bottom of the fork. The wheelbase is 49 inches.

A vertical, fire-tube boiler is suspended between the wheels, and a chimney projects backwards at an angle from the top of the boiler housing. The lower half of the housing is the firebox, the grate of which is now missing. A small circular door on the left side of the firebox allows charcoal to be placed inside. The housing is suspended from the center of the frame by means of a spring-loaded hanger intended to absorb some of the road shock to which the vehicle was subjected, and is braced at the bottom by two stay rods connected to the rear of the frame.

A hand-operated water pump is mounted vertically on the left forward side of the boiler housing. Three water-level cocks are located nearby. A drain valve is placed at the left rear of the base of the boiler.

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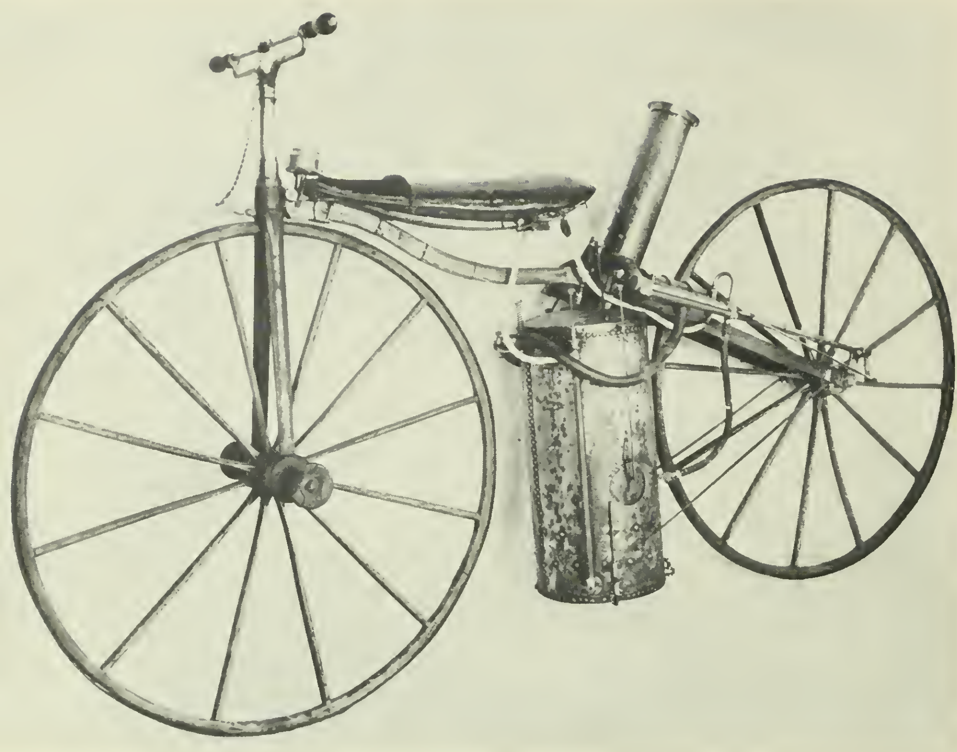


Figure 23.—Steam velocipede built by Sylvester H. Roper about 1869. Only one older self-propelled rood vehicle, the Dudgeon steamer, is known to exist in America.

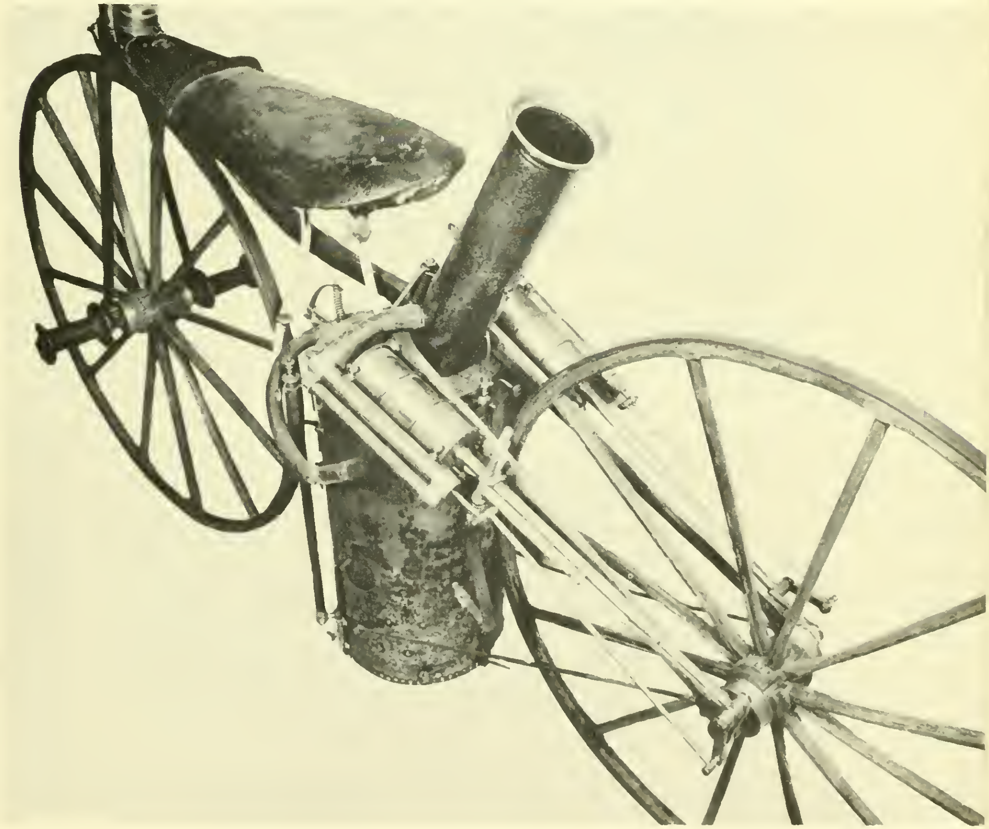
Oscillating steam cylinders (fig. 24) are pivoted on each side of the frame, next to the chimney. From measurements of the outside of the cylinders it is estimated that their bore is about 2¼ inches. The piston rods work on 2½-inch cranks on the ends of the rear axle. Piston valves for the cylinders are operated by eccentrics adjacent to their cranks. A feed-water pump is operated by the crank of the left cylinder. The exhaust steam is led by tubing into the base of the chimney to provide a forced draft. Projecting from the safety valve at the top rear of the boiler is a tiny steam pipe, also leading into the base of the chimney, that apparently performed the same function when the machine was at rest. A damper valve is located within the chimney.

At the top front of the boiler housing is located the throttle, actuated by twisting the handle bar. Twisting the bar in the reverse direction actuates a friction brake against the rim of the front wheel. Heavy tubing leads from the throttle to the steam chests of the cylinders. Tubing also leads to a gauge located at the front of the frame.

The water supply for the boiler is contained in a tank constructed in the shape of a saddle. The filler opening is at the front of the tank, while tubing leads from the rear bottom to the hand pump and the feed-water pump.

A study of this interesting early self-propelled vehicle reveals its builder as a man of ingenuity and an accomplished machinist.

Figure 24.—Roper steam velocipede, showing cylinders, valve chests, and feed-water pump on left cylinder.



SELDEN GASOLINE AUTOMOBILE, 1879
Transferred from the U. S. Patent Office in 1908
(USNM 252678)

George B. Selden, patent attorney and inventor of Rochester, N. Y., filed a patent application on May 8, 1879, for a road vehicle powered by an internal-combustion engine. This is the model (fig. 25) which was submitted with the application, upon which a patent (No. 549160) was issued finally on November 5, 1895.

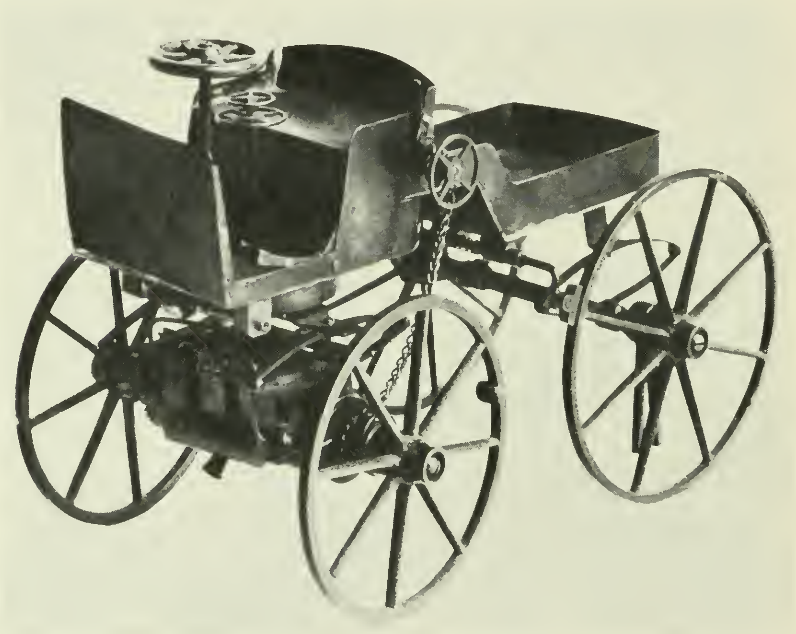


Figure 25.—Patent Office model of Selden automobile, submitted in 1879 and now in the National Museum.

Though many pioneer American automobile manufacturers and importers were licensed under this patent, others contested its validity. On November 4, 1899, just four years after the issuing of the patent, Selden made a contract with the Electric Vehicle Co., manufacturer of the Columbia electric automobiles at Hartford, Conn. Subsequently, on March 5, 1903, the Association of Licensed Automobile Manufacturers was formed, with the Electric Vehicle Co. and the Winton Motor-Carriage Co. as two of the ten charter members. The licensed companies agreed to pay a royalty of 1¼ percent of the retail list price on all cars sold. This later was cut to 1 percent, and finally to four-fifths of 1 percent. Each automobile built by a licensed manufacturer carried a patent plate (fig. 26).

The association published annual illustrated handbooks containing the specifications of the various makes of cars produced by the manufacturers who were members. At its height the association numbered 87 percent of the manufacturers in this country, these members producing over 90 percent of the gasoline automobiles built. The best-known independent was Henry Ford, who refused to join.

On October 21, 1903, suit was filed against Ford, and the court sustained the patent, holding that three of the claims were valid and infringed. Ford put up a bond and appealed. The issue, popularly known as the Selden Patent Suit, was decided finally in the Court of Appeals in January 1911, when the claims of the patent were held to be valid if limited to the use of the Brayton type of engine, and hence not to have been infringed because the Brayton engine was not being used then by anyone. Shortly thereafter the association was dissolved.

In addition to its licensing activities, the association had carried on research and standardization work under its mechanical branch. About a year prior to the final court decision, the mechanical branch had been discontinued, and all its records, apparatus, and engineering library had been turned over to the Society of Automotive Engineers.

Figure 26.—Patent plate of the type affixed to automobiles manufactured under the Selden license. Notice the serial number in the lower left corner.

Since that time this society has been instrumental in standardizing measurements pertaining to the automobile, a very worth-while and necessary project.

The patent application filed by Selden disclosed an automobile with a clutch, foot brake, muffler, front-wheel drive, and a power shaft arranged to run faster than the propelling wheels. The engine was a 6-cylinder unit with three power and three compression cylinders. A compressed-air tank was provided, the air being admitted to the power cylinders while admixed with liquid hydrocarbon fuel.

A full-sized version of the Selden vehicle, built as an exhibit for the court while the patent suit was under way, is now at the Long Island Automotive Museum, Southampton, N. Y. This automobile (figs. 27 through 31) was constructed in 1904 under the direction of George B. Selden, Jr., and Henry R. Selden, sons of the inventor. The original engine, built in 1877, was used.

Figure 27.—George B. Selden seated in the Selden automobile constructed in 1904. Henry R. Selden stands in front of car. This contemporary photograph was taken at Broadway and West 56th Street, New York City, in front of the garage of Wyckoff, Church & Partridge, automobile dealers.

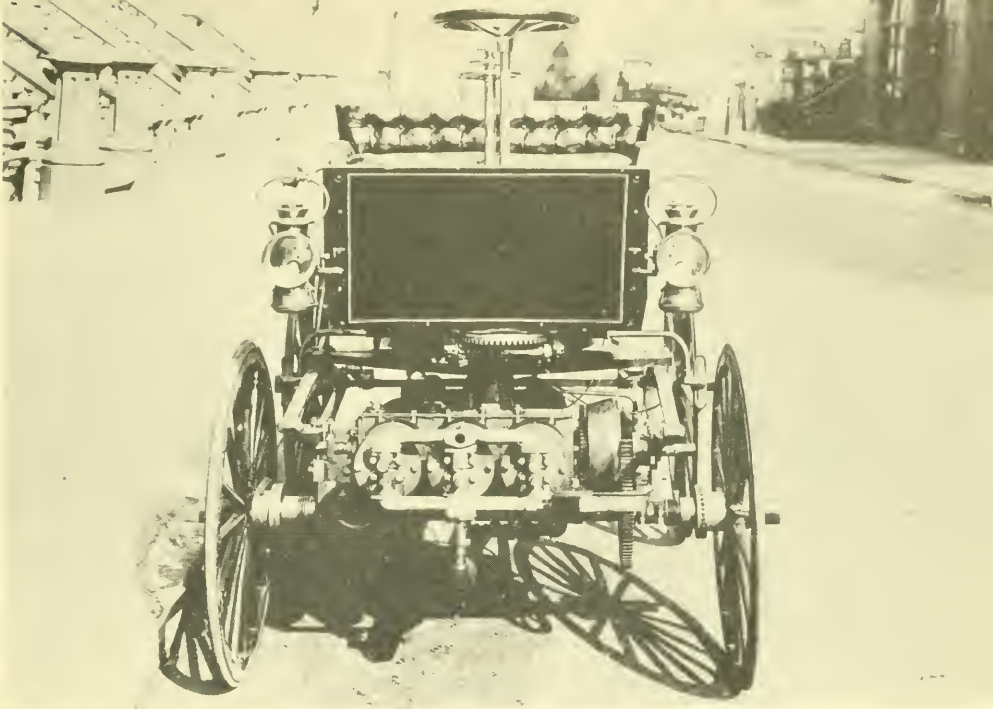


Figure 28.—Front of Selden automobile built in 1904. The front-wheel assembly could be rotated completely, an arrangement that provided for both steering and reversing the vehicle.

Figure 29.—Front-wheel assembly rotated 90 degrees, placing rear of engine at right side of vehicle.

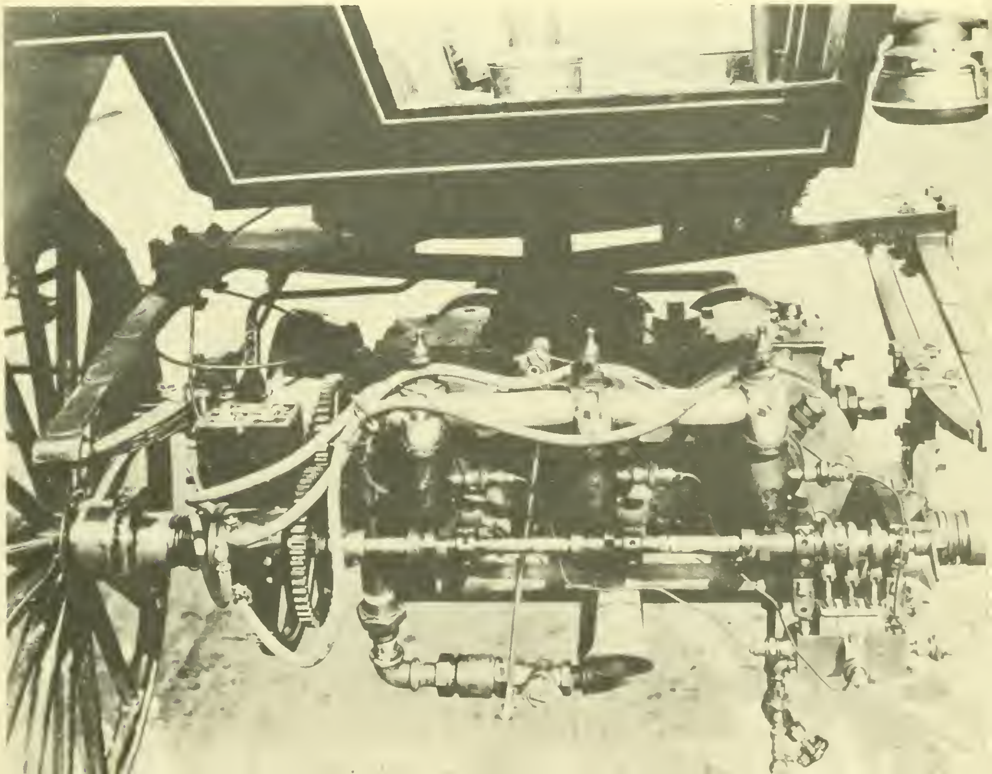


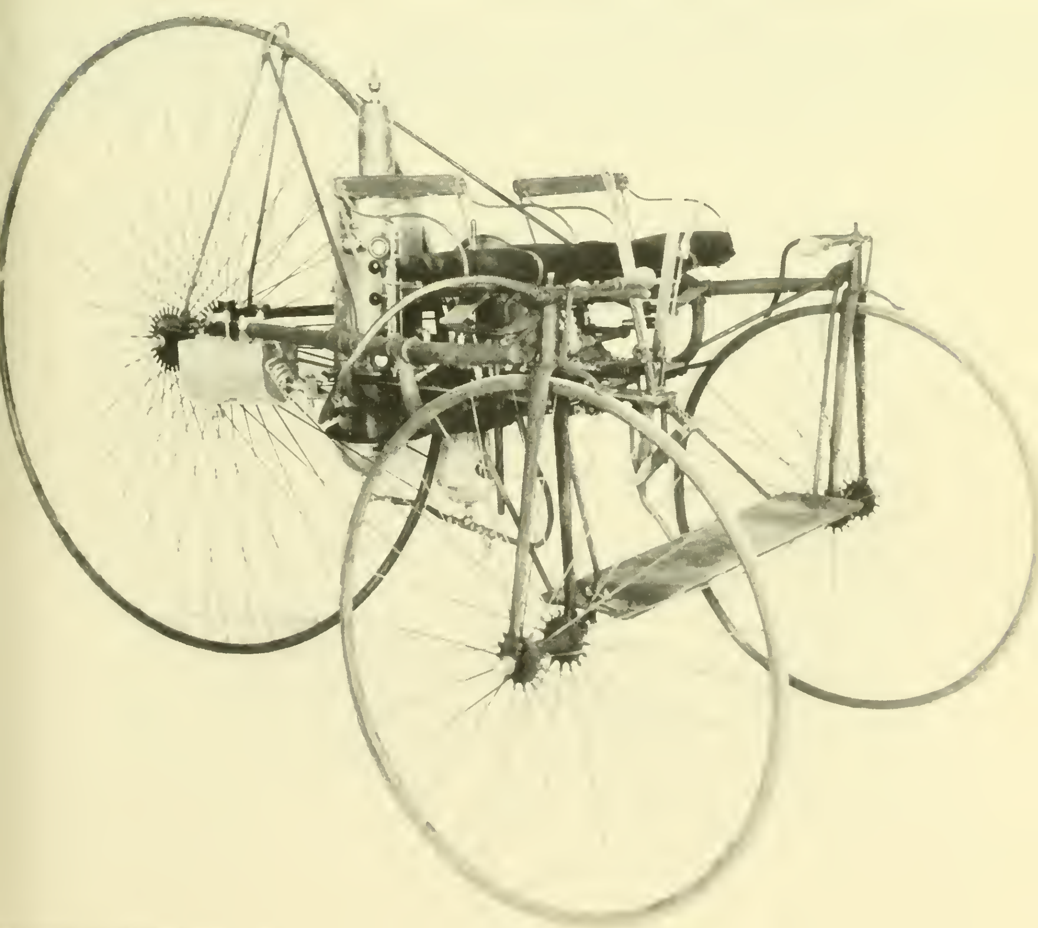
Figure 30.—Hugo Gibson at the wheel of the 1904 Selden car at the race track at Guttenberg, N. J., in June 1907.

Figure 31.—Hugo Gibson driving the 1904 Selden car on the Guttenberg, N. J., race track in June 1907.

LONG STEAM TRICYCLE, about 1880
Lent by John H. Bacon in 1956 (USNM 314810)

The Museum's oldest completely operable self-propelled road vehicle (fig. 32) is one with an interesting history. Built in about 1880 (the engine was built in 1879) by George A. Long of Northfield, Mass., the machine was disassembled many years ago after some years of disuse. In 1946 the present owner obtained from Long, in Boston, the engine (fig. 33), with its feed-water pump and driving pulleys. At that time Long, then 96 years old, recalled that many years earlier he had seen the remainder of the machine in Northfield. A search by Mr. Bacon lead to his obtaining all the parts extant, and subsequently to his restoring the machine to operable condition.

Figure 32.—Steam tricycle built by George A. Long in about 1880. It is still operable, although some of its parts are modern replacements.



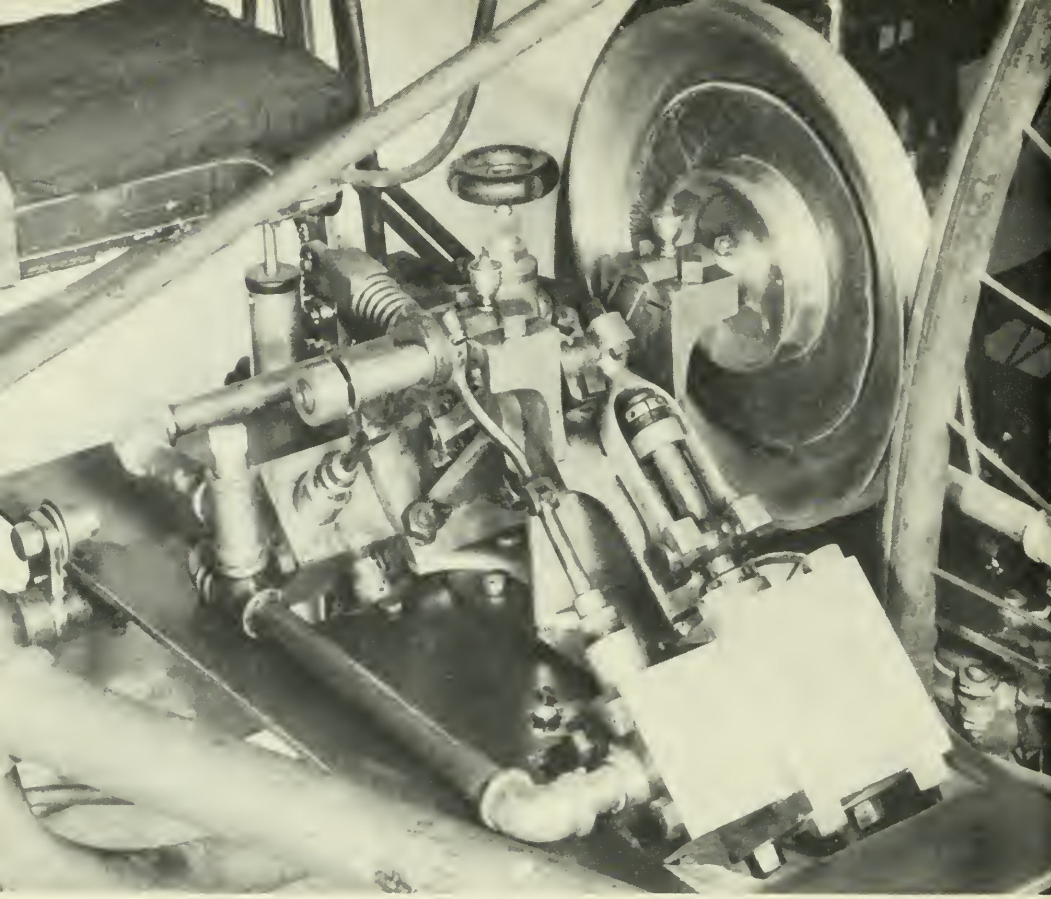


Figure 33.—The 2-cylinder, V-type steam engine of Long's tricycle.

To effect the restoration it was necessary to replace some missing parts. It is interesting to note that George Eli Whitney, of Bridgeport, Conn., constructed the replacement fire-tube boiler and its appurtenances. Whitney is well known as a pioneer steam automobile designer and builder of the mid-1890's, and his work greatly influenced the Stanley brothers of later steam fame. Other important restoration was performed on the tricycle by Russell Davis of Leominster, Mass.

The 2-cylinder, 90° V-type engine, with a stroke of 1⅝ inches, was designed and built by Long at Northfield in 1879, and the framework and running gear were constructed by him in the following year or so at Hartford, Conn., in Albert A. Pope's Columbia bicycle plant located in the factory of the Weed Sewing Machine Co. Several different types of boiler were constructed and tried at this

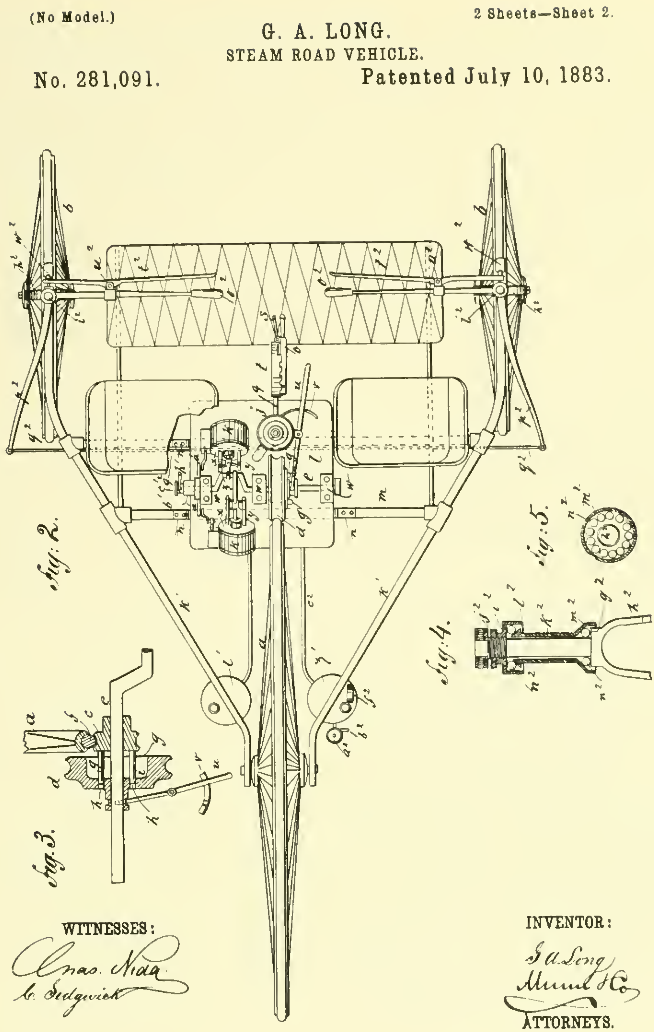


Figure 34.—Drawings from Long's patent, showing outline of tricycle as proposed by him in 1882.

time, one of which was built at Worcester, Mass. On August 29, 1882, Long filed an application for a patent for a "steam road-vehicle" consisting of a self-propelled tricycle powered by a 2-cylinder steam engine using gasoline as fuel. On July 10, 1883, U. S. patent No. 281091 was granted to Long. It is interesting to note that gasoline was the specified fuel. The drawings (fig. 34) appearing in the patent papers reveal a tricycle closely resembling the machine under discussion.

One of the claims made by Long was for the front-wheel forks to use improved steering heads utilizing small balls such as now have been used for many years on the steering heads of bicycles and motorcycles. Long unfortunately was unable to build such small balls at the time he constructed his machine, and the tricycle's two steering heads are therefore supplied with plain bushings.

The rear wheel, 5 feet in diameter, is the driving wheel. The two 3-foot front wheels are mounted in steering forks, the heads of which are connected by a curved tie rod. Spoon brakes operate against each solid front tire. It is obviously intended for two people to operate the vehicle. Steering by means of only one of the handle bars is very difficult, as is operation of both brake levers by one person. Each of the individual seats is mounted on a full-elliptic spring, and is adjustable in height.

The engine is attached to a steel plate (one of the replacement parts) mounted in the framework on small rollers so as to be movable backwards and forwards by means of a lever pivoted in front of the seat. On the crankshaft of the engine are two pulleys (fig. 33), the larger of which is splined and movable lengthwise on the shaft. Bringing the engine plate backwards forces one or the other of the driving pulleys into contact with the tire of the rear wheel. As the pulleys are of different diameter, two driving ratios are provided. The boiler and one of the two water tanks are also mounted on the engine plate, necessitating a flexible tube between the fuel tank and the burner beneath the boiler, as well as between the two water tanks.

In addition to the boiler, the burner, and the engine mounting plate, other replacement parts include the fuel tank, the two water tanks, the gauges, all piping, the hand-operated air pump, and the hand-operated water pump. The latter is, however, from an early steam automobile.

The machine weighs about 350 pounds, according to its owner, and operates at a steam pressure of approximately 100 pounds per square inch.

DURYEA GASOLINE AUTOMOBILE, 1893-94
Gift of Inglis M. Uppercu in 1920 (USNM 307199)

This car (figs. 15 and 35), built by Charles E. and J. Frank Duryea at Springfield, Mass., was operated on the streets there in September 1893 with a friction drive, and in January 1894 with the present gear transmission. It has a 1-cylinder, 4-cycle, 4-horsepower, water-cooled, gasoline engine with make-and-break electric ignition. The

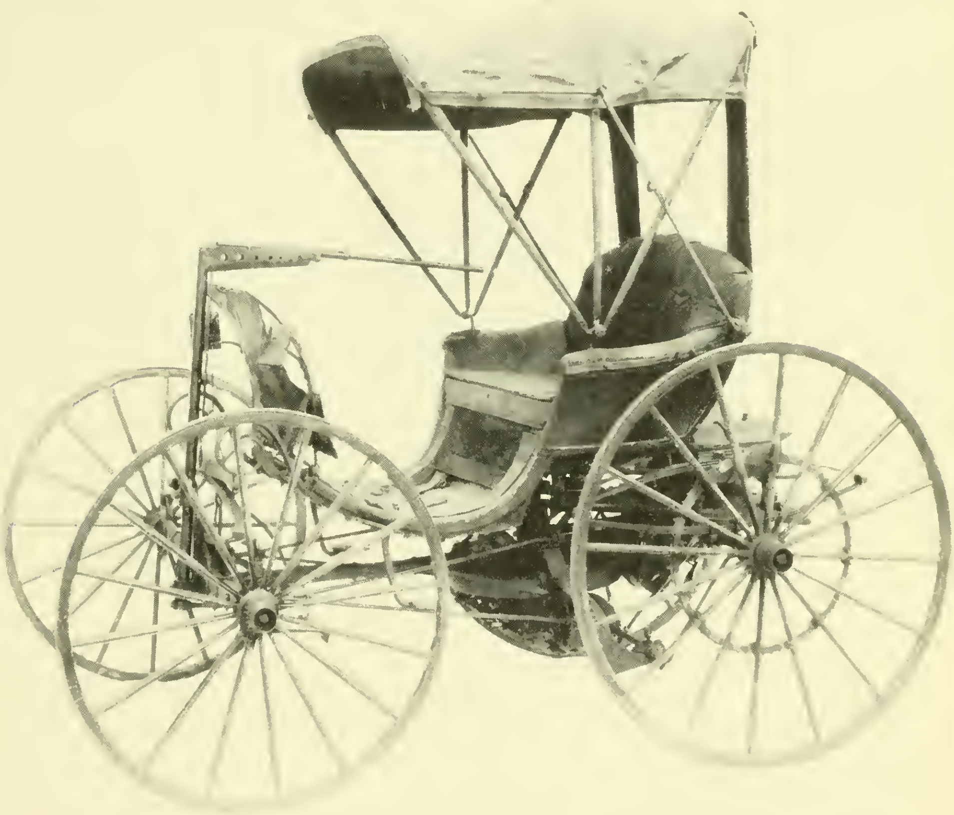


Figure 35.—Photo, made about 1920, of the 1893–94 Duryea automobile. It is interesting to compare this with figure 15.

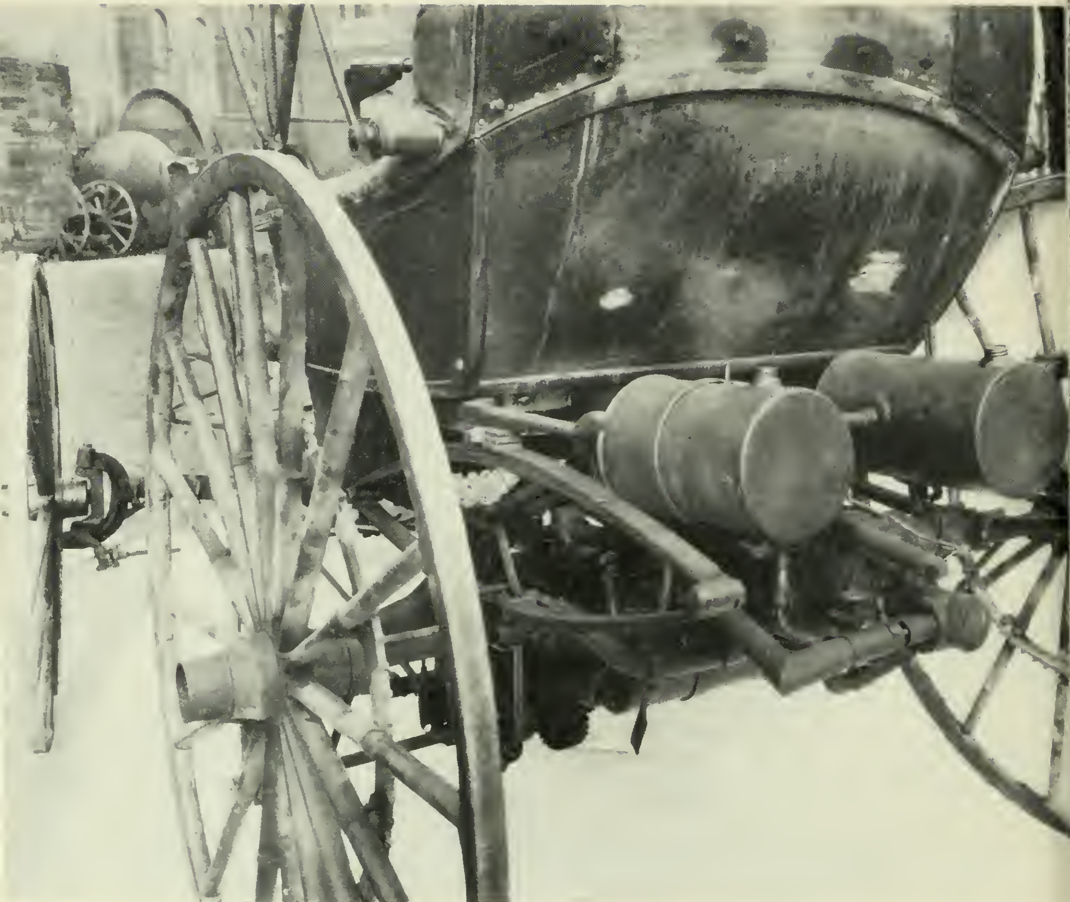


Figure 36.—Rear of 1893–94 Duryea automobile.

engine is placed almost horizontally beneath the carriage body, with its cylinder head extending backward and above the rear axle. The engine, transmission, and differential are mounted in a frame supported by the dead rear axle and also at the center of the front axle.

Power was transmitted through bevel gears from the vertical crankshaft to a main horizontal shaft and thence by spur gears to a parallel jackshaft, at each end of which was a small combination sprocket. The differential is built into this jackshaft. Chains formerly connected the jackshaft sprockets with large sprockets attached to the inside of the wooden spokes of the carriage-type rear wheels. These wheels are 44½ inches in diameter and have iron tires.

On the main shaft are three friction clutches, two for the two forward speeds and one for the reverse. These clutches were operated through cable connections by an up or down movement of the steering tiller. The steering knuckles on the front wheels are of the C type, the pivot axis of each intercepting the plane of its wheel at the ground. The front wheels are also of the wooden-spoked carriage type, with iron tires 38½ inches in diameter.

The hand starting crank, projecting at the rear of the car (fig. 36), turned the crankshaft by means of a pair of bevel gears which automatically unmeshed when the engine started. A floatless, constant-level jet carburetor received gasoline from a supply tank located above the carburetor and to the left of the engine. The supply was regulated by a needle valve to flow at the rate required to produce the desired power and speed. At slower engine speeds excess fuel overflowed into a tank below the carburetor, from which it was returned to the main supply tank by means of a hand pump. Ignition was obtained by a make-and-break electric igniter actuated by a projection on the piston head. The water tank is located to the right of the engine.

HAYNES GASOLINE AUTOMOBILE, 1894

Gift of Elwood Haynes in 1910 (USNM 262135)

This car (figs. 18 and 37), designed by Elwood Haynes, was constructed in the shop of Elmer and Edgar Apperson at Kokomo, Ind., in the fall of 1893 and the spring of 1894. On July 4, 1894, a successful trial trip was made at a speed of about 7 miles an hour.

Figure 37.—Photo, made about 1910, of the 1894 Haynes automobile. Figure 18 shows an earlier view.

The machine now is not as originally constructed, for certain changes were made about two years after the initial trial run. These included the replacement of the 1-horsepower, 2-cycle, Sintz gasoline engine by a 2-horsepower engine; the replacement of the 28-inch cushion-tire wheels with wire-spoked wheels mounting single-tube pneumatic tires 36 inches in outside diameter; and the substitution of a tiller-operated, fixed-axle steering mechanism for the original worm-and-gear-driven, swinging front axle of carriage design. The original axle, fixed so as not to swing, was retained for this purpose.

The vertical, 1-cylinder, water-cooled engine, with make-and-break ignition, delivered its power by chains to a jackshaft forward of the motor and parallel to the rear axle. A small sprocket at each end of this jackshaft is connected by a chain to a larger sprocket on each rear wheel. A spring-loaded, friction-type differential is provided at the left end of the jackshaft. Friction clutches on the jackshaft are operated by a vertical T-rod within reach of the driver and furnish a choice of two forward speeds. Operation of the clutches is by means of a chain, which is actuated by a sprocket on the lower end of the T-rod. A third forward speed of very low ratio is provided by a clutch-and-sprocket device on the right end of the rear axle. This appears to have been abandoned, as no means of operating it remains. No reverse is provided on the car. The engine was cranked through the spokes of the right rear wheel. A hand lever operates a friction band on the end of the jackshaft, for braking.

The foot-operated accelerator is mounted on the floorboard. A water tank beneath the seat is connected to the engine by two rubber hoses. The gasoline tank is beneath the floor, below the level of the carburetor. Fuel was pumped to the carburetor by a mechanical pump operated by the ignition linkage.

The chassis consists of a rectangular tubular frame upon which the body rests on long semielliptic springs. The total weight of the vehicle is about 1,000 pounds.

BALZER GASOLINE AUTOMOBILE, 1894

Gift of Stephen M. Balzer in 1899 (USNM 181658)

This unique vehicle (figs. 38 and 39) was designed and built by Stephen M. Balzer in New York City in 1894. Less than 6 feet in length and 3 feet in width, it is supported on four small, wire-spoked wheels equipped with single-tube pneumatic tires. The rear wheels are 26 inches in diameter, and the front wheels, mounted in forks of the bicycle type, are 17 inches in diameter. The forks are connected by a tie rod and are steered by a tiller.

A 3-cylinder, air-cooled engine of the rotary type is located beneath the seat. When running, the cylinders and crankcase revolved in a vertical plane around the stationary crankshaft. A stub shaft, turning with the crankcase, carries the driving gears of a 3-step, constant-mesh, change gear, which provides three forward speeds but no reverse. The driven shaft of the change gear is geared to the driving side of a clutch on the divided rear axle. The car was propelled by the left rear wheel. The desired gear ratio

Figure 38.—This 1894 Balzer automobile had a 3-cylinder rotary engine.

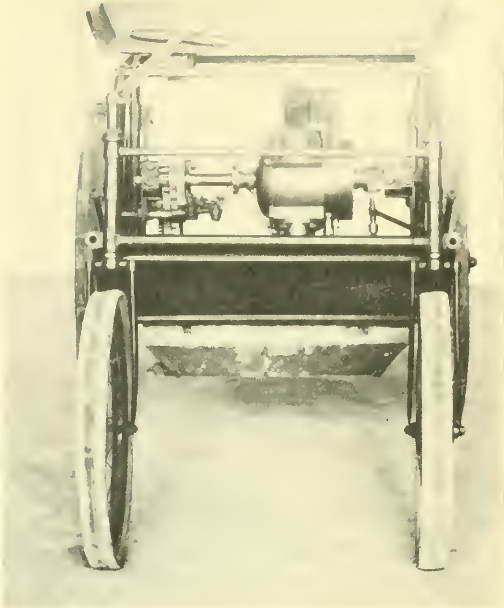


Figure 39.—Front of 1894 Balzer automobile.

was selected by shifting an internal keying arrangement (not readily examined now), which keyed one or another of the driven gears of the change gear to its shaft. Clutch and gear shift were both operated by a lever at the right of the vehicle's seat. Brushes that wiped segments on a commutator on the driving shaft distributed current to the electrical make-and-break ignition system of the cylinders.

Two poppet valves are provided for each cylinder, an inlet valve of the automatic type opened by atmospheric pressure when the piston was on its suction stroke, and an exhaust valve operated by a cam that revolved at the required speed on the stationary crankshaft. The cam was driven by gearing connected to the revolving crankcase; it operated the make-and-break linkage as well as the exhaust valve. Gasoline or vapor (it is not clear which) was piped from a tank beneath the floorboard and led through a fitting (now incomplete) which may have been a mixing valve. The mixture was led by a hollow shaft to a connection with three pipes within a chamber built on the rotating crankcase. It passed through these pipes to the inlet valves. The exhaust gases left the cylinders by means of three other pipes leading into the chamber on the crankcase. This chamber has many small holes drilled through its outer wall and could have served as a muffler as well as a stove to heat the incoming mixture.

CLARKE GASOLINE TRICYCLE, 1897

Gift of Louis S. Clarke in 1947 (USNM 313142)

In 1897, Louis S. Clarke founded the Pittsburg Motor Vehicle Co., Pittsburg, Pa., with himself as president and engineer, and constructed this experimental motor tricycle (fig. 40). The next year, with the experience thus gained, the company built a 4-wheeled automobile, now preserved in the Henry Ford Museum. In 1899, the company name was changed to the Autocar Co., which today is one of a small number of surviving pioneer automobile companies. This tricycle is known as the first Autocar.

The vehicle is a conventional tricycle with a gasoline engine driving the rear wheels. The frame is built of standard bicycle parts, with special parts designed and made by Mr. Clarke. The 1-cylinder, gasoline engine (fig. 41), with mechanically operated exhaust valve and automatic intake valve, has a gear on its crankshaft extension meshing directly with the ring gear of the differential. No gear

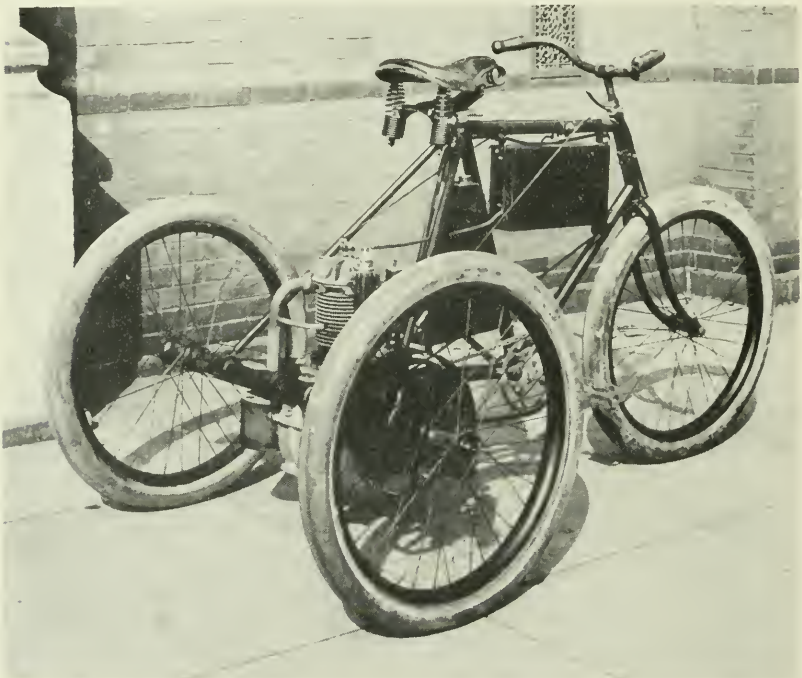


Figure 40.—This 1897 gasoline tricycle was the first vehicle built by Louis S. Clarke, who founded the Autocar Co.

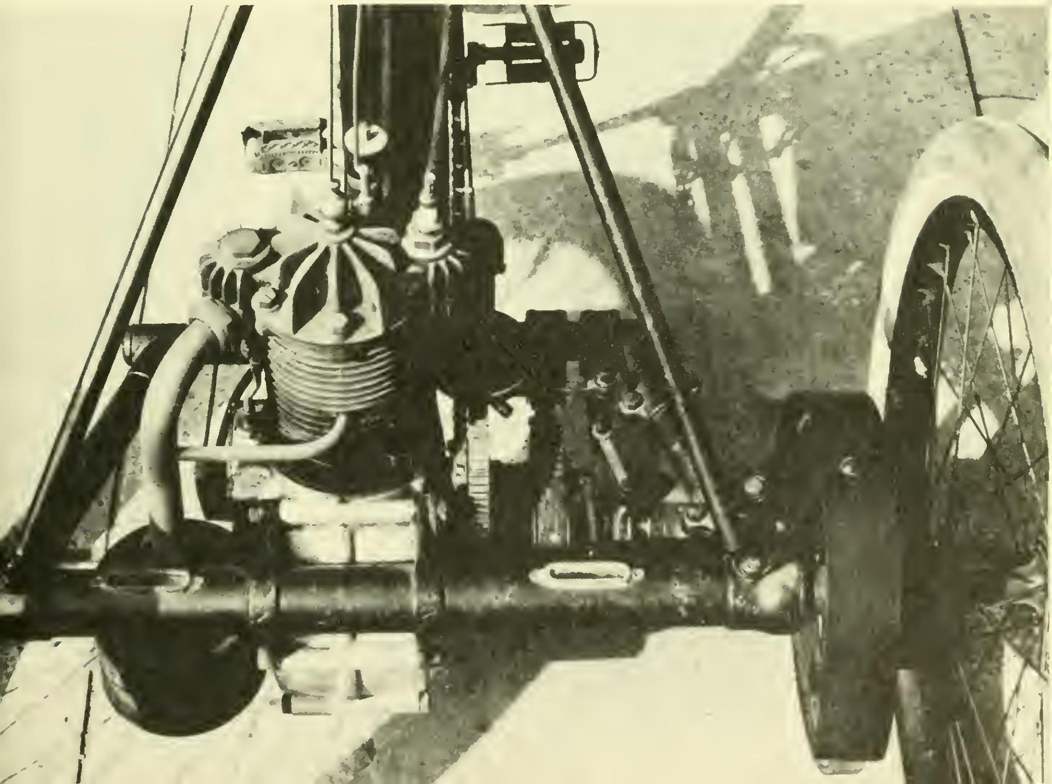
changes are provided. A clutch located on the crankshaft extension between the engine and the driving gear, and a band brake on the drum of the clutch, are operated by a single hand lever.

No throttle is provided, but speed of the engine was varied by means of a spark-advance lever. A fuel-flow regulator is provided on the exhaust-heated, gasoline vaporizer. The main exhaust pipe leads into a small muffler. The gasoline tank is located in the frame beneath the saddle, and the high-tension coil and batteries are in a box farther forward in the frame.

Bicycle pedals, with the usual sprockets and chain, enabled the rider to start the engine, or in the event of an emergency to pedal the vehicle. An overrunning clutch is built into this gearing so that the pedals are not driven by the engine while the tricycle is in motion.

The three wire-spoked, bicycle-type wheels mount 26-by-2½-inch single-tube pneumatic tires, of which, Clarke has stated, the front one is one of the original three and has never been off the wheel since its installation. The front wheel is supported in a fork and is steered by handle bars.

Figure 41.—Rear of 1897 Clarke tricycle, showing 1-cylinder engine.



The saddle, the handle-bar grips, the spark plug, a spark coil of about 1904, the two rear tires, and a relief pipe and valve on the crankcase of the engine are not original.

Figure 42 shows Mr. Clarke with the tricycle in 1944, shortly after the machine had been removed from storage, where it had been for many years.

Figure 42.—Louis S. Clarke, in 1944, and his first Autocar.

OLDS GASOLINE AUTOMOBILE, 1897
Gift of the Olds Motor Works in 1915 (USNM 286567)

Ransom E. Olds, builder of this machine (fig. 43), recalled a few years ago that it was one of four constructed at Lansing, Mich., in 1897, by the then newly formed firm, the Olds Motor Vehicle Co., of which Olds was manager. The machine was successfully operated that year at a speed of about 10 miles an hour with four passengers.

The car is equipped with a 6-horsepower, 1-cylinder, water-cooled engine (fig. 44) placed horizontally beneath the body to the rear of the vehicle, with the vertical flywheel in the center of the car so that the transverse crankshaft is located about midway between the front and rear axles.

Figure 43.—Ransom E. Olds built one gasoline automobile in 1895 or 1896, and four more of the same design in 1897. This 1897 Olds is the only remaining example of these first Olds vehicles.

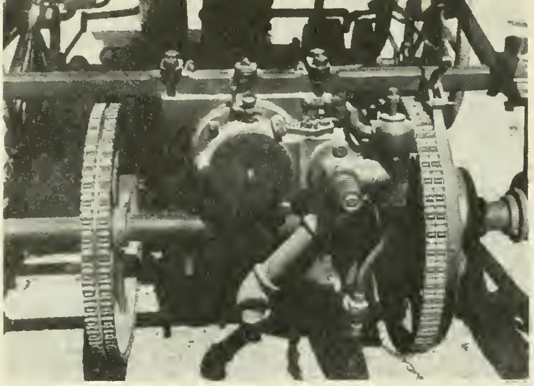


Figure 44.—The 1897 Olds automobile was powered by this rear-mounted, 1-cylinder engine.

Speed selection is provided by three friction clutches controlled by a system of cams and levers at the lower end of a vertical post located to the right of the driver. The clutches are mounted on extensions of the crankshaft on both sides of the flywheel. Two clutches on the left, each engaging a chain sprocket on the crankshaft, furnish two forward speeds; while the clutch on the right, in conjunction with a planetary gear, provides the reverse. Power was transmitted through chains to sprockets on a sleeve on the live rear axle. The sleeve is integral with the driving element of the differential. A spring compensator for absorbing shocks of power transmission is built into the differential, while a pedal operates a band brake on the differential unit.

The cylinder end of the engine is attached rigidly to the rear-axle support, while the crankshaft end is supported by curved iron straps attached to the front axle. The body rests on three full-elliptic springs, a transverse one at the front axle and the other two at the rear. Steering is accomplished by means of a tiller, which swings the front wheels about on their vertical pivots. Wheels are of the wooden artillery type equipped with solid rubber tires, the front 32 inches and the rear 36 inches in diameter.

A radiator consisting of 21 long horizontal tubes running fore and aft of the car is mounted flat against the underside of the body and is connected to the water tank and to the water jacket of the cylinder by two rubber hoses.

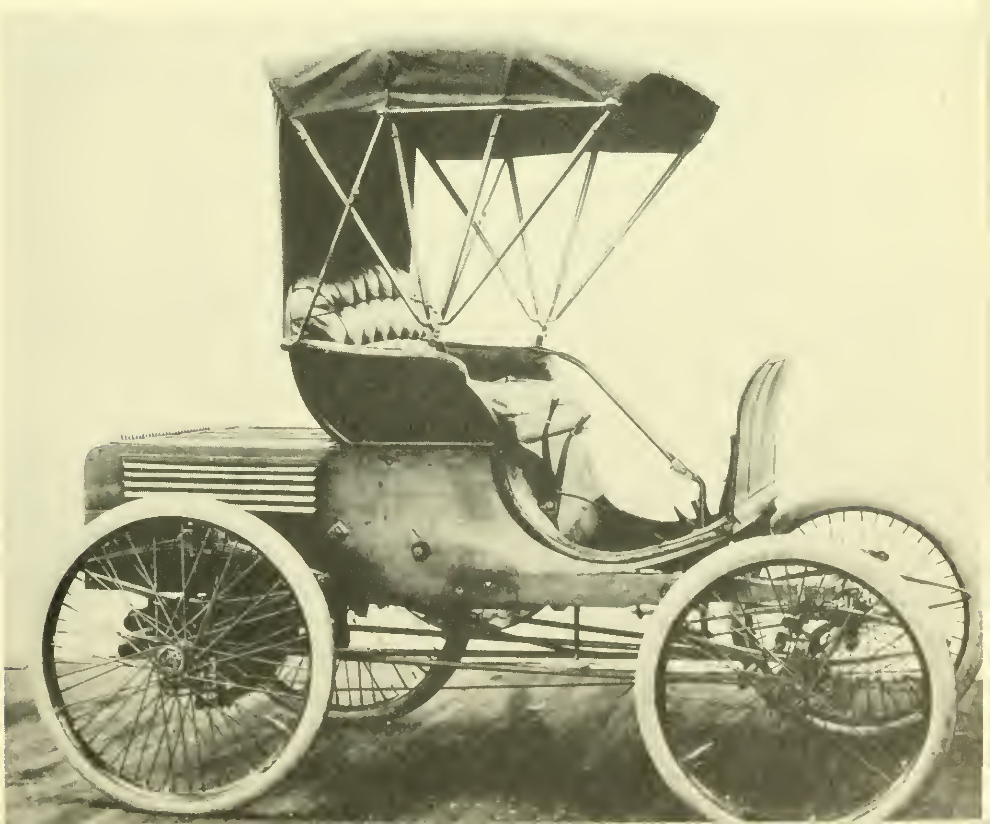
The gasoline tank hangs just below the engine; fuel was pumped from it to the carburetor by a small pump driven by an eccentric on the crankshaft. The eccentric arm also operated the exhaust valve of the engine, while the spring-closed intake valve is of the automatic variety. Make-and-break electric ignition was also controlled by the eccentric arm.

WINTON GASOLINE AUTOMOBILE, 1898
Gift of the Winton Engine Co. in 1929 (USNM 309601)

This car (fig. 45), the first Winton sold by the Winton Motor-Carriage Co., of Cleveland, Ohio, was built by Alexander Winton in 1898. Several earlier experimental models were constructed but never sold. This one was the first of a lot of approximately 25 cars scheduled for production in one year. It was bought on March 24, 1898, by Robert Allison, of Port Carbon, Pa., from whom it was subsequently repurchased by the Winton Co. Mr. Allison was 70 years old at the time of his purchase of the machine.

A 1-cylinder, water-cooled, horizontal, gasoline engine with make-and-break ignition supplied the motive power, the transmission being connected by a chain to a small shaft directly over the rear-axle housing. The small shaft, which is geared directly to a differential unit on the rear axle, also carries a brake drum, the external contracting band of which is actuated by a pedal at the left foot of the driver. Two speeds forward and one reverse are provided by the

Figure 45.—The first Winton sold was this 1898 1-cylinder automobile.



transmission, control being by two levers placed at the driver's right and by a small knob, which can be turned by hand.

The transmission consists of three exposed pairs of constant-mesh gears on two transverse parallel shafts, the rear shaft being a right-hand extension of the crankshaft. Of the left pair the gear on the crankshaft is integral with the driving sprocket of the chain. The right pair of gears includes a reverse idler gear in its train. To engage low speed the left of the two levers is pulled back, clutching the middle gear of the crankshaft to that shaft, after the hand-operated knob has been turned to clutch the mating and otherwise free-running gear to the front shaft. The crankshaft motion is thus transmitted from the crankshaft to the front shaft, and from the front shaft back to the sprocket gear running free on the crankshaft. To engage high speed the right lever is pulled back, clutching the driving sprocket directly to the crankshaft. Reverse is accomplished by pushing the left lever forward. This clutches the right-hand gear of the front shaft to the shaft, and transmits the crankshaft motion through the reverse idler gear and the front shaft back to the driving sprocket running free on the crankshaft.

A foot-operated accelerator was connected to the carburetor at the rear of the engine, but the carburetor is now missing from the vehicle. A large fin-cooled water tank is supported under the right side of the body at the rear, while the gasoline tank is to the left and over the engine. The hand starting crank, normally resting in a receptacle in the floorboard, is fitted to the gearing at the right of the engine through a hole in the side of the body.

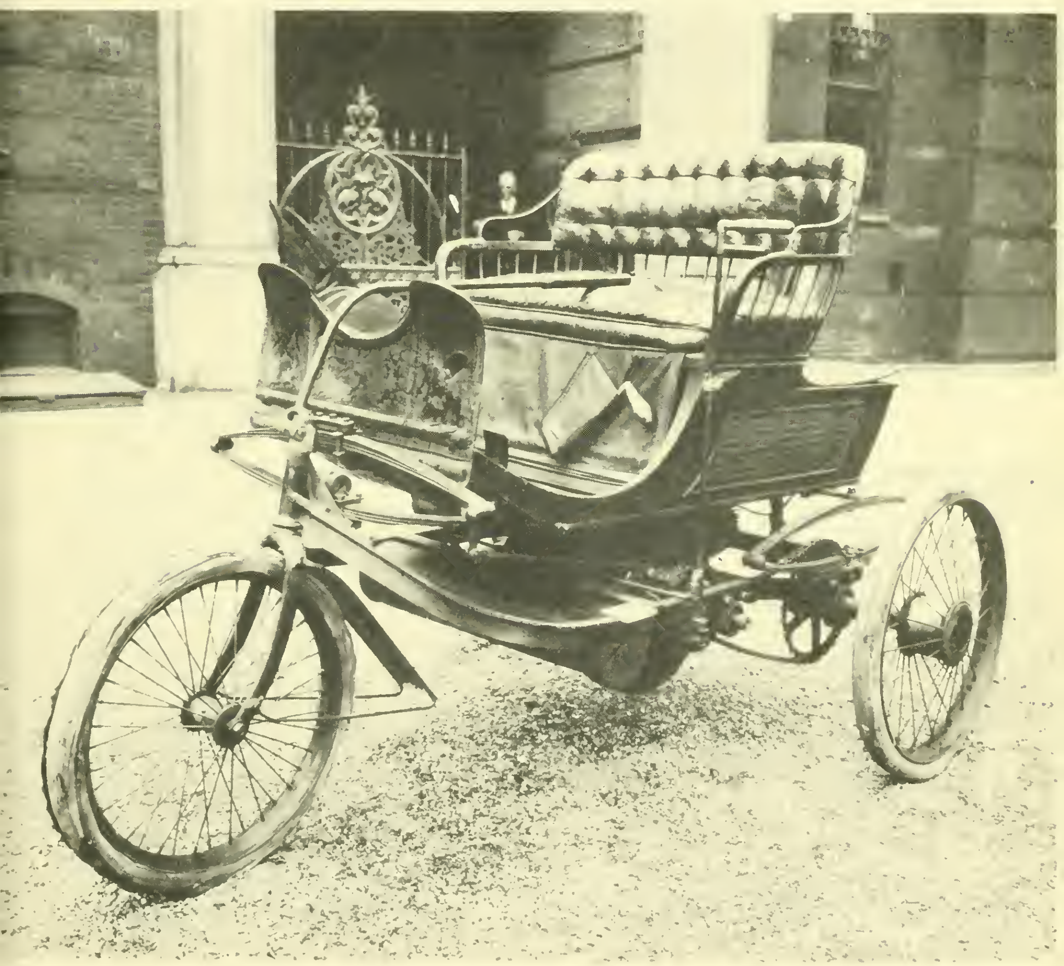
The front axle, which has steering knuckles at each end, is secured to the rear-axle housing by reach rods, thus keeping the two parallel. The frame of the car, which supports the engine, is mounted on the two axles by four full-elliptic springs, one of the earliest instances of excluding the weight of the engine from the unsprung weight. Steering is by tiller, and the four wheels are wire-spoked, the front wheels being equipped with 34-by-3-inch single-tube pneumatic tires and the rear with 36-by-3-inch tires of the same type.

KNOX GASOLINE AUTOMOBILE, 1899

Lent by Mrs. Lansing Van Auken in 1924 (USNM 308332)

Built by Harry A. Knox, of Springfield, Mass., this vehicle (fig. 46) is another example of the many makes of 3-wheeled automobiles constructed at the turn of the century. In 1909 this car was driven in the parade at the Hudson-Fulton celebration in New York City and was awarded a prize of $25 for being the oldest machine to cover the line of march under its own power.

Figure 46.—A number of these 3-wheeled, air-cooled, 1-cylinder Knox automobiles were built around 1900. This one was built in 1899.



The chassis is characterized by simplicity of construction, which was one of Knox's objectives in designing a 3-wheeled car. The angle-iron frame is roughly triangular, with the two sides parallel for half their length at the rear, then converging to a point at the front. There is a cross member at the center, where the sides begin to converge. The converging sides sweep upward at the front to a motorcycle-type fork in the apex of the triangle. This fork is steered by a tiller pivoted to the upper end of the fork so that it can be moved away from the driver. The rear of the chassis is bolted directly to the bearing housings of the rear-axle shafts.

The hub of the left wheel contains a bevel-gear differential, requiring that the axle shaft of the right wheel pass through the short tubular shaft of the left wheel, with the driving sprocket attached to the inner end of the tubular shaft. The three wheels are each radially wire-spoked, mounting single-tube 28-by-2½-inch tires. A small mudguard, turning with the fork, is mounted behind the front wheel.

The chassis is unsprung, all springing being between the chassis and the body and consisting of three full-elliptic springs, one at each side in the rear and one mounted transversely at the front just behind the fork.

The engine is a 1-cylinder unit of 4½-inch bore and 6-inch stroke, rated at 8 horsepower. It is air-cooled by radiation from a large number of small rods projecting from the cylinder. The engine is mounted horizontally in the center of the car, with the crankshaft parallel to the ground and with the cylinder to the rear. It is supported by two metal hangers, one attaching it to the chassis at the back and the other to the cross member in the center.

The right end of the crankshaft has a small eccentric, which drove a push rod connected to a piston-shaped valve in the valve chamber. A cam, driven at half crankshaft speed, operated another push rod, which actuated a poppet valve located between the combustion chamber and the piston valve. The poppet valve, which remained open for substantially 360° of the turning of the crankshaft, served as both exhaust and intake valve, the piston valve's position determining whether the exhaust or intake manifold was permitted to function.

The ignition timer is mounted adjacent to the engine camshaft, the cam of the timer being driven by the camshaft. A spark plug is located in the rear of the cylinder. The original spark plug was made in the Knox factory, as were all ball bearings used in the car.

The portion of the camshaft that drives the cam of the timer is spirally splined and is free to slide with respect to the rotor, advancing or retarding the ignition as it does so. In addition, the cam itself, which is integral with the splined shaft, is 3-dimensional, which means that as it is moved back and forth with respect to its follower it will advance or retard the motion of the follower and consequently the valve timing. The speed of the engine was controlled in this way.

Mounted on the back of the chassis, next to the intake end of the piston valve, is the carburetor, which is of the constant-level type, with hinged float and needle valve. This is similar to, and has all the essential features of, the modern type of carburetor, the needle valve being located horizontally near the top of the bowl. A jet, which is adjusted by a metering pin, projects into the intake manifold, which then leads directly to the intake end of the piston valve. The portion of the manifold on the other side of the jet is perforated with many small holes. Air, sucked through these holes as the piston descended, was carried past the jet to form the explosive mixture, which passed by the piston valve and then by the poppet valve.

Mounted on the carburetor cover plate is a vent tube leading to the float chamber. When starting the engine the operator placed a rubber hose on this tube. Blowing into the hose caused a gasoline mixture to be forced out of the jet and and into the intake manifold. There is no butterfly control of the carburetor, all speed control of the engine being exercised by the sliding camshaft. The exhaust end of the piston valve is connected by a long tube to the muffler, which is transversely mounted next to the chassis cross member in front of the engine.

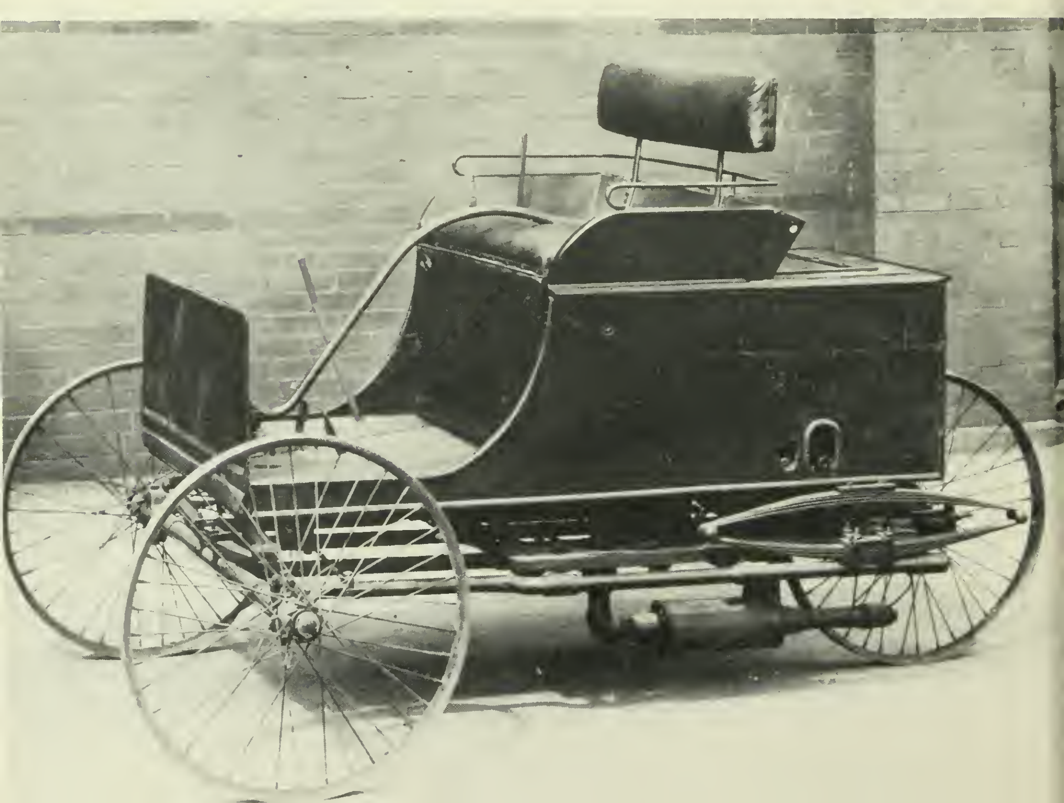
A cylindrical sight-glass oil tank is bolted to the front of the crankcase, allowing oil to flow via two oil lines to each of two main bearings, and thence to drip into the crank-case. Bleeder holes in the oil ring groove of the piston prevented "oil pumping" and returned oil to the crankcase.

The flywheel is on the left end of the crankshaft. The transmission is planetary and provides two speeds forward and neutral. There is no reverse. Control is by means of a vertical shaft mounted to the left of the driver's seat. The same shaft also supports the shaft that controls the engine speed. A chain connects the transmission sprocket to the sprocket on the rear axle.

The wooden body seats two and is upholstered in black leather. Beneath the cushions are the gas tank and a battery and coil compartment.

The back of the body is a utility compartment with a wooden cover. The body has two leather rebound straps passing beneath the back of the chassis. An ignition switch is located on the front of the coil compartment, behind the black leather seat curtain.

In the floorboard, near its left edge, is a ratchet-held brake pedal, which operates an external band on a drum of the transmission. A warning bell is mounted to the right of the brake pedal.



KELSEY AND TILNEY GASOLINE AUTOMOBILE, 1899
Gift of Joseph R. Darling in 1923 (USNM 308029)

Made by Carl W. Kelsey and I. Sheldon Tilney in Chestnut Hill, Pa., as an experiment in 1899, this vehicle (fig. 47) was never put into production, though in later years Kelsey did enter into the production of automobiles of different design, including both 3-wheeled and 4-wheeled cars.

This 3-wheeled machine has a frame made of pipe, with two wheels in front and one driving wheel in the rear. A light 2-passenger body is attached to the frame by three full-elliptic springs. The wheels are wire-spoked, 25 inches in diameter, and the front wheels are steered by a tiller. Single-tube pneumatic tires were provided.

A horizontal, 1-cylinder engine is supported on the left side of the frame, with the crankshaft end toward the rear. A planetary transmission, providing two forward speeds and reverse, is assembled on a transverse jackshaft driven by sprockets and chain from the engine. The high-speed clutch is operated by a lever at the right of the vehicle, while the low speed and reverse are controlled by two pedals. The drive to the rear wheel sprocket is transmitted by chain from a sprocket on the jackshaft.

The engine is water-cooled by circulation from a water tank in the upper right part of the body. The 4-cycle engine has an intake valve of the automatic type and an exhaust valve mechanically operated by a cam driven by gears at half crankshaft speed. A muffler is provided. Above the intake valve is a gasoline vaporizer fed by gravity from a small tank above it, behind the seat. Ignition is now by means of high-tension coil and spark plug, advance and retard being effected by a small lever to the right of the seat cushion. Originally the ignition was of the make-and-break type.

Figure 47.—Experimental 1-cylinder automobile built in 1899 by Kelsey and Tilney.

LOCOMOBILE STEAM AUTOMOBILE, 1900
Gift of Mrs. H. H. Smith in 1929 (USNM 309639)

In 1899 the twin brothers F. E. and F. O. Stanley (fig. 48) sold their newly created steam-automobile business to a group who began the manufacture of a car, first in Newton, Mass., and later in Bridgeport, Conn., under the name of Locomobile. This vehicle (fig. 49), sold new on July 4, 1900, for $750, represents Locomobile's early Bridgeport product. It bears the usual maker's plate carrying the patent date of November 14, 1899, is the style 2 machine, and is car No. 2795.

In general, the vehicle consists of a light tubular underframe carried directly on the axles, with the body supported on the frame by means of three full-elliptic springs, one at each side in the rear and one mounted transversely at the front.

Figure 48.—The twin brothers F. E. and F. O. Stanley in their first steam automobile, 1897.

Figure 49.—This 1900 Locomobile steam automobile was built by a firm which bought out the Stanley brothers' automobile business in 1899.

The carriage body, to which are attached all the principal parts of the driving mechanism, is constructed entirely of wood. The boiler and engine are below the seat portion of the body, while the back of the body accommodates the feed-water tank and the horizontal extension of the smoke box, which forms the chimney of the burner. Three levers, by means of which the engine and burner are controlled, are situated at the driver's right hand. The steering is controlled by a side bar, which operates the pivoted front wheels. Power was transmitted by a chain from a 16-tooth sprocket on the crankshaft to a 40-tooth sprocket mounted upon the differential gear on the divided rear axle, at the ends of which the rear wheels are keyed. A pedal actuates the external contracting brake band of the brake drum on the sprocket of the differential unit.

The underframe is constructed of tubing and consists of two longitudinal tubes brazed and bolted at each end to curved cross tubes, which are themselves brazed to straight cross tubes. The rear one of these is divided at its center to receive the differential gear on the rear axle. Additional stiffness is given to the underframe by stay tubes and rods. The tread is 53 inches and the wheelbase 58 inches.

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The boiler is of the vertical fire-tube type. It consists of a cylindrical drum, formed by upper and lower tube plates, and a shell plate strengthened by windings of steel piano wire to resist bursting. The tube plates are connected by about 300 copper fire tubes. The heating surface of the boiler consists of about 100 square inches of tube plate surface and over 4,000 square inches of tube surface, a total of about 30 square feet. Below the lower tube plate is the fire box, which contains the burner. The smoke box and drum of the boiler are thickly lagged with asbestos.

The water supply for the boiler was contained in a horseshoe-shaped tank of about 15 gallons capacity. The supply, drawn from the bottom of the tank, flowed to a feed pump attached to the engine frame and operated by a rocking lever from one of the engine's cross heads. The water entered the boiler at the lower tube plate, the water level in the boiler being indicated by a gauge glass placed on the right side of the carriage body. A small mirror near the brake pedal enabled the driver to see the glass readily.

The boiler was normally worked at 150 pounds pressure, as indicated by the pressure gauge at the driver's right foot.

The gasoline supply for the burner was contained in the cylindrical tank suspended from the frame below the floorboard of the body, air pressure being employed to maintain the supply. The air pressure was indicated by another pressure gauge on the footboard.

The engine is of the vertical, double-acting type having two cylinders each 2½ inches in bore and 3½ inches in stroke. The cranks are set at 90° to each other. The normal speed of the engine was about 400 revolutions per minute. The cylinders and steam chest are thickly lagged with asbestos. Figure 50 shows an engine of almost identical design.

About 3 brake horsepower was developed with a cut-off giving a mean pressure of about 50 pounds. With no cut-off, and with maximum steam pressure, about 10 to 12 brake horsepower could be developed for short periods. For its day this was a fairly high horsepower-to-weight ratio, as the car weighs only about 700 pounds. For this

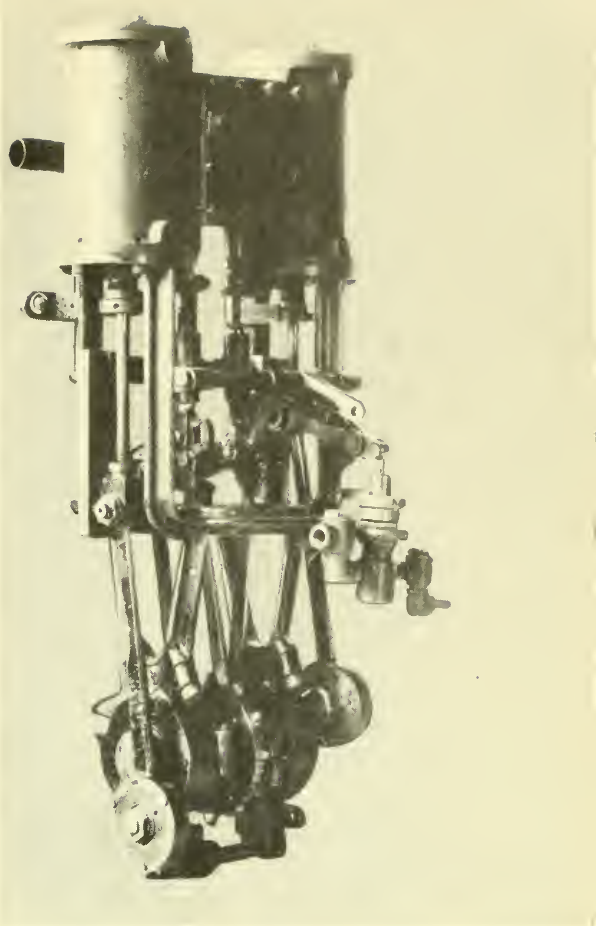


Figure 50.—Engine very similar to that in National Museum's 1900 Locomobile steamer. Its exact identity has not been determined.

reason the early steam cars could generally outperform the heavier, gasoline-engine-powered vehicles for short spurts.

The wheels are of the cycle type with tangent spokes and steel rims, and carry 28-by-2½-inch, single-tube, pneumatic tires.

In figure 51 is shown the engine of the first Stanley steam automobile (fig. 48). It was built in 1897 for the Stanley brothers by the Mason Regulator Co. of Boston, Mass., and has a 2½-inch bore and a 4-inch stroke. A later steam engine that is similar, though not identical, to the engine in the Museum's Locomobile is shown in figure 50. These two engines (USNM 310524 and 307387) are in the Museum collection, and were presented, respectively, by the Mason Regulator Co. in 1932, and by Louis S. Clarke in 1922.

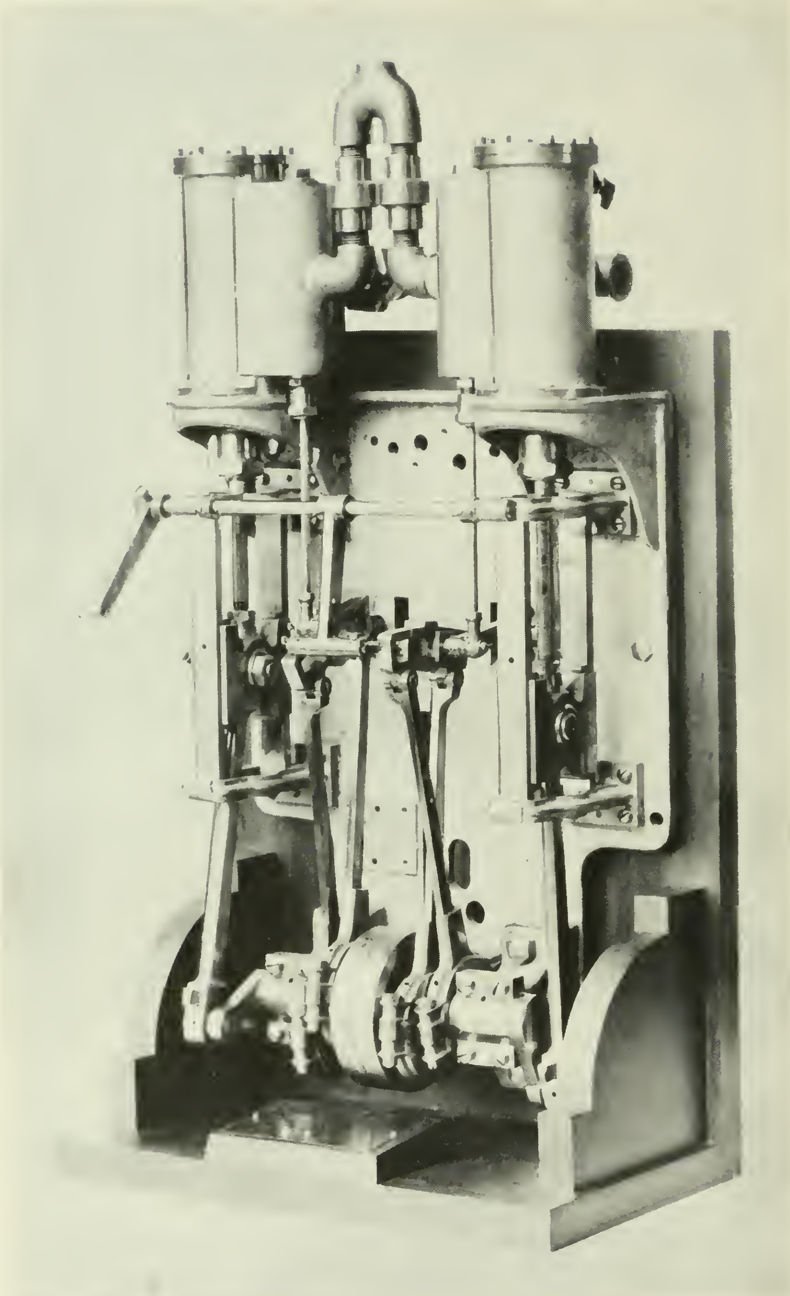


Figure 51.—Engine of first Stanley steam automobile, 1897.

Another interesting development of the Stanley steam engine is the power plant of the Stanley racing car that Fred Marriott drove to a speed of 127.659 miles an hour at Daytona Beach, Fla., on January 26, 1906, to establish a new world's land speed record. Figure 52 shows this engine (USNM 311899), presented to the National Museum in 1940 by Fred Marriott. It has a 4½-inch bore and a 6½-inch stroke.

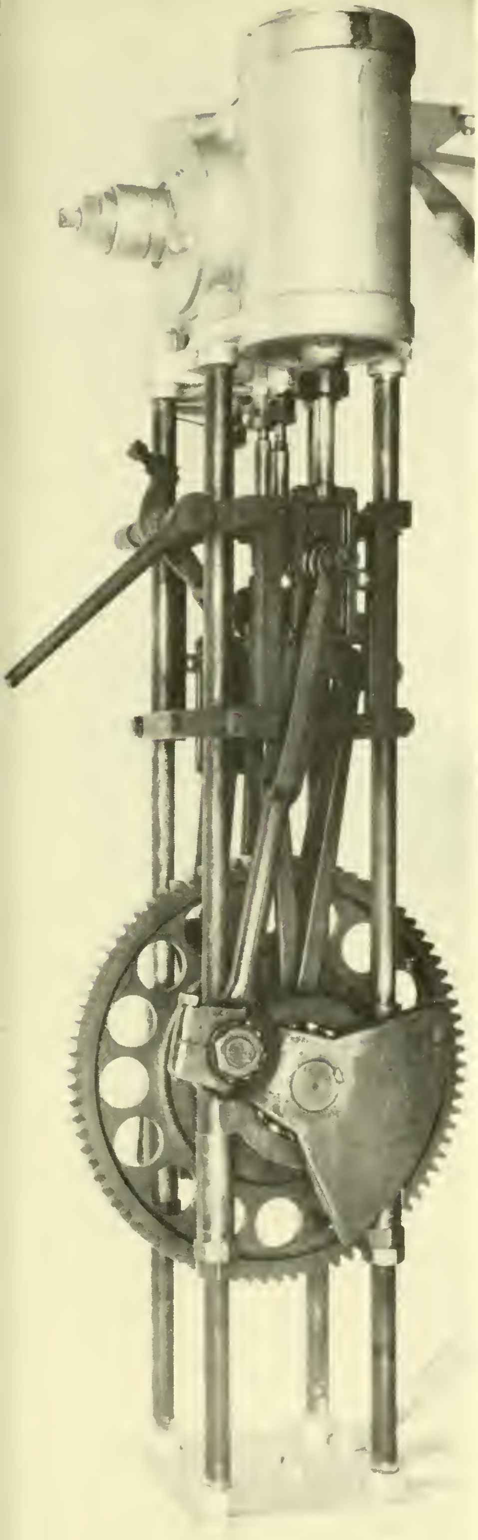


Figure 52.—Engine of Stanley steam racing car that broke the world's land speed record in 1906.

RIKER ELECTRIC AUTOMOBILE, about 1900
Gift of Mrs. Herbert Wadsworth in 1932 (USNM 310470)

At the beginning of the twentieth century the electric motor was a perfected machine as compared to the gasoline engine, with the result that electric vehicles were correspondingly quieter, cleaner, and more dependable than the early gasoline cars. This was reflected in the construction of luxurious closed vehicles, such as this one (fig. 53), several years before closed bodies appeared generally on gasoline automobiles. This vehicle was built by the Riker Motor Vehicle Co., of Elizabethport, N. J.

The frame of the vehicle consists of tubular front and rear axles, connected by tubular side members, the whole strengthened at its front corners by short tubular diagonal members. The front wheels, 30 inches in diameter and mounting solid rubber tires, are mounted on pivoted steering knuckles that are connected by a tubular tie rod. The outside diameter of the front tires is now about 34 inches, but some wear, of necessity, has taken place. The tire size does not appear on the tires. The rear wheels are 36 inches in diameter. They mount solid rubber tires 41 inches in outside diameter and are marked 42 by 3½. All four wheels are of the artillery type, having wooden spokes and felloes.

A large electric motor made by the Electric Vehicle Co., of Hartford, Conn., is mounted in front of each end of the rear axle. Each motor is geared directly to a large spur gear bolted to the spokes of its respective rear wheel. The gear ratio from wheel to motor is approximately 10 to 1.

Springs at the front and rear of the frame support the body. The front springs consist of a transverse semielliptic pair, the one mounted over the other so that the arch of the inverted upper one is clamped to the arch of the lower one. At the rear a transverse semielliptic spring is attached to two ¾-elliptic springs, which are mounted in a fore-and-aft direction over the rear wheels. The wheelbase is 82 inches, the front tread 54 inches, and the rear tread 65 inches.

The enclosed wooden body, creating an impression of great bulk, will accommodate four, two facing forward and

Figure 53.—Riker electric automobile constructed about 1900.

two toward the rear. Communication between passengers and driver was by voice tube. Glass windows in the two doors can be raised and lowered. Leather-covered fenders shield the four wheels of the vehicle. Electric side lights, operated from the batteries, are provided.

Projecting beyond the passenger portion of the body, at the front and at the rear, are two large compartments for storage batteries. The rear compartment contains three sets of 12 cells each, while the front contains one set, 48 cells altogether. The wiring from cell to cell is no longer in place, and so the exact system used is not now known.

Above the rear battery compartment, 7 feet above ground, is the exposed seat for the driver and the footman. On the left a steering tiller is attached to the upper end of a long, vertically mounted shaft, which at its lower end is connected by a long rod to the left steering knuckle. In front of the driver is a combined 150-volt voltmeter and ammeter, which indicated the state of charge and the rate of charge and discharge of the batteries. On the left is a lever that controls a horizontal drum type of controller under the driver's seat. This governed the speed and reversed the vehicle.

External contracting brake bands on the two rear-wheel brake drums are operated by a pedal pivoted in the floorboard.

A 5-horsepower motor-generator set in the garage of the vehicle was used for overnight charging of the batteries. This set (USNM 310471) was received with the vehicle and appears to be contemporary with it. Both the motor and generator were made by the Wagner Electric Manufacturing Co., of St. Louis, Mo. The motor is a 5-horsepower, 208-volt, single-phase a.c., 60-cycle unit, while the generator is a 125-volt d.c. unit capable of charging at a rate of 28 ampere hours at 1,800 revolutions per minute. A Weston voltmeter, Weston ammeter, circuit breakers, fuses, switches, a rheostat, and variable resistance complete the charging equipment.

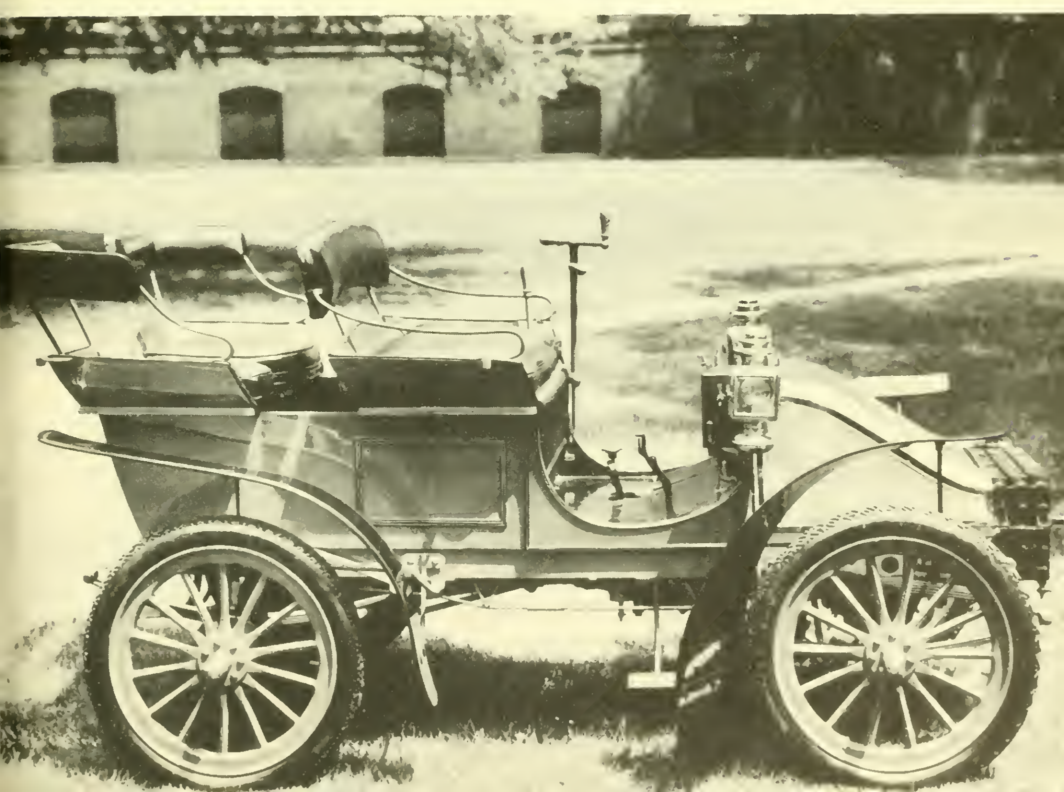
AUTOCAR GASOLINE AUTOMOBILE, 1901

Gift of the Autocar Co. in 1922 (USNM 307257)

This car (fig. 54), one of the first shaft-driven automobiles made in the United States, was designed by Louis S. Clarke, vice president and consulting engineer of the Autocar Co. in 1901. In November 1901 it was driven from the factory in Ardmore, Pa., to the automobile show at the old Madison Square Garden in New York City in 6 hours 5 minutes over frozen, rutty, country roads, a commendable performance.

The car has a 4-passenger body with a rear-entrance tonneau (fig. 55), with the controls to the left of the driver's seat. The upper of the two control handles which stand at the driver's left hand is the steering control; the lower is the gear shift. Between the body molding and the seat cushion is a lever that operates the clutch. Twisting the handle of this lever controls the carburetor throttle. Outside the body, to the driver's left, is a small handle for adjusting the spark.

Figure 54.—Autocar built in Ardmore, Pa., in late 1901, and restored in 1956 by the Autocar Division of the White Motor Co.



Three pedals protrude from the floorboard. One is a ratchet-locked pedal operated by the left foot, controlling external contracting brake bands on the drums of the two rear wheels. Another is a spring-returned pedal that operates external contracting brake bands on a drum behind the transmission. The third, also spring-returned, actuates a shift to place the transmission in reverse.

The chassis, which has a wheelbase of 66½ inches and a tread of 56 inches, is of wood reinforced by steel. The four fenders are wooden.

The four springs are full-elliptic, and front and rear axles are both tubular. The front axle has a conventional tie rod, but the rear end of the drag link on the left is cut in the form of a toothed rack which meshes with a pinion on the lower end of the steering lever. The rear axle has an enclosed differential and is stiffened by a brace. Torque rods lead from the top and bottom of the differential housing to a cross member at the left center of the chassis. The wooden wheels each have 14 spokes and mount 28-by-3-inch clincher tires.

The engine (fig. 56) is a 2-cylinder, horizontal-opposed unit of 3¾-inch bore and 4-inch stroke. It is held in the frame by two metal strap hangers from each cylinder and

Figure 55.—Rear entrance of 1901 Autocar.

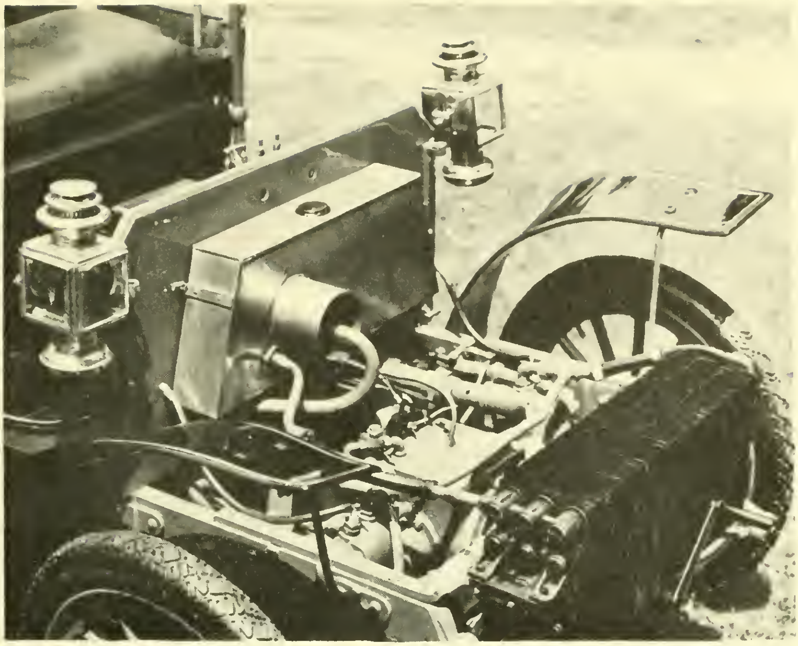


Figure 56.—Radiator, 2-cylinder engine, and water tank of 1901 Autocar.

is trussed by two rods to each side of the frame. The exhaust valve of each cylinder is operated by a camshaft in the crankcase between the two cylinders. The intake valves are automatic in operation. A spark plug is located adjacent to each intake valve. The ignition timer is at the rear of the plate on the top of the crankcase. A small breather pipe is also attached to the plate. In the flywheel at the back of the engine is a floating-disk clutch, operated by the lever already mentioned.

Each cylinder has its individual exhaust pipe, one going to the right of the car, the other to the left, and each leading into a separate muffler under the floor of the tonneau. There is an equalizer tube between the two exhaust pipes just in front of the two mufflers.

The carburetor is located under the front floorboard to the right. An air intake tube conducted hot air into the carburetor, the air being heated in a circular device attached to the front of the water tank which is secured to the front of the dash under the hood. The intake manifold from the carburetor leads to a point between the flywheel and the rear of the engine and then branches off to the intake valve chamber of each cylinder.

The two cylinders are water-cooled, the water being circulated through a radiator (not the original design) and the tank by means of a pump driven by a flat belt on a pulley on the front end of the crankshaft. The pump is located at the lower right of the engine, while the radiator is in front. The present radiator has 15 horizontal pipes arranged in five tiers of three each, with cooling fins spaced along each pipe. The circuit of the water is from tank to pump to the bottom of the jackets on the cylinders, through the jackets and out the top to the left top of the radiator, and then through the radiator and out of its right top to the water tank.

The transmission, housed in a separate case behind the flywheel, is connected to the clutch in the flywheel by a short shaft, and to the differential by a drive shaft with a universal joint at each end. It is of the selective type, with two speeds forward and one reverse.

The gasoline tank and a battery box are under the front-seat cushion beneath a hinged wooden cover. The body is principally of mahogany.

On the rear of the dash are a Splitdorf 2-unit coil box, and a 1-quart lubricator, which is a horizontal, cylindrical tank with glass ends. Four oil pipes lead out of sight glasses at the bottom. One pipe leads to the crankcase, one to the differential pinion bearing, while the other two are no longer connected. A flow control for each pipe is at the top of the pipe.

In May 1954 four new tires and inner tubes, contributed by Harvey S. Firestone, Jr., were installed on the car, and the old ones that were on the car when it was presented to the Museum were discarded. In the winter of 1955–56 the car was put in running condition by the White Motor Co. branch of Arlington, Va., and in the spring of 1956 it was repainted, and reupholstered in black leather, by the Rite-Way Auto Painters of Washington, D. C., through the courtesy of the Autocar Division of the White Motor Co., Exton, Pa.

WHITE STEAM AUTOMOBILE, 1901
Gift of the White Co. in 1928 (USNM 309497)

This White steam car (fig. 57) was made by the White Sewing Machine Co., of Cleveland, Ohio, during the first year that White automobiles were manufactured. It bears a maker's plate carrying patent dates from September 22, 1896, to October 29, 1901, and showing it to be car No. 260.

Figure 57.—Steam automobile built in 1901 by the White Sewing Machine Co. of Cleveland, Ohio.

The engine is of the 2-cylinder, double-acting type with link reversing gear. Ball bearings are provided for the main journals and eccentrics. The slides and cross heads are hardened and ground and were lubricated from automatic oil cups. The cylinders were lubricated from a specially designed cup which held enough oil for about 10 hours of operation. The exhaust steam was muffled so as to be practically noiseless. No condenser was used, although this feature is found on the later White steamers.

The semiflash boiler consists of spiral coils of seamless tubing placed one above another and surrounded by a casing of heat-insulating material. The successive horizontal coils of tubing are connected by pipes passing up and over the top coil so that the water entering at the top cannot go through the coils by gravity but is held in place entirely subject to the action of the pump. The water entered and filled the upper coils, while the steam was formed in the lower coils and passed out of the lowest coil next to the fire. The upper coils acted as water heaters, and the water was converted into steam in the lower coils at a point which varied with the amount of steam being used by the engine. The steam was superheated in the lowest coil, resulting in higher economy of operation and practically invisible exhaust.

There was no fixed water level to be maintained and consequently no water gauge to be watched. The water supply was automatically controlled by the steam pressure, which avoided hand regulation of the fuel. An auxiliary hand water pump, located by the driver's right leg, was provided for use in starting or to replace the power water pump if the latter became inoperative. The water was carried in a 20-gallon copper tank back of and partially surrounding the casing of the boiler.

Gasoline was used as a fuel and was carried in a cylindrical tank of about 8 gallons capacity located under the footboard. It was forced through the vaporizing coil to the main burner by means of air pressure pumped up by hand. The air pump, located by the driver's left leg, could be operated from the seat. A 40-pound air-pressure gauge on the dash indicated the amount of pressure in the fuel tank. The burner was started with a pilot light. A small amount of gasoline was run into a drip cup and was then lighted with a match to heat the pilot light. The flame of this pilot light heated the vaporizing coil and lighted the main burner. The pilot light was kept burning while the car was in use.

The throttle was operated by a handle on a verticle shaft supported on the right side of the body to the driver's right. To open the throttle the handle was moved toward the rear.

The running gear consists of two highly arched axles, front and rear, of heavy seamless tubing, connected on each side of the car by two fore-and-aft reach rods of hickory. The front wheels, which are wire-spoked and carry 30-by-3½-inch clincher tires, turn on swiveled steering knuckles connected by a tie rod. The left knuckle is connected to the steering shaft, which is pivoted on the body and turned by a tiller. The rear wheels are identical to the front ones. The tread of the car is 52 inches and the wheelbase is 72 inches.

The driving axle at the rear is divided, an enclosed differential unit connecting the two halves. A chain connects the crankshaft sprocket of the engine with the driving sprocket of the differential. A contracting brake band on the differential is controlled by a pedal at the driver's right foot. A small hand lever by the driver's right leg is used to alter the position of the reversing links of the valve mechanism.

The body, a two-seater, is supported on the running gear by four full-elliptic springs, one at each corner of the body. Behind the seat is a horizontal tube, serving as a chimney, from the center of which another tube leads down to the fire box of the burner. The engine and boiler are beneath the seat, while the water tank is under the rear deck of the body. On the rear deck is a large wicker basket. Built in the rear of the body is a tool compartment with a hinged access cover at the back. A buggy-type top, two kerosene head lamps, and a kerosene tail lamp complete the equipment.

In May 1954 four new inner tubes, contributed by Harvey S. Firestone, Jr., were installed in the old but serviceable tires on the car, and the old tubes were discarded.

FRANKLIN GASOLINE AUTOMOBILE, 1902
Bought from the H. H. Franklin Manufacturing Co. in 1937
(USNM 311195)

According to a statement by the late H. H. Franklin, this is the third Franklin automobile built and the first one sold, two earlier cars having been retained by the factory for experimental purposes. Several years ago Mr. Franklin stated that it was sold originally for $1,250 to S. G. Averell, of Ogdensburg, N. Y. (fig. 58), and was bought back by Franklin in June 1916.

The angle-iron frame of the car has a 71-inch wheelbase and carries a 2-seated body of wood with leather upholstery. The air-cooled engine is mounted transversely at

Figure 58.—S. G. Averell in his 1902 Franklin automobile, the first Franklin sold, now in National Museum.

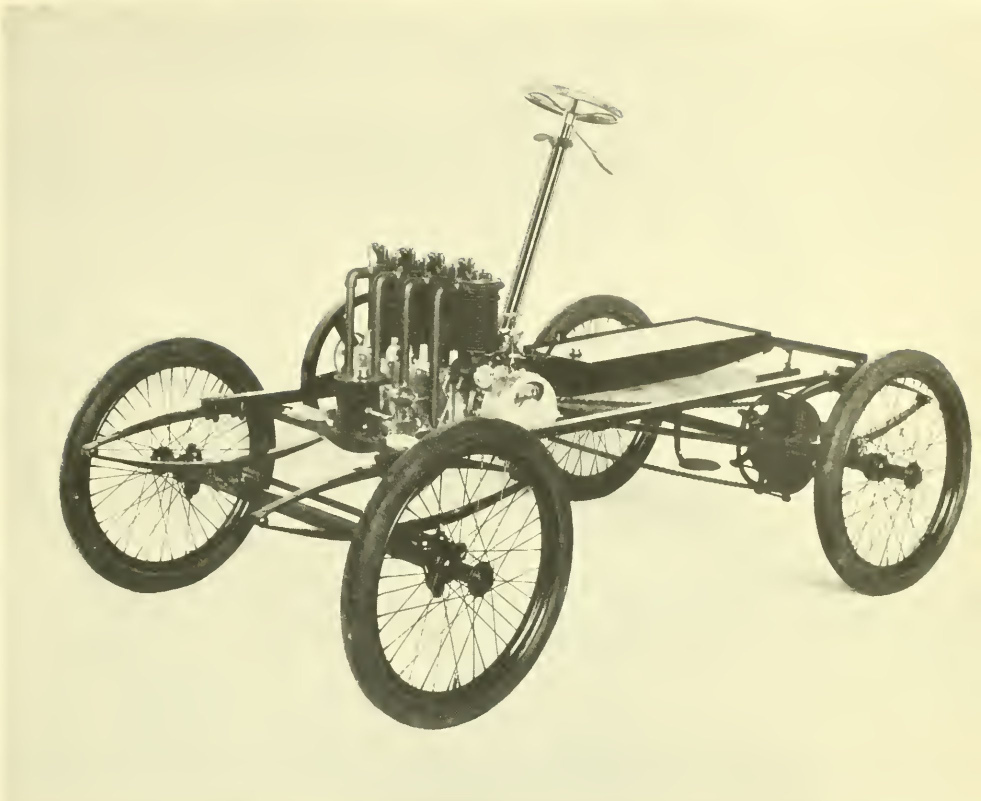


Figure 59.—Chassis of National Museum's 1902 Franklin car during restoration in early 1947.

the front of the frame (fig. 59). Front axle and rear-axle housing are tubular, with the rear-axle housing connected by stay rods to a center cross member of the frame. Four full-elliptic springs are used for the two axles. The wheels are wire-spoked, but the rims are not original, now mounting 30-by-3-inch clincher tires instead of 28-by-3-inch tires. The replacement rims are mounted over the original ones.

The exposed differential at the left of the center of the rear-axle housing is connected by a long chain to the planetary transmission at the left end of the engine. The brake pedal at the right actuates an external contracting band on the brake drum of the differential unit. Two large grease cups supply lubrication to the two rear-wheel bearings in the ends of the rear-axle housing.

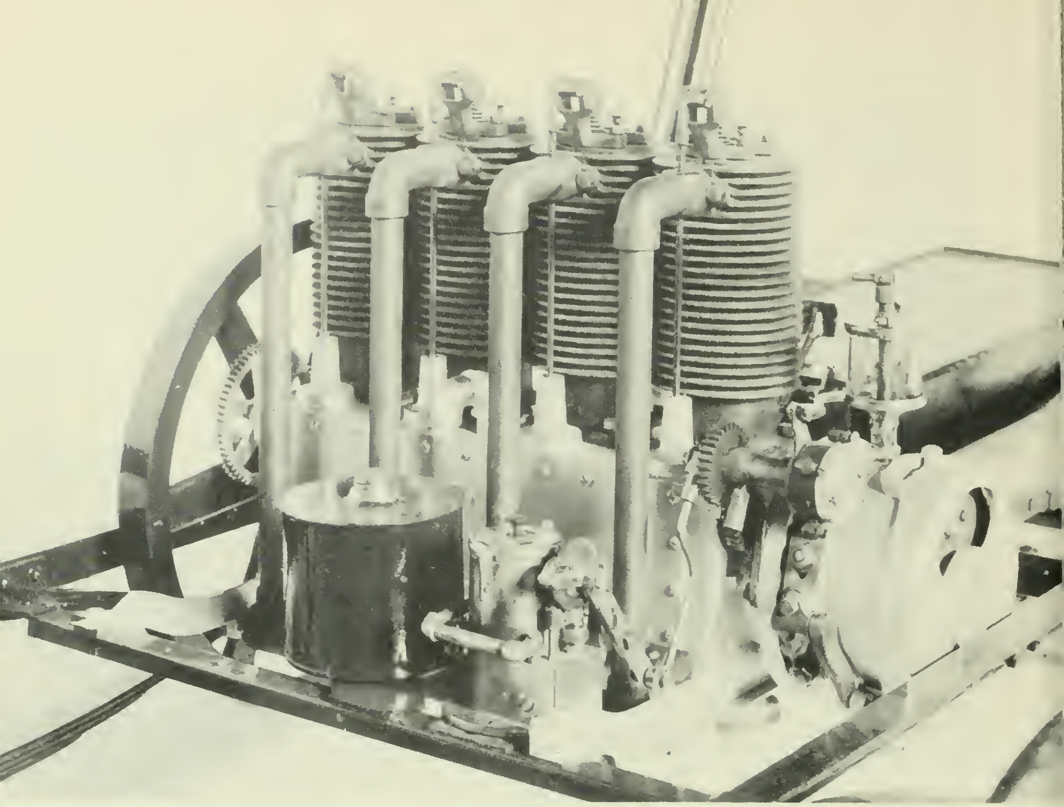


Figure 60.—The air-cooled, 4-cylinder engine of the 1902 Franklin car was rated at 7 horsepower.

The car is right-hand drive and is equipped with a steering wheel. A drag link crosses from the steering-gear box to the left steering knuckle. Two levers are supported on the column below the steering wheel. The right one is for spark control, and the left is for the carburetor throttle located in the vertical part of the intake manifold a foot above the carburetor. A fuel-mixture control handle from the constant-level, float carburetor extends through the floorboard. To its left is a spring-returned pedal for reversing the transmission. A lever at the right of the body shifts the forward gears of the transmission. The central position of the lever is for neutral, the rear position is for low speed, and the forward position is for high speed. Beneath the right side of the floorboard, and extending to the rear of the car, is a long, narrow gasoline tank. The muffler, which extends from the front of the car to the rear, is located in the center of the car, directly to the left of the gasoline tank.

The 7-horsepower engine (fig. 60), with four separately cast cylinders, has a bore of 3¼ inches and a stroke of 3¼ inches, and is equipped with integral horizontal cooling fins about one-sixteenth of an inch thick spaced three-eighths of an inch apart. The crankcase is of ferrous material and has a large, rectangular access cover at the front. The flywheel and hand crank are on the right end of the crankshaft.

The intake manifold on the rear side of the engine is mounted transversely, with the vertical riser containing the throttle valve at its center (fig. 61). The four exhaust pipes in front of the cylinders drop to a manifold, which connects to a pipe leading back to the muffler. There is one automatic, overhead intake valve and one pushrod-operated, overhead exhaust valve in each cylinder. Each of the four push rods passes through the horizontal portion of its exhaust pipe.

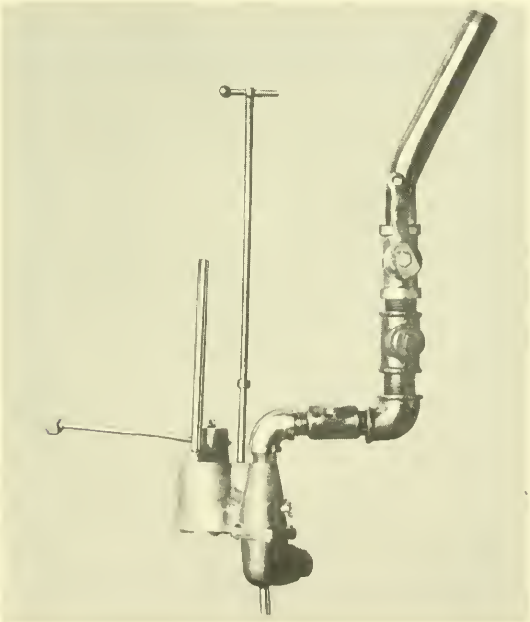


Figure 61.—Carburetor and throttle valve of 1902 Franklin.

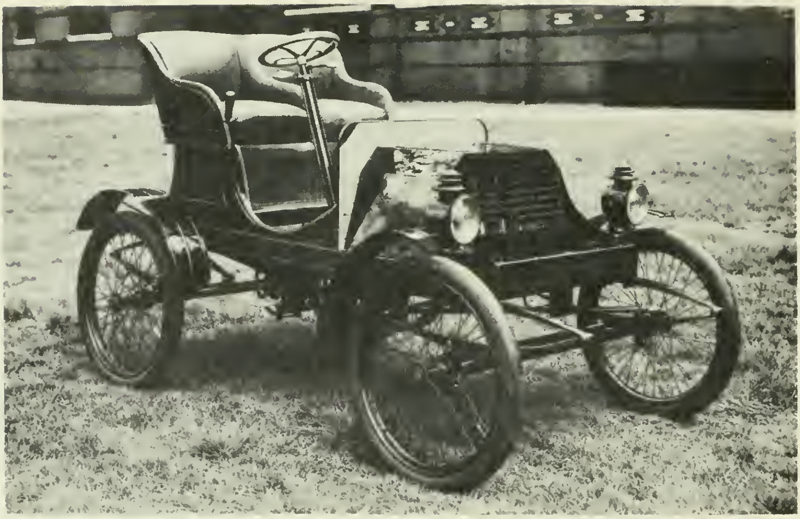


Figure 62.—1902 Franklin automobile in 1947, after restoration by staff of National Museum.

The camshaft is driven by external spur gears adjacent to the flywheel. The original ignition equipment has been replaced with a low-tension distributor, which is driven by the left end of the camshaft through external gears. An arm, mounted eccentrically on the timer gear, operates a ratchet-controlled, mechanical, pump oiler in front of the engine. The oiler discharged into the crankcase and, when adjusted properly, kept the oil level at the proper height. Splash lubrication was employed within the engine. A reserve oil tank next to the mechanical oiler kept the oiler filled.

This car was restored by the Museum staff early in 1947, at which time it was disassembled, cleaned, reassembled, and refinished. The leather upholstery was replaced, the woodwork was repaired where necessary, and the entire car was refinished with varnish-color brushed on (fig. 62). As the ignition coils were not original, but were replacements from a model-T Ford, they were left off the restoration. The wrapped-tread tires of about 1916 were retained, and were equipped with new butyl-rubber inner tubes donated by Harvey S. Firestone, Jr.

The car was acquired from the H. H. Franklin Manufacturing Co., of Syracuse, N. Y., in 1937, when the business was liquidated.

INDIAN MOTORCYCLE, 1902

Gift of the Indian Motocycle Co. in 1930 (USNM 309934)

The design of this machine (fig. 63) was conceived in 1901 by the noted bicycle racer Oscar Hedstrom for the Hendee Manufacturing Co., of Springfield, Mass., later to be known as the Indian Motocycle Co. This machine was made in 1902, the year that the model was first offered for sale. The engine number is 150.

The motorcycle is equipped with a 1¾-horsepower, 1-cylinder, 4-cycle, air-cooled, gasoline engine with an automatic intake valve and a cam-actuated exhaust valve. Dry cells, a coil, a timer, and a spark plug compose the ignition system, the timer being advanced and retarded by a small lever at the front of the frame on the steering head. This lever was used also for the compression release, lifting the exhaust valve from its seat when moved to the retarded position, and as an ignition switch. Another lever, on the frame cross bar, is designed for the fuel adjustment.

A float-equipped Hedstrom carburetor was supplied with gasoline from the tank on the rear fender. A section of the tank contained oil, which flowed by gravity through a sight glass into the crankcase. A small exhaust pipe leads to a muffler beneath the crankcase.

Power was transmitted from the engine to the rear wheel by a double-reduction sprocket-and-chain drive on the left side of the frame. As the machine has no clutch or change gear, the engine is connected to the wheel at all times. A pedal-and-chain drive, incorporating a New Departure coaster brake, is provided on the right side to supplement the engine. The brake is engaged by slight backward pressure on the pedals. The pedals remained at rest when the engine was propelling the machine.

The diamond frame is of tubular construction, the wooden-rimmed wheels mount 28-by-1½-inch, single-tube, pneumatic tires, and the complete machine weighs just under 100 pounds.

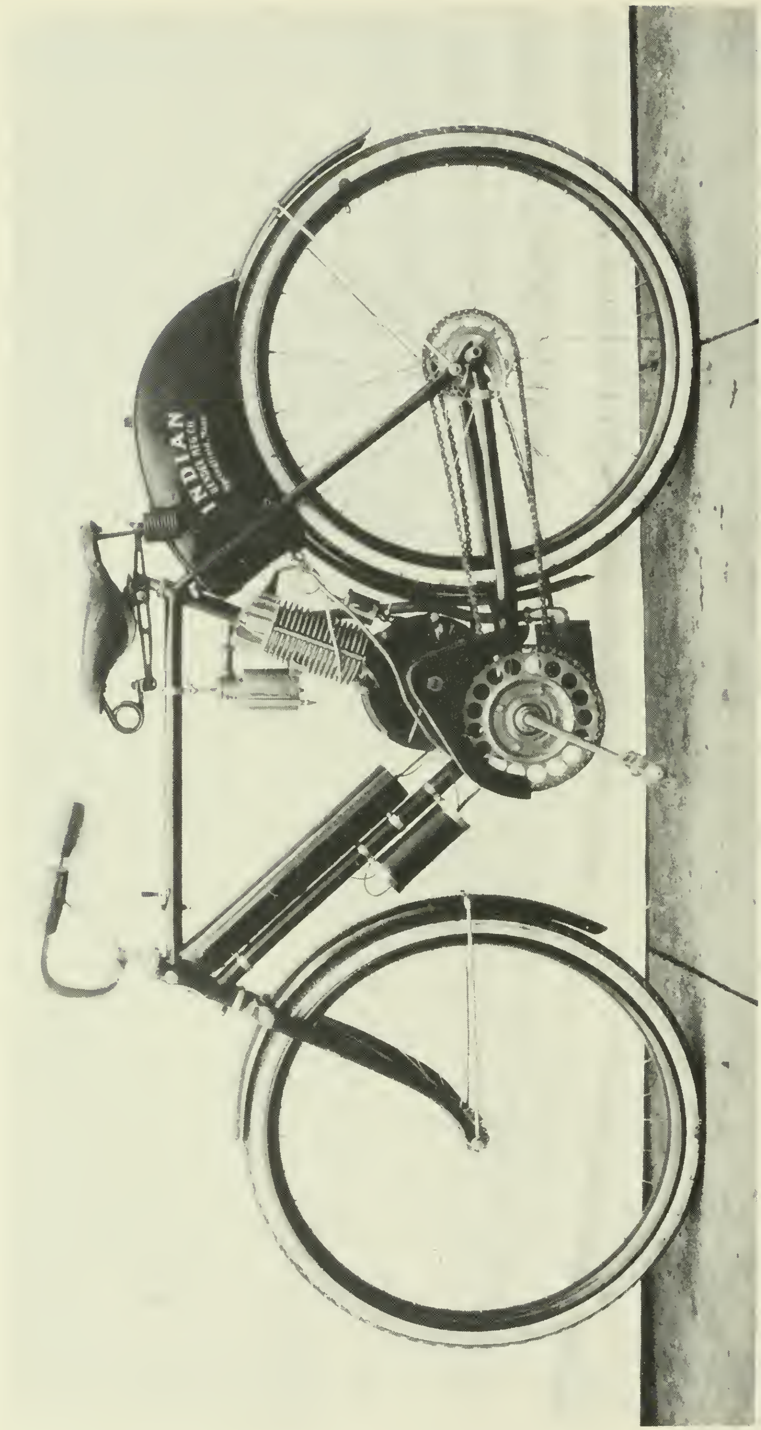


Figure 63.—1902 Indian motorcycle.

WINTON GASOLINE RACING AUTOMOBILE, 1902
Gift of the Winton Engine Co. in 1929 (USNM 309602)

This 4-cylinder racing car, built by Alexander Winton and known as the "Bullet No. 1," was Winton's second racing machine. He had previously built a 1-cylinder racing car for the first Gordon Bennett road race, held in France in 1900.

On September 16, 1902, at Cleveland, Ohio, Winton drove this car on a horse track (fig. 64) a distance of 10 miles in 10 minutes 50 seconds. This was an average speed of 55.38 miles an hour, a very creditable showing for that time. Again, on March 28, 1903, at Daytona Beach, Fla., Winton covered a mile in 52.2 seconds, an average speed of 68.96 miles an hour. Figures 65 through 67 show Winton with the car at that time.

Figure 64.—Alexander Winton driving the Winton "Bullet No. 1" on a dirt track at Cleveland, Ohio, in 1902. This is not the Cleveland track on which he broke several records that year.

The car as now exhibited is a little the worse for the wear and neglect of former years, and some parts are missing. However, the engine and the rear-axle gearing are free to turn over, the clutch can be depressed, and the transmission gear shifted.

The massive, water-cooled, 4-cylinder engine has a bore of 6 inches and a stroke of 7 inches, with a total piston displacement of 792 cubic inches. It is mounted at the front

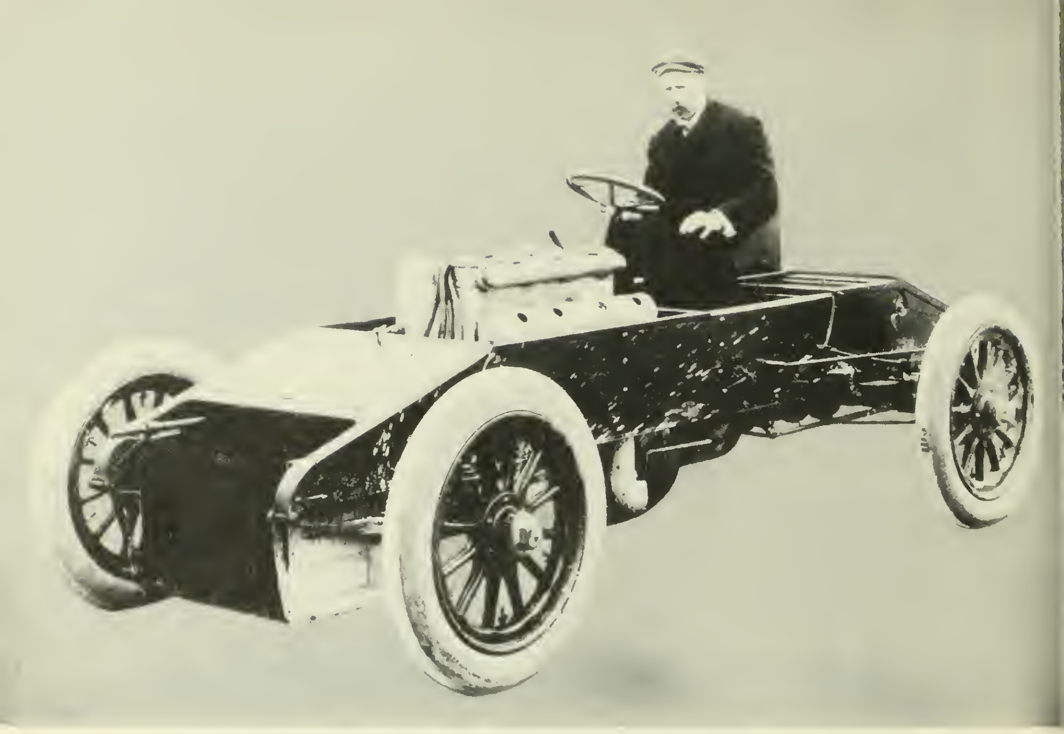


Figure 65.—Alexander Winton at the wheel of the "Bullet No. 1." This and the two succeeding photographs were made at Daytona Beach, Fla., in March 1903.

Figure 66.—Alexander Winton at Daytona Beach, Fla.

Figure 67.—Alexander Winton at Daytona Beach, Fla. The hood shown over the engine is no longer with the car.

of the chassis, with the crankshaft parallel to the sides of the frame. Two support arms on each side of the engine, cast integrally with the crankcase, support the engine in the frame. The crankcase and the base are of aluminum, while the 1-piece water jacket of the four cast-iron cylinders is formed of brass sheeting screwed in place, all of which aided materially in reducing the weight of the machine. Other aluminum parts of the engine are the timing-gear cover at the front, the intake manifold and the covers for the cages of the overhead intake valves, the water pump, the carburetor, and the base of the air pump.

The engine is of the 4-cycle type, with camshaft-actuated exhaust valves on the left side and automatic, overhead intake valves located directly over the exhaust valves. The carburetor is on the right side of the engine and is connected to the intake manifold on the left by a vertical riser leading up the right side and over the top of the engine (figs. 68 and 69). The exhaust ports lead to a heavy sheet-metal exhaust manifold, which in turn is connected to a large muffler under the left side of the car. A cut-out is fitted to the rear of the

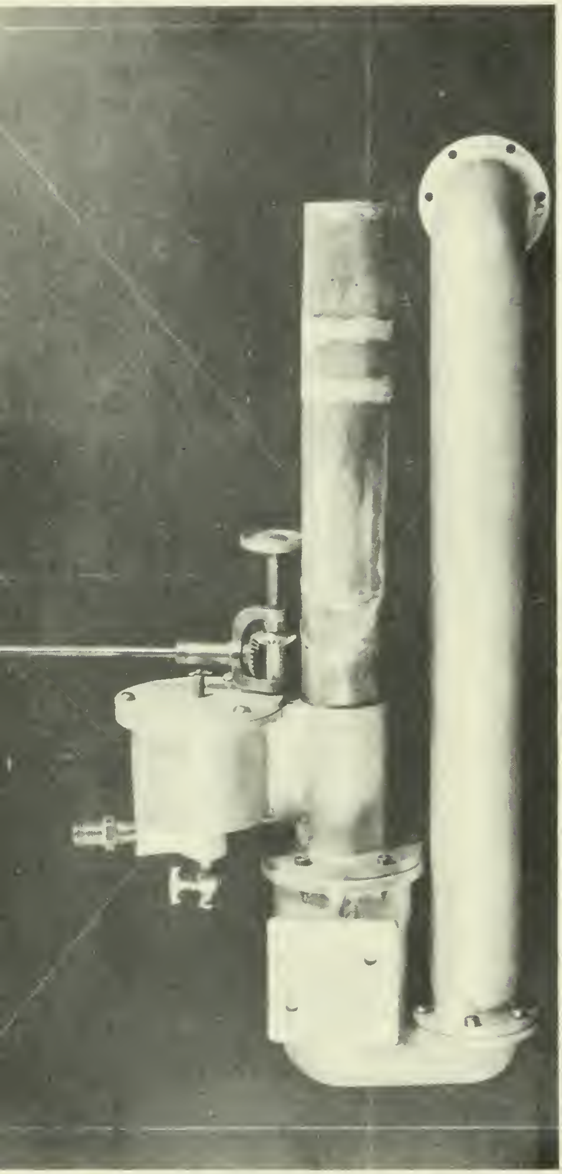


Figure 68.—Carburetor and part of intake manifold of Winton "Bullet No. 1."

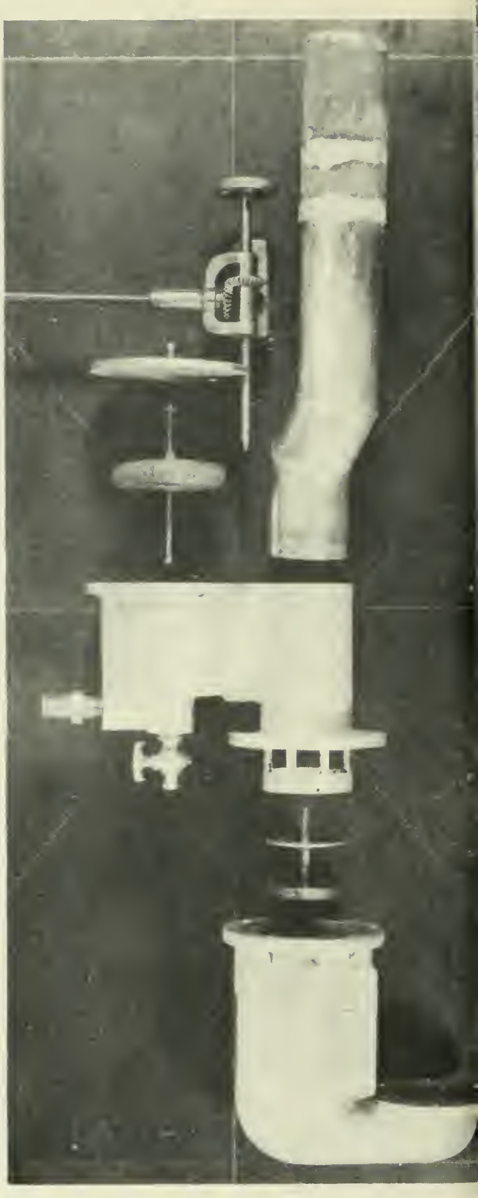


Figure 69.—Exploded view of carburetor of Winton "Bullet No. 1."

muffler and is controlled by a lever at the front of the driver's seat. The muffler was not always on the car; it was often removed for racing, as shown in figure 65.

A crank throw on the forward projection of the crankshaft drives a reciprocating-piston air pump (figs. 70 and 71), which supplied compressed air for the unique system of controlling the engine speed. When the engine was running, compressed air was supplied to the lower ends of small cylinders enclosing pistons on the stems of the four intake valves. The air pressure opposed the motion of the valves as they were being drawn open by engine suction. Two relief valves, one a foot plunger, the other a

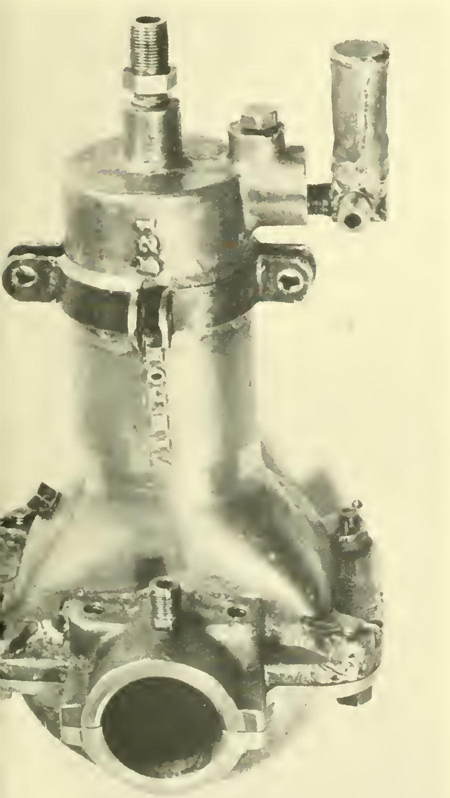


Figure 70.—Pump that supplied compressed air used to control opening of intake valves on engine of Winton "Bullet No. 1."

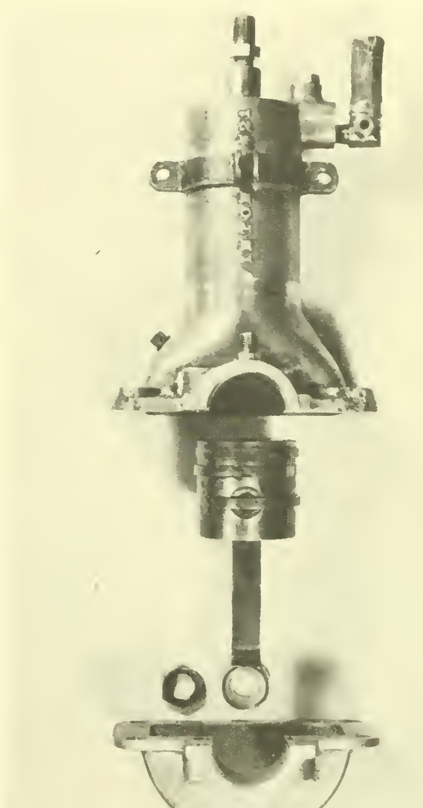


Figure 71.—Exploded view of air pump of Winton "Bullet No. 1."

hand valve, were used to vary the pressure on the valve pistons and so control the speed of the engine. As the air pressure was reduced, the valve opening and the engine speed were increased. The aluminum, float-equipped carburetor contains no throttle valve.

An oil reservoir of sheet brass, secured to the right side of the engine, delivered oil by gravity to a 16-unit, sight-drip oiler (fig. 72) located at the front of the engine above the air pump. A shut-off valve is placed between the reservoir and the oiler. Each unit of the oiler is equipped with a sight glass and a metering adjustment. The oil dripped by gravity to the camshaft and engine bearings, to the timing gears, to the cylinder walls, and to the bearing surfaces of the air pump.

To the left of the air pump is a large, hard-rubber, low-tension ignition timer (fig. 73), driven from within the timing-gear cover. The timer can be advanced and retarded by means of a lever placed near the steering column and within reach of the driver. It is not known now where the coils and battery were located. A threaded spark-plug hole is provided in the top of each cylinder, above the center of each piston.

Also driven from within the timing gear cover is the centrifugal water pump attached to the left side of the crankcase. The discharge opening of the pump leads into the left section of the water jacket of the engine. The cooling water passed from the top of the right section of the water jacket to a water tank secured to the right side of the engine behind the oil reservoir, then to the upper right portion of the radiator, and from the lower left of the radiator back to the pump. The water tank has an overflow pipe and a filler opening for the entire water system.

The radiator, placed low at the extreme front of the car, consists of 54 horizontal tubes arranged across the front, six rows deep and nine rows high, each tube carrying dozens of cooling disks pressed into place. The adjacent ends of the tubes are connected by cast aluminum header plates on each side of the radiator. As each plate incorporates diversion channels, the flow of water from side to side was controlled. The water tank is formed of sheet copper with soldered seams.

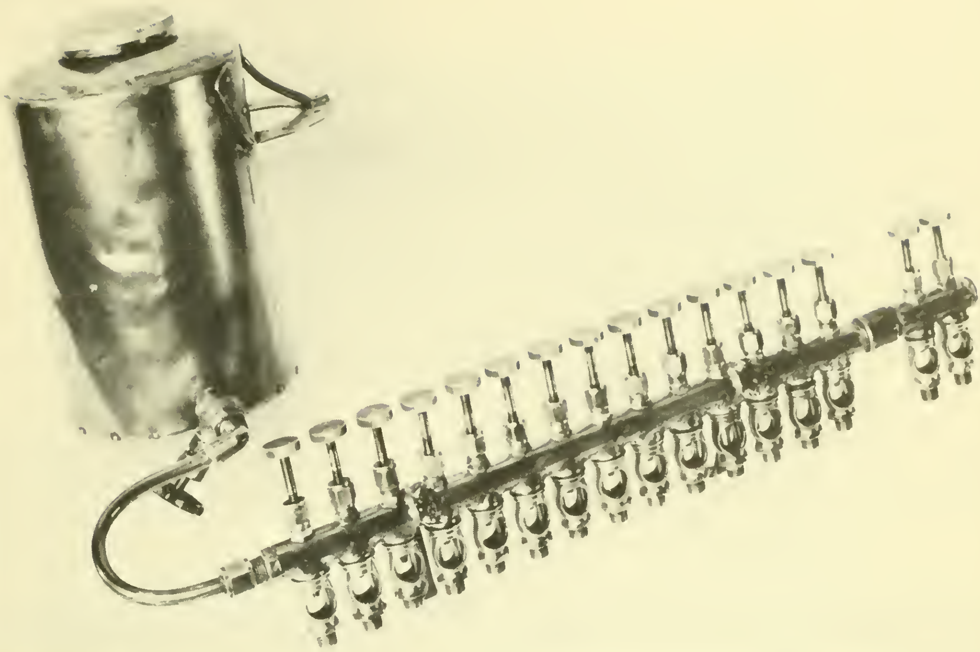
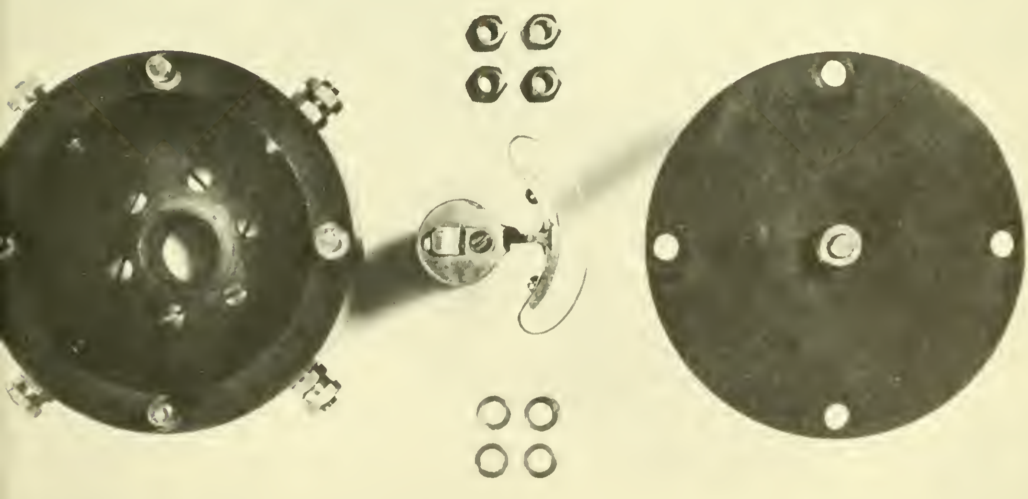


Figure 72.—Sight-drip oil feed and supply tank for engine of Winton "Bullet No. 1."

Figure 73.—Exploded view of low-tension ignition timer for engine of Winton "Bullet No. 1."



A shaft for a starting crank extends over the right side of the radiator. A gear is fitted to the rear end of the shaft in proximity to a similar gear secured to the extension of the crankshaft, directly behind the air pump. A large idler gear, normally out of engagement with these two gears, is mounted loosely on a short shaft so that when moved rearward it will engage them, allowing the engine to be cranked. The linkage controlling the motion of the idler gear is missing. The starting crank is 18 inches long, with a left-hand ratchet incorporated in the shaft end. This form of ratchet and the arrangement of the rear-axle gears indicate that the engine ran in a counterclockwise direction, rather than in the usual clockwise manner as viewed from the front.

The frame of the car consists of two wooden rails 2 inches thick and 3½ inches high, rigidly positioned by the four engine arms and the four arms of the transmission. One wooden cross member is placed at the rear of the frame.

The transmission housing, its integral supporting arms, and its cover plate are of aluminum. The transmission, located in the center of the frame behind the heavy, 20-inch flywheel of the engine, provides two forward speeds and one reverse. The progressive speed changes are effected by one sliding gear on the keyed mainshaft within the housing. When it is in the rear position, it engages an idler gear, which reverses the drive. With the gear in the center position, low speed is obtained. Direct drive, without involving gearing, is obtained when the gear is in its forward position. Shifting of the gear is effected by moving the inner of two vertical levers at the right of the driver's seat. A locking handle on the end of the lever must be squeezed to lift an arm out of one of four notches when a shift is required, the notches representing reverse, neutral, low, and direct drive. The gears ran in lubricant.

The clutch, located within the flywheel, is a leather-faced cone disengaged by forward motion. It is held engaged by a very heavy coil spring. The clutch is disengaged by depressing the brake pedal or by pushing forward the hand brake lever. The foot brake operates internal expanding shoes within the bronze brake drums attached to the rear wheels, and the hand brake was formerly connected to external contracting bands on the same drums. The

Figure 74.—Steering wheel, column, and gear box of Winton "Bullet No. 1."

hand system now lacks the brake rods and one of the bands. A ratchet and pawl holds the hand brake engaged.

The rear-axle gearing is completely enclosed within a bronze housing, and the axle shafts are within tubular steel housings. The bevel gears and the differential ran in lubricant. The driving gear has 35 and the driven gear 37 teeth, very nearly a 1-to-1 ratio. A divided truss rod beneath the differential housing helps support it. Semielliptic springs, with full shackles at each end, attach the axle housing to the frame. Radius rods at each side connect the housing to the sides of the frame, while two torque arms to the right of the gear housing are connected to the transmission right rear support arm. The transmission is connected to the rear-axle gearing by a short telescoping drive shaft with a universal joint at front and rear. The two pieces are keyed together to allow the smaller diameter shaft at the rear to slide backward or forward within the hollow front portion.

The front axle is a solid steel forging with a kick-up at each end. It is held in place by two semielliptic springs with full shackles at their rear ends. Spindles on the ends of the axle are connected by a tie rod. The aluminum steering gear housing (fig. 74) contains a double-threaded worm and sector (fig. 75), the pitman arm of which is connected to the right spindle by a long drag link. The steering wheel has four spokes and a hub of bronze. The spring hangers for the six full shackles of the four springs are also bronze. The four wooden-spoked wheels carried clincher tires 22 inches in inside diameter. The wheelbase is 98 inches and the tread 56 inches.

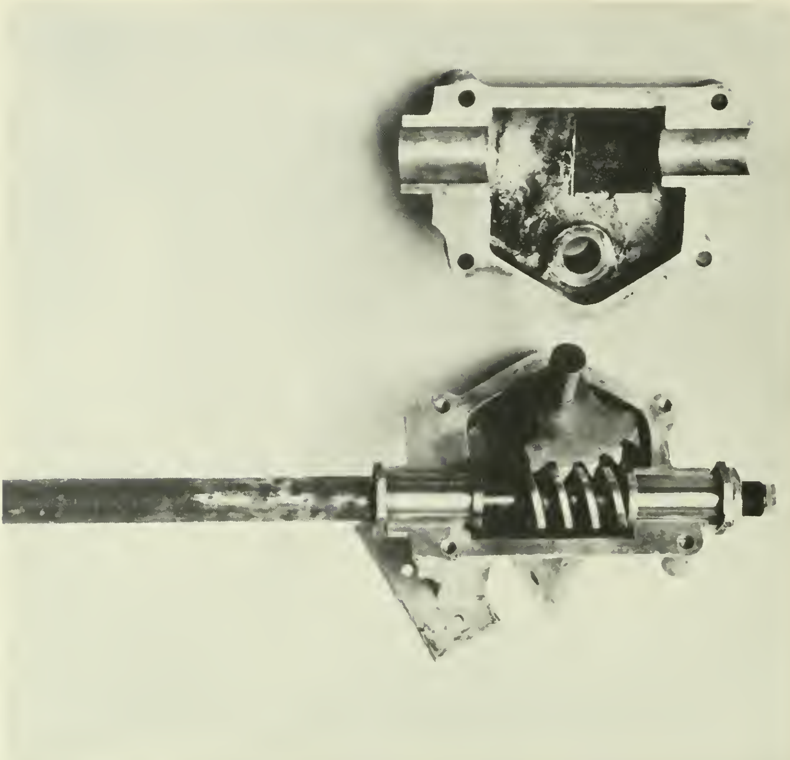


Figure 75.—Disassembled steering-gear box of Winton "Bullet No. 1."

A low wooden body, originally equipped with an engine hood, is fitted to the frame. A single seat is now secured on the right of the body. Beneath the seat is a sheet-copper gasoline tank. The seat must be removed to gain access to the filler cap of the tank. A hinged, rectangular, sheet-aluminum cover is located above the distributor and the air pump.

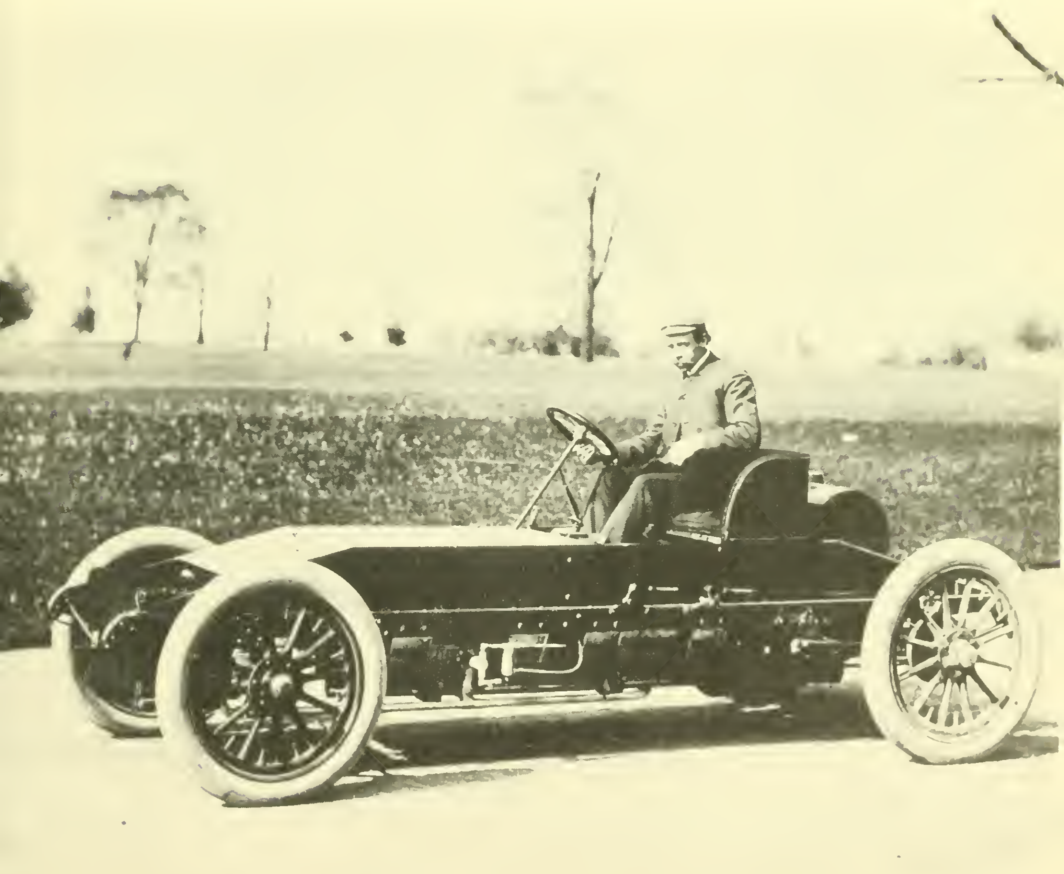
This Winton, one of the foremost racing cars of its day, and one of the oldest racing automobiles in existence, was not a converted passenger vehicle, as was so often the case at that time, but was a carefully designed machine intended for racing only. An examination reveals that none of the parts appear to have been added as afterthoughts. Ornate wooden scrolls and paintwork, apparently considered necessary by the body builders, are incongruous notes in an otherwise strictly functional design.

WINTON GASOLINE RACING AUTOMOBILE, 1903
Gift of the Winton Engine Co. in 1929 (USNM 309603)

This car (fig. 76), called "Bullet No. 2," and one of the first automobiles to use an 8-cylinder, in-line engine, was the third racing car constructed by Alexander Winton. It was built for the fourth Gordon Bennett road race, held in Ireland in 1903 (fig. 77), and was driven in that race by Winton until a minor mechanical failure forced it to withdraw. Others, including Earl Kiser and Barney Oldfield (fig. 78), drove the car in various contests in the United States, Oldfield covering a mile in 43 seconds at Daytona Beach, Fla., on January 28, 1904. This is equivalent to 83.7 miles an hour, very close to the world's speed record at that time.

The power plant consists of two 4-cylinder, in-line engines bolted together to form a straight-eight with the cylinders lying in a horizontal plane. The bore and stroke are 5¼

Figure 76.—Alexander Winton in the Winton "Bullet No. 2."



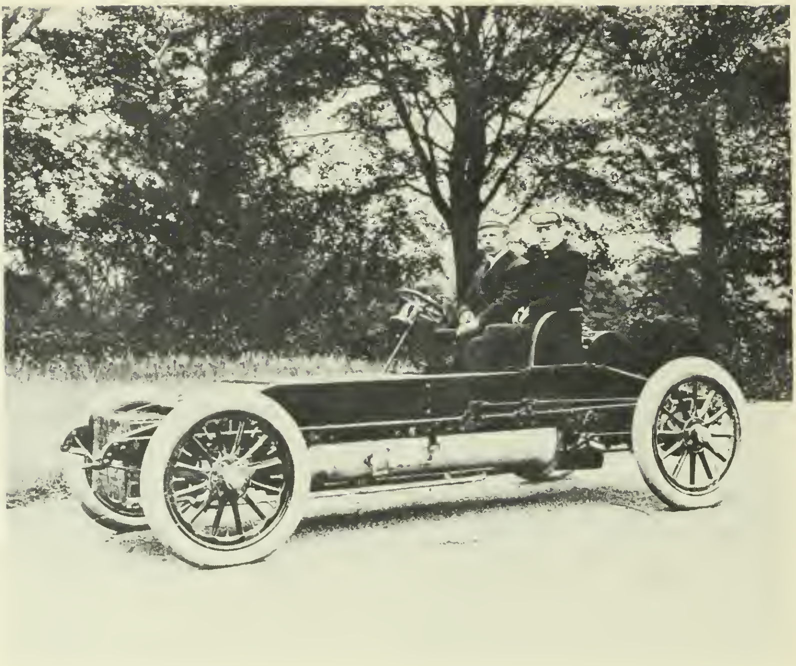


Figure 77.—Alexander Winton and John J. Jack in the Winton "Bullet No. 2" at Kilcullen, Ireland, in 1903.

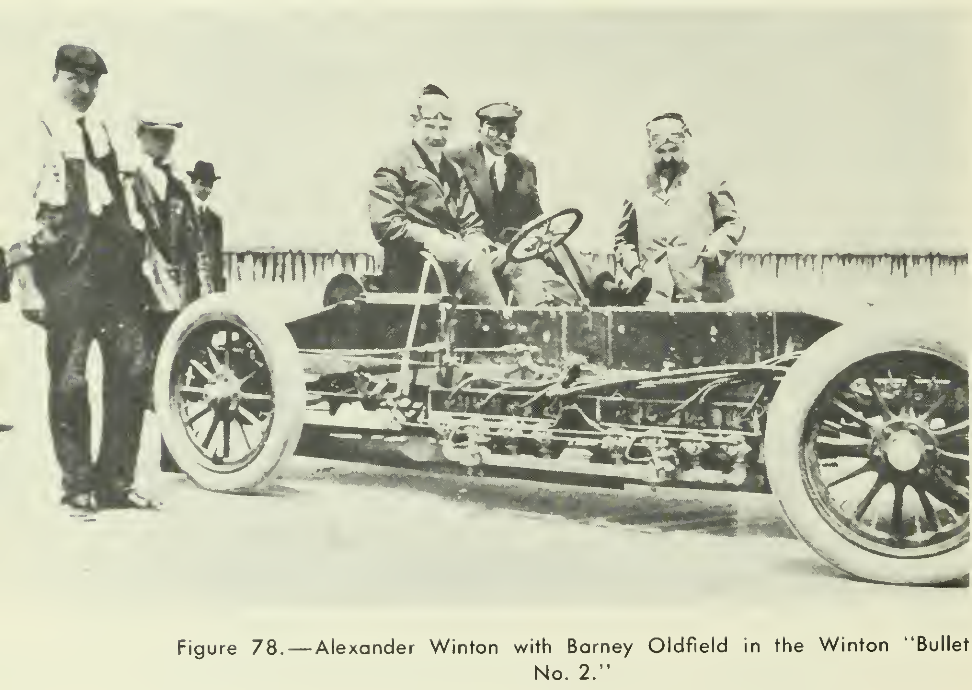


Figure 78.—Alexander Winton with Barney Oldfield in the Winton "Bullet No. 2."

and 6 inches, respectively, with a total piston displacement of 1,029 cubic inches. The engine is mounted in the center of the chassis, with the crankshaft parallel to the sides of the frame. The two aluminum crankcases are attached to the left frame member by four integrally cast arms, while the two 4-cylinder blocks are secured to the right frame member.

The two crankshafts are bolted together in the space between the two crankcases, as are the two camshafts. Leading up between the two engines, and driven by the camshaft, is a shaft attached to the ignition distributor, now incomplete.

The engine is of the 4-cycle type, with cam-actuated exhaust valves lying horizontally at the bottom right of the engine. To the right of the exhaust valves are the automatic intake valves, which would be overhead valves if the engine were mounted upright. Each 4-cylinder block is fitted with an aluminum intake manifold, both of which are now damaged. The two carburetors are missing. There are no exhaust manifolds, the spent gases having been exhausted directly into the open, beneath the blocks. The engine ran in a clockwise direction.

Access plates are located over each of the eight throws of the crankshaft, enabling ready inspection of the bearings. Each 4-cylinder unit is equipped with five main bearings.

A sheet-brass oil reservoir, with a shut-off valve, is secured above the front cylinders. It delivered oil by gravity to a float-equipped, constant-level oiler on each set of cylinders. Oil then flowed by gravity from these two oilers to the ten main bearings, the eight cylinder walls, the timing gears, and the air pump.

Secured to the outside of the crankcase of the front engine is an air pump operated by a rod connected to the skirt of the third piston. When the engine was running, compressed air was supplied to the pistons on the ends of the eight intake valves to control the amount of their being drawn open by the engine suction. Two relief valves, one a foot plunger, the other a hand valve, served to vary the pressure as desired. The lower the pressure, the farther the intake valves would be drawn open, and the faster the engine would run.

An aluminum centrifugal water pump is secured beneath each engine. Each is now in a damaged condition. The pumps are connected by a shaft, and the front pump is driven by a shaft extending back from the aluminum cover provided for the timing gears at the front of the engine. The water jackets of the two blocks are formed of sheet aluminum, while the water manifolds are aluminum castings. A water tank, of sheet brass, is integral with the top water jacket of the front cylinders. It contains the filler cap and an overflow pipe for the entire water system.

The radiator, placed low at the extreme front of the car, consists of 42 horizontal tubes arranged across the front, six rows deep and seven rows high, each tube carrying dozens of cooling disks. The adjacent ends of the tubes are connected by cast aluminum header plates on each side of the radiator. The cooling water passed from the top water jackets of the cylinders into the water tank, then to the upper right portion of the radiator, and from the lower left of the radiator back to the two pumps. The pumps discharged into the bottom water jackets of the cylinders.

The low-tension ignition timer was advanced and retarded by a small lever at the driver's seat, but a connecting link is now missing. It is not known now where the battery was located, but the eight coils were secured to the inside of the body above the rear crankcase. Only four incomplete coils now remain in place. A threaded spark-plug hole is provided in the center of each cylinder head.

The frame of the car consists of two wooden rails 2 inches thick and 3½ inches high, rigidly secured by the two engines; and of two wooden cross members, one at the front and one at the rear.

The rear-axle gearing is completely enclosed within a bronze housing, and the axle shafts are within tubular steel housings. The bevel gears and the differential ran in lubricant. The gear ratio is approximately 1¼ to 1. A divided truss rod beneath the differential housing helps support it. Semielliptic springs, with full shackles at each end, attach the axle housing to the frame. Radius rods at each side connect the housing to the sides of the frame, while two parallel torque arms connect the housing to the rear chassis cross member. Three grease cups are fitted to the differential housing, providing lubrication for the pinion bearing and the differential bearings. Leather rebound straps, both ends of which are attached to the frame, pass beneath the axle housings on each side of the differential.

The front axle is a solid steel forging with a kick-up at each end. It is held in place by two semielliptic springs with full shackles at their rear ends. Spindles on the ends of the axle are connected by a tie rod. The aluminum steering gear housing contains a worm and sector, the pitman arm of which is connected to the right spindle by a drag link 4 feet long. The steering wheel has six spokes and a hub of aluminum. Two leather rebound straps pass beneath the front axle. The four wooden-spoked wheels carry 34-by-4½-inch clincher tires. The wheelbase is 111 inches and the tread 56 inches.

There is no change-gear box, as only direct drive is provided for forward speed. A large metal clutch disk is connected to the rear-axle gearing by a short drive shaft with two universal joints. The disk, of the same diameter as the flywheel at the rear of the engine, and with gear teeth cut around its edge, is immediately behind the flywheel and can be connected to it by means of a clutch of the internal-expanding shoe type.

Reverse is effected by the use of a 6-foot-long auxiliary shaft lying at the upper left of, and parallel to, the engine, and extending from the front end of the crankshaft to the metal disk just behind the flywheel. A small sliding gear is keyed on the rear end of the auxiliary shaft, and can be meshed with the toothed disk by moving forward a short lever at the rear of the coil box. Another small gear, fitted to the front end of the crankshaft, meshes with an idler gear, which in turn is meshed with a gear on the front end of the auxiliary shaft. A clutch, built into the hub of this latter gear, can be engaged by moving forward a long lever to the left of the driver.

When reverse is desired, the main clutch in the flywheel must be disengaged by moving forward a short distance the long lever to the right of the driver; then the gear on the rear of the auxiliary shaft must be engaged; and finally the clutch in the hub of the gear on the front of the shaft must be engaged. Power would then be transmitted from the front of the engine to the drive shaft via the auxiliary shaft, with the drive shaft turning in a counterclockwise direction as viewed from the front.

A shaft for a starting crank extends forward from the crankshaft and passes through a space provided between the radiator tubes.

Brake drums, probably of cast iron, are attached to the rear wheels. Pushing the long clutch lever forward to the limit of its travel contracts external bands on the drums. Pulling the lever back releases these bands and engages the clutch in the flywheel. Internal shoes within the drums are expanded by depressing a pedal by the driver's left foot.

A low wooden body, the sides sheathed with sheet aluminum, is fitted to the frame. A single wooden seat is secured to wooden planking on the right. A cylindrical gasoline tank containing a shut-off valve and a filler opening is located behind the seat. A rectangular sheet aluminum cover is attached to the body behind the tank, with another at the front of the car, the latter hinged to open for inspection. Another hinged aluminum cover was formerly mounted directly behind it but is no longer in place.

Like its predecessor, this racing car was a machine designed for high-speed performance. Contemporary photographs reveal that the car's design underwent slight changes from time to time, as an additional lever once existed to the right of the driver's seat, and the seats themselves are not the original ones. Figure 79 shows the car as it appeared many years after it had been withdrawn from racing. Many parts, including the carburetors, are now missing from the relic.

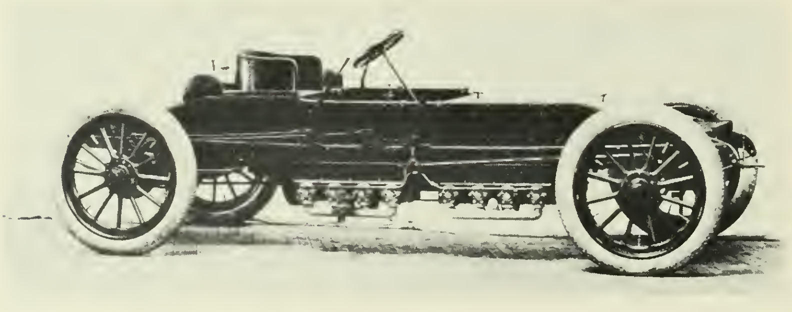


Figure 79.—Photo made in the Winton factory of the "Bullet No. 2" some years after its retirement from racing.

WINTON GASOLINE AUTOMOBILE, 1903
Gift of H. Nelson Jackson in 1944 (USNM 312831)

The first trip from coast to coast across the continent in an automobile was made in 1903 by H. Nelson Jackson driving this Winton, assisted by Sewall K. Crocker (fig. 22). The trip, from San Francisco, Calif., to New York City, occupied 63 days, only 44 of which were used in traveling. The car, purchased secondhand in San Francisco by Jackson, left that city on May 23 and reached New York on July 26 after having traveled over roads and trails that would be impassable for the modern, low-slung passenger automobile.

The water-cooled engine is of the 2-cylinder, 4-cycle, horizontal-opposed type located near the center of the frame, beneath the left seat. The bore is 5¼ inches, and the stroke 6 inches. The flywheel is located in about the center of the vehicle; it rotated in a vertical plane parallel with the sides of the frame. It is 24 inches in diameter, with a rim 2½ inches thick and 3½ inches wide. The engine is suspended in place from two chassis cross members.

Each cylinder is fitted with a carburetor, one of the earliest instances of multiple carburetion on a standard-production machine. An exhaust pipe leads from each cylinder to a common muffler, the latter equipped with a cut-out operated by a small lever in front of the driver's seat. On the left side of the engine is an enclosed train of gears which drives the two exhaust camshafts, the water pump, and the ignition timer. The timing-gear cover is of aluminum.

The water system includes the water jackets on the two cylinders, the centrifugal pump of aluminum, a radiator, and a water-storage tank, together with the necessary piping. The radiator, composed of horizontal tubing fitted with radiating disks, is placed in the front of the car and behind an opening in the wooden hood fitted to the body at the front.

Behind the radiator is a cylindrical tank made of two separate sections, the left one for water. A filler cap is provided at the top of the tank, while an overflow pipe is located within the tank. A pipe from the water jackets at the top of the engine cylinders leads to the bottom of the radiator. The top of the radiator is connected to the side of the water tank, while a pipe connects the bottom of the tank to the pump, the case of which is cast integrally with the water manifold at the bottom of the two cylinders.

From the bottom of the gasoline section of the tank a pipe carried the fuel to both carburetors. A shut-off valve handwheel is located on the top of the tank, next to the filler cap. Access to both tanks is by means of a hinged aluminum cover in the top of the wooden hood.

The carburetors, which are of rather massive construction, have float bowls equipped with cork floats. Parts of the carburetors are of aluminum, and each carburetor incorporates the intake valve for its cylinder. These valves are of the automatic, suction type and are controlled in the amount of their opening by an air-pressure system similar to that on the Winton "Bullets." An air pump, located by the rear engine cylinder, is operated by a rod connected to the skirt of the piston of the front cylinder.

When the engine was running, air was compressed, and this compressed air was supplied to the two intake valves to control the amount of their being drawn open. A foot-operated plunger and a hand valve are connected to the piping, and by opening either one the pressure was caused to drop according to the amount of opening. The lower the pressure, the more the intake valves would open, and the faster the engine would run. The carburetors contain no throttle valves.

Each cylinder of the engine has a compression release in the form of a petcock. Each petcock is operated by means of a long rod reaching to the right side of the body beneath the seat and floorboard, where the person cranking the car can easily control them. When the petcocks are closed the rods are held in the proper position by clips to prevent accidental opening.

The ignition system consists of a spark plug in each cylinder, a low-tension timer, a Jefferson spark coil, a battery, and a switch. The timer can be advanced and retarded by means of a small lever located to the right of the muffler cut-out lever.

The transmission, located to the right of the engine, and with its mainshaft in line with and connected to the engine crankshaft, is a very advanced design for its time. The housing, of aluminum, with an easily removed cover of the same material, is cubical and contains two parallel shafts. On each shaft are three wide-faced spur gears placed so that the gears on one shaft are constantly meshed with the opposite gears on the other shaft. An idler gear is interposed between the two gears of the right-hand set for reverse. The first gear on the mainshaft is free to rotate on the shaft. An extension of this gear hub, outside the housing, is integral with the driving sprocket located between the housing and the flywheel. The mating gear is pinned to the countershaft. The other two gears on the mainshaft are pinned to it, while their mating gears are free to turn on the countershaft. Each of the three gears that are free to turn is, however, fitted with a clutch in its hub, so that by clutching the proper gear a low speed, a high or direct drive, or a reverse drive can be obtained.

Two vertical clutch levers are provided at the right of the driver's seat. By pulling the left lever back, low speed is obtained by clutching the center gear of the countershaft to that shaft. By pushing the left lever forward, reverse is obtained by clutching the right gear of the countershaft to that shaft. By pulling the right lever back, direct drive is obtained by clutching the left gear of the main shaft, and hence the driving sprocket, directly to the crankshaft extension. By pushing the right lever forward, a band brake is contracted around a brake drum attached to the driving sprocket.

A starting hand crank fits onto the right extension of the mainshaft, at the right side of the body. Oil, supplied from a sight-drip oiler on the dashboard, dripped into a set of holes in brackets within the transmission to lubricate the bushings. The gears rotated in this same lubricant. A drain plug is located in the bottom of the housing. It can be seen that this transmission is a logical development of the earlier one described for the 1898 Winton.

The frame of the car consists of angle-iron sections comprising the two side members and the front and rear cross members. Other cross members support the engine and the steering-gear housing in the frame. The steering-gear housing is of aluminum and contains a completely enclosed worm and sector. The worm is turned by a column to which is attached a steering wheel that can be tilted up to give easier access to the driver's seat. The sector is attached to a short pitman arm, which in turn is attached to the left front wheel spindle by a transverse drag link. The front axle, a solid bar, is attached to the frame by two semielliptic springs, one at each side. Full shackles are used only at the rear ends of these two springs. Spindles attached to each end of the axle are connected by a tie rod behind the axle.

The rear axle is of the tubular variety, with enclosed half axles and exposed differential unit, the sprocket of which is driven by a chain from the driving sprocket on the output shaft of the transmission. The rear-axle assembly is externally strengthened by three truss rods. It is attached to the frame by two semielliptic springs, one on each side. Full shackles are used at each end of each spring, and two external, adjustable, radius rods are therefore fitted to the axle assembly to prevent forward and backward motion. A brake drum is attached inside each rear wheel. Contracting bands on the drums are controlled by a pedal that can be locked in the depressed position through the use of a multiple-toothed ratchet incorporated in the pedal. The pedal pivots on the front engine support and is returned to the off position by a long, narrow coil spring.

The four wheels are of the wooden-spoked type with nondemountable rims. Fitted to the rims are 32-by-4-inch clincher tires. New inner tubes, contributed by Harvey S. Firestone, Jr., in May 1954, allow the ancient tires to remain inflated. The wheelbase of the car is 91 inches and the tread 56 inches.

The sight-drip oiler consists of a horizontal, cylindrical, brass tank secured to the dashboard in front of the driver; it is capable of holding about 1 quart of oil. Six oil lines, each incorporating a small sight glass, lead from the bottom of the tank. At the top of the tank are six adjustable valves that enable the flow of oil to be metered or shut off. The first and third lines from the right lead into the transmission, while the fifth and sixth lead to the main bearings of the engine. The second and fourth are now disconnected, though the fourth probably led to the air pump.

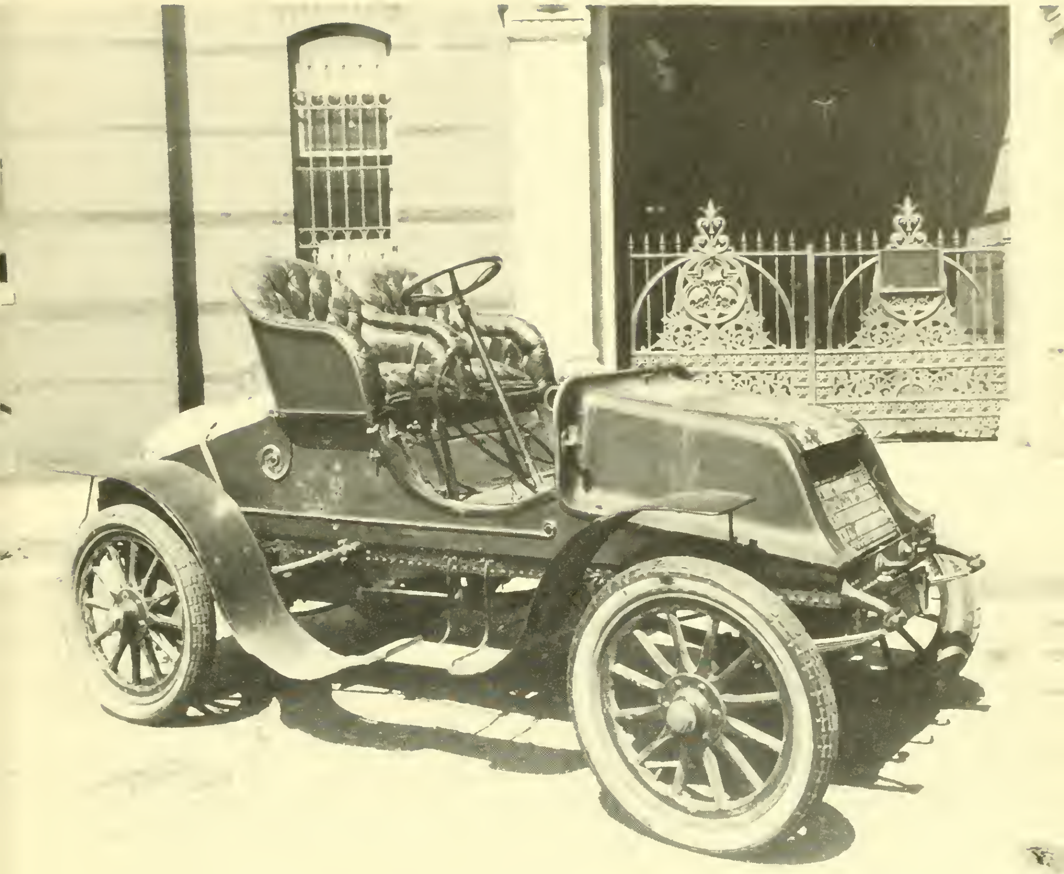


Figure 80.—The 2-cylinder 1903 Winton that made the first automobile trip across the United States under its own power.

The 2-seated body is of wood, with upholstery of tufted black leather. The two side step plates are of iron, while the four laminated fenders and the removable hood are wooden. Side lamps, a single head lamp, and a bulb horn were originally fitted but are no longer part of the equipment. A spare tire is attached to the left side of the body, though on the famous trip the spare was carried over the front of the hood. None of the five tires are original, nor were they used on any part of the trip. In the tonneau of the car, covered with a tarpaulin, is much of the spare equipment and tools that were carried on the trip. Figure 80 shows the car as it looks today.

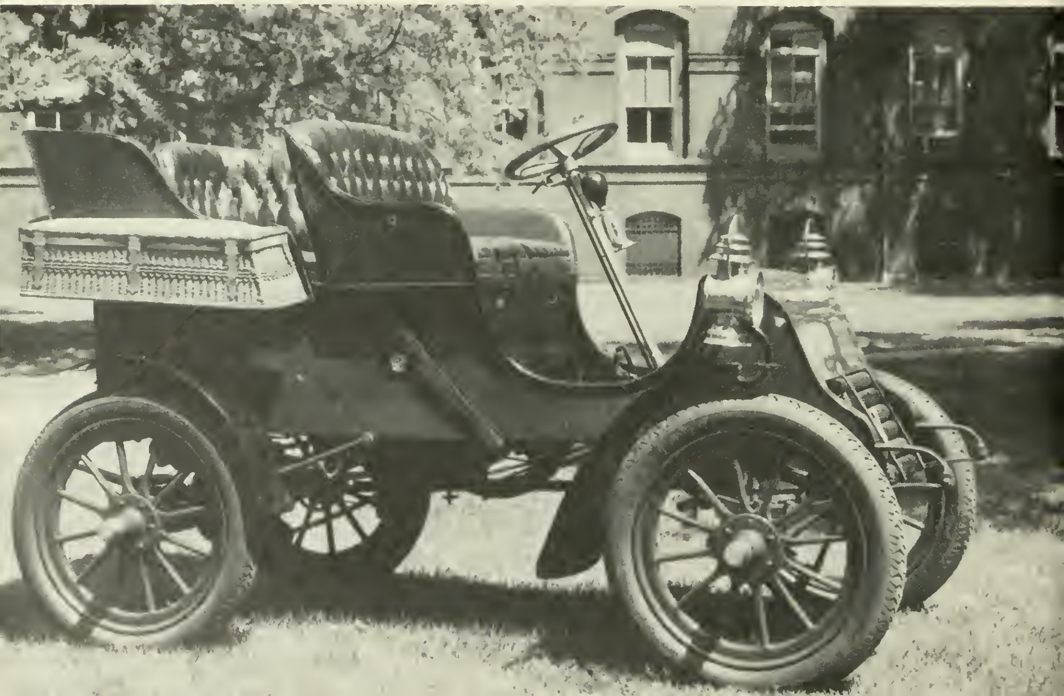
CADILLAC GASOLINE AUTOMOBILE, 1903

Gift of the Cadillac Motor Car Co. in 1923 (USNM 308217)

This model-A Cadillac (fig. 81) represents the type of car constructed during the first year of manufacturing by the Cadillac Automobile Co., of Detroit, Mich. It sold for $850 when new.

The 1-cylinder gasoline engine, built by Leland and Faulconer, is water-cooled. The bore and stroke of the engine are each 5 inches, giving a total piston displacement of 98.2 cubic inches. It is mounted horizontally in the frame, with the cylinder toward the rear of the car. The flywheel is under the left front seat of the body, and the hand crank can be attached to the crankshaft at the flywheel. The engine is cranked in a counterclockwise direction from the left side. It is not original with the car, however, but is from a Cadillac of about 1906, as indicated by the oiler and by the method of cranking. Originally the engine was cranked from either side of the car by means of a secondary shaft connected to the crankshaft by sprockets and chain. This shaft is still in place beneath the body but is no longer connected to the crankshaft, which is not fitted with a sprocket.

Figure 81.—The Museum's 1-cylinder 1903 Cadillac. This car was reconditioned in 1955 through the Cadillac Motor Car Division of General Motors Corp.



Ignition of the engine was by spark plug and high-tension coil. Spark advance and retard were performed by means of a short lever in a slot to the right of the driver. The coil is contained in a compartment in the left front of the body. The dry cells are located in a box suspended beneath the left end of the front floorboard. Engine speed was controlled by a lever, working on a segment beneath the steering wheel, which controlled the amount of opening of the mechanically operated inlet valve. The exhaust valve leads into a short pipe, which, in turn, leads into a sheet-metal muffler beneath the right rear of the body.

A centrifugal pump circulated the water through the jackets of the cylinder and through the water tank and the radiator. The latter is composed of a long, seamless, copper tube five-eighths of an inch in outside diameter over which are slipped hundreds of copper radiating disks spaced three-eighths of an inch apart. The tube is bent and shaped so that it forms a unit six tubes in height by two tubes in depth, the tubes all lying horizontally. The water tank is contained in a compartment in the right front of the body, and the system is filled through a pipe beneath the left front seat.

The planetary transmission, with steel pinions and bronze gears, provides two speeds forward and one reverse. Low speed is engaged by depressing a pedal, high speed by moving forward a long lever at the right of the driver, and reverse by moving the lever rearward. Neutral is the central position of the lever.

Power was transmitted by a single chain to a differential in the center of the divided rear axle. Brake drums are attached to the two halves of the axle, adjacent to the differential. The two contracting brake bands are simultaneously actuated by a spring-returned pedal now equipped with a nonoriginal ratchet-and-pawl device. This holds the pedal locked in the depressed position so that it can be used as a parking brake.

Steering is accomplished through a rack and gear mounted at the base of the steering column and connected by a drag link to the left front-wheel steering knuckle. The rack and gear are adjustable for wear. The two steering knuckles are connected by a tie rod.

The angle-steel frame is carried on four semielliptic springs. An adjustable stay rod on each side, from the center of the frame down to the rear axle, maintains the position of the axle. The wheelbase is 70 inches and the tread 53 inches. Wooden-spoked wheels mounting 30-by-3½-inch clincher tires are provided, front and rear. These wheels are fitted with ball bearings. The front axle is tubular.

The gasoline tank is beneath the driver's seat. To its left is a mechanical oiler, belt-driven from a pulley on the crankshaft of the engine, that has four outlets serving the engine bearings and the cylinder wall. This oiler is not original with this model but is a feature of the later engine now installed in the car.

The 4-passenger body is of wood, entrance to the tonneau being by a single door in the rear. The complete tonneau is removable, leaving a 2-passenger runabout when removed. No top or windshield is provided. Four metal fenders are mounted above the wheels of the vehicle. A step plate is provided for each side of the front seat, and another plate serves the rear entrance. Brass kerosene lamps on each side at the front, and one at the rear, provided illumination. A bulb horn is attached to the steering column. The vehicle weighs approximately 1,350 pounds.

Wicker baskets (USNM 310913), presented by Charles P. Ashley in 1934, are suspended above the rear fenders on each side of the tonneau. These are authentic accessories of the period and served as additional storage space when touring with a heavily loaded car.

In May 1954 four new tires and inner tubes, contributed by Harvey S. Firestone, Jr., were installed on the car, and the old ones that were on the car when it was presented to the Museum were discarded. In the summer of 1955 the car was thoroughly cleaned, otherwise overhauled from the standpoint of appearance, repainted in red, and reupholstered in tufted black leather by the Antique Auto Shop of Northfield, N. J., through the courtesy of the Cadillac Motor Car Division of General Motors Corporation.

OLDSMOBILE GASOLINE AUTOMOBILE, 1903
Bequest of Thomas A. Peabody in 1944 (USNM 312854)

One of the most popular cars in its day was the light, low-priced, curved-dash Oldsmobile runabout (fig. 82). Produced from 1901 to 1906, with only minor changes in design, it was known for economy of operation, quietness, and smooth performance, despite its large, 1-cylinder engine. The price was $650, at the Olds Motor Works in Detroit, Mich.

The engine, of 4½-inch bore and 6-inch stroke, ran at a maximum speed of a little over 700 revolutions per minute. It is placed horizontally, with the cylinder head at the rear of the car and the flywheel below the seat. The inlet and exhaust valves are located in a chamber at the side of the cylinder head and are operated mechanically by rockers working from cams on a shaft turning at half crankshaft speed. This shaft, parallel to and outside the cylinder, is driven by gearing at the crankshaft.

Figure 82.—The Museum's 1903 Oldsmobile. This 1-cylinder car was reconditioned in 1956 by the Oldsmobile Division of General Motors Corp.

Opposite the exhaust valve cam on this shaft, and in a different plane, is an auxiliary cam. The depression of a foot button shifts the exhaust rocker so that its roller bears against both the cam proper and this auxiliary cam, and prevents the exhaust valve from seating completely. By this means, compression can be reduced while the engine is being cranked. The removal of a cover makes both valves accessible for inspection.

The ignition was of the high-tension type, fed by a set of 6-volt dry cells. The current passed through a trembler coil, and the time of firing was controlled by a commutator placed on the half-speed camshaft. A spark plug is screwed into the end of the cylinder, and the charge was ignited when the piston was at approximately top dead center. A small lever at the driver's right allowed the spark timing to be advanced or retarded.

The carburetor made by George M. Holley, of Bradford, Pa., is of the constant-level, float type. The speed of the engine was controlled by a throttle valve in the carburetor, connected by linkage to a pedal in front of the driver. The gasoline tank is at the right rear of the car, beneath the deck behind the seat and above the carburetor.

The exhaust gases were passed through a muffler to the left of, and below, the engine.

Cooling fins and a water jacket surround the cylinder of the engine, the fins being at the end nearer the crankcase. A water tank is at the left rear of the car, beneath the deck. The radiator is composed of a long tube over which are slipped hundreds of radiating disks. Bent and shaped so that it forms a compact unit, it is suspended horizontally beneath the floorboard. Water was circulated by a gear pump driven by the left end of the crankshaft. All water connections are made with rubber hose.

Grease cups are fitted to the two main bearings. A sight-feed oil cup provided lubrication to the cylinder wall, the flow being adjustable by a lever mounted on the wooden panel behind the driver's legs. A drain cock in the bottom of the crankcase allowed the old oil to be removed after it had accumulated.

The starting crank handle is placed on the right side of the body, enabling the engine to be cranked by the driver while sitting in the car. A sprocket on the shaft upon which the crank is mounted is connected by a chain to a sprocket on the engine crankshaft. An overrunning clutch is incorporated within the hub of the latter sprocket so that the engine will not drive the crank handle once the engine has been started.

The 2-speed forward and 1-speed reverse transmission is of the planetary type. The reverse and the low speed forward are operated by band and drum clutches, and the high speed by a friction compression clutch. A single shaft carrying three eccentrics, with the three throws in different directions, serves to actuate each of the three clutches individually by tightening bands around the drums for the two lower speeds, and through a bell crank moving in a direction longitudinal to the main shaft for the high speed. A vertical extension of the eccentric shaft is located to the right of the driver, to be operated by his right hand, full forward position of the lever engaging the high-speed clutch.

A brake pedal is connected to an external contracting band on a brake drum located on the transmission shaft between the low-speed and reverse drums.

A sprocket on the transmission, between the reverse drum and the brake drum, is connected by chain to the differential unit on the rear axle. Located on the differential unit is a brake drum. The band of this brake is actuated by a hand lever adjacent to the gear shift and spark levers.

The rear-axle housing is tubular and is strengthened by a truss rod running beneath it. The tubular front axle, likewise strengthened with a truss rod, is equipped with pivoted steering spindles at each end, and the two are connected by a tie rod. Between the steering-tiller post and the arm to the center of the tie rod is a full-elliptic spring, which turns as the tiller is turned and prevents road shock from reaching the tiller.

Wooden-spoked artillery wheels, mounting 28-by-3-inch clincher tires, are used. The front wheels are supported on tapered roller bearings, and the rear wheels are on straight roller bearings. Grease cups provided lubrication for the rear wheel bearings.

Long truss-shaped springs, one on each side, connect the front axle to the rear-axle housing. The connection at the rear is adjustable to take up slack in the driving chain. The rectangular frame is of channel steel and is mounted upon the two springs. The wheelbase is 66 inches and the tread 55 inches.

The engine and transmission are hung in the center of the frame, with the 2-seated wooden body over them. The bolts securing the body to the frame pass through rubber blocks, thus lessening the chassis vibration that might reach the body. A step plate is located on each side, and four metal fenders are placed over the wheels. Oil headlights and taillight supplied illumination.

This car was in use up through 1941, and came to the Museum in 1944 upon the death of the owner. The Museum purchased new inner tubes for the tires in about 1950. In early 1956 the car was returned to Lansing, Mich., where it was repainted in black, and reupholstered in tufted black leather by the Oldsmobile Division of General Motors Corporation.

Figure 83.—This 1904 Columbia electric was in use until 1931, in Washington, D. C. Its owner was a doctor.

COLUMBIA ELECTRIC AUTOMOBILE, 1904
Gift of Mrs. Sewell M. Johnson in 1933 (USNM 310575)

The Columbia Mark LX electric runabout was first introduced in the fall of 1903 by the Electric Vehicle Co., of Hartford, Conn. This one (fig. 83) was used by Dr. J. O. Skinner until 1931, and represents a typical doctor's vehicle of the early period of motoring when an electric vehicle was more reliable than a gasoline one.

This automobile was designed to reduce the dead weight as much as possible without sacrificing its traveling capacity. The running gear and body were lightened as much as was thought consistent with safety and durability, to allow more weight in the battery and the motor for increased storage capacity and power. The vehicle seats two persons, and a 40-mile traveling range was claimed for it. The weight is 1,200 pounds, and the maximum speed was about 15 miles an hour.

The frame consists of oak sills reinforced by angle steel 1¾ inches on each side. All springs are of the semielliptic type, 36 inches long. The front springs are shackled at their rear ends, the rear springs at their front ends. A Collins axle with plain bearings is used in front, and a large tubular axle equipped with roller bearings is employed in the rear. The wheelbase is 64 inches and the tread 48 inches. The 24-inch-diameter artillery wheels carry new 30-by-3-inch clincher tires and inner tubes contributed by Harvey S. Firestone, Jr., in May 1954. The car is steered by a side lever located at the left of the operator. A single controller handle, also located at the operator's left, governed the speeds, forward and reverse.

The body has a boxlike compartment, front and rear, each originally containing half of the battery equipment. The batteries consisted of 20 two-volt cells, but none are in place now. They had a capacity of 120 ampere hours at a 30-ampere discharge rate.

The motor, believed to have been made by the General Electric Co., is of 6-pole construction, completely enclosed, and rated at 30 amperes at 40 volts. It is located in the body of the vehicle beneath the seat, rather than on the rear axle; this position prolonged the life of the motor and the tires.

The armature pinion is of steel of the herringbone type, meshing with another herringbone gear of bronze carried on the countershaft. These gears are fully enclosed, and they operated without noise. The outer end of the countershaft carries the driving sprocket, which transmitted power to the rear axle by a chain. An adjustable distance rod holds the countershaft at a constant distance from the rear axle. Lubrication of the motor bearings and countershaft bearings was by oil-soaked waste carried in a small pocket on each bearing, the pockets being supplied with spring-closed covers.

The differential is of the bevel-gear type, enclosed, and running in oil. The hubs of the rear wheels carry drums upon which external contracting brake bands act when operated by a pedal. The brake pedal includes a ratchet for locking purposes.

The controller handle moves in two slots having an offset between them. The forward slot gives the three forward speeds and the rear slot the two backing speeds. First speed is obtained by grouping the two sets of batteries in parallel and connecting them in series with the motor and a resistance, the latter carried in a frame beneath the body. In the second speed the two sets of batteries act in parallel on the motor without the resistance, and in third speed the two sets are in series. The two backing speeds correspond to the first two of the forward speeds, with the field commutated. The controller is of the drum type, located under the driver's seat, and its contacts are of hard drawn copper. Seven cables enter the controller.

The body is of wood, the fenders are of leather stretched and sewn over a metal frame, and the folding top is of leatherette. Step plates are attached to each side of the vehicle. Kerosene lights and a Stewart speedometer complete the equipment, the latter being of much later date than the vehicle.

ROLLS-ROYCE GASOLINE AUTOMOBILE, 1907
Gift of Rolls-Royce, Ltd., in 1947 (USNM 311998)

This nonoperable one-quarter-size model (figs. 84 through 87) represents the 40–50-horsepower, 6-cylinder Rolls-Royce car which, in 1907, ran out a 15,000-mile reliability road trial officially observed by the Royal Automobile Club. At the conclusion of the trial, in which it ran 14,371 miles without an involuntary stop for other than tire troubles, the car was dismantled and examined. All parts in which the slightest measurable wear could be detected were replaced, at a cost of just over the equivalent of $10.

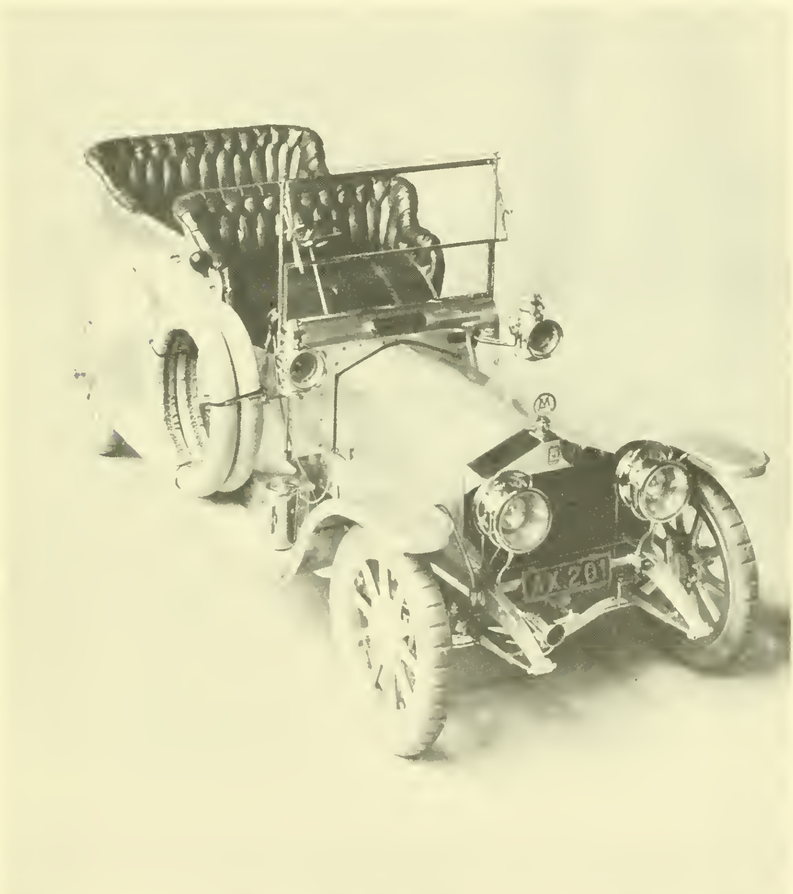


Figure 84.—Model of 1907 Rolls-Royce "Silver Ghost."

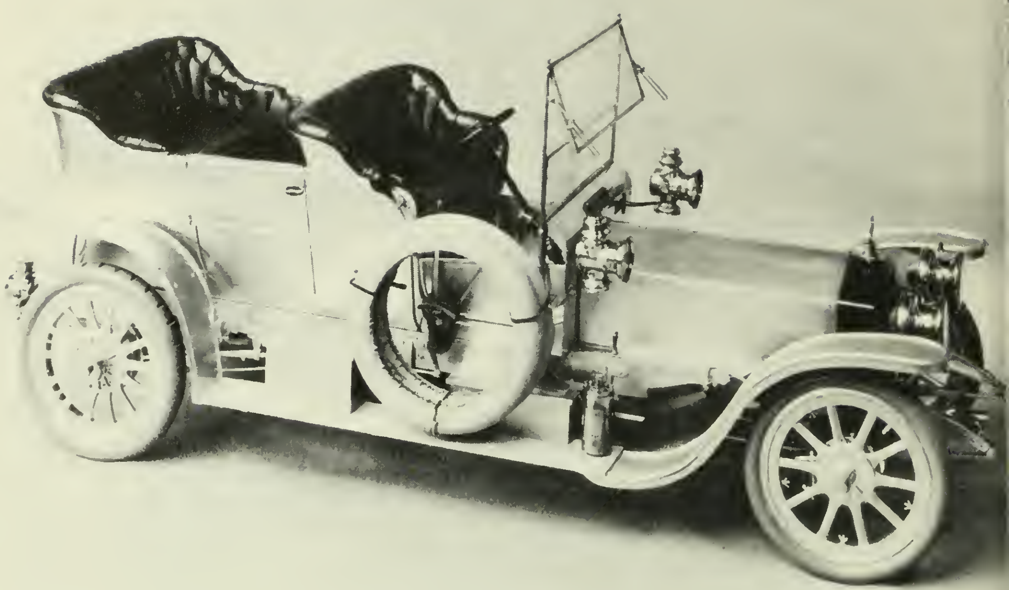


Figure 85.—The famous Rolls-Royce "Silver Ghost" series started with the 1907 version, of which this is a model, and was continued for almost 20 years with only minor mechanical changes.

The full-sized car has a 6-cylinder engine of 4½-inch bore and 4½-inch stroke, developing about 48 horsepower. The cylinders are cast in two groups of three, with the valves all on one side and operated from a single camshaft located in the crankcase. The crankshaft is hollow and has a main bearing between each two adjacent cranks. Forced lubrication was provided. The crankcase is of aluminum, and the oil pan can be easily removed for inspection. The fuel mixture was supplied by an automatic carburetor, which could be adjusted for richness from the dashboard, and the speed was controlled by a centrifugal governor acting on a throttle valve. Both battery and magneto ignition are fitted to the engine, each system using a separate set of spark plugs. The cylinders were cooled by water jackets into which the water was forced by a rotary pump from the radiator, in front of the engine. A belt-driven fan is mounted behind the radiator.

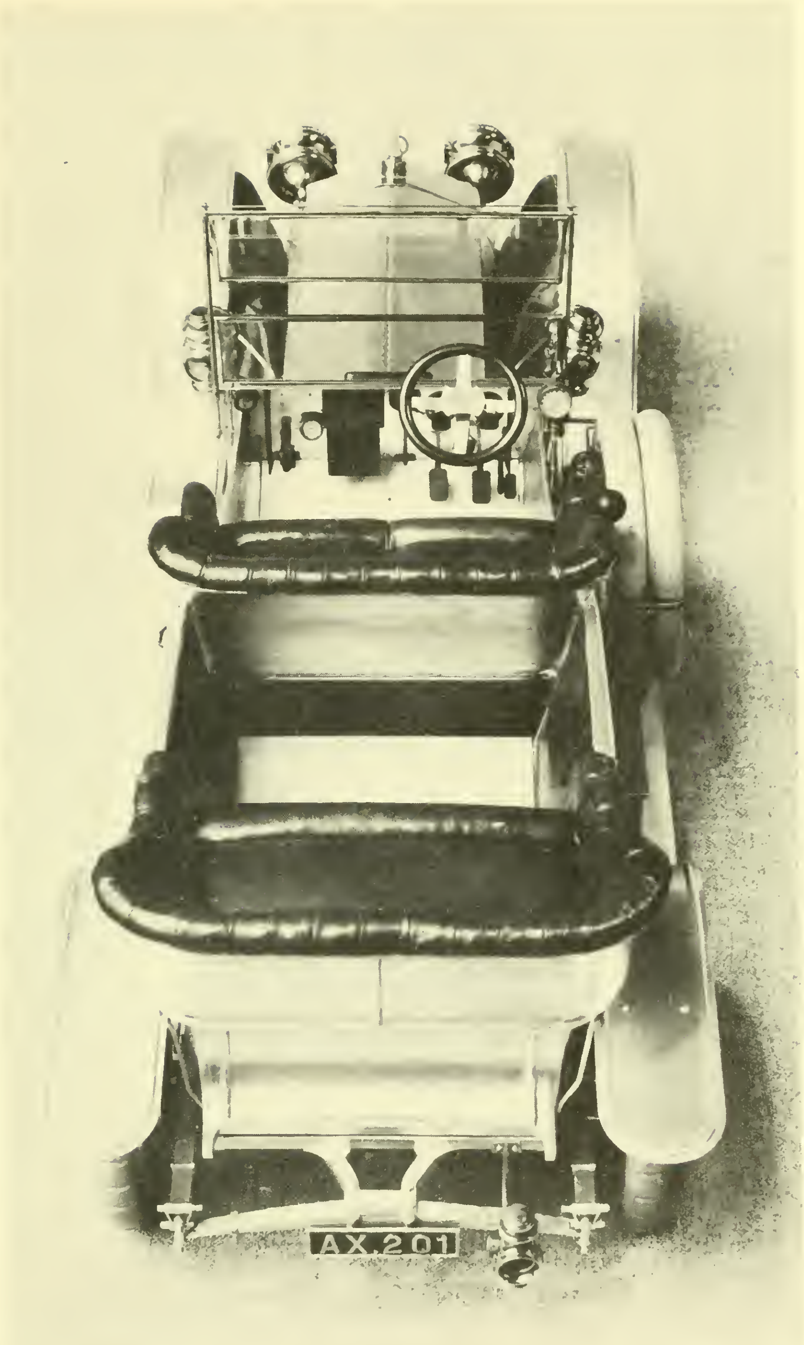


Figure 86.—Note how details of the platform-type rear springs are carried out in this quarter-scale model of the 1907 Rolls-Royce.

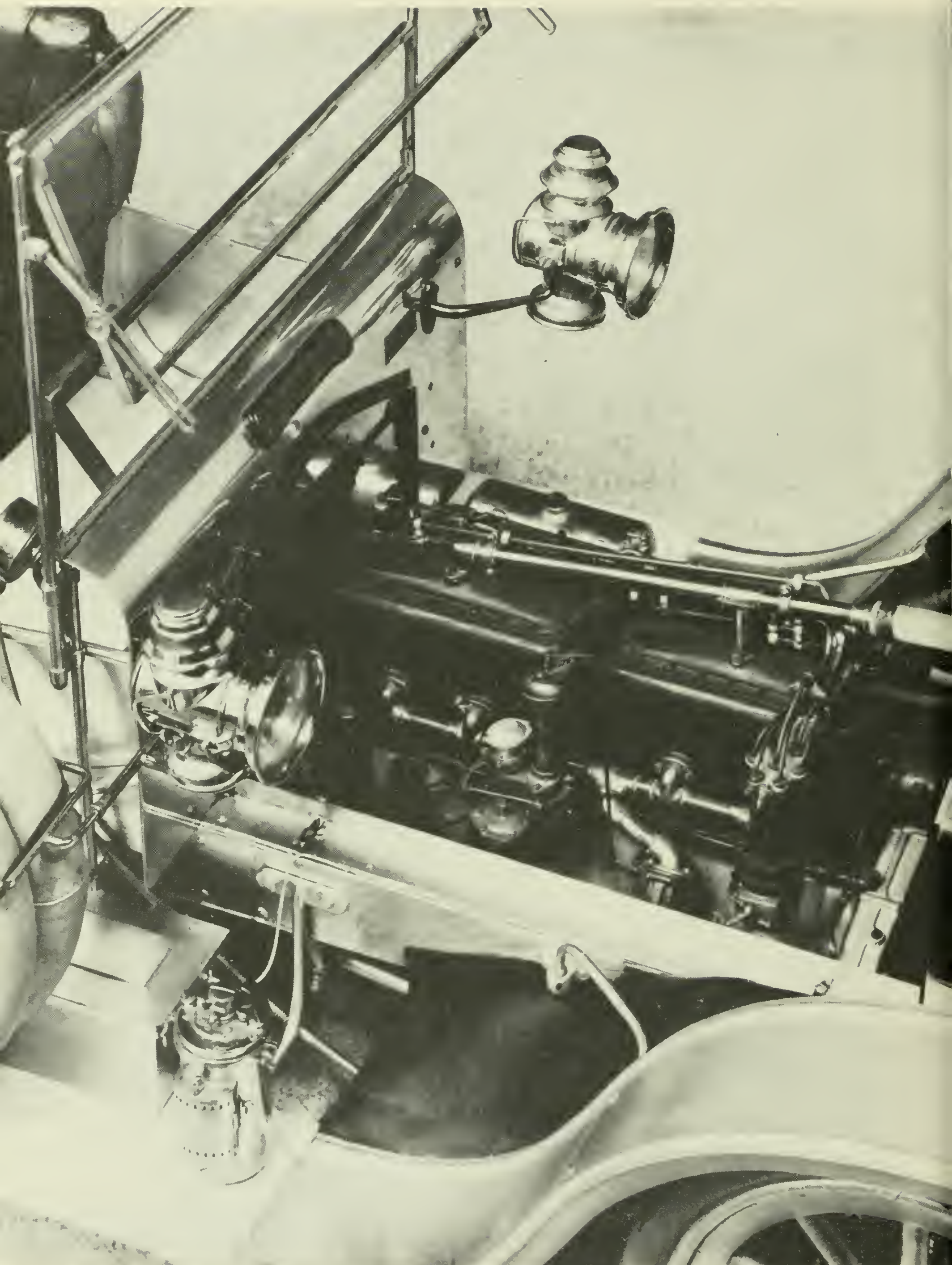


Figure 87.—Details in engine compartment of model of 1907 Rolls-Royce. The engine is not operable.

The flywheel forms one member of a cone clutch so arranged that there is no external thrust; the other member of the clutch is connected with the gear box by a shaft with universal joints. The gear box has a gate change with four forward speeds and a reverse, direct drive being obtained on third speed. Power was transmitted to the rear axle by a shaft having a universal joint at each end, this shaft driving the two halves of the axle through bevel gears and a differential unit contained in a central housing. The axle housing is trussed and tied to the frame by radius rods. The axles run in ball bearings, and each driving wheel is fitted with a brake drum and an expanding brake band operated by a hand lever. There is also a pedal-operated brake acting on a drum fitted on the drive shaft behind the gear box. The front axle is an I-section forging having pivoted ends fitted with ball-thrust bearings.

The frame is of pressed steel, of channel section and of varying depth; it is supported on four semielliptic springs, those at the back having their rear ends carried by the ends of a transverse spring fitted to a central bracket at the rear of the frame. The wheels are of the artillery type and are fitted with grooved pneumatic tires; the front ones are 875 by 105 mm., and the rear are 880 by 120 mm. The wheelbase is 135 inches and the tread 56 inches. The car is fitted with a "Roi des Belges," 4-seater, open, touring body with adjustable windshield. The gas tank is carried beneath the driver's seat, and the batteries and the acetylene generator for the lamps are carried on the right running board, where two spare tires are also attached. The car weighs about 3,300 pounds, unloaded, and about 4,000 pounds with passengers and baggage.

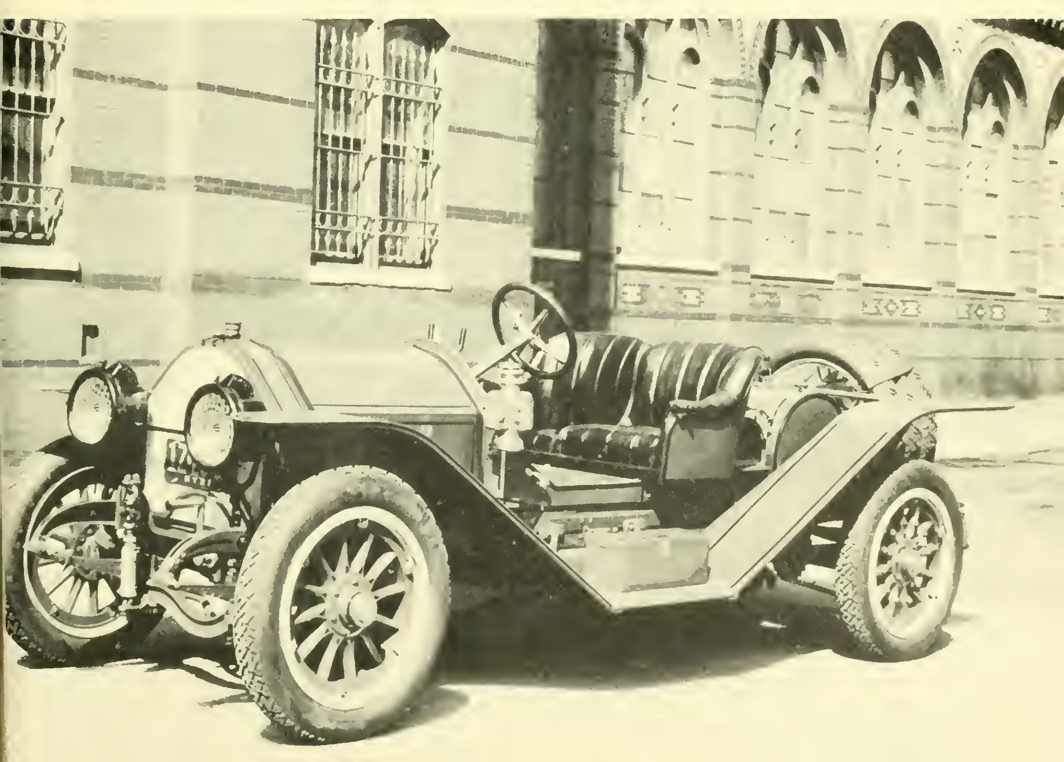
SIMPLEX GASOLINE AUTOMOBILE, 1912

Gift of Mr. and Mrs. John D. Adams in 1929 (USNM 309549)

This car (fig. 88), made by the Simplex Automobile Co., of New York City, represents one of the most powerful and popular automobiles of its day; it was capable of a speed of around 80 miles an hour. It was used until 1928 by the son of the donors.

The water-cooled engine (figs. 89 and 90) is of the 4-cylinder, 4-cycle, T-head type, with cylinders cast in pairs. The bore and stroke are the same, 5¾ inches, giving a total piston displacement of 597 cubic inches. Each cylinder has an intake valve on the right side and an exhaust valve on the left, operated by two camshafts in the aluminum crankcase. The exhaust camshaft is movable lengthwise by means of linkage controlled by a handle reached from under the front of the radiator. Moving the camshaft lifts the exhaust valves partially from their seats, lowering the compression and aiding in starting with the hand crank. The exhaust manifold leads to a muffler under the left side of the car.

Figure 88.—This 1912 chain-drive, 50-horsepower Simplex was reconditioned in 1949 through the courtesy of George C. Hane, of Washington, D. C.



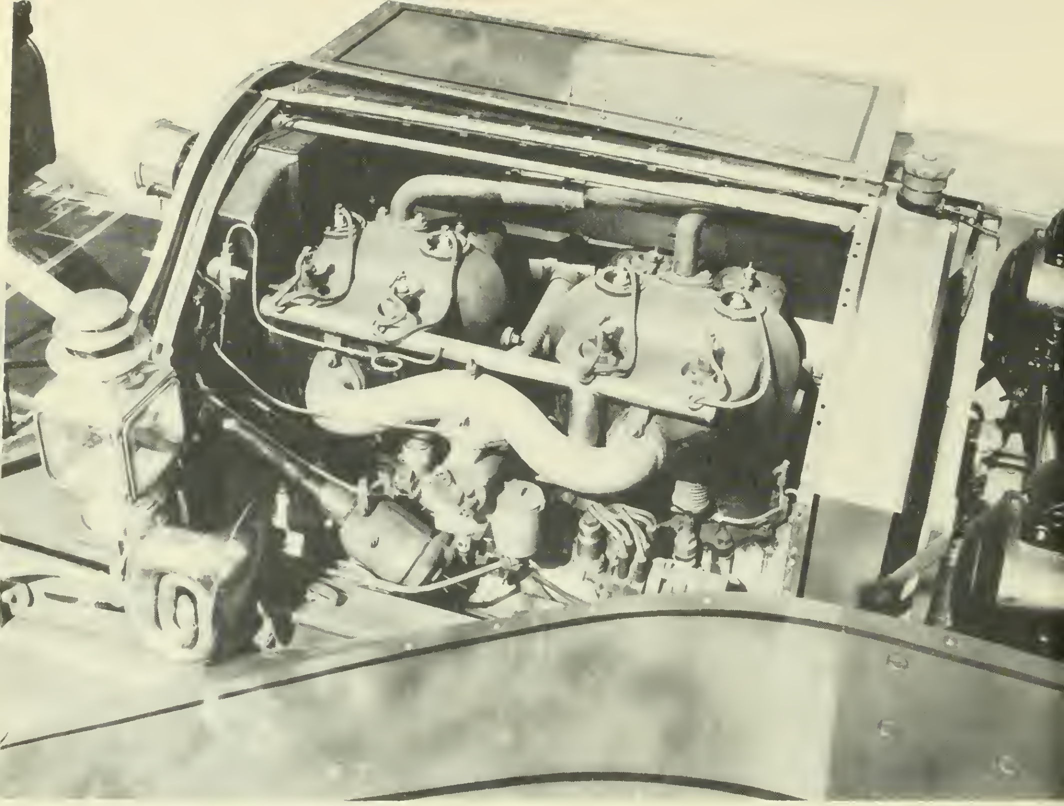
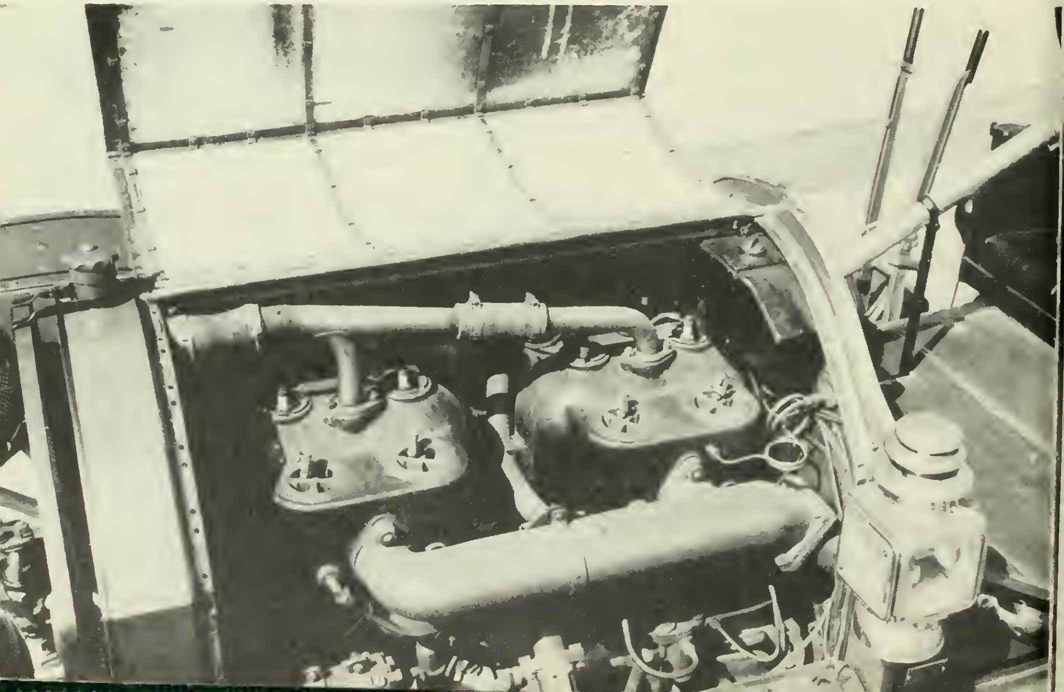


Figure 89.—Intake-valve side of engine of 1912 Simplex. A larger engine, with a 6 1/10- by 5 3/4-inch bore and stroke, was also available for this automobile.

Figure 90.—Exhaust-valve side of engine of 1912 Simplex. The petcocks were for priming to facilitate starting in cold weather.



A Bosch DR-4, 2-spark, dual magneto, fitted to the right front of the engine and driven by a shaft projecting back from the timing gear case, furnished spark to two spark plugs in each cylinder.

A similar shaft on the other side of the engine drives a water pump and, by means of sprockets and chain, a Bijur electrical generator, which is not original.

A small tank, mounted on the front of the dash above the engine, held a supply of oil. It contains a pump driven by a vertical shaft geared to the rear of the intake camshaft. This oil, replenished from the tank behind the seats, was pumped to the bearing surfaces inside the engine, draining into the oil pan of the crankcase. An oil-level glass in the back side of the small tank is visible to the driver. A shut-off valve handle projects through the dash, shutting off the external oil supply to the cylinder walls when closed.

A Bijur electric starting motor, not original equipment, hangs below the left rear part of the engine so that its gear can engage a ring gear shrunk on the flywheel of the engine.

The frame, of 128-inch wheelbase, is supported on four semielliptic springs. JM shock absorbers are mounted on the rear shackles of the rear springs, while the front springs are equipped with telescopic, airplane-type "jounce preventers" made by Ernst Flentje, of Cambridge, Mass. The rear axle is a solid, "dead" axle on which the rear wheels turn. Truss rods at each end of the axle lead forward to the frame of the car. Adjustments on the ends of the rods allow the axle to be shifted to take up slack developing in the chains. Internal expanding brake shoes in the rear-wheel brake drums are controlled by the hand-brake lever to the right of the driver.

The steering wheel turns a post within a column and, by means of a worm and gear in the steering-gear box, controls steering linkage connected to the two front wheels.

The transmission, of the selective, sliding-gear type with four forward speeds and one reverse, is combined with the differential in a single aluminum case in the center of the car, the speeds being selected by a lever adjacent to the hand-brake lever. The driving sprockets of the chain

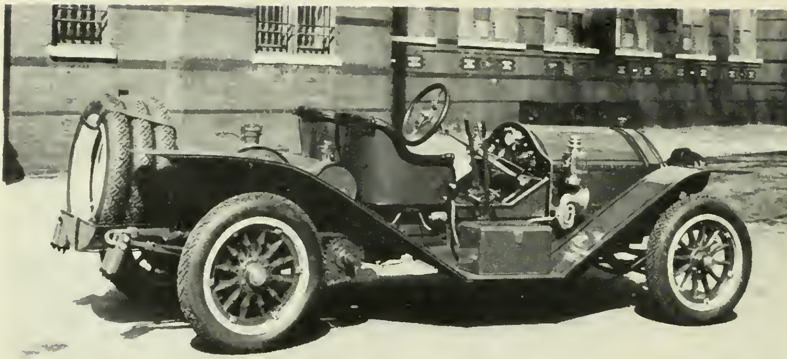
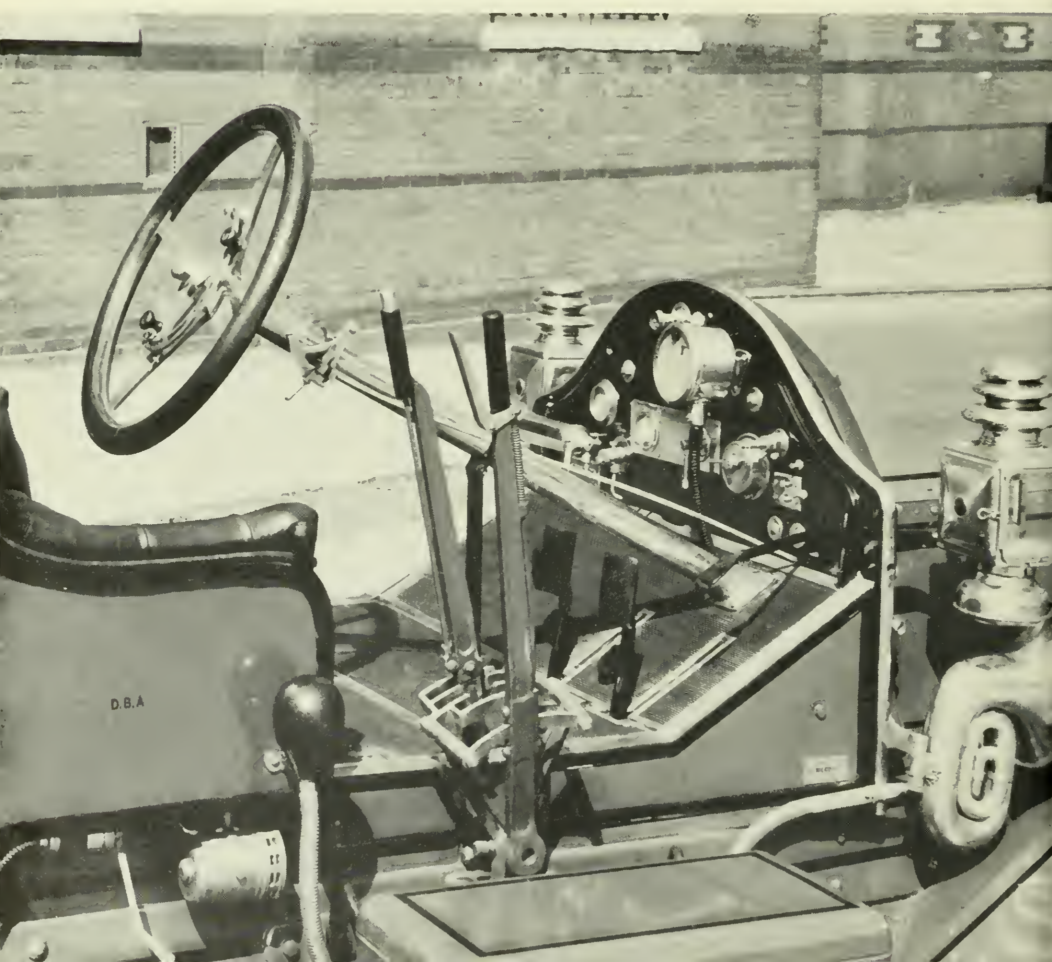


Figure 91.—The 40-gallon gasoline tank and 13-gallon oil tank were necessary on this 1912 Simplex. The gas consumption was high, and gas stations few. The oil was not recirculated after it had been used once.

Figure 92.—Controls and instruments of 1912 Simplex. There was no provision for a windshield.



drive are on the jackshafts, or output shafts, of the differential. These also carry brake drums, with external contracting bands controlled by the brake pedal. A multiple disk clutch is incorporated in the flywheel and is controlled by a pedal to the left of the brake pedal.

Final drive is by double chain, one to each rear wheel. The front sprockets have 25 and the rear sprockets 40 teeth. The Simplex was one of the last American makes to use chain drive.

The body, made by Holbrook of New York, is of the bucket-seat speedster type and is painted red with black striping. It was one of the few American cars of its date still using right-hand drive.

Behind the two individual bucket seats (fig. 91) is a 13-gallon, cylindrical oil tank 12 inches in diameter and 27 inches wide, equipped with a quick-opening, racing-type filler cap. Behind the oil tank is a 40-gallon, cylindrical gasoline tank 21 inches in diameter. It is also 27 inches wide and is equipped with a similar filler cap. Pressure in the two tanks forced gasoline to the carburetor, and oil to the oil tank under the hood. Pressure of about 2 pounds per square inch was maintained in the two tanks by the exhaust pressure of the engine passed to the tanks through a Lunkenheimer filter and pressure regulator. When the engine was at rest, pressure could be raised in the tanks by a hand pump. A gauge at the hand pump indicated the pressure at all times. Valves on the tanks allowed the driver to shut off the pressure if desired.

The original wooden-spoked artillery wheels have been cut down to accommodate 23-inch demountable rims equipped with 33-by-5-inch straight side tires. Mounted upright behind the gasoline tank are three spare rims equipped with tires.

The car is equipped with a Mayo honeycomb radiator, protected by a stone-guard on the front. The spokes of the flywheel are shaped to act as a fan behind the engine. A Juhasz carburetor (bearing the patent date of June 22, 1915), with a barrel-valve throttle, has replaced the original carburetor. Either a foot accelerator or a lever on the quadrant on the steering wheel can be used to control the throttle. Also on the quadrant is a lever to advance or retard the ignition.

Acetylene headlights, Dietz combination electric-kerosene side lights, and a combination taillight are provided. On the left running board is a tool box that may have contained at one time an acetylene tank, as no tank is now on the car. On the right running board is a battery box. A muffler cut-out pedal is located between the brake and clutch pedals, and there is a starter button in the center of the floorboards just in front of the seats. A siren, switch, and rheostat are mounted below the level of the driver's seat, to the right, on the outside of the body. A bulb horn is attached to the right side of the body, just forward of the driver's right foot, while the bulb is secured to the right side of the driver's seat.

Instruments on the dash (fig. 92) include a Standard Foxboro air-pressure gauge for the gasoline and oil tanks, Weston ammeter, Bosch ignition switch, and a 100-m.p.h. Warner auto meter (speedometer) driven by gearing on the right front wheel. A primer is fitted to the intake manifold to assist starting in cold weather. A handle on the steering column is connected to the cable-controlled choke of the carburetor.

This specimen was known as the 50-horsepower model, although the developed horsepower was considerably greater than 50. It is car No. 778 of the Simplex series.

In 1949 the car was completely repainted in red with black striping, and reupholstered in pleated black leather by Haley's, Inc., automobile dealers in Washington, D. C., through the courtesy of George C. Hane, the owner. At the same time the seven old tires and inner tubes were replaced by new ones contributed by Harvey S. Firestone, Jr.

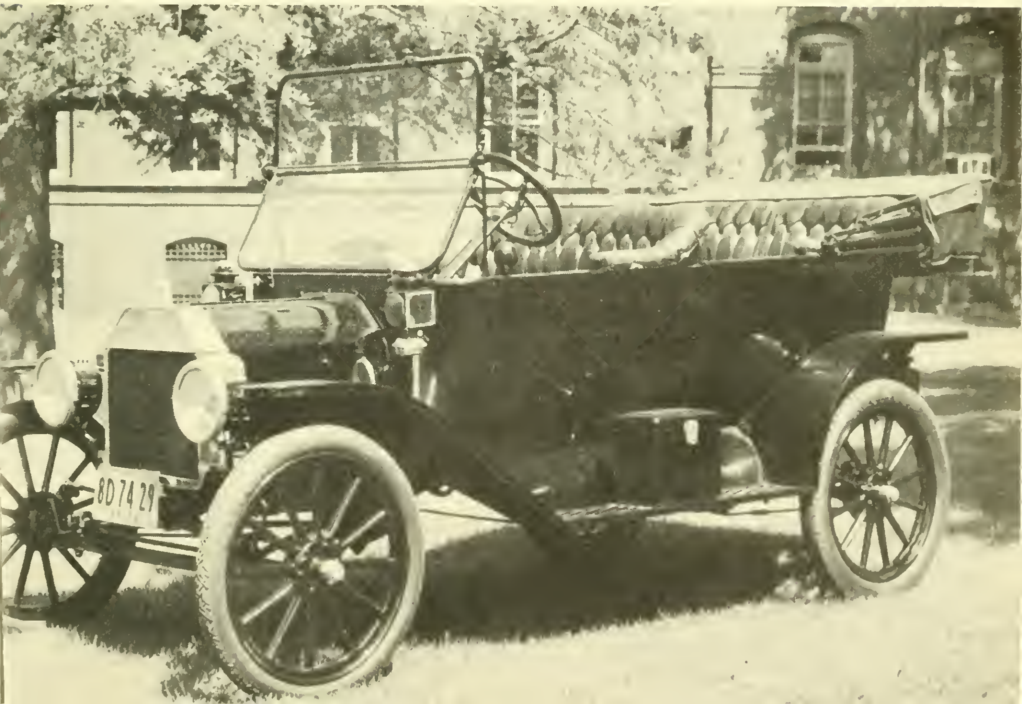
FORD GASOLINE AUTOMOBILE, 1913

Gift of Harvey Carlton Locke in 1935 (USNM 311052)

Probably the best known and most discussed automobile in the world is the famous model-T Ford, of which over 15,000,000 were built. The model first appeared late in 1908 and was made with only minor changes for almost 20 years. The total production of all other American makes of cars for this period was approximately the same figure. This example (fig. 93), with engine No. 211098, was purchased new for $600 in Rochester, N. Y., on April 4, 1913, by the father of the donor. In the ensuing 22 years the car was driven slightly less than 54,000 miles.

The engine is a 4-cylinder, 4-cycle, water-cooled, L-head unit of 3¾-inch bore and 4-inch stroke, with a rated horsepower of 22.5. Actually it developed 20 horsepower at 1,600 r.p.m. The block and crankcase are made in one casting. The crankshaft is supported in three bearings, as is the camshaft, which mechanically operates the eight valves. A constant-level carburetor is provided. The water-jacketed cylinder head is cast separately, an early use of this design.

Figure 93.—Model-T Ford of 1913, one of over 15,000,000 cars of this model built between 1908 and 1927. This car was reconditioned in 1956 through the courtesy of the Ford Motor Co.



The cooling water was circulated by thermosyphon action, although the first several thousand model-T cars built in 1908 had centrifugal water pumps. A belt-driven fan is mounted behind the radiator at the front of the car.

The lower half, or oil pan, of the crankcase is formed of pressed steel and extends back to enclose the bottom of the flywheel, the planetary transmission, and the universal joint. Another pressed-steel piece, bolted to the top of this extension, completes the enclosure.

The magneto consists of permanent magnets, bolted to the forward face of the flywheel in a circle close to its rim, and a series of flat insulated coils supported upon a stationary spider in a circle opposite the magnets. As the flywheel revolved, the magnets passed the coils and generated current at about six volts. The current was supplied through a low-tension timer to four trembler coils, which raised the voltage for ignition.

The planetary transmission, providing two speeds forward and one reverse, is attached to the rear side of the flywheel. The low-speed and reverse gears and the foot-brake drum have spring-steel bands faced with friction lining. The high-speed clutch is composed of a number of steel disks. All these parts are fully enclosed in the oil-tight, pressed-steel case. The rotation of the flywheel supplied oil for the engine lubrication and the transmission.

The rear-axle housing is made of pressed steel, in two halves, joined in the vertical center plane of the differential housing. Roller bearings, at the inner and outer ends of each half of the housing, support the axle shafts. Angular braces connect the outer ends of the axle housing to the forward end of the torque tube enclosing the drive shaft. A truss rod (not original equipment) beneath the axle housing stiffens it.

A semielliptic spring is mounted transversely on each axle. These springs are linked to the axles, and their centers are firmly held in and clipped to the U-shaped front and rear cross members of the frame. These members are curved to fit the spring arches. Front axle alignment is maintained by diagonal braces from the ends of the axle to the front of the flywheel housing. The frame is of pressed-steel

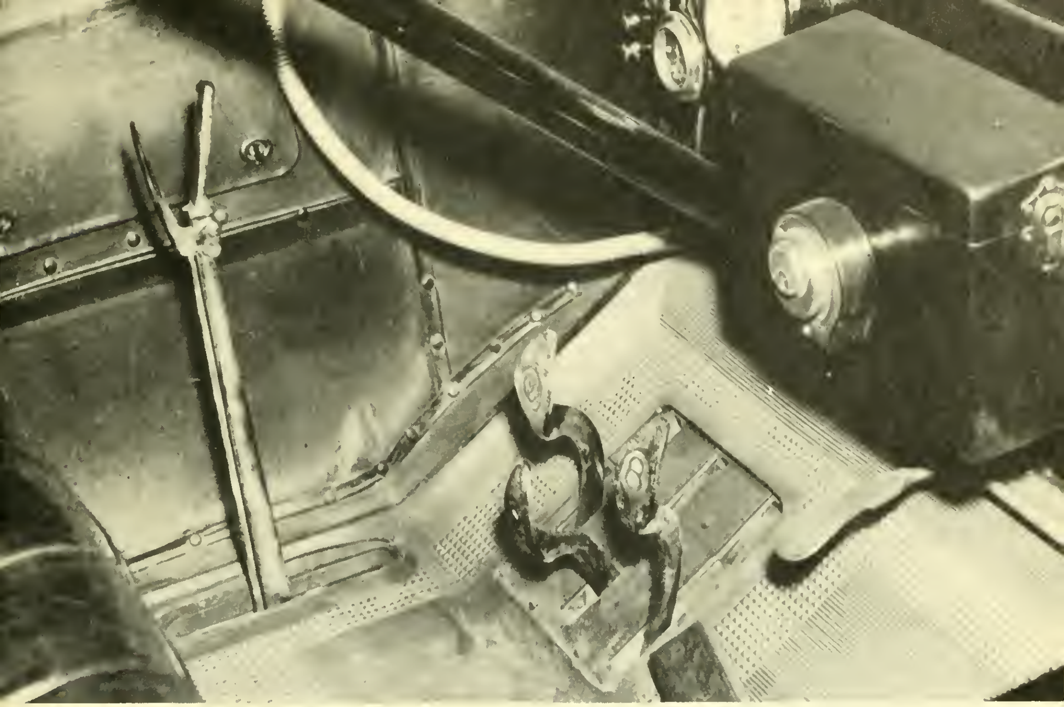


Figure 94.—Controls and coil box of 1913 Ford in National Museum. As these models came off the assembly line, only the hand brake, the three pedals, and a simple ignition switch were provided. Spark and gasoline controls were located on the steering column just below the wheel.

construction. A muffler is located beneath the right side of the car.

The two forward speeds are controlled by the left pedal (fig. 94), the reverse by the center pedal, and the transmission brake by the right pedal. Expanding brakes, acting on the rear-wheel drums, are operated by the hand lever. Pulling up the hand lever half way depresses the left pedal without engaging the brakes. This puts the transmission in the neutral position, with neither the low-speed gear nor the high-speed clutch engaged. To engage low speed the pedal is depressed completely; to engage high speed, both the pedal and the hand lever are released entirely. Spark control and throttle levers are under the steering wheel within easy reach. The steering-gear box is of the planetary type and is located within the hub of the steering wheel. An arm at the lower end of the steering column on the left side of the car passes over to the right steering knuckle on the front axle. The two steering knuckles are connected by a tie rod.

The wheelbase of the car is 100 inches, the tread 56 inches, and the car weighs a little over 1,200 pounds. Wooden-spoked wheels with 30-by-3-inch clincher tires are used on the front, 30-by-3½-inch clincher tires on the rear. The touring body is of wood and metal, and is upholstered with tufted black leather. Two doors are provided in the rear, while a single door on the right serves the front seat. A folding windshield and a collapsible top are provided, as are a bulb horn, a John W. Brown kerosene taillight, and a pair of E and J kerosene side lamps. The gasoline tank is beneath the front seat. No spare tire is carried.

Many accessories were formerly available for the Ford car, and this car is fitted with a Ward-Leonard electric starting motor, a Ward-Leonard electric generator, a Stewart and Clark speedometer, a New Haven clock, a foot accelerator, an Anderson intake manifold, a running-board tool box, a running-board battery box, a special coil box made by the K-W Ignition Co., a Hoyt ammeter, a rear-view mirror, a hand-operated windshield wiper, and a pair of electric headlights made by John W. Brown. Antirattling devices are fitted to the brake rods and steering rods.

In May 1954 four new tires and inner tubes, contributed by Harvey S. Firestone, Jr., were installed on the car, and the old ones that were on the car when it was presented to the Museum were discarded. In March 1956 the car was thoroughly cleaned and refurbished, and the body repainted by the National Auto Top Co. of Washington, D. C., through the courtesy of the Ford Motor Co.

HARLEY-DAVIDSON MOTORCYCLE, 1913
Gift of Paul Edward Garber in 1947 (USNM 313147)

This motorcycle (fig. 95) was purchased secondhand in 1918 by the donor (fig. 96), and was used by him for several years. It was restored by the Harley-Davidson Motor Co. in 1947. The engine number is 4336–D.

It is equipped with a 5-horsepower, 1-cylinder, 4-cycle, air-cooled, gasoline engine of 3⁵⁄₁₆-inch bore and 4-inch stroke, giving a total piston displacement of 35 cubic inches. Known as the model Nine B, "5-35," it sold for $235 at the factory in Milwaukee, Wis.

The cylinder casting and its integral head are of heat-treated gray iron. The piston is heat treated and ground and is fitted with three piston rings and a hollow, steel wrist pin. An I-beam section of chrome-vanadium steel, fitted at both ends with phosphor-bronze bushings, serves as the connecting rod. Separate camshafts for the intake and exhaust valves are driven by gears in the magneto drive train. The overhead, intake valve is of nickel steel, while the 2-piece exhaust valve has a cast-iron head and a nickel-steel stem. The crankcase is of polished aluminum, with the hardened, tool-steel crankshaft mounted in it in phosphor-bronze bearings. An oil drain plug and an overflow pipe are provided in the crankcase.

Ignition was by Bosch high-tension magneto with spark plug, and the fuel was vaporized by a constant-level, float-equipped, Schebler carburetor. A priming petcock is located in the left side of the cylinder head. A 2-section tank, one for gasoline, the other for oil, is mounted at the upper bars of the frame, above the engine. Filler caps and shut-off metering valves are located on top of both tanks. The lubricating oil for the engine passed by gravity through a sight glass into the crankcase. Ignition and throttle are controlled by twisting the grips of the handle bars, the left for spark timing, the right for throttle opening.

The loop-type frame of brazed tubing forms a cradle to support and protect the motor. Tubular handle bars are attached to a steering fork fitted with both main and recoil springs. The wire-spoked, metal-rimmed wheels now mount 28-by-3-inch clincher tires, though the original tires

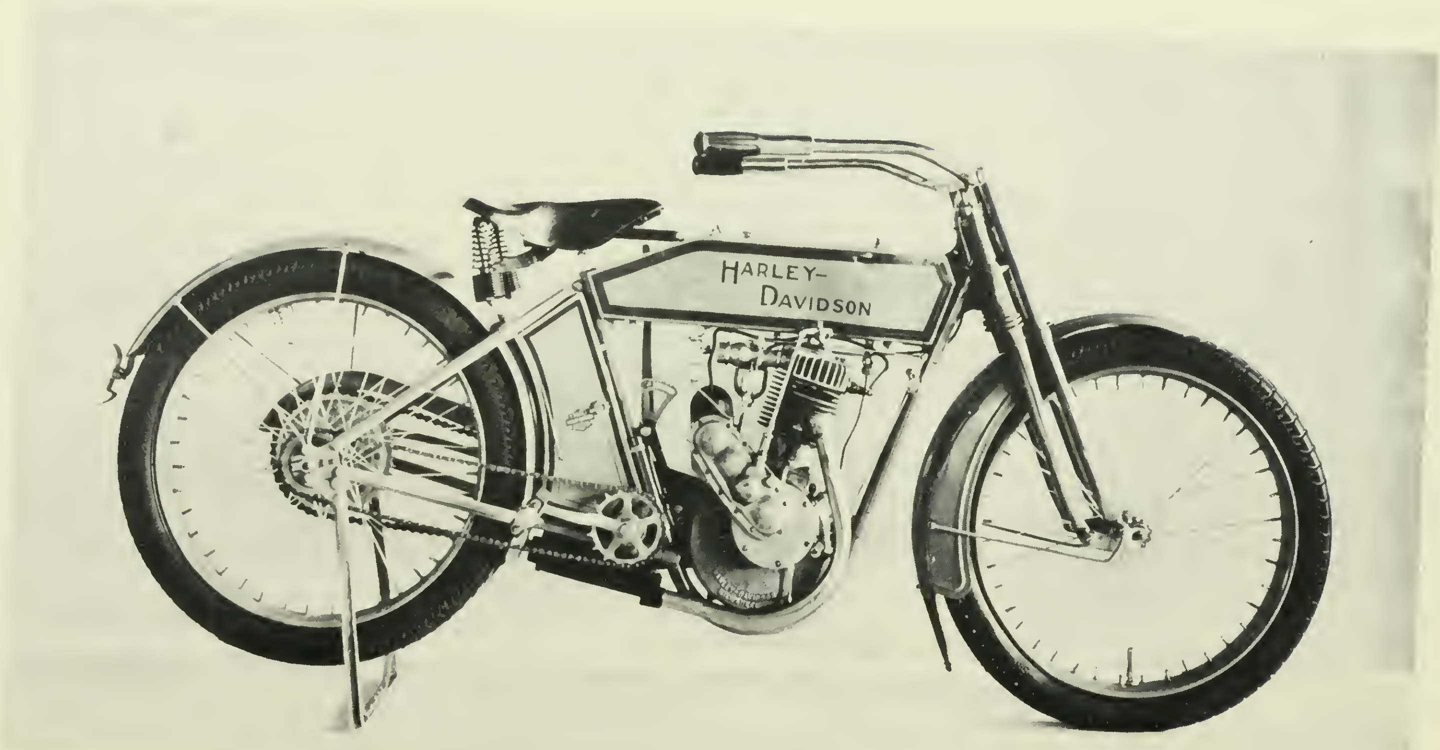


Figure 95.—This 1913 Harley-Davidson motorcycle was restored in 1947 by the manufacturer.

were 28 by 2½. A metal mudguard is located above each wheel, and a stand is supplied at the rear of the frame. Beneath the saddle is a metal tool box, and below the box is a muffler connected to the exhaust port by a curved pipe. The wheelbase is 57 inches.

The rear wheel is driven by a double-reduction roller chain from a sprocket on the engine crankshaft to a sprocket at the hub of the rear wheel. This hub is equipped with a clutch operated by a hand lever on the left side of the machine. Forward motion of the lever engages the clutch. Metal guards cover the two chains. A pedal-and-chain drive, incorporating a New Departure coaster brake, is provided on the right side. With the rear wheel raised from the ground, and the clutch engaged, the pedals are used to crank the motor for starting. The brake is engaged by slight backward pressure on the pedals. The pedals are not driven by the forward motion of the machine. They can be used to propel it in an emergency, in which case the clutch would be disengaged.

At the time of the motorcycle's restoration in 1947, new tires and inner tubes, contributed by Harvey S. Firestone, Jr., were fitted to the machine.

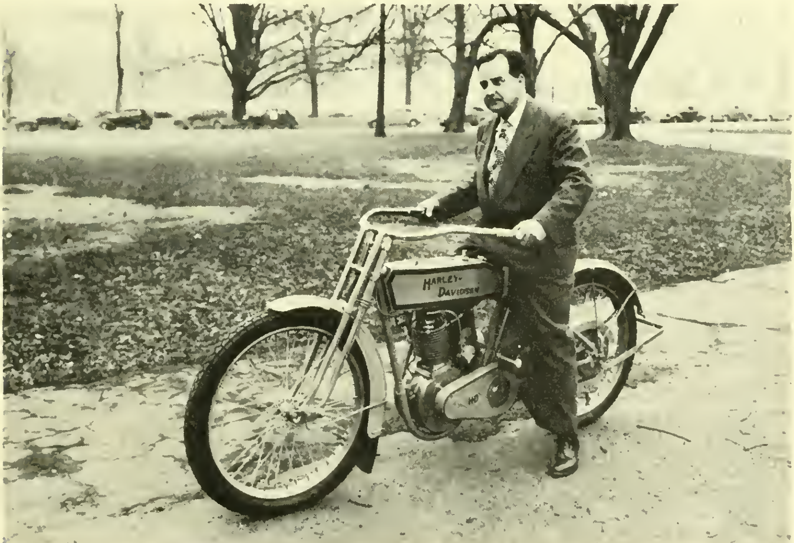


Figure 96.—Paul Garber astride the 1913 Harley-Davidson which he presented to the National Museum.

RAUCH AND LANG ELECTRIC AUTOMOBILE, 1914
Gift of Mrs. William C. Gorgas in 1929 (USNM 309622)

This vehicle (fig. 97), originally owned by Surgeon General William C. Gorgas, represents the period when electric passenger automobiles were at the height of their popularity. Its roomy interior, comfort-providing body, and quietness and smoothness of operation together created an automobile especially suitable for city driving and for trips of short distances and frequent stops. It was made by the Rauch and Lang Carriage Co., of Cleveland, Ohio.

The range of the vehicle on the most favorable speed, about 13 miles an hour, was readily 100 miles per charge, according to John H. Hertner, the designer. Higher speeds cut down materially the mileage per charge, the top speed being 19 miles an hour.

The frame of the chassis consists of two parallel side members of channel section separated by seven cross members. In the center of the frame, suspended from two of the cross members, is the electric motor, which propelled the vehicle. Rated at 80 volts and approximately 2½ horsepower, the motor is connected to the worm-driven rear axle by a short drive shaft with two universal joints and a slip joint. This permits supporting the motor rigidly on the frame.

The rear-axle assembly is a complete unit of the floating type. The housing is composed of three sections, the center one holding the complete differential mechanism, including the worm and worm wheel. The two end sections containing the axle shafts are bolted to it. The axle shafts are fitted into the differential unit by means of splined ends. Torsional strains are taken care of by means of a torque bar connected to the lower front of the differential housing by a tapered joint and to the motor by a universal connection. The bar lies directly beneath the propeller shaft.

The rear-axle assembly is attached to the frame by two ⅞-elliptic springs. The upper part of each spring is pivotally connected to the frame, and the lower part is similarly supported on the axle housing. The forward end of the lower half of each spring is connected to a spring bracket at the side of the frame. The spring eyes are fitted with bronze bushings, while hardened and ground spring bolts with grease cups are used.

The brakes on the rear wheels are of the internal expanding type and are operated by either of two pedals, as the vehicle is fitted with dual controls permitting operation from either the front or the rear seat. Each brake pedal incorporates a ratchet to lock it in the depressed position.

Figure 97.—1914 Rauch and Lang electric automobile. Because of their simplicity of operation, electrics were favored by women drivers of the period.

The front axle is tubular and is attached to the frame by two conventional semielliptic springs. The front wheels turn on individual steering knuckles connected by a tie rod. The drag link, connected to the left steering knuckle, is operated by either of two steering bars, one at the front seat and one at the rear seat.

The wheelbase of the chassis is approximately 100 inches and the tread 54 inches. Wooden-spoked wheels are provided with 36-by-4-inch solid rubber tires. The vehicle's weight is approximately 4,000 pounds.

A controller handle is located to the left of both the front and rear seats. These complete the dual set of controls. Moving the handle to the rear applies an external contracting brake on the motor shaft, while moving it forward controls the speed of the motor. To reverse the motor, the operator depressed a pedal in front of the driver's seat, at the same time operating the controller handle as before for the speed control. Each controller handle has a built-in cylinder lock.

Beneath the rear-seat cushion is a compartment, which now contains a set of tire chains and a Weston combination voltmeter and ammeter. The voltmeter scale range is from zero to 120 volts, and the ammeter scale from plus 50 to minus 150 amperes. The instrument could indicate the state of charge and the rate of charge and discharge of the batteries, but it is not known now where or if the instrument was permanently connected to the car.

The enclosed body seats four persons, two in the rear and two on individual seats in front. The head room is a few inches less than 5 feet. There is one door on each side, each fitted with a window which can be raised and lowered. Cylinder locks enable the doors to be locked from the outside, while thumb screws on the inside lock the door handles. Two other windows on each side are fixed in place, but the front windshield and the rear window can be raised and lowered. All eight windows are fitted with roller shades, and a glass visor is located in front of the windshield.

Within the front battery compartment are 30 storage batteries of one cell each, while 15 are located in the rear compartment. Hinged covers are provided for the two compartments. Fenders and running boards are fitted to the body.

Electric headlights, side lamps, and taillight are supplied. A Stewart-Warner speedometer is placed inside the body within view of the driver. Interior illumination and a flower vase complete the equipment.

CLEVELAND MOTORCYCLE, 1918

Gift of Richard and Russell Fiedler in 1951 (USNM 313692)

This motorcycle (fig. 98) was built by the Cleveland Motorcycle Co., of Cleveland, Ohio, bears engine No. 5283, and cost $175, f.o.b. Cleveland. Advertisements of the period claimed 75 miles from a gallon of fuel, and 35 to 40 miles an hour for this machine. This make of motorcycle was introduced in August 1915, at which time the f.o.b. price was $150. It was one of the most popular lightweight motorcycles of the period.

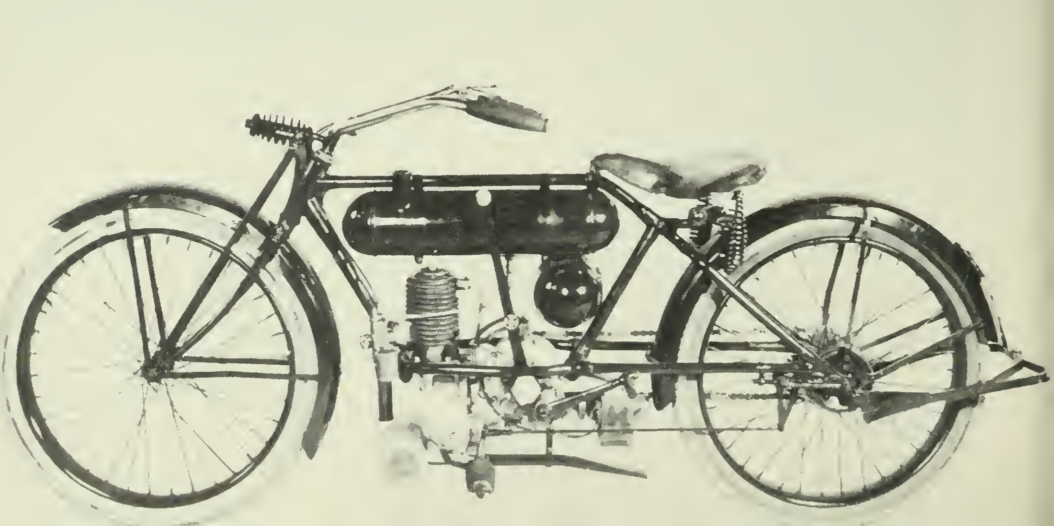
The machine is equipped with a 2½-horsepower, 1-cylinder, 2-cycle, air-cooled, gasoline engine of 2½-inch bore and 2¾-inch stroke. The total piston displacement is 13½ cubic inches. The cylinder casting and its integral head are of cast iron. The carburetor, bolted to the inlet port at the front of the cylinder, is a Brown and Barlow, float-feed, single-jet type with auxiliary air control. The two hand-operated controls of the carburetor are located on the right handle bar. The motor is lubricated by mixing oil with gasoline in the fuel tank. Ignition is supplied by a Bosch high-tension magneto with spark plug.

The frame is of heavy-gauge seamless steel tubing, brazed at the joints, and the wheelbase is 54 inches. The engine and gear box are secured in the frame by two large suspension bolts. The gear box is integral with the aluminum crankcase and contains a set of 2-speed sliding gears of chrome-nickel steel and a heat-treated, alloy-steel worm with a titanium-bronze worm gear, as well as a multiple-disk clutch composed of 13 hardened and ground steel disks. The low ratio of the gear box is 10 to 1, and the high ratio 6.1 to 1. The transmission gears are lubricated by running in an oil bath. Forward motion of a hand lever on the left side of the machine engages the clutch. A brake pedal, also on the left side, operates a contracting brake band on a drum on the left side of the rear wheel. Gear changes are made by a pedal operated by the right foot. A kick starter is attached to the left side of the gear box. The rear wheel is driven by a roller chain from a sprocket on the output shaft of the transmission, on the right side of the machine. There is no guard over the chain.

The wire-spoked, metal-rimmed wheels mount 26-by-2½-inch clincher tires with inner tubes. Tubular handle bars with rubber grips are attached to the steering fork, which is fitted with a coil spring. A cylindrical, cast-aluminum muffler, mounted in front of the crankcase, is attached to the exhaust port of the cylinder. A metal mudguard is located above each wheel, and a stand is supplied at the rear of the frame. A cylindrical fuel tank suspended from the frame above the engine is fitted with a shut-off valve at the bottom. A small, metal, tool box is attached beneath the rear of the fuel tank. Rubber-covered footrests are provided adjacent to the brake and shift pedals. The saddle is a Mesinger "Auto Cushion." No battery, generator, lighting equipment, or warning signal is provided. The weight of the cycle is approximately 150 pounds.

This motorcycle was restored by the Museum staff during November and December, 1951, at which time it was disassembled, cleaned, refinished, and reassembled. The old tires of the early 1920's have been equipped with new butyl-rubber inner tubes. The 1926 license plate of the District of Columbia, attached to the rear fender at the time of presentation to the Museum, was also refinished with its original colors.

Figure 98.—This 1918 Cleveland motorcycle was restored in 1951 by the staff of the National Museum.



AUTOCAR GASOLINE TRUCKS, 1921

Gift of the Autocar Co. in 1922 (USNM 307255 and 307256)

These one-quarter-size models represent the type XXVI–B (fig. 99) and XXVI–Y (fig. 100) Autocar trucks of 1921. Except for the wheelbase and the type of body, the two types are identical. The former has a 156-inch wheelbase and a unit construction rack body, while the latter has a 120-inch wheelbase and a rotary dump body with power hoist.

The wheels of the larger model and the dumping action of the dump body truck were originally operated by concealed electric motors. Otherwise the models are inoperative.

The frame of the full-sized vehicle is made of pressed steel of channel section and is fitted with cross members and braces. All four springs are of the semielliptic type. The tread is 63 inches. The front axle is drop-forged steel of I-beam section. The front wheels are mounted on adjustable, tapered, roller bearings. The front tires, of solid rubber, are 34 by 5 inches.

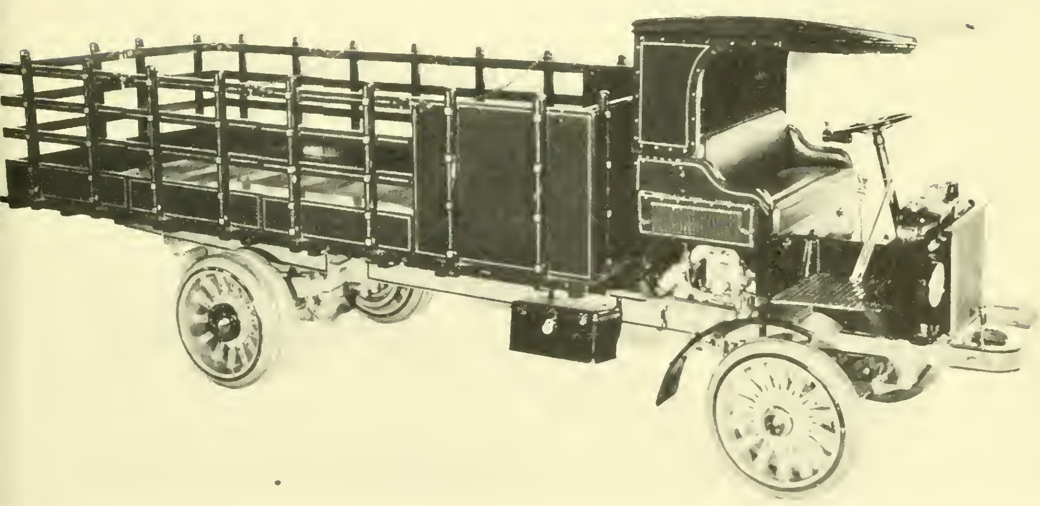


Figure 99.—Model of 1921 Autocar truck, type XXVI–B. This quarter-scale model represents a vehicle with a 156-inch wheelbase.

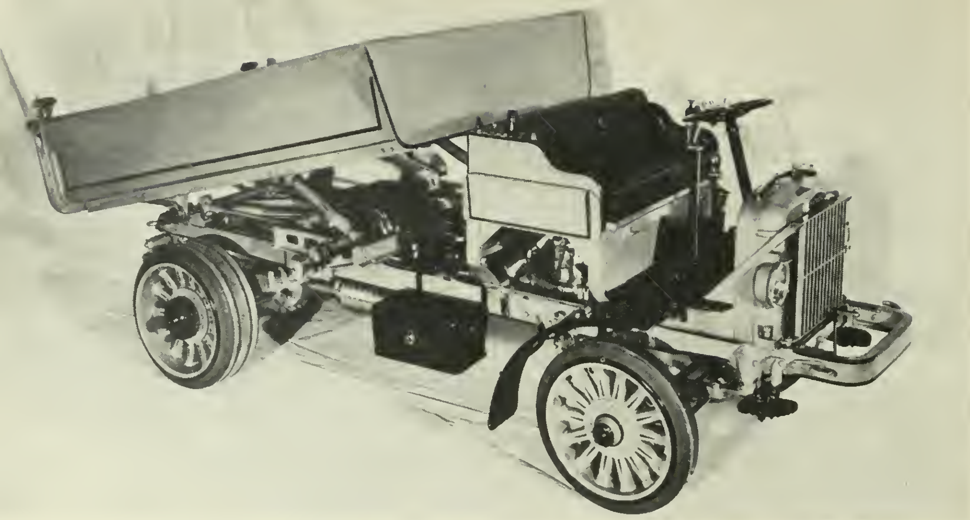


Figure 100.—Model of 1921 Autocar truck, type XXVI–Y. This quarter-scale model represents a vehicle with a 120-inch wheelbase.

The rear axle is of the full-floating, double-reduction, gear-driven type, the gear reduction being compounded through bevel and spur gears. This construction allows low reduction without the sacrifice of road clearance. It also reduces the angularity of the propeller shaft, giving straight lines for the transmission of power. All the gears in the rear axle are of heat-treated steel carried on adjustable, tapered, roller bearings. The complete gear train is mounted on a cover plate bolted to the axle housing. This cover plate and gear train can be removed as a unit from the axle housing for inspection and adjustment purposes. The rear wheels are mounted on adjustable, tapered, roller bearings carried on an extension of the axle housing. By this means the rotating parts of the rear axle carried no part of the weight of the truck, their only function being to transmit the power to the rear wheels. The driving axles are of heat-treated alloy steel. The rear tires, of solid rubber, are 36 by 10 inches.

The engine and clutch are in one unit, which is carried in the frame by means of 3-point suspension under the seat structure. The engine is a 4-cylinder, 4-cycle, water-cooled unit of 4¼-inch bore and 5½-inch stroke, with a rated horsepower of 28.9. It is equipped with a counterbalanced crankshaft of heat-treated alloy steel mounted on two ball bearings.

Carburetion was effected by means of an automatic, float-feed type carburetor, to which gasoline was delivered by gravity from a 25-gallon tank behind the seat.

The water for the cooling system was circulated by a centrifugal pump and cooled by means of a vertical-tube radiator. Air circulation was assisted by a belt-driven fan behind the radiator.

Ignition was by a high-tension magneto, gear driven by the engine.

Engine lubricating oil was circulated by a gear pump driven from the camshaft and located in the lower engine pan. The pump supplied oil to jets under the connecting rods, insuring a constant level for the connecting rod dippers under all conditions.

The clutch is of the dry-disk type, consisting of two driving plates faced with asbestos fabric and attached to the flywheel, and one driven plate attached to the driving shaft. It is controlled by a pedal.

The transmission is of the selective type, with four forward speeds and one reverse. All gears and shafts are heat-treated alloy steel mounted on ball bearings. The transmission is suspended from the frame at three points and is connected to the clutch by a fabric-disk universal joint. Power was transmitted to the rear axle by means of a tubular drive shaft equipped with a universal joint at each end.

Steering is effected by means of an irreversible steering gear on the left side of the vehicle.

The two sets of brakes, service and emergency, operate on steel drums bolted to the rear wheels. Both are of the internal expanding type, the service brake being operated by a pedal, and the emergency (or parking) brake by a hand lever.

Speed changes are made by a hand lever to the right of the driver. Engine speed was controlled by spark and throttle levers on the steering wheel and by a pedal or "accelerator." The engine speed and the vehicle speed were controlled by a governor, which operated both by motor speed and by car speed and could be set and locked for a predetermined maximum speed.

Gas headlights with acetylene tank and an oil taillight are provided for illumination.

CADILLAC GASOLINE AUTOMOBILE, 1923

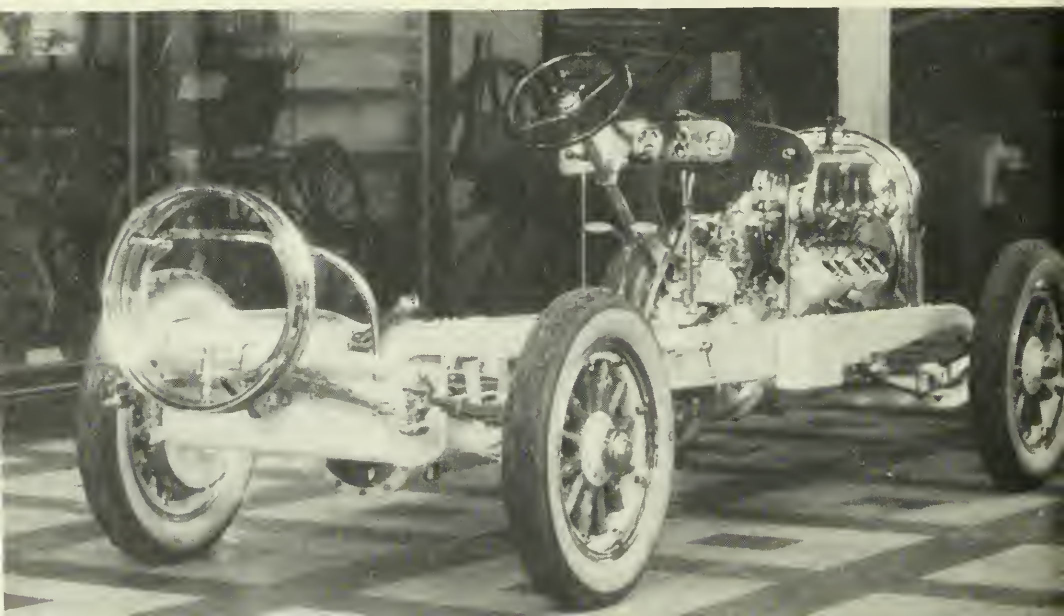
Gift of the Cadillac Motor Car Co. in 1923 (USNM 308218)

This Cadillac chassis of 1923 (figs. 101 and 102) was originally exhibited in the Museum in contrast with the model-A Cadillac of 1903 (fig. 81) to indicate the many changes made in the automobile in a 20-year period. It is the model 61, which followed by 8 years the first Cadillac with a V-8 engine, the model 51 of 1915. It illustrates the construction of a quality car of its date.

The V-shaped engine consists of two 4-cylinder blocks with detachable cylinder heads placed at a 90° angle upon an aluminum crankcase. The bore and stroke are 3⅛ inches and 5⅛ inches, respectively, giving a total piston displacement of 314.4 cubic inches. At 2,700 revolutions per minute 60 horsepower was developed. The 16 valves are mechanically operated by a single camshaft located in the center of the engine above the crankshaft, which is supported in three bearings.

At the front of the engine a Morse timing chain drives the camshaft and also the Delco distributor of the battery ignition system. A pivoted weight, turning with the shaft of the distributor, automatically advanced the ignition timing as higher speeds were reached. The timing chain also turns a shaft, lying in the V of the engine, to drive the

Figure 101.—Photo, made in 1923, of 1923 Cadillac chassis in Transportation Hall of National Museum.



Delco electric generator used for charging the battery of the car. The generator is also the starter motor. The starter pedal mechanically engages the starter gear with a large ring gear on the flywheel at the rear of the engine, and closes the starter switch. When the engine was running, the unit acted as a generator.

Engine lubrication was by both force feed and splash. The crankshaft is drilled for the passage of oil to the bearings from a gear oil pump at the bottom front of the engine. The oil capacity of the crankcase is 6 quarts. A removable aluminum oil pan is bolted to the bottom of the crankcase for access to the lower interior of the engine.

A constant-level, float carburetor is connected to an intake manifold, which branches off to both cylinder blocks. Gasoline from the 20-gallon tank at the rear of the car was forced to the carburetor by air pressure in the tank. This pressure was maintained by a small air compressor driven by the engine. With the engine at rest, and pressure down in the tank, a hand pump on the instrument panel board was used to establish the initial pressure.

The intake manifold was heated by the exhaust gases passing through a jacket on the manifold. Each block has its own exhaust manifold, and an individual muffler in the center of the car.

The engine is water-cooled, with a water pump for each block. The pumps, located at the lower front of the engine, are driven by the timing chain. A vertically mounted, tubular radiator is at the front of the chassis with a fan, driven by the timing chain, located behind it. The capacity of the cooling system is 6 gallons. An expansion tank, connected to the overflow pipe of the radiator, is located on the right side frame member.

The selective transmission provides three speeds forward and one reverse. The speed is selected by a gear-shift lever mounted in the top of the gear box. A built-in lock enables the shift lever to be locked in the neutral position. On the side of the transmission housing is a small Kellogg air-cooled, 1-cylinder air pump. This pump, for inflating tires, is operated by engaging its driving gear with one of the transmission gears by means of a small lever attached to the pump.

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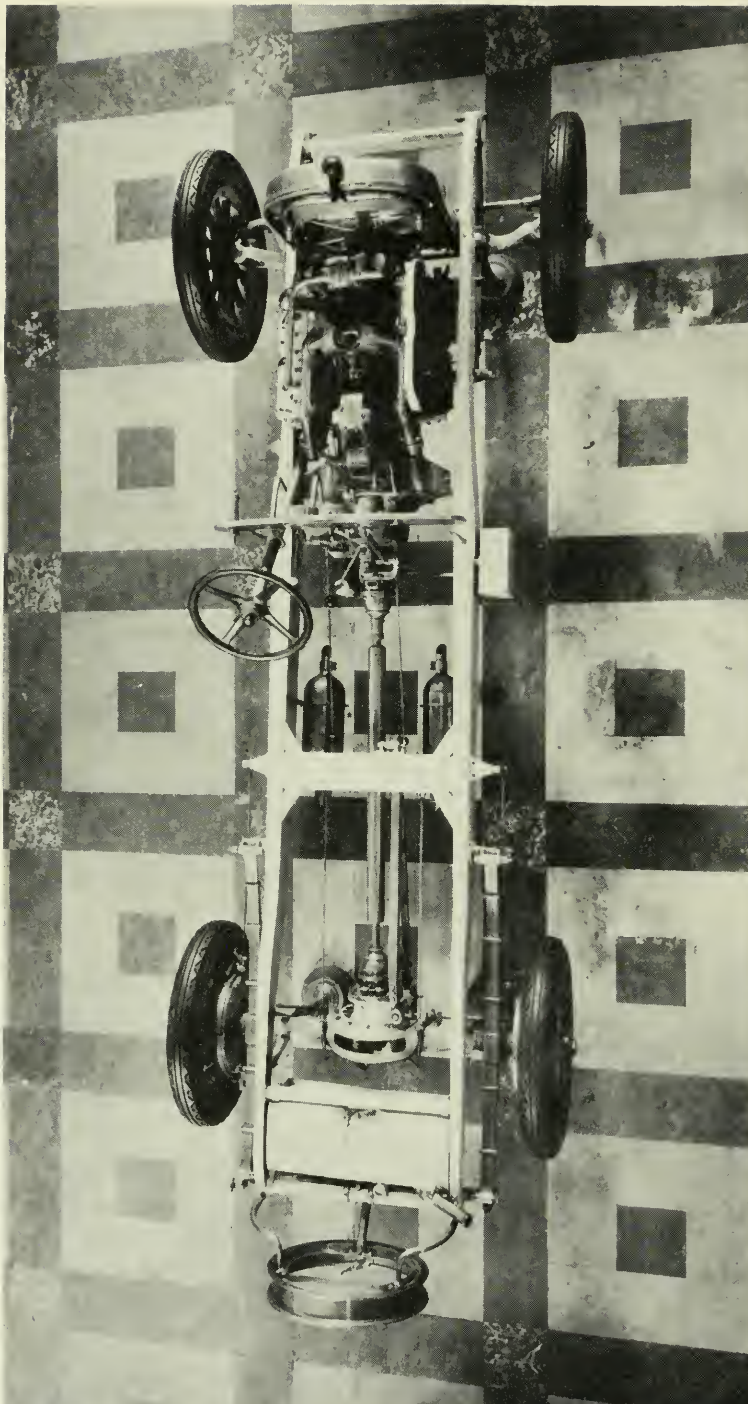


Figure 102.—Overhead view of 1923 Cadillac chassis.

The transmission is secured directly behind the engine, with a multiple-disk clutch between the two. The clutch is disengaged by depressing the left of two large pedals. The hand-brake lever, pivoted on the outside of the gear box, is connected by rods to internal, expanding shoes within brake drums on the rear wheels. The brake pedal is connected by rods to external, contracting bands on the same drums.

The frame of the chassis is formed of two U-shaped channels with four strengthening cross members. It is supported on two semielliptic springs at the front, and on a pair of semielliptic springs and one transverse spring at the rear. The Timken front axle has pivoted steering knuckles at each end, connected together by a tie rod parallel to, and in front of, the front axle. Worm and sector steering is used, with the steering wheel at the left side of the car.

The wheelbase is 132 inches and the tread 56 inches. Kelsey artillery type wheels with demountable rims of 23-inch diameter are used, mounting 33-by-5-inch straight-side pneumatic tires. No shock absorbers are provided, but rebound straps are fitted to the outer ends of the rear-axle housing. The rear axle is the Timken full-floating type with Timken differential unit. A torque arm leads from the rear axle to the center cross member of the chassis. A propeller shaft with a Spicer universal joint at each end connects the transmission with the differential unit.

The gasoline tank is suspended at the rear of the car between the two side members of the frame. The cap, when screwed home, is airtight. A float-operated fuel gauge is located at the top rear of the tank. Behind the tank is a carrier for a spare rim and tire. Alemite fittings for lubrication are provided for all shackle bolts, front-axle kingpins, steering parts, etc. A crank-handle extension projects forward below the radiator.

The instrument panel contains an oil-pressure gauge, an air-pressure gauge, a Weston ammeter, a Van Sicklen speedometer, and an Elgin clock.

The majority of parts are cross-sectioned, revealing mechanisms seldom seen by the automobile owner. All water passages are painted green, while all parts related to the intake and exhaust systems are painted red. The frame is painted white.

BANTAM ¼-TON ARMY TRUCK, 1940

Transferred from the U. S. War Department through Col. E. S. Van Deusen in 1944 (USNM 312822)

In 1940 the American Bantam Car Co., of Butler, Pa., constructed 62 of these ¼-ton, 4-wheel-drive trucks, which were the prototype of the famous "jeep" or "peep." Modified and standardized for volume production, many thousands were built by the American Bantam Car Co., Willys-Overland Motors, and the Ford Motor Co. Combining simplicity, exceptional mobility, reliability, low silhouette, and a capacity out of proportion to its size, the jeep proved a very versatile and successful military vehicle. It is on its way to becoming a legendary symbol of allied military unity during World War II.

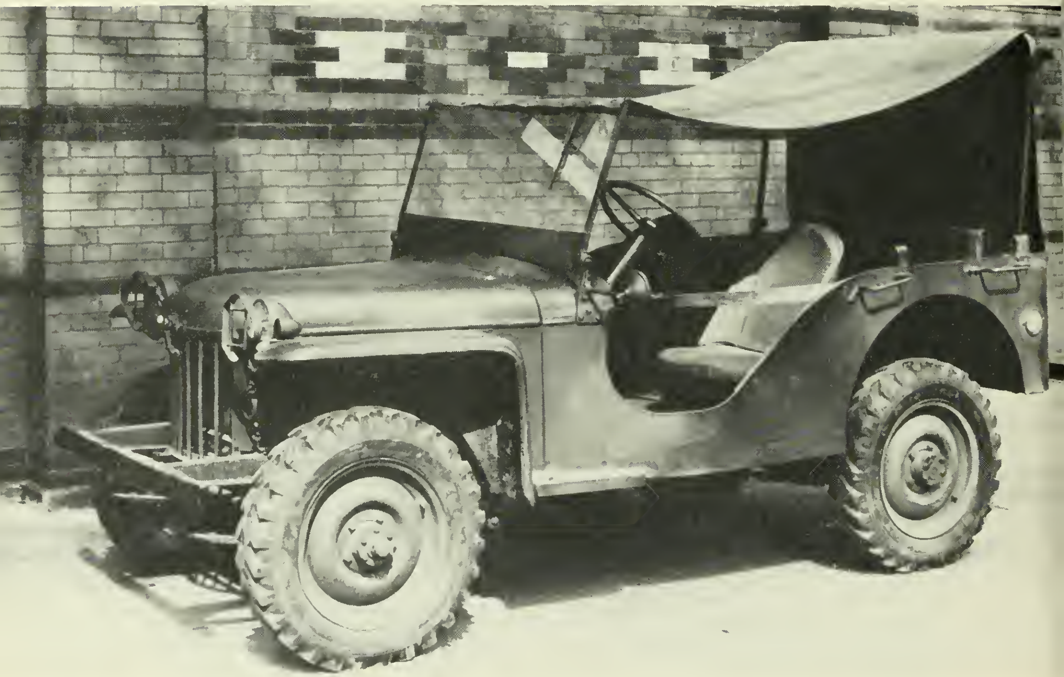


Figure 103.— 1940 Bantam 1/4-ton Army truck, one of a group of 62 prototypes of the world-famous "jeep."

This Bantam prototype (fig. 103) differs from the standard jeep chiefly in its appearance and in the fact that it is powered with a Continental engine. It is the seventh one of the 62, serial number 1007. It was delivered to the

Army on November 29, 1940, and was given the Army registration number W–2015330. Upon delivery to the Army Board at Fort Knox, Ky., it was put through a series of tests equivalent to about 100,000 miles of service and was then retired from active Army service.

The Continental engine is of the 4-cylinder, L-head type with a bore of 3³⁄₁₆ inches and a stroke of 3½ inches, developing 46 horsepower at 3,250 revolutions per minute. It is water cooled, with a belt-driven fan and centrifugal water pump behind the radiator. All electrical equipment on the engine—the ignition coil and distributor, the voltage regulator, the generator and the starting motor—are by Auto-Lite. The 6-volt storage battery is located beneath the hood, to the left of the engine.

A constant-level, float carburetor is used and is fitted with an air filter on the air intake. A mechanical fuel pump and a fuel filter are used in conjunction with the carburetor. A gear oil pump supplied the bearing surfaces of the engine with lubricating oil under pressure at all times, the oil passing first through a filter attached to the cylinder head of the engine.

The gross weight of the vehicle is 2,700 pounds, the wheelbase is 79 inches, and the tread is 48 inches. Disk wheels, secured to the brake drums by five bolts, mount 5.50–16 tires. A spare wheel and tire can be carried at the back of the vehicle.

The frame is of steel and is connected to the front- and rear-axle housings by four semielliptic springs. The frame is located above the housings, while the springs pass beneath them. Telescopic shock absorbers are provided for each spring.

Power can be transmitted from the engine to all four wheels when desired, but the front wheels are usually driven only when the necessity arises on difficult terrain. A transfer case is located near the center of the frame, to the left of the transmission, and provides means for driving a shaft leading to the differential unit in the front-axle assembly. The shaft passes to the left of the engine, which is offset to the right in the frame for this purpose. A similar shaft leads from the transfer case to the differential unit in the rear-axle assembly. Each differential unit contains spiral bevel gears, and each drive shaft has a universal joint at each end. The left of two short levers on the transfer case enables the driver to engage or disengage the front shaft, while the rear remains engaged. The right of the two levers enables a low- or high-gear ratio to be selected within the transfer case. The selective transmission provides three speeds forward and one reverse, the operating lever being located to the right of the two short levers.

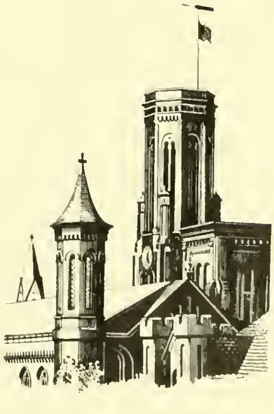
The final drive to the two front wheels is by a shaft and universal joint at each end of the front-axle housing. The steering is of the conventional worm and follower type, with the tie bar connecting the two front-wheel spindles located in front of the axle. Four-wheel hydraulic brakes are provided, the right pedal actuating the master cylinder. The left pedal operates the disk clutch located between the engine flywheel and the transmission. The parking-brake lever is mounted beneath the left end of the instrument panel. Each of the four brake drums is mounted on two tapered roller bearings, while each of the two front-axle kingpins is similarly supported.

The 4-passenger body is constructed entirely of metal. No doors are provided, the passengers climbing over the low sides to enter. Safety straps are installed at the outer side of each front seat. No rear fenders exist, the wide body at the rear extending over the rear wheels. A folding windshield with shatter-proof glass is supplied. A hand-operated windshield wiper is in front of the driver. A rear-view mirror is attached to the windshield base on the left. The radiator is protected by a grillwork of vertical bars in the front. Bumpers are provided, front and rear. The hood is of the "clam shell" variety, hinged at its back and latched with a single latch at the front. The gasoline tank is beneath the rear seat. Provision is made for a fire extinguisher under the right, front seat. A collapsible top is composed of easily removed pipe framework and canvas.

Headlights are mounted on each fender at the front, with a small auxiliary light for blackout use next to each. They are protected by a small grillwork. The dimmer switch for the headlights is button-operated by the driver's foot and is located between the clutch and brake pedals.

Two taillight units are supplied, one at each side on the back of the body. The right one incorporates a taillight and a stop light for use in blackout. The left one incorporates a service taillight and stop light and a blackout taillight. Reflectors are provided at the back and at the sides near the back. A pintle hook for towing purposes is located at the back of the vehicle, attached to the frame. Handles on each side of the body can be used for assisting the vehicle by manpower. A muffler is placed beneath the right side of the body.

The instrument panel contains a water-temperature gauge, an oil-pressure gauge, an electrically operated gasoline gauge, an ammeter, and a speedometer. The starter button is at the left end of the panel and actuates a solenoid attached to the starting motor. Hand-operated choke and throttle controls are provided, the latter supplementing the accelerator pedal. A light switch is located in the center of the panel. The blackout lights are energized when the switch is pulled out to the first position. To turn on the service lights the switch must be pulled out to its second position, this requiring the additional pushing of a small button in the side of the switch housing. The ignition switch (key-operated) is placed directly below the light switch. No manual ignition spark advance is provided, as the distributor incorporates a centrifugal automatic advance and retard mechanism. A button in the hub of the steering wheel controls the horn, which is located below the left headlight.



PICTURE CREDITS

With the exception of figure 42, the negative numbers for the figures listed below are those of the U. S. National Museum.

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In addition to the above publications there are many periodicals, some of which are no longer being published, which provide contemporary descriptions of many automobiles and contests. These include the following:

Automobile, The (first published September 1899).
Automobile Trade Journal (merged into *Motor Age* in 1928).
Automotive Industries (started as *The Automobile*).
Cycle and Automobile Trade Journal (became *Automobile Trade Journal*).
Horseless Age, The (first published November 1895, merged into *Motor Age* in 1918).
Motor (first published in 1903).
Motor Age (first published September 1899).
Motor Life (first published March 1906).
Society of Automotive Engineers Journal (first published in April 1911 as *S. A. E. Bulletin*).

During the years 1904 through 1929, illustrated handbooks were issued annually by the Association of Licensed Automobile Manufacturers and its successors, the Automobile Board of Trade and the National Automobile Chamber of Commerce. This organization is now called the Automobile Manufacturers Association. These books list the major specifications for all the automobiles made by the members of those groups, and are a valuable source of information. The Automobile Manufacturers Association also publishes a pamphlet entitled "Automobile Facts and Figures," which contains many statistics pertaining to the automobile industry.

Several clubs currently issue illustrated publications containing articles by authoritative writers, as well as reprinted articles from the old commercial periodicals. The publications of some of these clubs are as follows:

Antique Automobile, The—Published quarterly by the Antique Automobile Club of America, Inc., c/o Tradesmens Bank and Trust Co., Broad and Chestnut Streets, Philadelphia 10, Pa.
Bulb Horn, The—Published quarterly by the Veteran Motor Car Club of America, Inc., 15 Newton Street, Brookline 46, Mass.
Horseless Carriage Club Gazette, The—Published quarterly by the Horseless Carriage Club of America, 215 North Larchmont Boulevard, Los Angeles 4, Calif.
Old Timers News—Published by the Automobile Old Timers, Inc., 22 East Thirty-eighth Street, New York 16, N. Y.

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