VINTAGE AIRPLANE

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Details, Details

Looking closely at an Historical Reproduction

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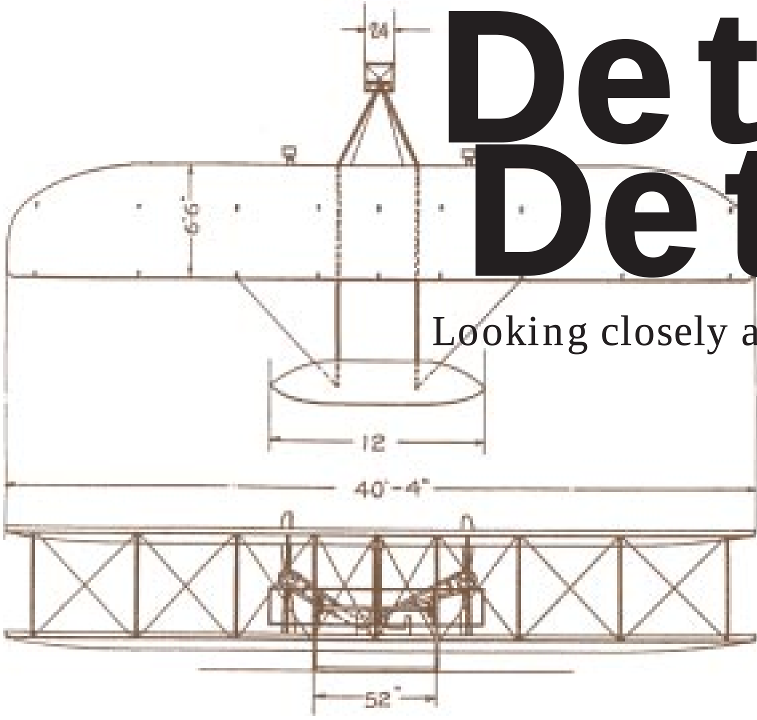

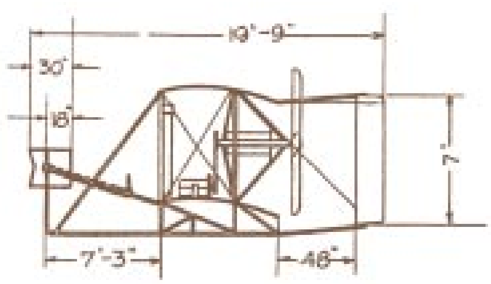

JIM KOEPNICK

The 180-pound reproduction engine is bolted to the lower wing at four points, just to the right of the engine. (The Wrights built the Flyer with both right wings 4 inches longer to compensate for the engine's off-centerline placement. The engine weighed about 34 pounds more than each brother, so they added to the wing area on the right side.) On the right is the valve camshaft, linked to the crankshaft sprocket (left) with a linked chain. Its tension was taken up by the boxwood idler roller (center). Centered on a bracket next to the end of the crankshaft is a Veedol revolution counter, which was mounted on a long flexible bracket secured to a wing rib.

After his very exacting restoration of a Curtiss Jenny, Ken Hyde of Warrington, Virginia, chose to pursue a different line of research dealing with the pioneer era of flight. After researching and building a Wright glider and kite, he came to EAA with a proposal. Would EAA be interested in collaborating with his new organization, "The Wright Experience," with the ultimate goal of creating the most exact reproduction of the 1903 Wright *Flyer* ever built?

An agreement was reached, and the extraordinary aircraft created by The Wright Experience has been the centerpiece of EAA's "Countdown to Kitty Hawk" celebration during the past year. Since not everyone was able to visit the exhibit on its multi-state tour, we'll share a number of details of the reproduction *Flyer*.

First off, it's a pretty good-sized biplane. Though only 21 feet, 1 inch long, it spans 40 feet, 4 inches. It has 510 square feet of wing area, yet only 12 horsepower was needed to fly the airplane, with the engine turning 1,000 rpm as the two propellers produced 132-136 pounds of thrust while they turned 330 rpm. But to reproduce that action, to exactly re-create the handiwork of the Wrights and their mechanic/machinist, Charles Taylor, would require years of research and require outstanding workmanship. The Wright Experience team followed the actual handwork processes used by the Wrights and Taylor as closely as possible. You can see much of this work and even more details of its construction as it was documented by The Wright Experience at its website *www.wrightexperience.com*. I'd particularly recommend the web pages dealing with the reproduction of the Wright propellers—it's quite fascinating!

Let's take a look at many of the details that make up the reproduction 1903 Wright *Flyer*.

We'll start at the heart of the machine, the 4-cylinder engine designed by the Wrights and built, for the most part, by Charlie Taylor in the Wrights' machine shop. The experienced hands of the staff at Hay Manufacturing of Lake Geneva, Wisconsin, built the new reproduction engine. For many years, the Hay family had been running a copy of the 1903 Wright engine that they made in time for the 75th anniversary of the flight. We've been fortunate to have their display of running antique aircraft engines in the VAA area since the 1970s.

The Wright Experience turned to Hay's to re-create an even more exact version of the engine. Did you know the engine on the Wright *Flyer* on display at the Smithsonian National Air and Space Museum is not the complete original engine? In fact, the original aluminum engine block, damaged when the *Flyer* was rolled over and over by a gust of wind after the fourth flight, is on display at the Wright Brothers National Historic Memorial at Kill Devil Hills, North Carolina. To this day, the original crankshaft and flywheel are still missing, gone since the close of the 1906 aeronautical exhibit held in conjunction with the Annual Automobile exhibition in New York City. The crankshaft and flywheel in the motor mounted on the 1903 *Flyer* displayed at the National Air and Space Museum is from the 1904 motor. Orville Wright personally attested to that substitution, made when the motor was reassembled for display.


LEEANN ABRAMS

Each of the four connecting rods is built up instead of forged, using a seamless steel tube with the bronze rod ends screwed and pinned in place.


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Using a rosebud tip on his torch, Steve Hay heats up the sprocket for the valve camshaft in preparation for silver soldering.


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This is the aluminum crankcase casting with the cylinders, pistons, and crankshaft in place. The racetrack area to the right on top of the casting is the vaporization/intake manifold for the engine. A plate with a small can soldered to it is mounted over this area. As air is drawn through the can, fuel is introduced from a small tube (there is no carburetor of the type we would know), and it vaporizes as it makes contact with the warm, then hot crankcase. The lightweight engine construction can be seen in the open webs of the case on the left. When completed, a simple sheet metal plate covered the area over the crankshaft and the connecting rods.


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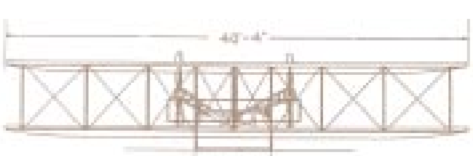
Using a lathe, Mike Newberg turns the raw crankshaft, which was drilled out from a steel blank.

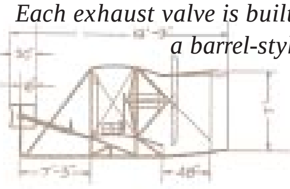
LEEANN ABRAMS PHOTOS

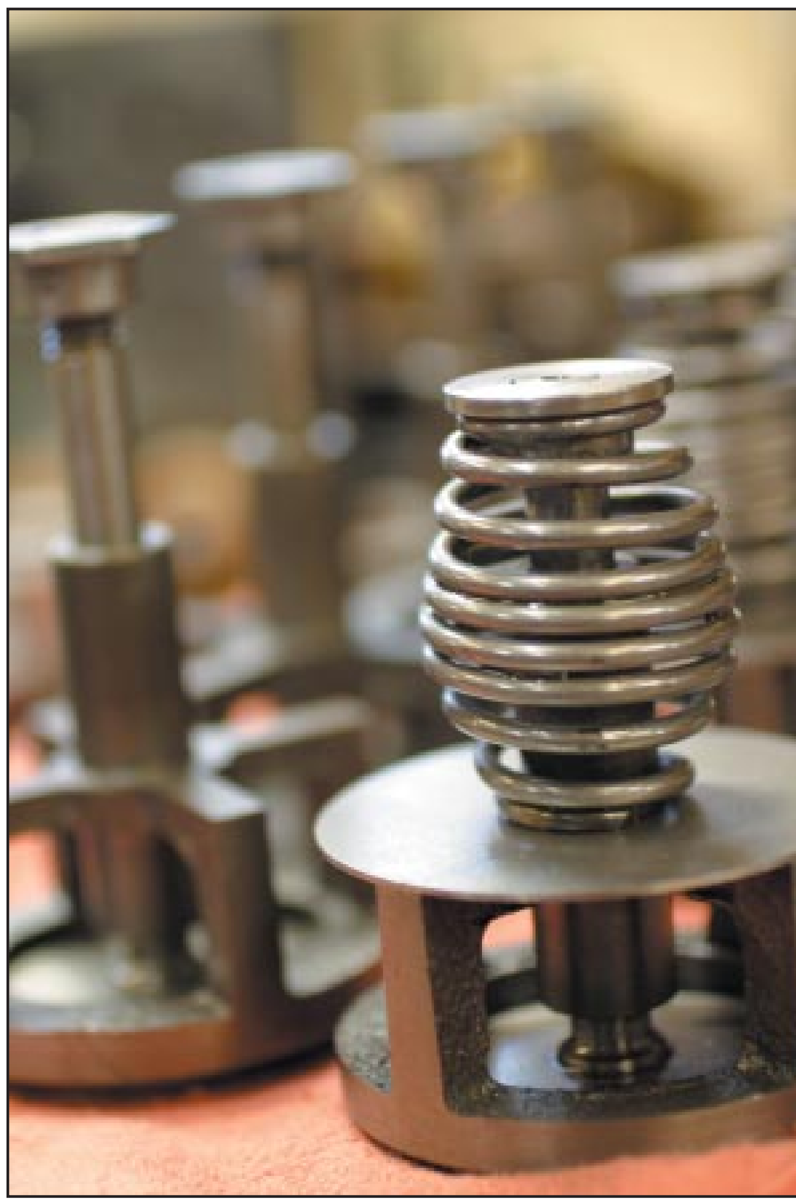
Every aspect of the first Wright brothers' engine built by Charlie Taylor is exactly duplicated, including the open rocker arms, which are built up using sheet steel. The spring steel keeper is positive acting, yet it allows quick disassembly when needed.

LEEANN ABRAMS PHOTOS

The cast iron pistons slip into cast iron cylinders, which are screwed into the cast aluminum crankcase.







Each exhaust valve is built up with a barrel-style spring.

H.G. FRAUTSCHY PHOTOS

The engine controls are a clever arrangement using a control lever attached to the engine and fuel valve with cords. When placed with the end of the lever fully to the left, the fuel valve was closed.

Moved to the center position, the main is fuel valve opened, allowing the engine to be started. (A second fuel valve was set in advance to the proper fuel flow needed for the engine to run. While it could be adjusted prior to takeoff, it was not intended to be used in flight.)

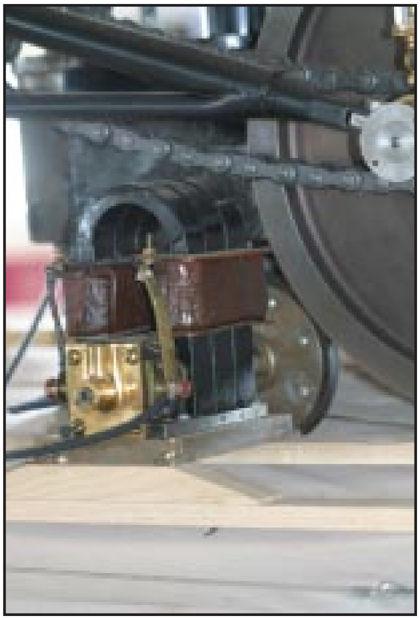
When all was ready for the aircraft's launch, moving the lever to the far right, as shown here, would push the start/stop/reset button on the stopwatch, stat the indicator of the Jules Richard anemometer, and pull on the cord secured to one end of a bell crank that held the Veedor revolution counter off the end of the crankshaft. When the bell crank was pulled, the flexible bracket forced the counter's rubber tip into contact with the end of the crankshaft, and it started counting engine revolutions. To release the restraining wire holding the Flyer in place, a small spring clip was pulled upward (not visible).

Pulling the lever all the way back to the left would close the fuel valve, stop the anemometer recording and stopwatch, and pull the bell crank the opposite direction and move the revolution counter away from the crankshaft. The Wrights put this instrument package together in this way so they could quantify what had happened during the flight, and calculate the distance flown through the air. They didn't intend to refer to the instruments while in flight. Think of the three instruments as the first "in-flight data recorder."

JIM KOEPNICK PHOTOS

The output end of the crankshaft is a busy place. You can see the beautiful brass and glass oil cup used to lubricate the bearing inside the bracket sleeve for the chain guide tubes.

The entrance to each of the chain guide tubes has a pair of boxwood rollers put in place to keep the chains from being chewed up as they entered each guide tube.



H.G. FRAUTSCHY PHOTOS

The Packer Engineering Company of Naperville, Illinois, built the beautiful reproduction dynamo used on the reproduction Flyer. The dynamo produces voltage which is supplied to the make or break ignition system used on the Wright engine. Each time the contacts in each ignition chamber are cycled, the collapse of the magnetic field in the dynamo creates a surge of electricity that jumps the contact points, creating an ignition spark. The dynamo is friction driven off of the engine's flywheel.

JIM KOEPNICK

The forward rudder, what we now call the elevator, was controlled by a simple sash chain, which was wrapped around a pair of wooden drums, one on the control lever actuated by the pilot, and the other here between the two control surfaces. One of the few mistakes made by the brothers was the placement of the centerline of the hinge. It was too close to the center of pressure of the surfaces, so that when a pitch change was made to the control surface, the surface would be acted on by the relative wind, and would drive to full deflection, much farther than the pilot intended. Both Orville and Wilbur experienced this troublesome characteristic, and had to quickly learn to make very small adjustments to the pitch control during their four flights. Coupled with the pitch instability of the basic design, the brothers did a great job learning to compensate, and were able to increase each subsequent flight's duration and distance. Their prior experience with their gliders, and practice with their 1902 glider, proved invaluable.

JIM KOEPNICK

All of the special cotton muslin fabric specially woven for the reproduction Flyer was secured in place by stitching or small tacks. Over 1,900 tacks were used on the original and the reproduction.

H.G. FRAUTSCHY

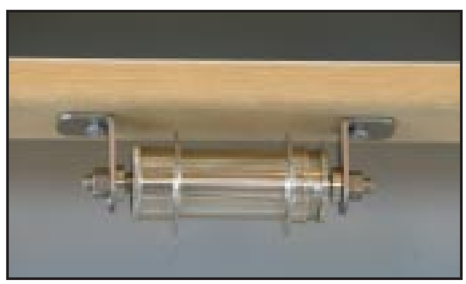
Here's a wider view of the engine and drive train, along with the hip cradle used for wing warping controls. On the far left is the radiator. The fuel line can be seen starting in the foreground and running along in front of the cradle. The cradle is attached to the wing structure by the two black steel straps you see extending aft of the sides of the cradle, and the wing warping control wires cross just behind it and are attached to each side of the cradle.

JIM KOEPNICK

H.G. FRAUTSCHY

The steel parts for the drive train were all expertly brazed in place, just as the Wrights had done a century before. As experienced bicycle makers, brazing steel tubing framework was second nature to the brothers, as well as Charlie Taylor, their mechanic. The ends of the propeller driveshaft brackets are stiffened with hard wire bracing, wrapped and then soldered. The small brass cup is an oil cup for lubrication of the shaft bearings. The propellers were mounted with a "crush block" under the nut and washer, with a wider plate on the opposite side of the propeller.

Each of the wing warping wires was connected to a short length of link chain, which ran over rollers to allow for their attachment to the upper and lower wings. You can see the wing warping control guides quite clearly in the Daniels/Wright photograph taken on December 17, 1903. Also, by attaching the interplane struts using a single point, the wing structure was flexible yet braced. Only the center section of the wings was rigidly trussed with bracing wire. The outer panels were braced in this flexible manner.



A pair of bicycle hubs was used to guide the Flyer down the launching rail. A full landing gear would be heavy, and wheels would be useless on the sands of the Outer Banks, so the brothers wisely chose to keep it simple and use a pair of skids to land upon. They continued to use this method for many years, believing it to be superior until proper ground preparation was made to flying grounds, and the aircraft's performance improved to the point that it was not seriously hindered by the additional weight of a wheeled landing gear.

JIM KOEPNICK PHOTOS

The lower crosspiece attaches here at the lower front end of the skids.