

EARLY CURTISS AIRCRAFT ENGINES

By K. M. MOLSON

Glenn Hammond Curtiss was born at Hammondsport, New York in 1878. He grew up there and as a young man moved away briefly to accept employment with the Eastman Kodak Company in nearby Rochester. Returning to Hammondsport, he established a small shop to sell and repair bicycles.

Soon he had bicycles made to his own specifications by a nearby factory and marketed under his own brand name, establishing branches of his business in neighboring towns. The idea of a motorcycle interested him, and he purchased engine castings and had them machined by the Kirkham brothers* in their machine shop at Bath, a few miles away. This led to a successful motorcycle, and requests for machines like it started to come in.

Financed by two local businessmen, a small motorcycle factory was established, and the performance of its machines, coupled with Curtiss' skill as a rider, soon made the Curtiss motorcycle very well known. His outstanding accomplishment in this field was achieving a speed of 136.3 mph in January 1907 which was a new land speed record at that time. The success of the Curtiss motorcycles attracted the attention of Captain Thomas Scott Baldwin, the well-known balloonist and dirigible operator. In a short time Curtiss was supplying engines to Baldwin that were somewhat lightened and modified motorcycle engines. They were air-cooled and initially had two cylinders. Some later airship engines supplied were four cylinder, in-line models but also air-cooled.

Curtiss showed no particular interest in aviation at this time but seemed merely content to supply light engines to dirigible operators as long as they were willing to pay him well for them. Meanwhile, Dr. Alexander Graham Bell had been experimenting with large tetrahedral kites, and he wished to apply power to them. He met Glenn Curtiss originally in New York City in 1905 and tried to interest him in this idea but without much success.

Dr. Bell went to Hammondsport in the spring of 1907, and he managed to persuade Curtiss to get work started on a four cylinder engine for him. He also attempted to have Curtiss visit him at his summer home in Baddeck, Nova Scotia, without success. The first engine, more or less a duplicate of the engines supplied to Captain Baldwin, was unsatisfactory in being too heavy and not delivering sufficient power. However, Dr. Bell ordered a larger engine and specified that Curtiss should deliver it in person to Baddeck, Nova Scotia and show how it should be run on the basis of being paid twenty-five dollars a day and expenses for his visit. Glenn Curtiss, possibly disappointed by the failure of his earlier engine, agreed to these terms and delivered the engine to Baddeck as requested. During this visit he met Mrs. Bell and the group that was to become the well-known Aerial Experiment Association, on October 1, 1907, at the suggestion of and financed by Mrs. Bell.

This visit to Baddeck in July of 1907 changed Glenn Curtiss' life. For possibly influenced by the charm of

Mrs. Bell and the enthusiasm of the young engineers, he formed a great interest in the development of heavier-than-air machines which was to remain with him throughout his career.

It was agreed that in the new association J. A. D. McCurdy, F. W. Baldwin, Glenn Curtiss and Lt T. E. Selfridge were each to develop a powered aircraft and that in addition they would pool their knowledge so that each machine would be a logical development from the preceding one. Curtiss was looked to for the supplying of power plants for the machines.

The first engine was an eight cylinder, air-cooled Vee engine developing 40 hp and fitted initially in the first machine of the Association, the Red Wing of Lt Selfridge. This engine later was fitted to the White Wing of F. W. Baldwin and in this aircraft achieved flights up to 615 feet. Still later, it was fitted to the well-known June Bug developed by Glenn Curtiss and powered this aircraft when it won the Scientific American Trophy in 1908.

For the Silver Dart, the aircraft of J. A. D. McCurdy Curtiss undertook to develop an improved powerplant. He produced a Vee-8, water-cooled engine developing up to 50 hp at 1600 RPM which featured concentric intake and exhaust valves and a copper water jacket. A separate mixing valve or carburetor was originally provided for each cylinder. However, during the winter of 1908 the fuel supply system was altered and a single carburetor or mixing valve was provided for each of the cylinder banks.

This engine was fitted to the Silver Dart and resulted in the most successful combination of aircraft and powerplant produced by the Aerial Experiment Association. The Association, having achieved its purpose, was disbanded in the spring of 1909. The American rights to the patents and knowledge gained by the Association were assigned to Glenn Curtiss.

In the spring of 1909 Glenn Curtiss built a new aircraft at Hammondsport following the general lines developed by the Aerial Experiment Association but in a much smaller and simplified version. The completed aircraft was delivered to the Aeronautical Society of New York on June 16, 1909. This was the first commercial aircraft ever bought in the United States. To power it he developed a new engine, a four cylinder, water-cooled, vertical in-line engine developing 25 hp. This engine also featured the copper water jacket but had ignition by Bosch magneto in place of battery and operation of the intake and exhaust valves by a single rocker arm actuated by a single push-pull rod. These features were to remain as Curtiss standards for some time.

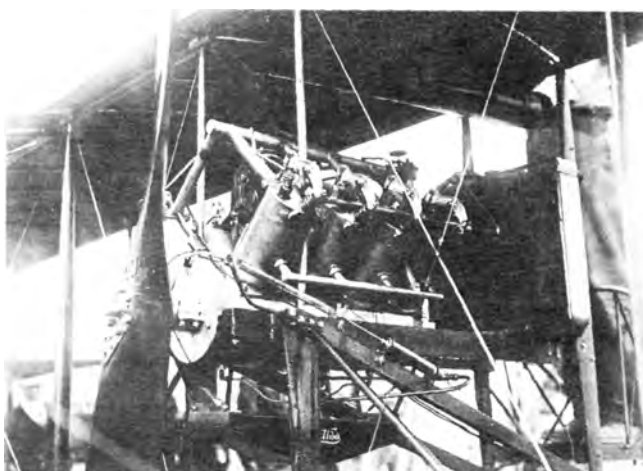
The success of this machine, the Gold Bug as it was known, induced Curtiss to build a similar machine named the Golden Flier to enter the competition at Reims, France and the race for the Gordon Bennett Trophy. For this aircraft he produced a new Vee-8, water-cooled engine developing 63 hp. With the Golden Flier he won the Gordon Bennett Trophy race and at that time became holder of the world's speed records on land and in the air simultaneously--a feat which has not been duplicated by any other person.

In 1910 Curtiss built a number of aircraft for sale and for the use of Curtiss exhibition pilots. It would seem that some of the engines in the early aircraft were identical to that fitted in the Gold Bug. However, alternative power plants, consisting of a slightly enlarged version of the four cylinder engine and a new eight

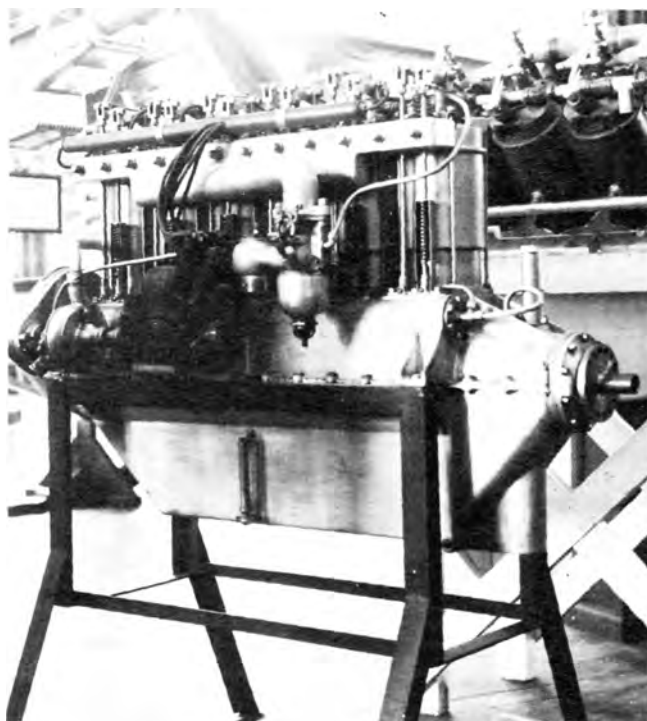
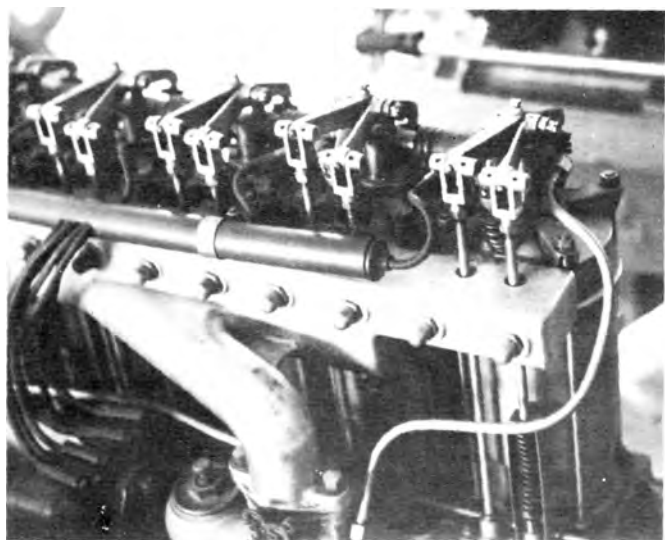
* In Curtiss' biography, THE SKY STORMING YANKEE by Clara Studer, the machining of castings by Kirkham is referred to and in one case, reference is made to consultation with him concerning the design of a new engine. However, some autobiographical notes on Charles Kirkham held by the National Air Museum in Washington indicate that Kirkham probably played a prominent part in the design of these early engines. In 1914 he was appointed chief engineer for the Curtiss Company.



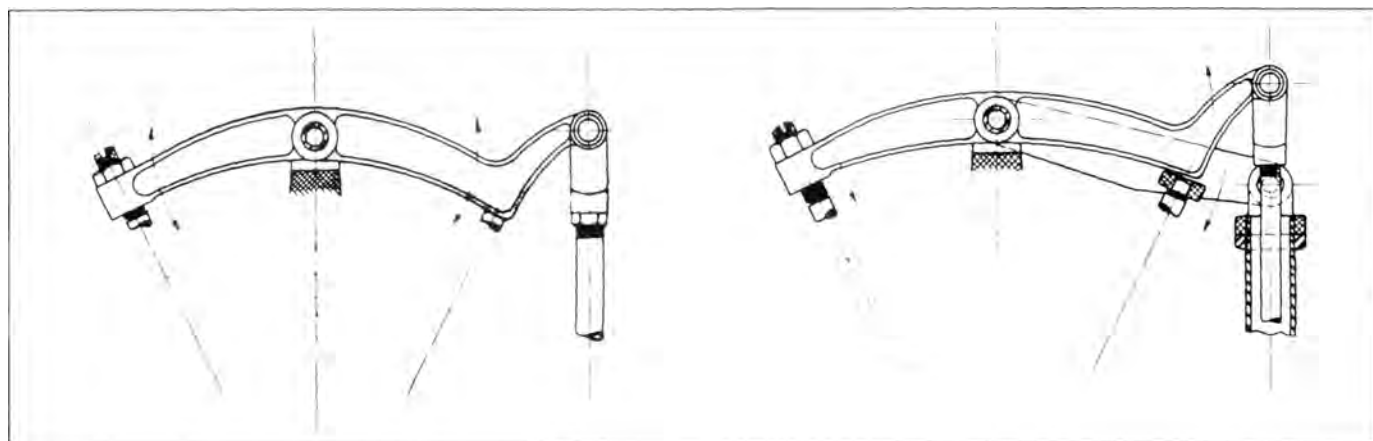
Curtiss "Silver Dart" engine at National Aviation Museum, Ottawa, Canada. (Photo - National Aviation Museum 4004)



Curtiss Vee-8 engine installed in the Gordon Bennett Trophy-winning Curtiss Pusher of 1909. (Photo - Unk)



Two photos of the Curtiss model S engine of 1912 as it appears today on display at the Glenn H. Curtiss Museum in Hammondsport, New York. The general configuration of the engine is shown to the right, while valve gear detail can be seen in the photo above. (Photos - National Aviation Museum, 6196 above and 6198 at right)



Drawing at left shows the valve-operating gear used on Curtiss engines subsequent to the Silver Dart engine and up to and including the model O. At the right is the valve gear as used on the Curtiss OX and OXX engines.

cylinder engine, were introduced on most of the machines. It was at this time the original, simple Curtiss carburetor or mixing valve was replaced by the Schebler carburetor which was to be a standard Curtiss feature until World War I. The battery ignition system was replaced by a Bosch magneto. However, the battery ignition was apparently still considered standard, and there was an additional charge for the magneto.

Late in 1910 he made a Vee-8, water-cooled engine developing 65 hp intended for the Gordon Bennett competition in 1911. The Curtiss monoplane designed for this event did not participate, however, and it is not believed the engine was produced other than in an experimental model or two.

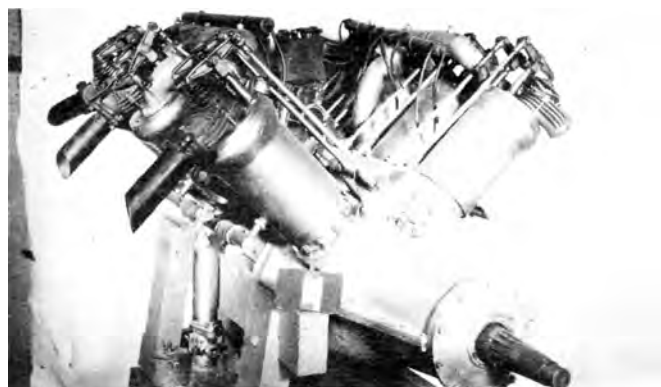
During 1911 two improved and enlarged engines were introduced--a vertical in-line, four cylinder model developing 40 hp and another Vee-8, water-cooled engine developing 70 hp and known as the Model L. The model L also featured twelve hold-down bolts for each cylinder in place of the previously used four. The following year the model L was improved slightly and incorporated the monel water jacket in place of the copper water jacket. This improved model was known as the model O.

Also in 1912 the Curtiss Company introduced a new six cylinder, in-line, water-cooled engine developing 60 hp and known as the Model S. From information supplied by the Glenn H. Curtiss Museum in Hammondsport, it would appear that only six specimens of this engine were produced, and five of them were purchased by the U. S. Navy. The sixth engine remained in Hammondsport where it is today on display at the museum. This was the first Curtiss engine to depart from the single rocker arm operating both intake and exhaust valves since the Silver Dart engine of 1908.

In 1912 an improved four cylinder, in-line engine was introduced and known as the model T, developing 40 hp at 1300 RPM. In 1913 the model OX was introduced, being a new Vee-8 engine developing 90 hp at 1400 RPM and featuring the unusual rocker arm arrangement developed by Henry Keckler. This change on valve operation was the major difference between it and the earlier model O and enabled the valves to remain open for a longer period while at the same time the intake valve could be lifted higher to obtain better filling of the cylinder. This engine was originally equipped with a Schebler carburetor and Bosch magneto. It continued in production as the model OX until 1916 when the model OX-2 was introduced, featuring minor improvements. Soon the model OX-5 was introduced and featured still other minor improvements. It is not known whether any models designated OX-3 or OX-4 were produced or whether these designations were assigned to experimental engines only. The carburetor was altered to a Zenith-type and the magneto to the Berling during the war years.

During 1914 a more powerful Vee-8 engine was produced known as the OXX and developing 100 hp. This engine was introduced with little announcement, and it is not known if the early models featured the Zenith carburetor and two Dixie magnetos which were used on the final version, the OXX-6. A model OXX-2 was produced and possibly other models prior to the OXX-6. Also in 1914 the Curtiss Company introduced three other models--a model C, eight cylinder engine developing 110 hp (It has been stated the Model C was not made but it was advertised by the Curtiss Company in 1914.); a model U, six cylinder, vertical in-line engine developing 120 hp; and the model V, eight cylinder, Vee engine developing 160 hp and originally intended for installation in the flying boat "America." The model V was later developed into the model VX and V-2 engines of improved performance, and finally, a model V-4 engine was introduced in 1916 which may be considered a twelve cylinder development of the original eight cylinder model V.

There are numerous examples of the OX-5 engine that have survived in museums and in private hands. However, there are very few survivors of the other early Curtiss models. One engine which started out as a Curtiss mod-



Curtiss V-2-3 engine of the Air Force Museum collection.

el OX survives in the Glenn H. Curtiss Museum but has been so heavily modified since its original manufacture, that today it is for all practical purposes just another OX-5 engine. The known survivors of the early Curtiss engines other than OX-5 and OXX-6 models are listed below. Probably other interesting engines will be added to the list when the complete holdings of the National Air Museum in Washington become known.

Engine Model	Custodian
8 cylinder air-cooled (Similar to Red Wing)	National Air Museum, Washington
Silver Dart	National Aviation Museum, Ottawa
1910(4 x 4) Vee-8	National Aviation Museum, Ottawa
L	National Air Museum, Washington
O	National Aviation Museum, Ottawa
OX-2 (incomplete)	National Air Museum, Washington
S	Glenn H. Curtiss Museum, N. Y.
S	National Air Museum, Washington
VX	National Air Museum, Washington
V-2	Glenn H. Curtiss Museum, N. Y.
V-2-3	The Air Force Museum, Ohio
V-4	National Air Museum, Washington

The model identification of the early Curtiss engines is not entirely clear. Glenn D. Angle lists some identification letters in AEROSPHERE FOR 1939 which may be correct. Also some notes prepared by Mr. Hugo T. Byttebier and obtained from the National Air Museum state that the Curtiss catalog B, which was advertised in January 1909, identifies the early Curtiss engines as follows (with A/C for Air-cooled Cylinders; W/C for Water-cooled Cylinders):

Model A:	A/C of 3.25 x 3.25 & approx 3 3/4 hp/cyl at 1800 RPM
Model B:	A/C 3 5/8 x 3.25 5 hp/cyl at 1800 RPM
Model C:	A/C 3 5/8 x 4 6 hp/cyl at 1800 RPM
Model D:	W/C 3 5/8 x 4 6 7/8 hp/cyl at 1600 RPM
Model E:	W/C 5 x 5 12.5 hp/cyl at 1500 RPM

(Powers are maximum for short periods)

This would indicate that probably the first engine supplied to Dr. Bell would be a model A-4 and the Red Wing's engine would be a B-8. However, the engine for the Silver Dart is apparently not listed unless the bore of the water-cooled model D is actually 3 3/4 instead of 3 5/8. Angle indicates the model E may have been manufactured as a dirigible engine. Also, it is of interest to note the model C listed is in direct conflict with the model C advertised for sale in 1914. Model G was a small motorcycle engine which can be seen at the Curtiss Museum at Hammondsport.

EDITOR'S NOTE: On the next two pages appear a chronological listing of early Curtiss engines, prepared in great detail by the author, Mr. K. M. Molson. He is Curator, National Aviation Museum, McLeod and Metcalfe Streets, Ottawa 4, Ontario, Canada.

A CHRONOLOGICAL LISTING OF EARLY CURTISS ENGINES FOR HEAVIER-THAN-AIR AIRCRAFT

MODEL	DATE	CYL.	ARRGT.	COOL.	HP	RPM	DISPL.	BORE	STROKE	WT.	WT/HP	CARB.	MAG.	LENGTH	WIDTH	HEIGHT	U.S. \$	REFERENCES
	1907	4	Vert.	Air	20					120								A.E.A. ret: Curtiss No. 1 & 2, Parkin J. H., Bell and Baldwin, page 45.
Red Wing	1908	8	Vee	Air	40	1800	218.68	3.625	3.25	148	3.75		Bat.					First Curtiss engine to fly heavier-than-air machine—Red Wing. Ref: Angle's Aerosphere 1939.
Silver Dart	1908	8	Vee	Wat.	50	1600		3.75	4.00	175	3.50	8 orig. 2 later (Curtiss)	Bat.		21 +	17 +		First used in "Loon". Concentric valves. Two push rods. 1st Curtiss water-cooled Vee engine Ref: Aeronautics , March 1909, page 95, quotes 35 hp at 1000 rpm.
Aero. Soc. of New York	1909	4	Vert.	Wat.	25	1300		3.75	4.00	97 (incl. mag.;1	5.20	Orig. Curtiss. Later Scheb.	Bosch				1600 ⁰	Ref: Aeronautics , Sept. 1909, page 87, July 1909, page 13. Probably produced in small numbers in 1910. Ref: adv. brochure for Herring-Curtiss Aeroplanes by Wyckoff, Church & Partridge, N. Y. City.
Reims	1909	8	Vee	Wat.	63	1475		4.25	4.437	225			Bosch					Ref: Aeronautics , Oct. 1909, page 137. 2nd Curtiss water-cooled Vee engine—for history see Aeronautics , Jan. 1912, page 30.
	1910	8	Vee	Wat.	50			3.75 x	4.0	175			Bosch				3150 (incl. mag.)	Ref: Aeronautic Supply Co. Catalogue No. 3
	1910	4	Vert.	Wat.	30	1300		4.00 x	4.00				Bosch				2100 (incl. mag.)	Ref: Catalogue No. 3. The Aeronautic Supply Co., page 10.
	1911	8	Vee	Wat.	50	1200		4.00	4.00	202	5.00	Scheb.	Bosch	40 +	25.5 +	24 +	3.000 ⁰	Aeronautics , July 1911, page 8; June 1911, page 229. Also see Aeronautics , Dec. 1910, page 227; July 1909, page 13; Sept. 1909, page 86, Dec. 1910, page 207. Aeronautic Supply Co. Cat. No. 3 list this engine at 60hp.
	1910	8	Vee	Wat.	65	1150		4.5	4									Experimental for Curtiss monoplane. Intended for 1910 Gordon Bennett. Ref: Aeronautics , Dec. 1910, pages 212, 206.
	1911 (?)	4	Vert.	Wat.	40	1100 (?) 1500	251.32	4.00	5.00	175	4.38	Scheb.	Bosch	37.5	16.5	29.5	1.200	Intake and exhaust valves operated by single push rod 8. rocker arm. Ref: Aero , May 18, 1912, page 176. Glenn Angle's Aerosphere 1939 states that there were 2 identical models to these specifications designated H & K.

L	1911	8	Vee	Wat.	70	1500	502.64	4.00	5.00	275 ⁰	3.56	Scheb.	Bosch	49.9	30.0	27.06		12 hold down studs per cylinder. Copper jacket. Aeronautics , Aug. 1911, page 69. Cat. in Nat'l. Air Mus., Wash.
O	1912	8	Vee	Wat.	75	1100	502.64	4.00	5.00	285	3.80	Scheb.	Bosch	50	30	27	-2.250 2,200	Monel jacket . Improved version of Model L. Ref. Aero , May 11 & 18, 1912 and June 1, 1912. Single rocker arm.
S	1912	6	Vert.	Wat.	60	1400	376.98	4.00	5.00	245	4.08			44.5		29.5	-1.750 1.600	~~Separate~~ rocker arms for intake and exhaust valves. Two push rods. Ref. Aircraft , June 1913, page 88, Aero & Hydro , Feb. 1913, page 384; Aeronautics , July 30, 1915, page 18.
T	1912	4	Vert.	Wat.	40	1300	251.32	4.0	5.0	175	4.38						1,200	Ref. Aircraft , June 1913, page 88 .
OX	1913	8	Vee	Wat.	90	1400	502.64	4.00	5.00	390	4.33	Early Scheb. Late Zenith	Prod. Bosch Prod. Berl.	55.375	29.75	35.125		First Vee engine with 2 push rods since Silver Dart engine, Ref. Aircraft , Dec. 1913, page 236 . Also compare OX & OX-2, Ref. rear cover Flying , June, 1916; rear cover Aero & Hydro , Oct. 25, 1913. Ref. Aero & Hydro , May 24, 1913, page 151.
OX(XI)	1914	8	Vee	Wat.	100	1400	567.4	4.25	5.00	401	4.01	Zen	Dixie (2)	55.375	29.75	35.125		
C	1914	8	Vee	Wat.	110			4.5	5.5									Ref. Aeronautics , Oct. 15, 1914 front cover.
U	1914	6	Vert.	Wat.	120		824.67	5.0	7.0									Ref. Aeronautics , Oct. 15, 1914 front cover.
V	1914	8	Vee	Wat.	160	1100	1099.56	5.0	7.0	700		Scheb.	Bosch					Ref. Aero & Hydro , Mar. 14, 1914, page 299; Aeronautics , July 30, 1915, page 18.
V-2		8	Vee	Wat.	200	1400	1099.56	5.0	7.0									
V-4	1916	12	Vee	Wat.	250	1400	1649.3	5.0	7.0	1125	4.56	Zen.	Dixie (2)	85.625	34.12	40		Ref. Aviation , Oct. 15, 1916.
VX		8	Vee	Wat.	180	1400		5.0	7.0									Similar to model V. Ref. Jane's , 1919, page 152b.

Model OXX seems to have been introduced without any announcement in the press. This is probably due to its similarity to the model OX, its main difference being in the increased bore. It is not known whether two magnetos were fitted to the early OXX models or not. Also, it is not known whether early OXX engines had Zenith carburetors and Dixie magnetos as were supplied with the OXX-6 engines. It would seem logical that early OXX engines had Schebler carburetors and Bosch magnetos.

NOTE 2 Bosch magnetos were introduced on Curtiss engines in 1909. However, battery ignition was still listed as standard equipment in 1910 and the magneto cost \$100 extra on the 4 cylinder model and \$150 extra for the 8 cylinder

NOTE 3 All Vee engines are 90 degrees.

+ Figures from specimen in National Aviation Museum, Ottawa.

0 Includes radiator and propeller