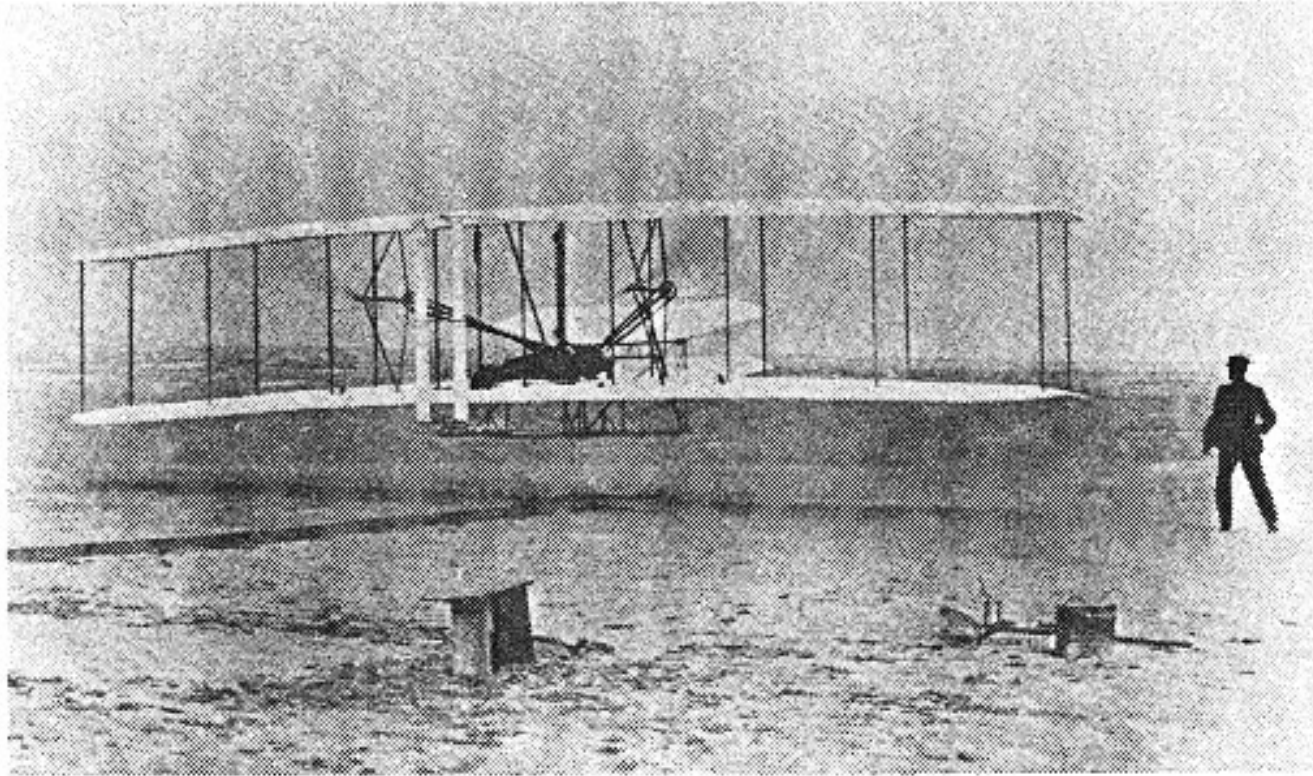


X.W.A.R.N. N8JFA

Feb, 2001 / August 2010

The Engine That Powered Flight



The Engine That Powered Flight

Frank J. Beafore
Dayton, Ohio



Introduction

Wright Brothers

"We were lucky enough to grow up in an environment where there was always much encouragement to children to pursue intellectual interests."

—Orville Wright



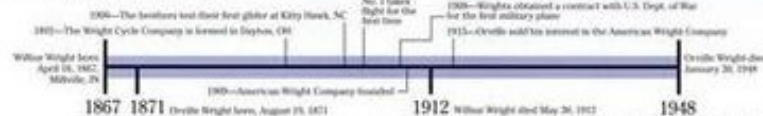
The Wright's Flyer had a 'tail first' arrangement. Wing-warping allowed the plane to turn, but the brothers found that a bank could cause the plane to spiral into the ground. They added movable rudders to keep the turn under control.



17 December 1903 at Kitty Hawk: Flyer No. 1 rises into the air for the first time. Three flights were made that day. The longest, piloted by Wilbur, was 852 feet and took 59 seconds.



10 October 1902: Orville in man-carrying glider with Wilbur at left and Dan Tate at right.



Orville (left) and Wilbur Wright, American inventors and aviation pioneers, achieved the first powered, sustained, and controlled flight of an airplane in 1903. The brothers built two sturdier, more reliable planes in the next two years, and in 1906 received a U.S. patent for a powered aircraft.



Introduction

- ◆ Inspiration
- ◆ Wright Brothers
- ◆ Charles Taylor
- ◆ Engine Details
- ◆ The Build
- ◆ Conclusion



In the Beginning



Discussion of the Concept



Wing in Construction



Howard DuFoul – Author and Wright / Taylor Engine Expert



* 1915 - 2009



Howard's Shop



Howard at Wright State



Flyer at Wright State



Howard's Presentation



Mr. DuFour at Wright State



Where did it all Start?

Dayton Ohio – West Side



The Brothers and I



Wilber and Orville Wright

- ◆ Wilber, born in Millville, near New Castle, Indiana and Orville, born in Dayton, Ohio – both, never finished High School.
- ◆ But...both went on to become the World's first aerospace scientists.



Orville Wright's 100th Birthday Anniversary

“It was clear from the very start, that they would end up with a successful flying machine. **They missed no logical point.....made no wrong turns....were sure of their grounds by never taking for granted** anything from their predecessors until checked by their own tests. We can move on, and leave in well recorded pages of many histories, this story of how those two men created **the real flying machine.**”

-Grover Loening (Loening Aeronautical Engineering)



Time Table to Flight

- ◆ 1878 – Father (Bishop Wright) gives sons a toy “helicopter”.
- ◆ 1888 – Wrights open a publishing company with a home made printing press.
- ◆ 1892 – Wrights open a bicycle shop as the bicycle craze sweeps the country.
- ◆ 1895 – Designed and built an internal combustion engine to power their shop.
- ◆ 1896 – Otto Lilienthal, German aeronautical engineer, killed in a glider crash.
- ◆ 1900 – Wrights build their first glider and test it at Kitty Hawk, NC.
- ◆ 1901- Build a wind tunnel to test miniature wing shapes.
- ◆ 1901 – Return to Kitty Hawk with a larger, heavier glider with adjustable wing camber.
- ◆ 1902 – Flight of their glider 622 feet, in 28 seconds.
- ◆ 1903 – First manned, powered flight.



The Wright Cycle Company



1034 West Third Street, Dayton OH



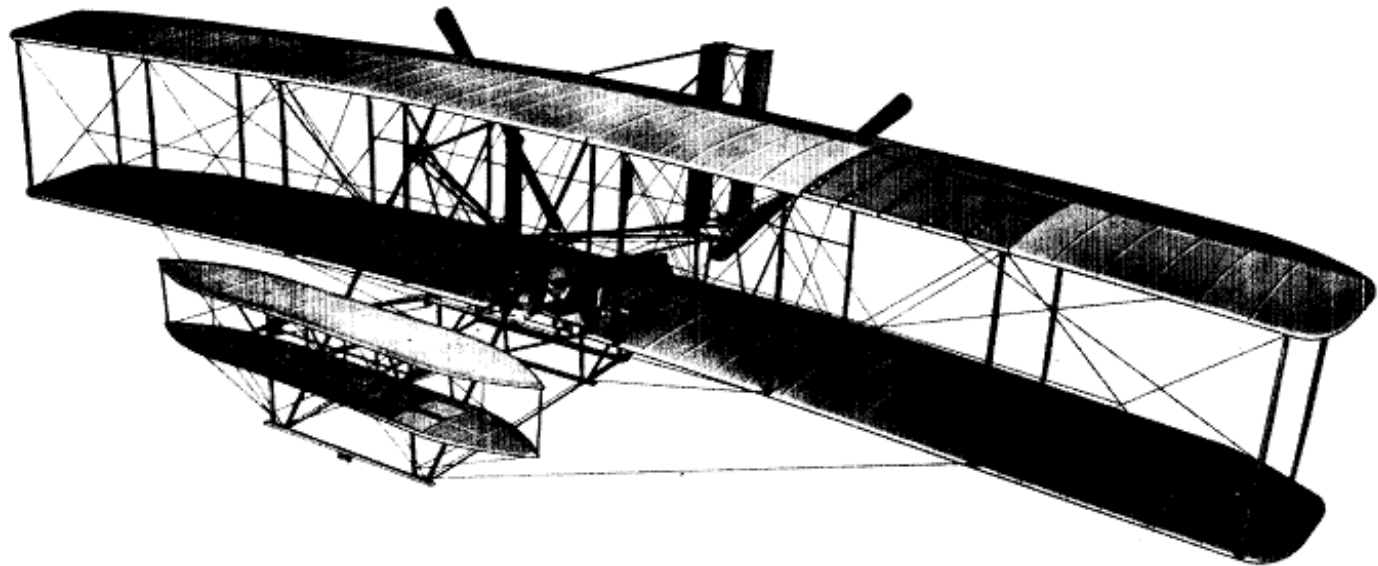
The work of “bicycle men”

- ◆ No surprise, that the first flyer was based on the bicycle design of the day.
 - Triangular Frame for rigidity
 - Spokes for fasteners
 - Hubs for rail guides
 - Sprockets for controls





1903 Flyer

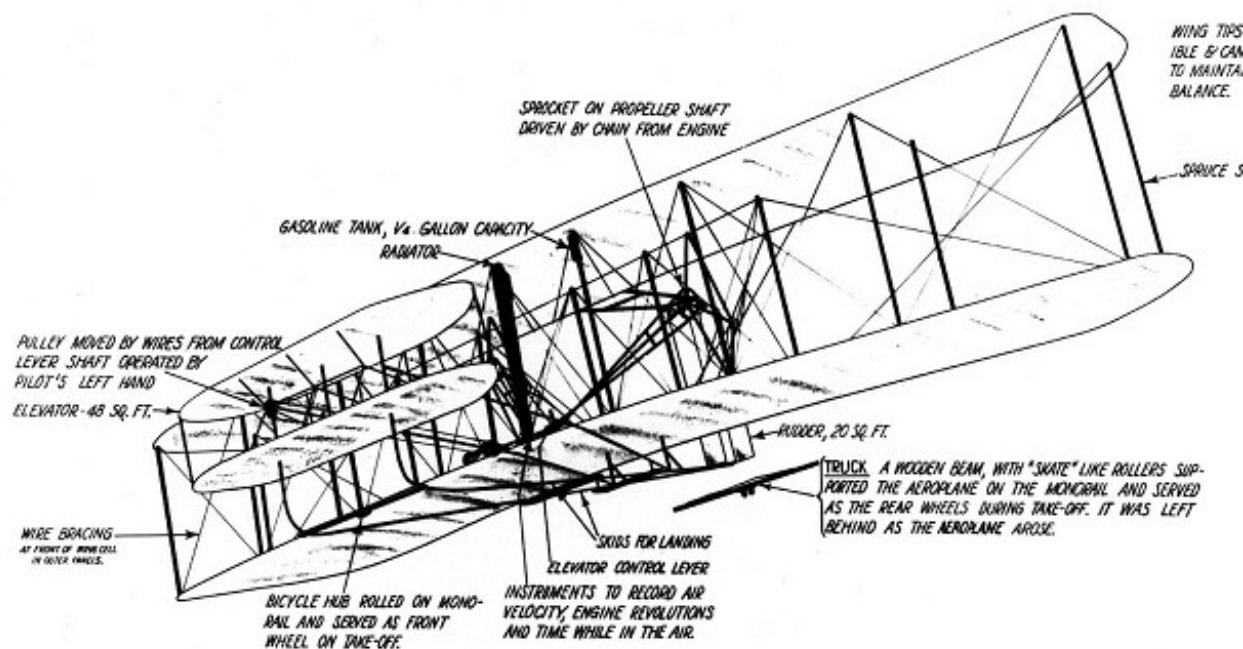


The First Aerospace Scientists

- ◆ Without the Wright's basic Scientific Approach, man would, probably not fly for another 10 to 15 years.
- ◆ First successful propeller design,
- ◆ First variable control surfaces (wing warp),
- ◆ First air tunnel,
- ◆ First air tunnel instruments,
- ◆ First light weight propulsion unit.



Flier 1 – Details



WING SPAN, 40 FT. 4 IN. - CHORD, 6 FT. 6 IN.
 OVERALL LENGTH, 21 FT. 3/8 IN. - HEIGHT, 9 FT. 3 3/4 IN.
 WING DROOP (ANTI-DIHEDRAL), 10 INCHES
 WEIGHT, 605 POUNDS (WITHOUT PILOT).
 WING AREA, 510 SQ. FT. - AIR SPEED, 31 MILES PER HOUR
 WING LOADING, 1.46 LB. PER SQ. FT.
 POWER LOADING, 62 1/2 LB. PER HORSE POWER (WITH PILOT)
 REVOLUTIONS PER MIN: ENGINE, 1025; PROPELLERS 396
 (REDUCTION, ABOUT 3 TO 1)

PILOT LAY PRONE WITH HEAD FORWARD,
 HIS LEFT HAND OPERATING THE ELEVATOR
 LEVER, HIS HIPS IN A SADDLE. SHIFTING THE
 HIPS SIDEWISE PULLED WIRES ATTACHED
 TO THE SADDLE BY WHICH THE WING TIPS
 WERE WARPED AND THE RUDDER TURNED
 (A DOUBLE ACTION FROM ONE MOVEMENT) THUS
 CONTROLLING BALANCE AND DIRECTIONAL
 STEERING.

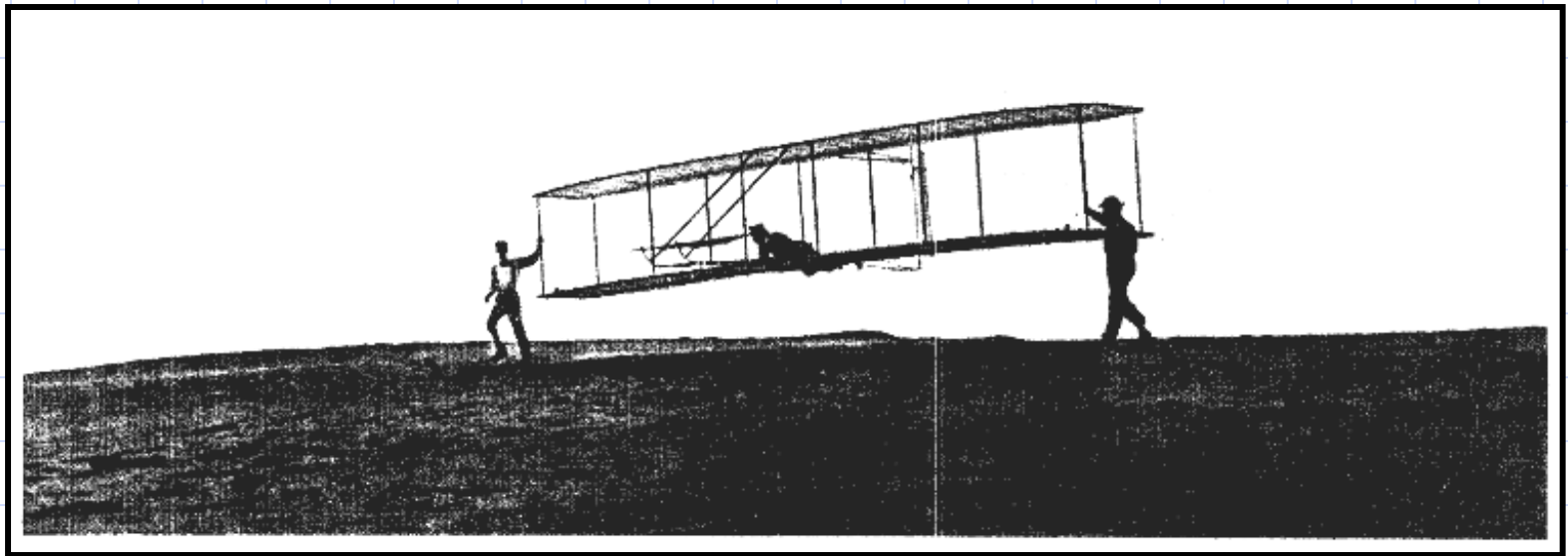


Aircraft Specifications

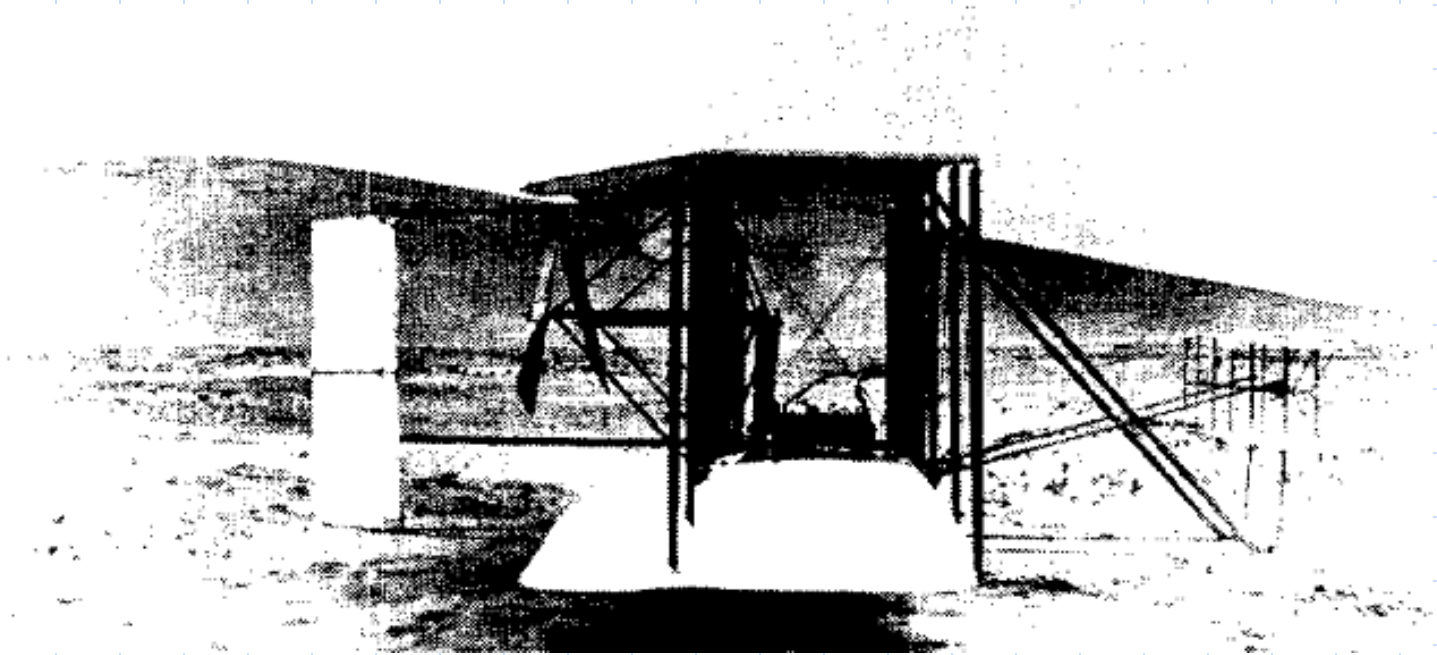
- ◆ Wing Span = 40'4"
- ◆ Length = 21'1"
- ◆ Wing Chord = 6'6"
- ◆ Wing Surface = 510 sq.ft.
- ◆ Wing Load = 1.47 Lbs/ sq. ft.
- ◆ Weight = 605 pounds w/o pilot
- ◆ Pilot Weight 143 pounds +/- 2 pounds



Glider Test

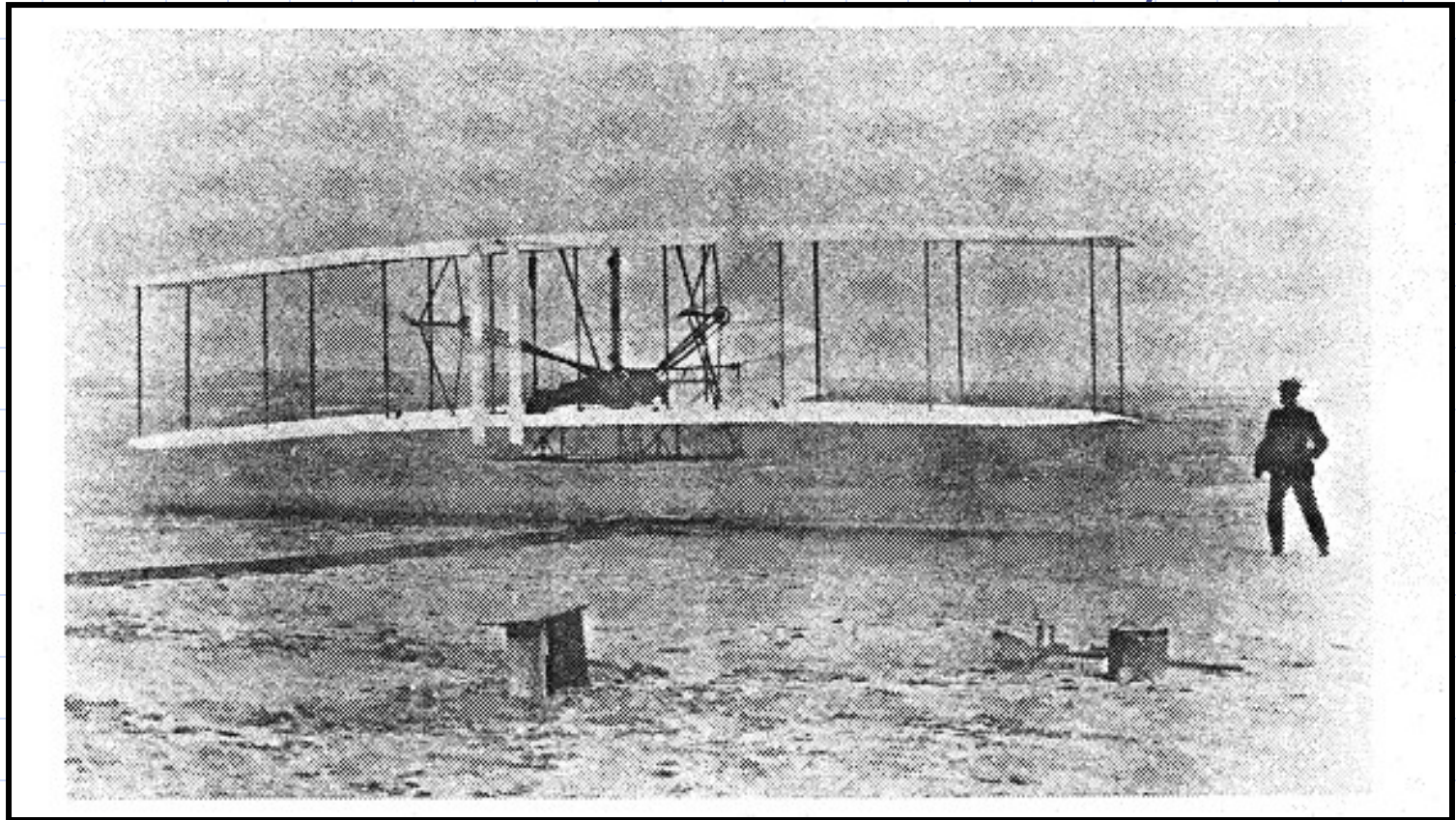


Flyer Side View at K.H.



First Flight

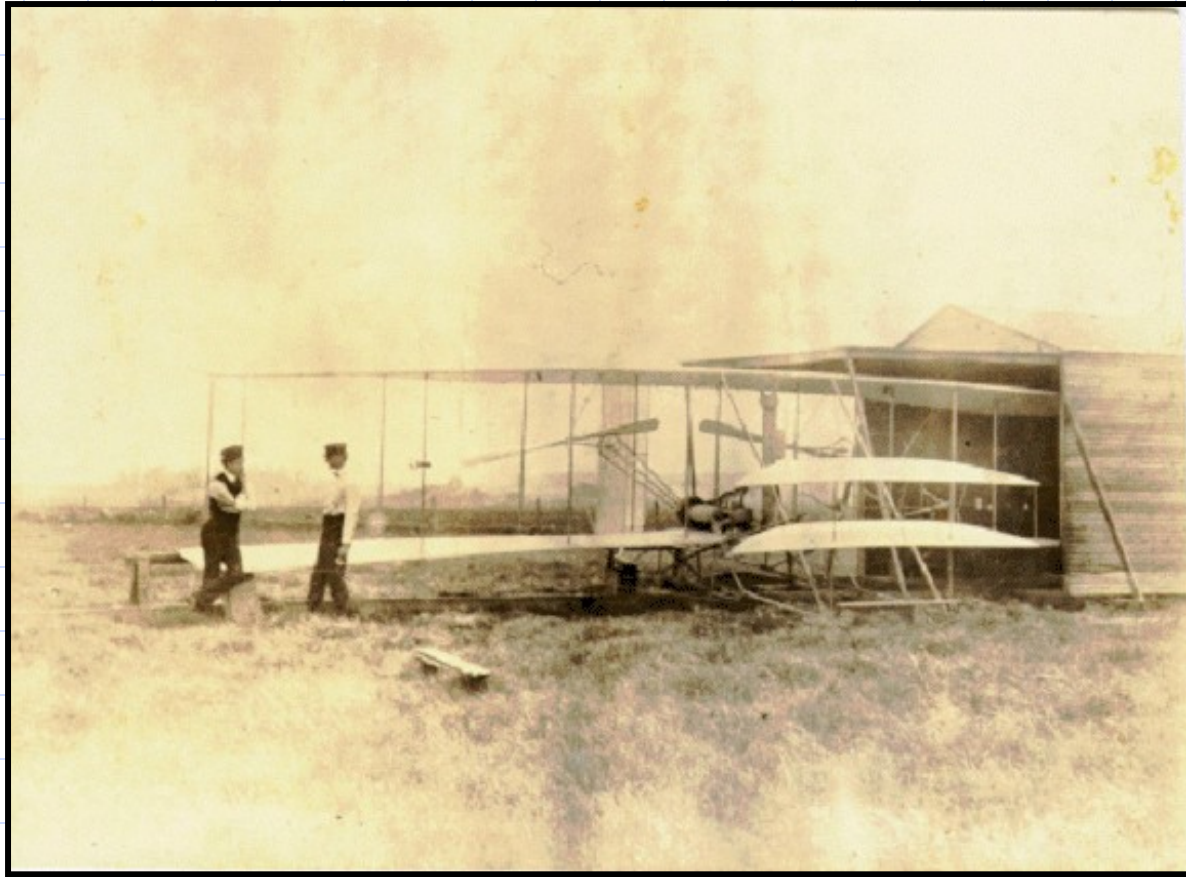
December 17, 1903



Simms Station



Huffman Prairie - circa 1904



Huffman Prairie – Launch Derrick



Huffman Prairie – First Hanger



Carillon 1



Carillon 2



Carillon 3



Carillon 4

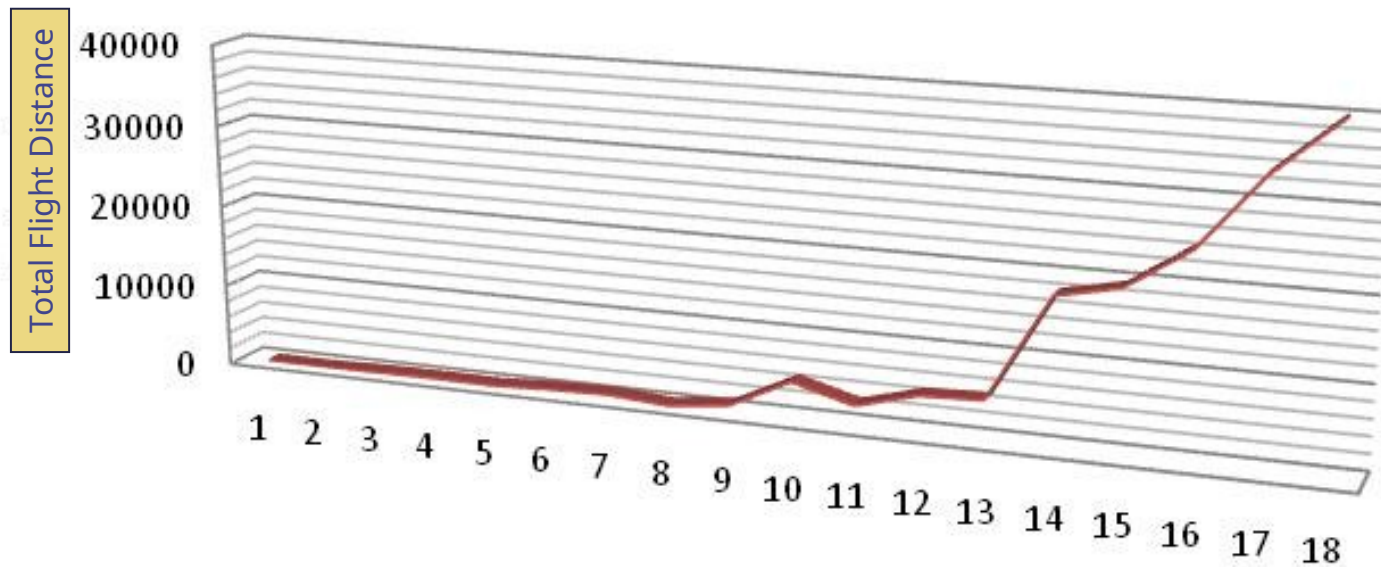


Carillon 5



[illegible]

Wright Brothers - 1905 Flight Data



Distance per Flight



The Big Question

Who can / will build an engine of approximately 150 pounds mass, and deliver 12 horsepower?



Engine – The Beginning

Having its roots in a modified machine shop engine, Charles Taylor, under the direction of Wilber and Orville Wright, designed and built the first controlled, manned, aircraft propulsion unit. After being rejected by many automotive engine builders, the Wrights turned to Charles Taylor to completely engineer and build the engine. Using excellent engineering rules, the engine was developed to deliver the appropriate horsepower to weight ratio and the correct physical form factor.



Charles Taylor

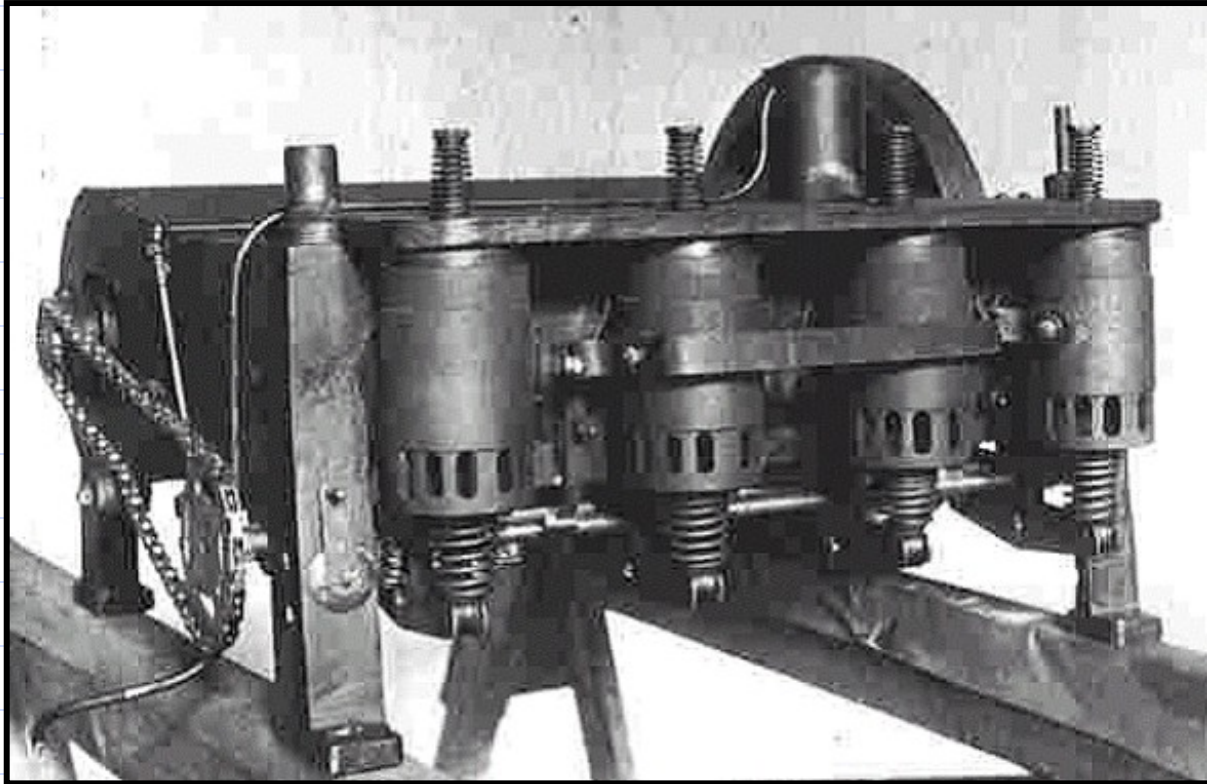


Where is the original Engine ?

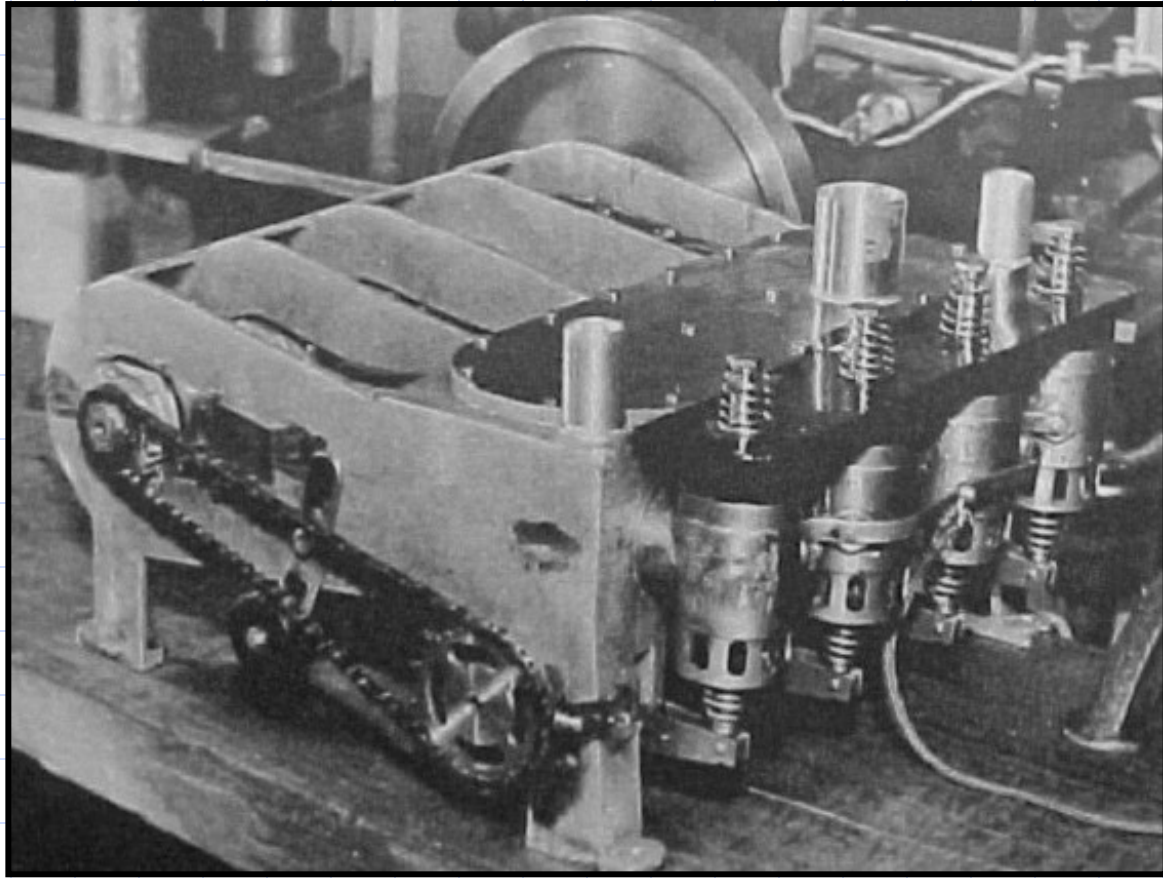
- ◆ One is in Washington, DC (Mod1903)
- ◆ One broken in crash at Kitty Hawk (Mod1903)
- ◆ One is in Dayton OH – Engineers Club
- ◆ 2 castings at Kitty, Hawk NC
- ◆ Casting No 6 with Howard DuFour



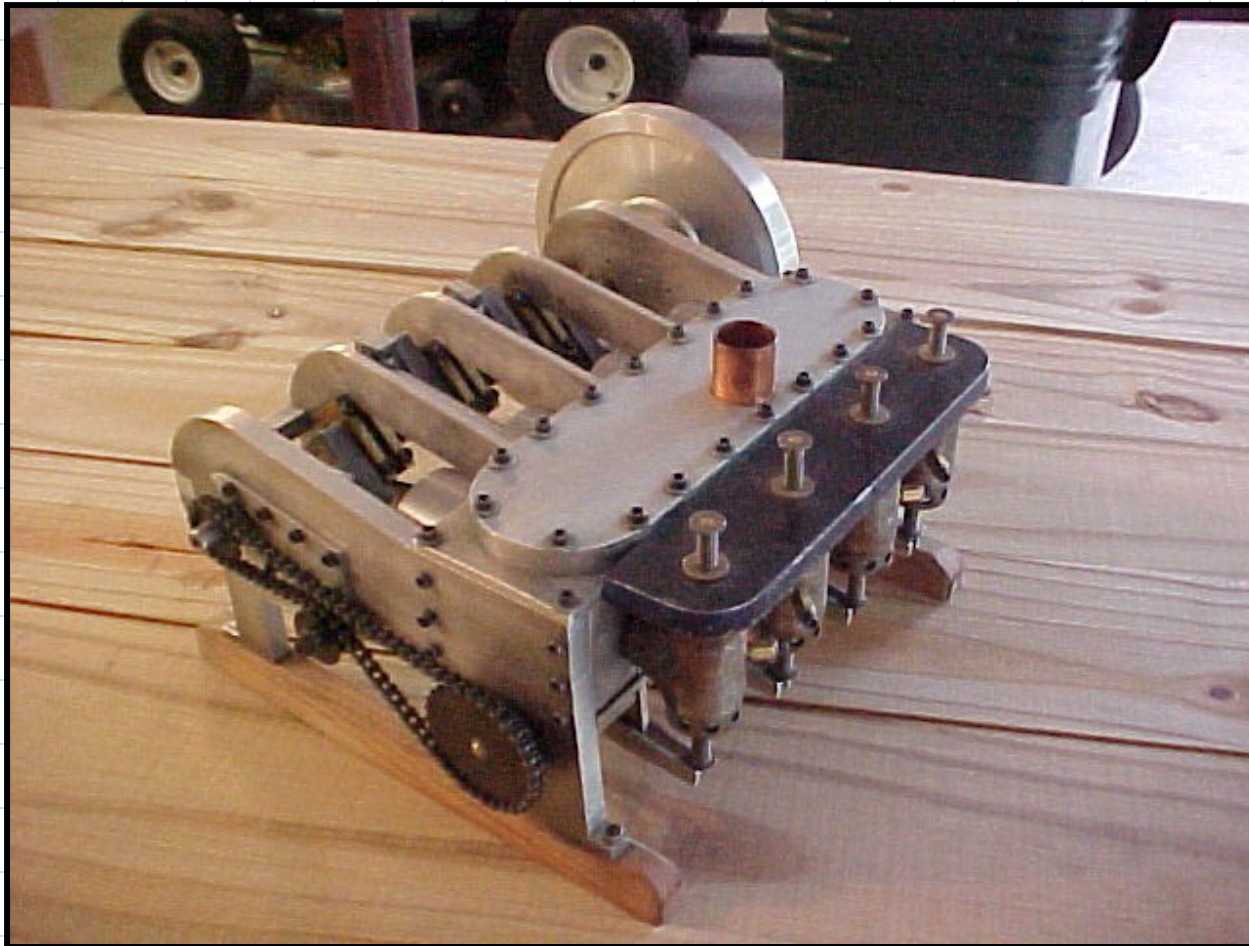
Original Model 1903



$\frac{1}{2}$ Scale Model in Dearborn, MI



1/2 Scale Model – Bellbrook, OH



Where are the other models ?

- ◆ One Full Scale Model at Wright Brothers Airport, Springboro, OH
- ◆ One Full Scale Model at Caltech
- ◆ One 1/3 Scale, Howard DuFour
- ◆ One 1/2 Scale in Dearborn, MI (Greenfield Village)
- ◆ One 1/2 Scale in Bellbrook, OH

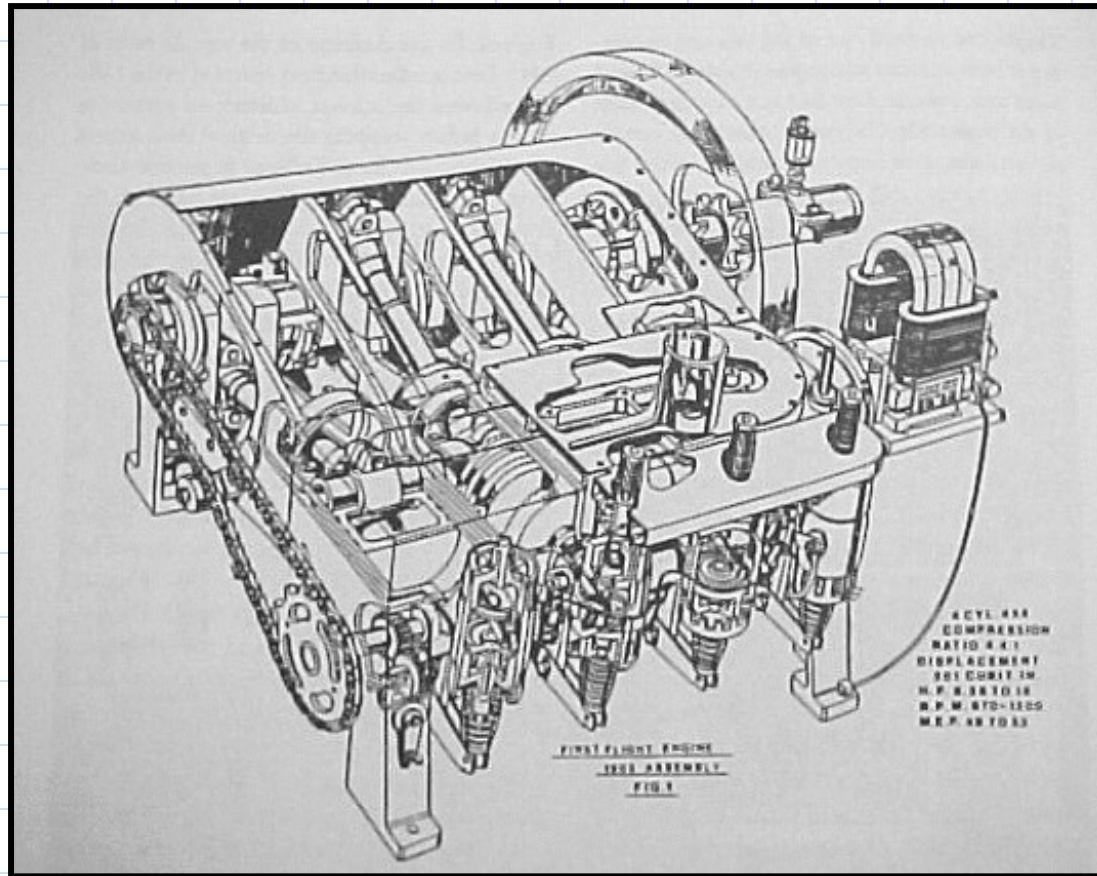


The Power Unit

- ◆ 152 Pounds Dry
- ◆ 170 Pounds Wet
- ◆ 12 Hp at 1020 RPM
- ◆ 4 Cylinder, 4 Cycle, Gasoline
- ◆ 4 Inch Bore x 4 Inch Stroke
- ◆ Low Tension Make/Break Spark
- ◆ 10V / 4Amp Ignition

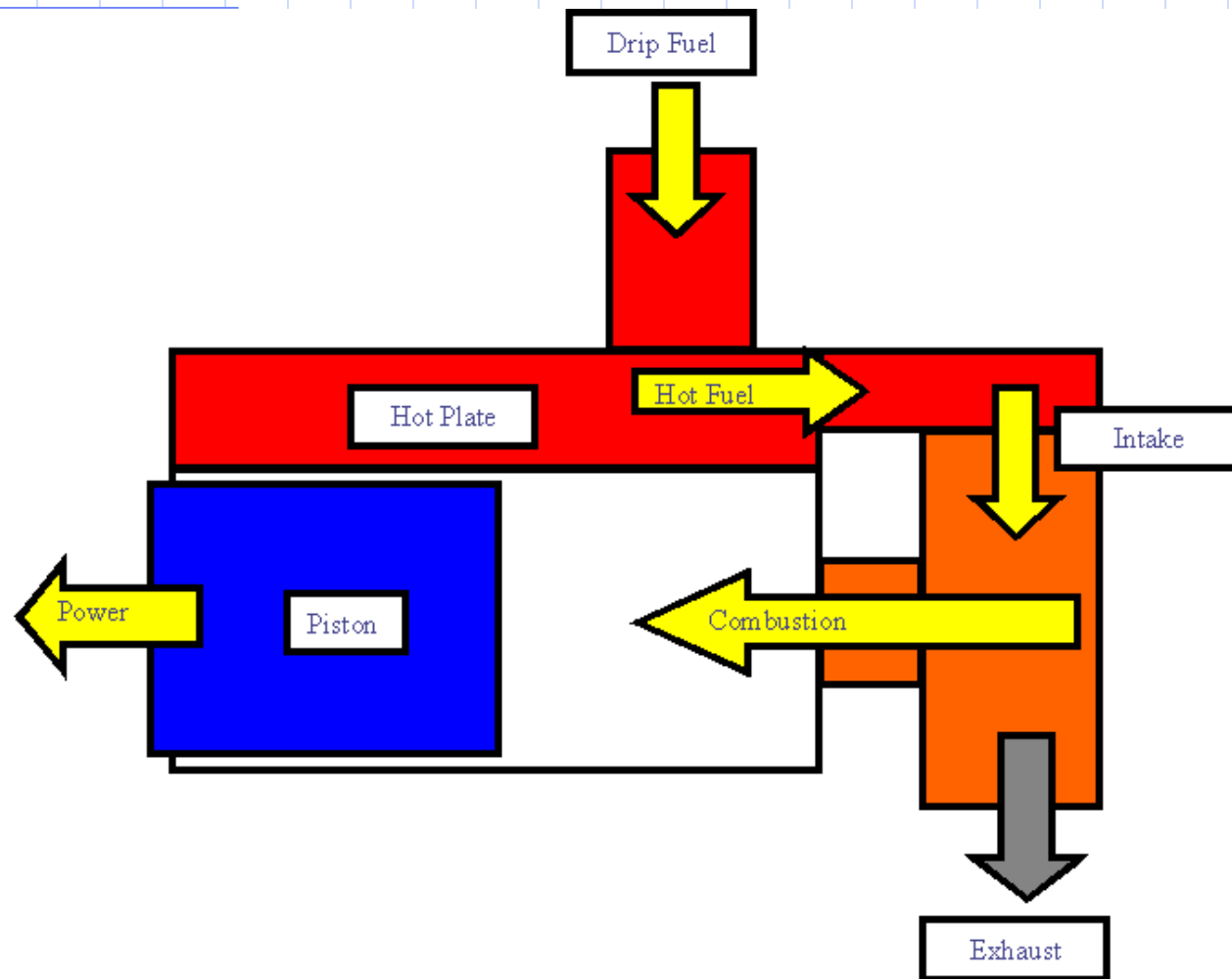


Engine Details

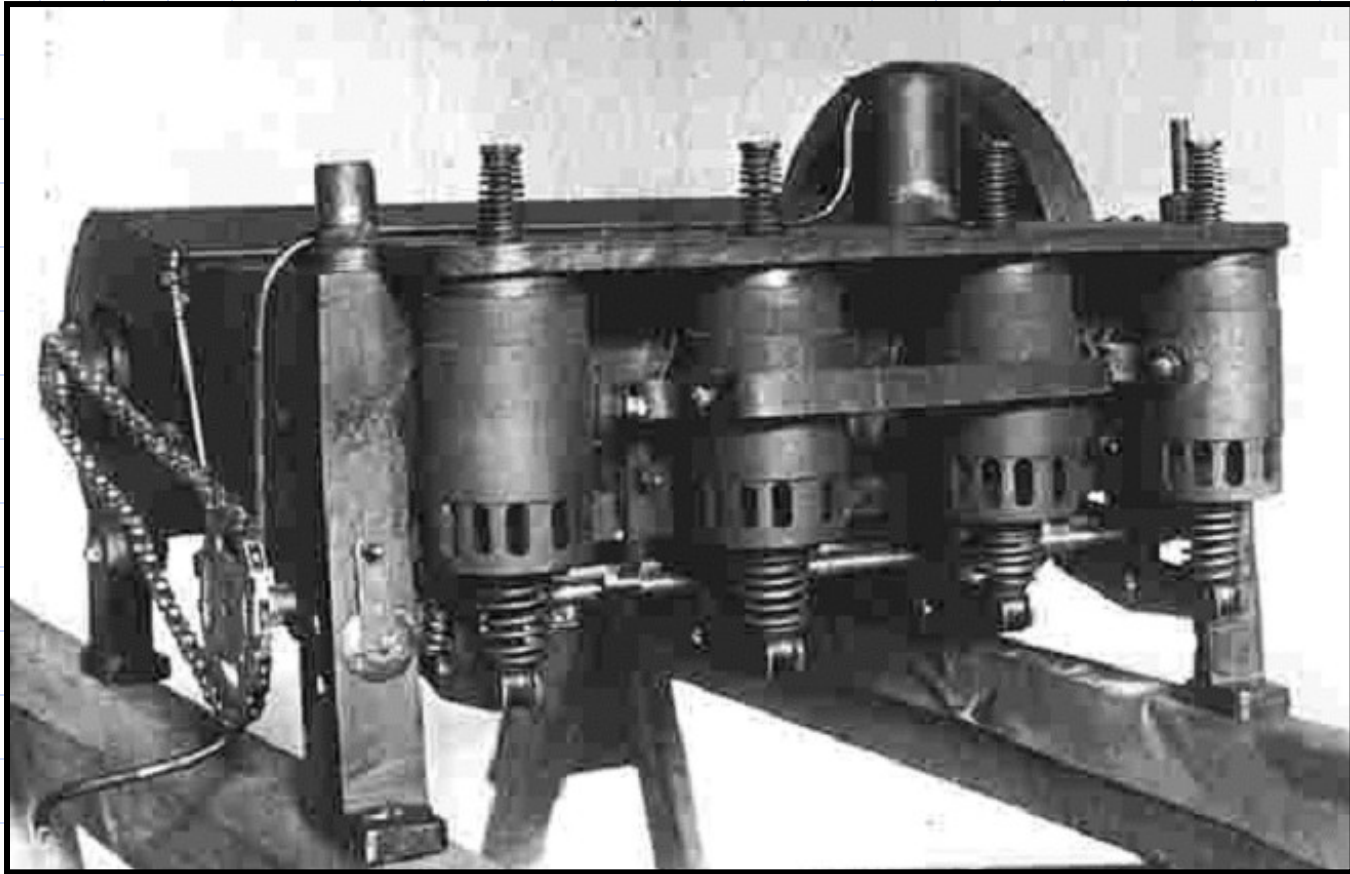


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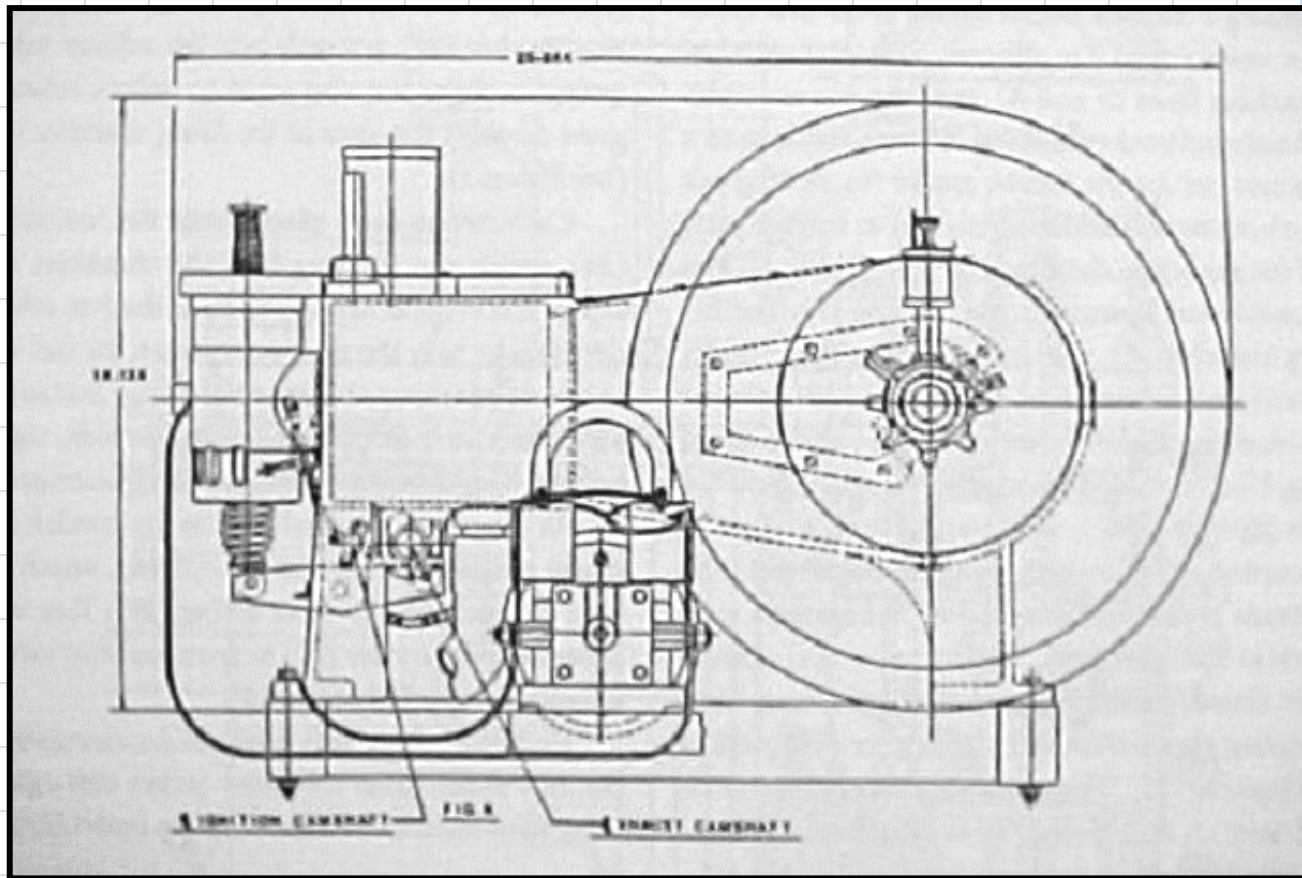
Principals of operation



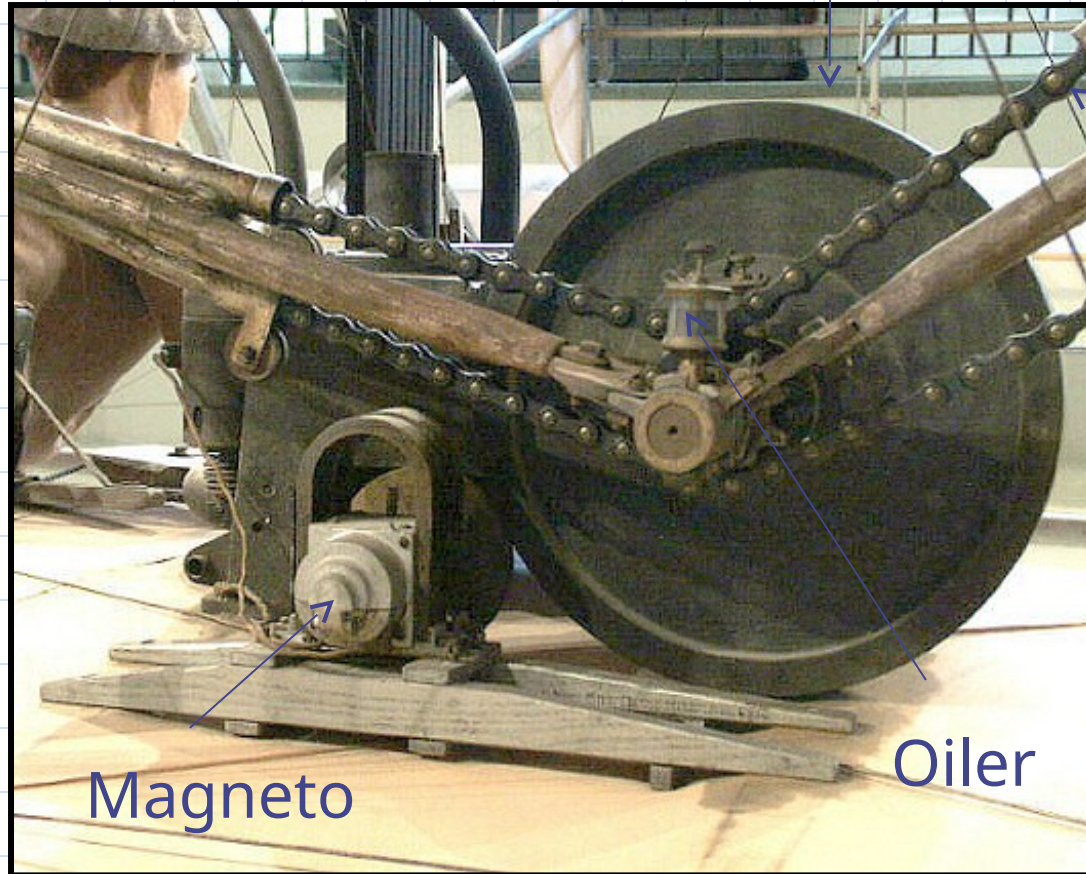
1903 Engine - Rear



Side View



1905 Engine – Flywheel



Bicycle Chain

Magneto

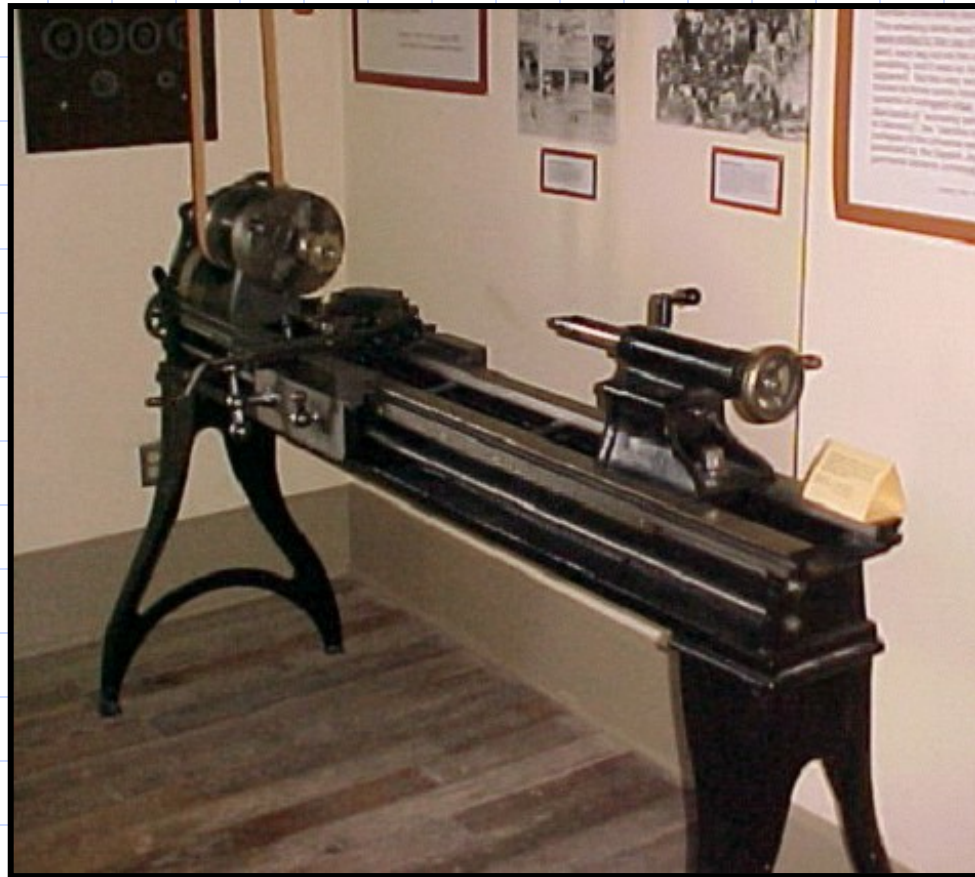
Oiler



Wright's Bicycle Shop



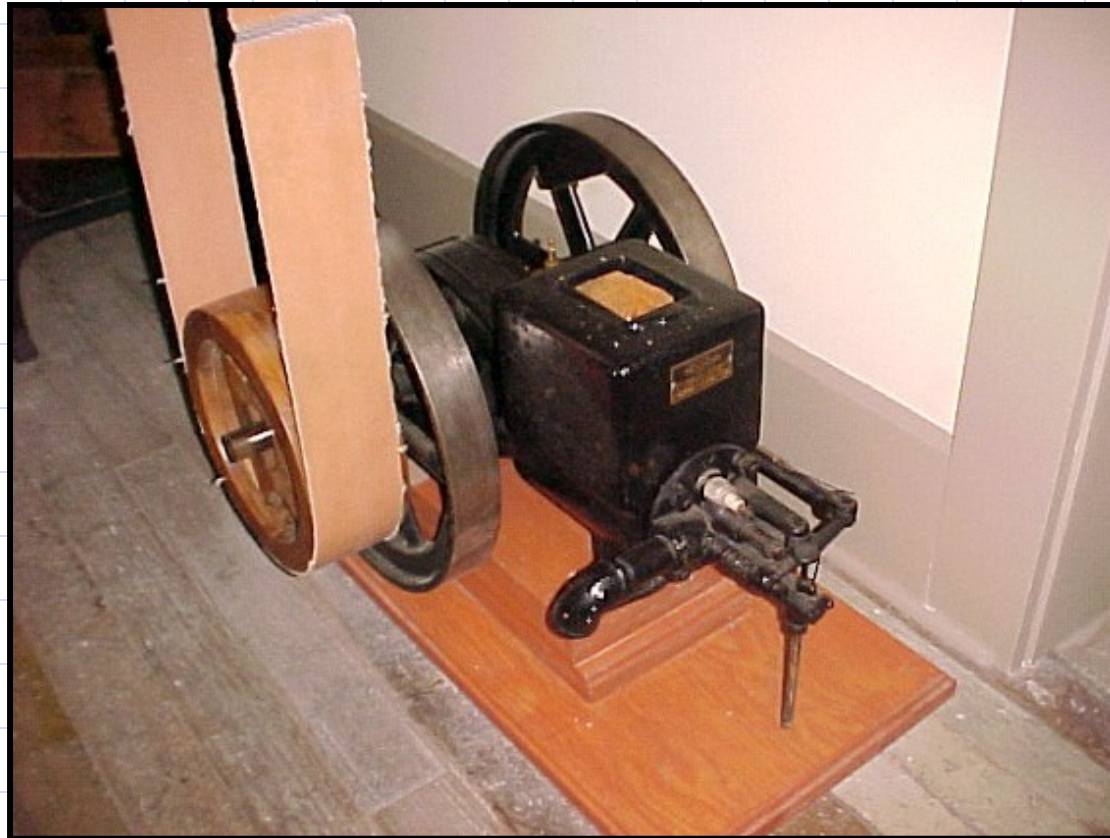
Putnam Lathe



Drill Press



Shop Engine



1905 Engine - Side



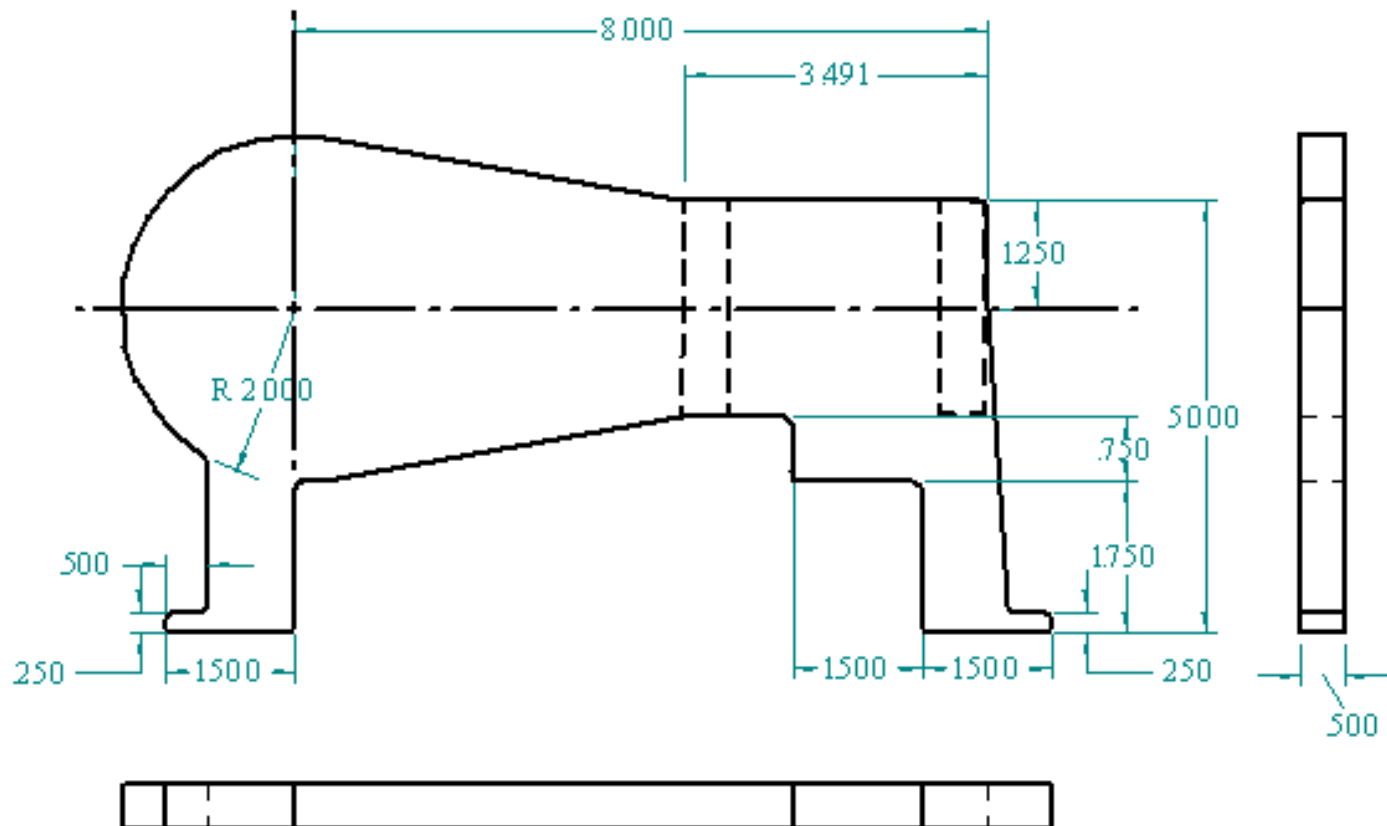
Building the $\frac{1}{2}$ Scale Model

- ◆ Based on drawings by Ford Motor Company – Greenfield Village.
- ◆ Original was cast aluminum.
- ◆ Model is aluminum plate Construction.

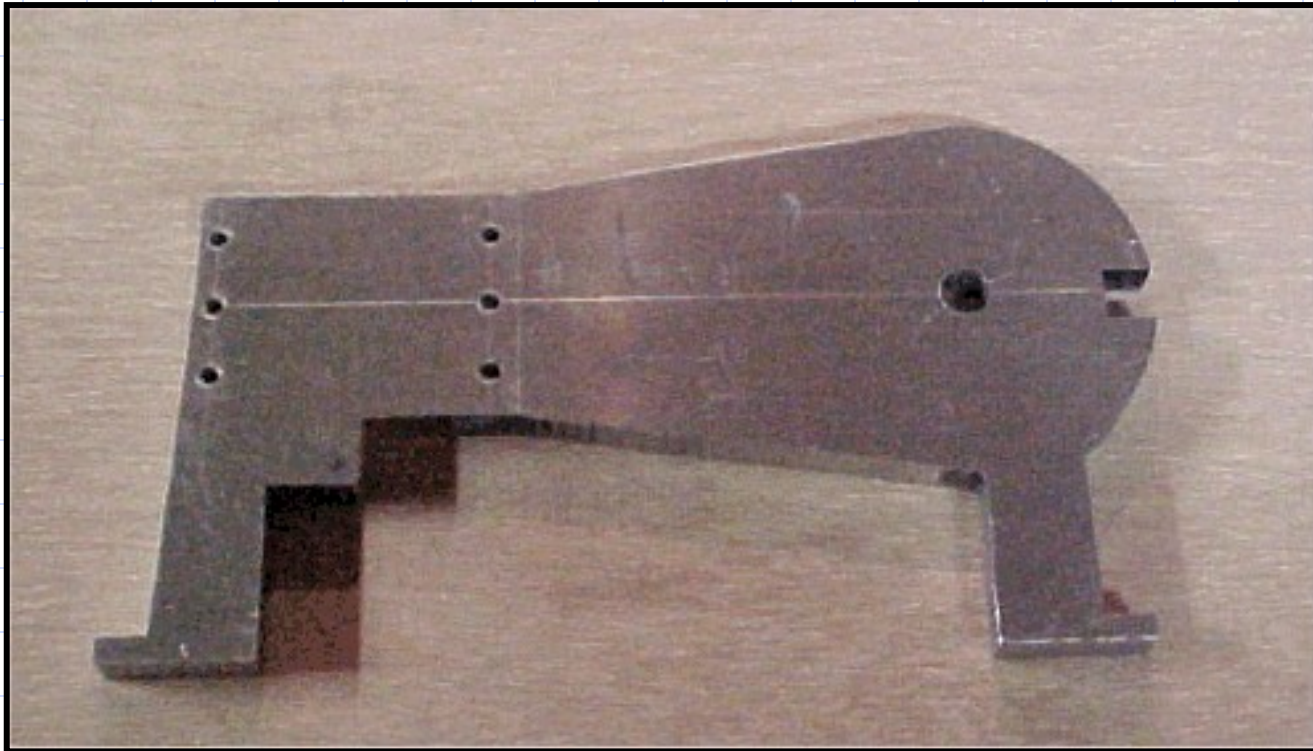




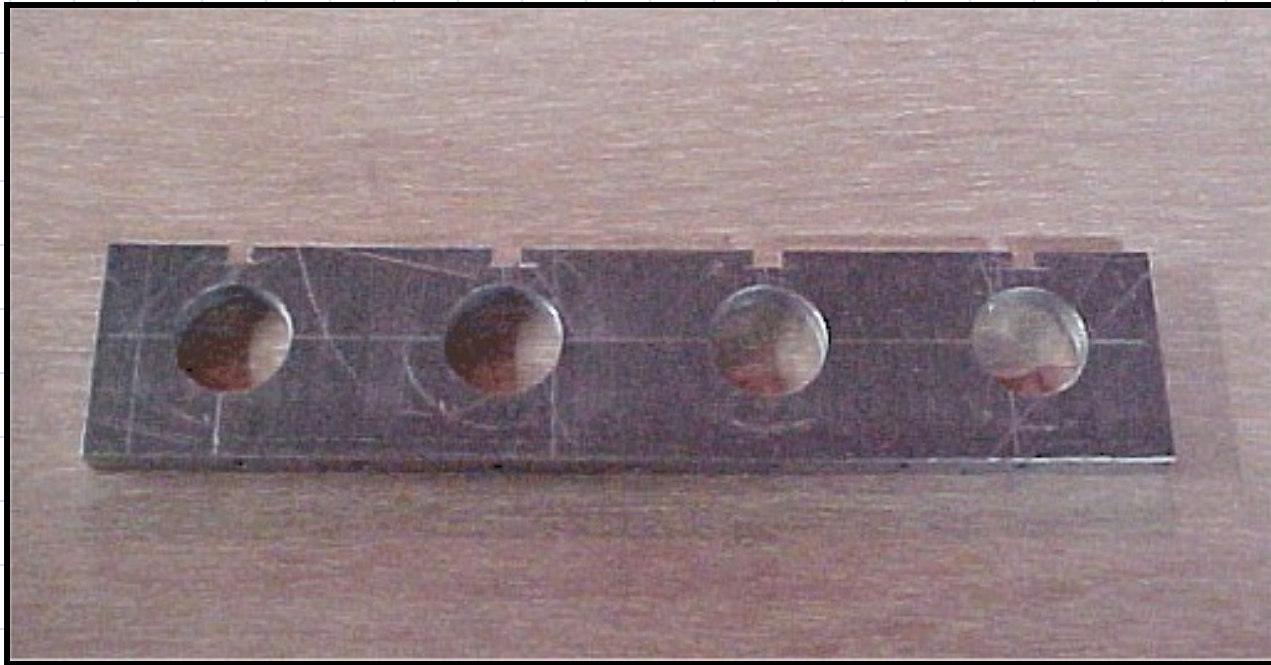
1/2 Scale Model End Plate



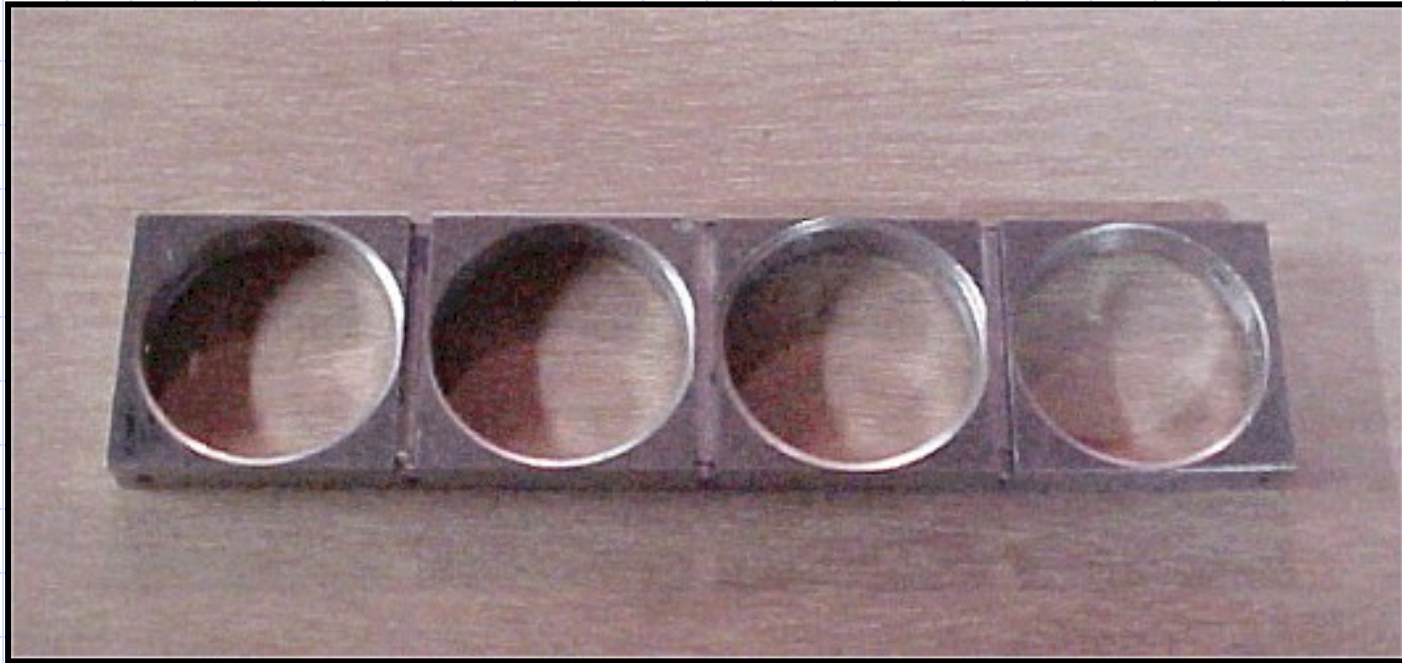
End Plate



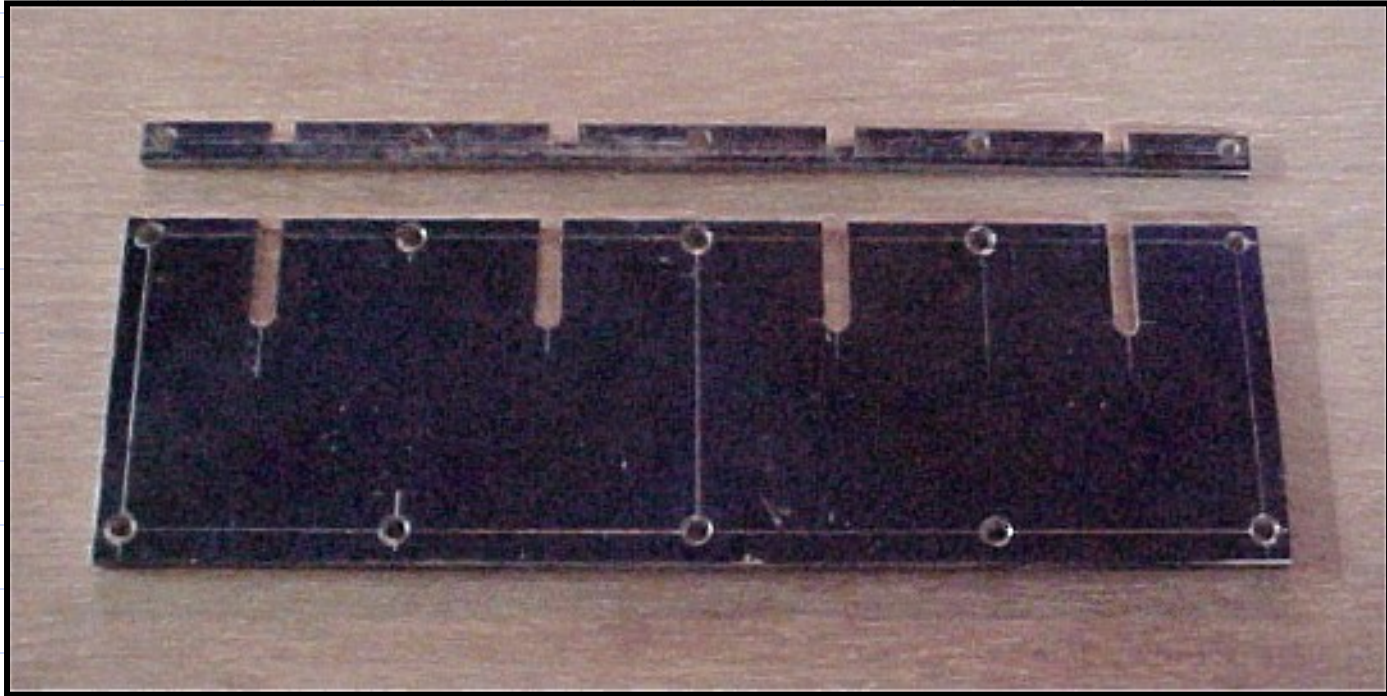
Rear Cylinder Plate



Front Cylinder Plate



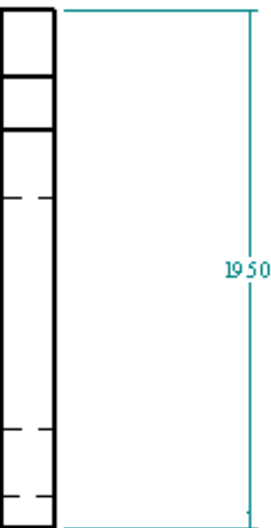
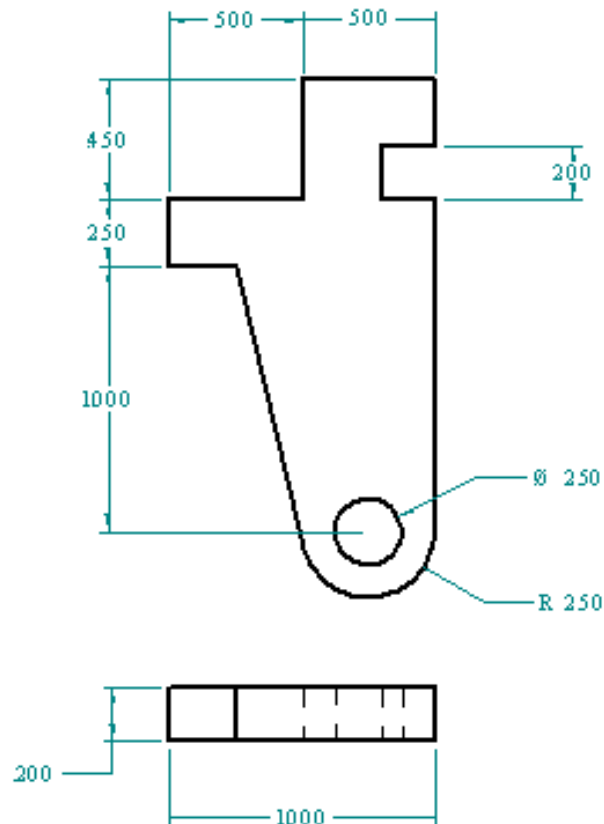
Bottom Plate



Stand-Off Retainer



Rocker Stand-Off



Valve Stand-Off



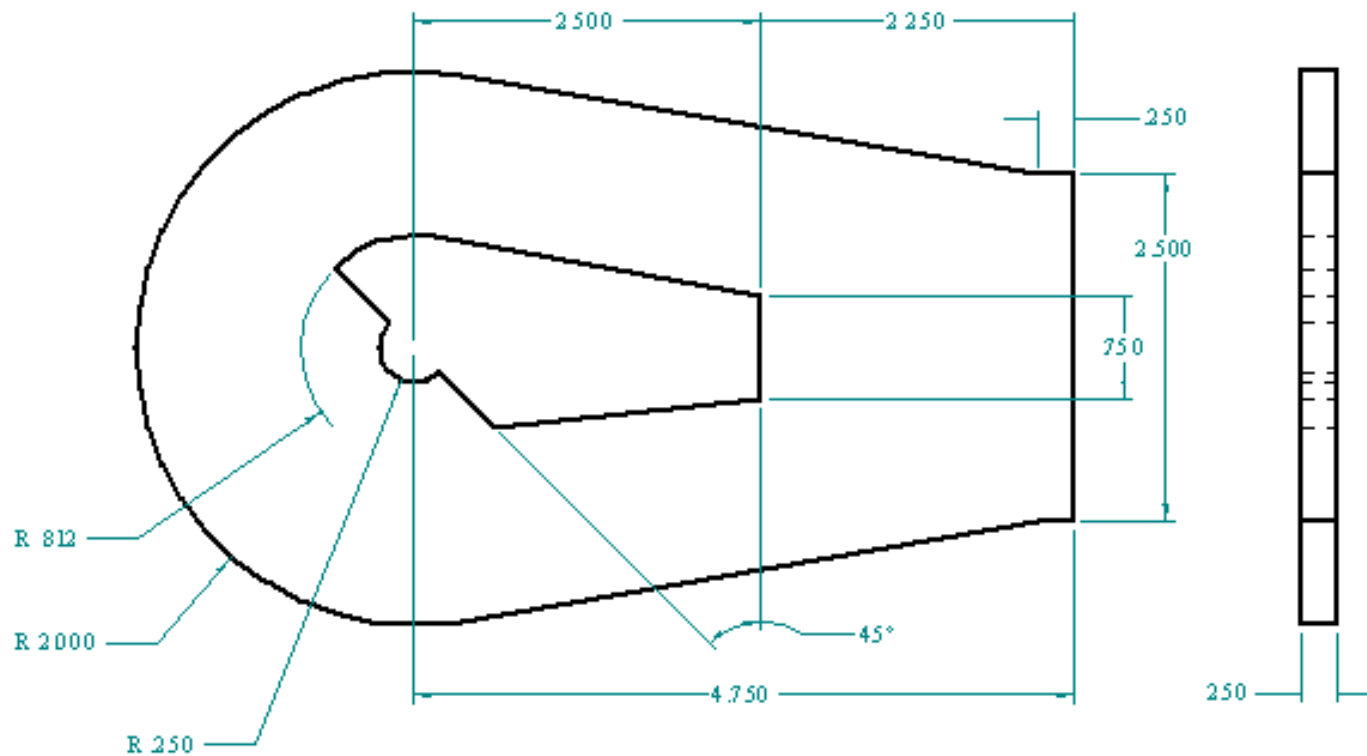
Rocker Stand Off



Bearing Assembly



Middle Plate



Model 1903 Middle Plate



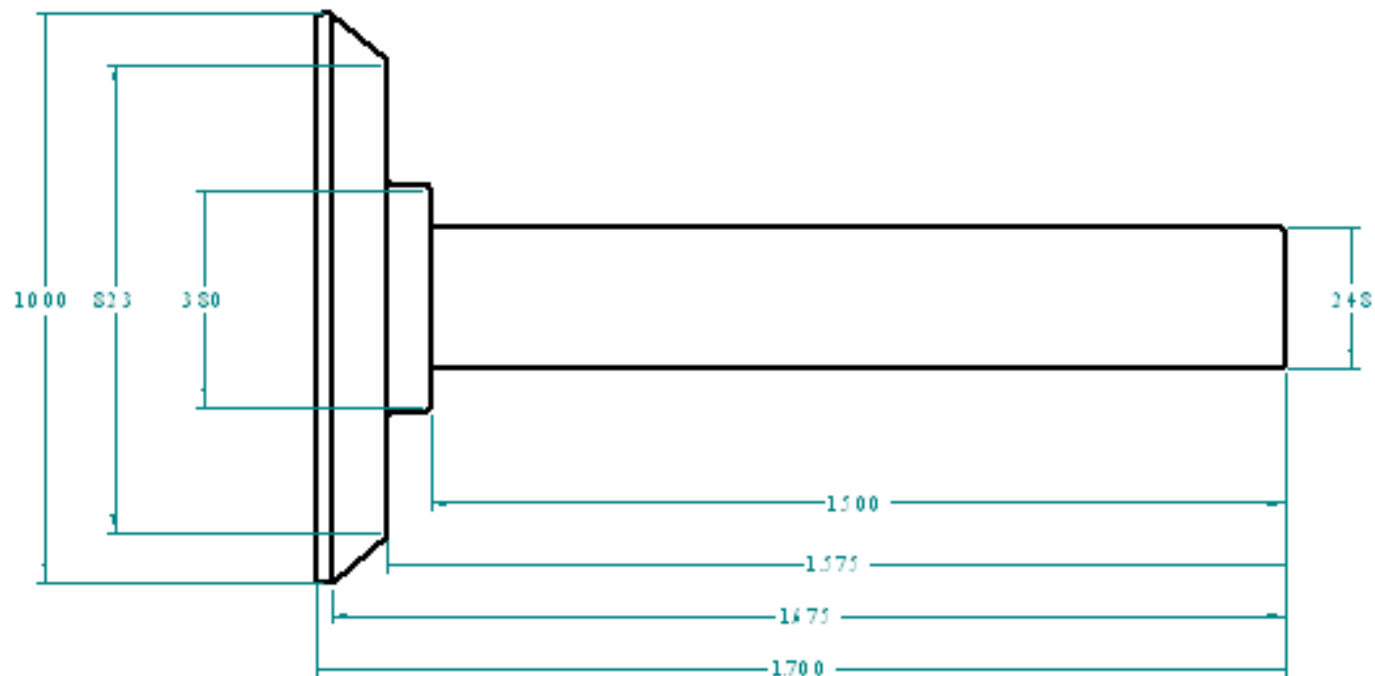
Middle Plate



Top Plate - Vaporizer



Valve Detail



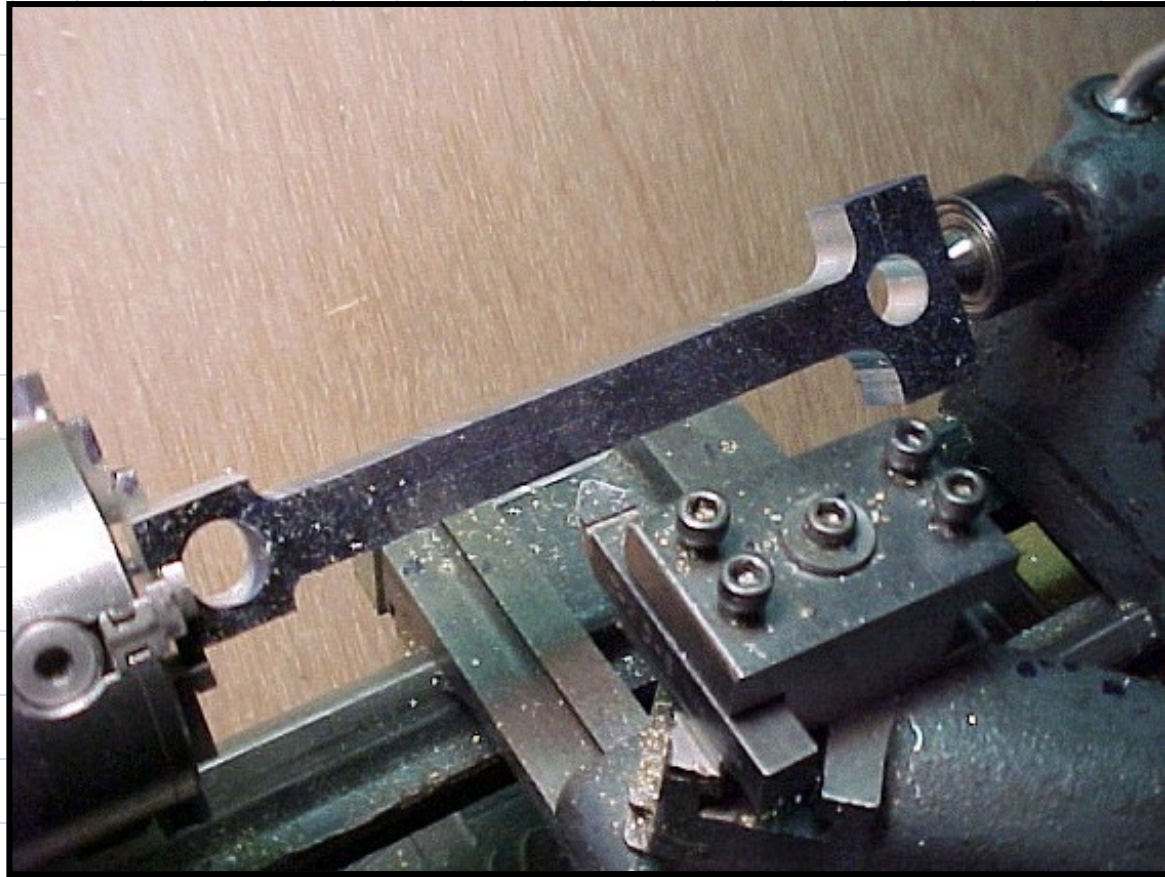
Model 11903 Valve Detail



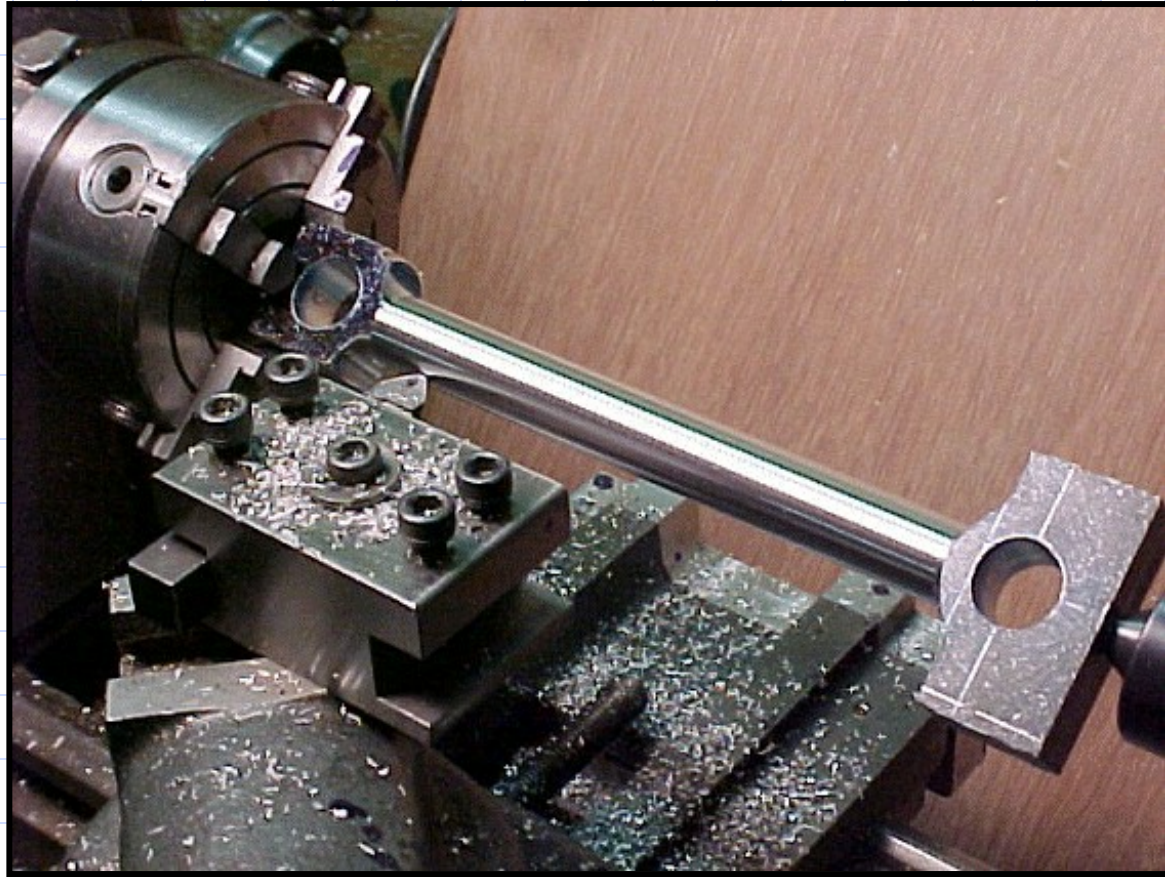
Con Rod Blank



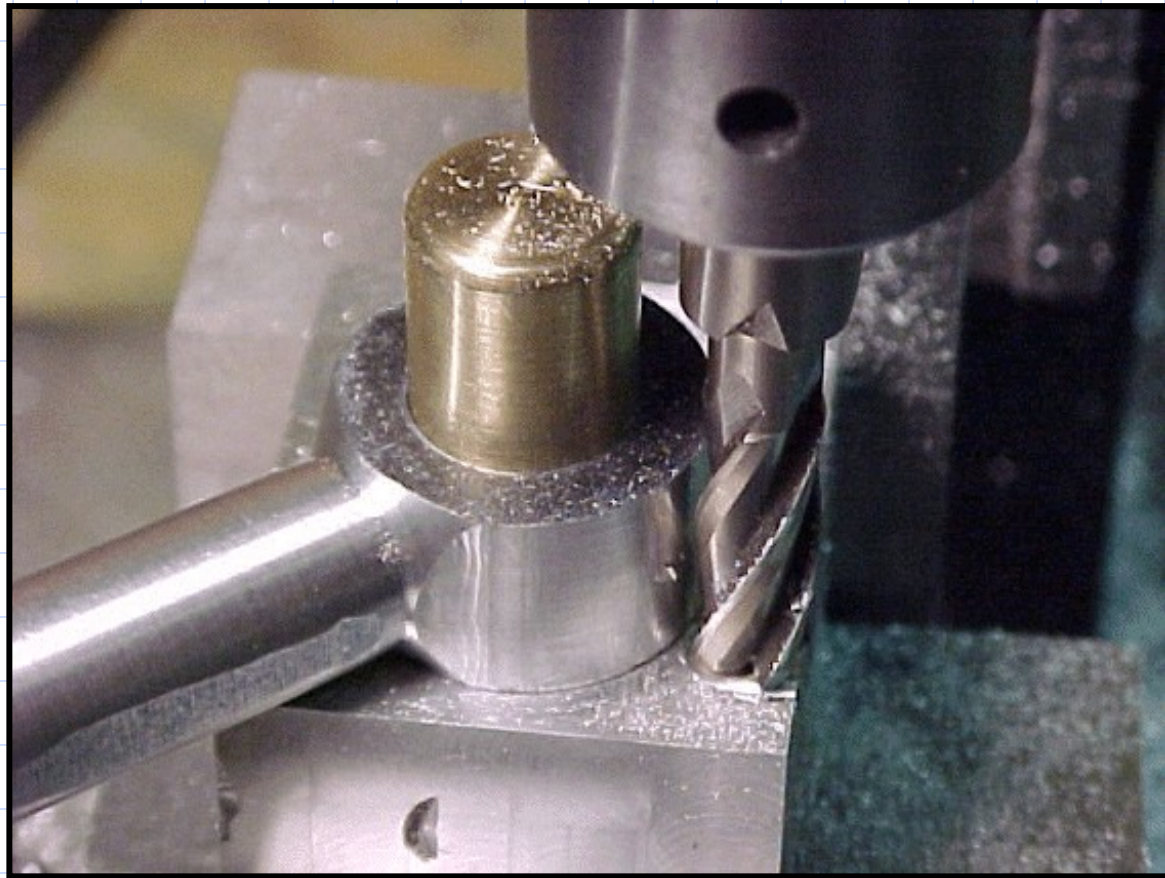
Con Rod Blank - Turned



Con Rod - Lathe



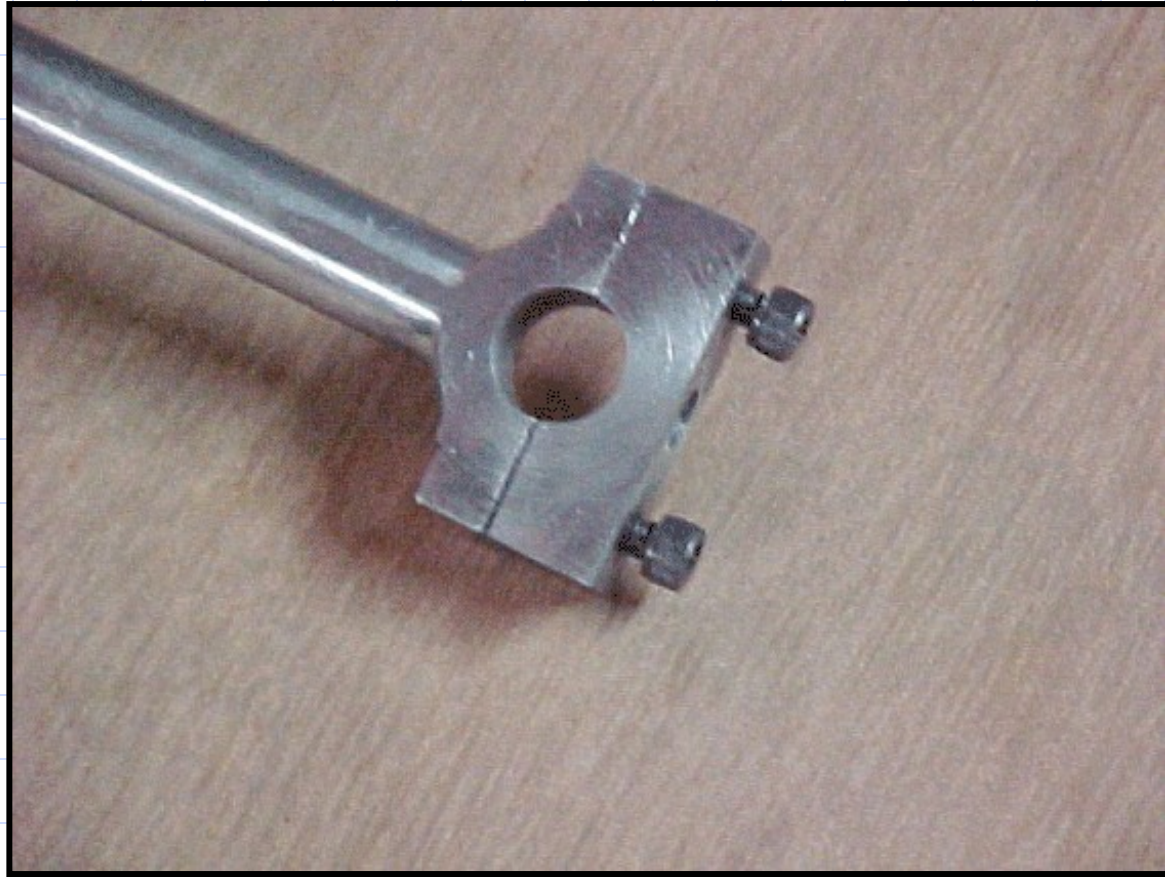
Con Rod - Milled



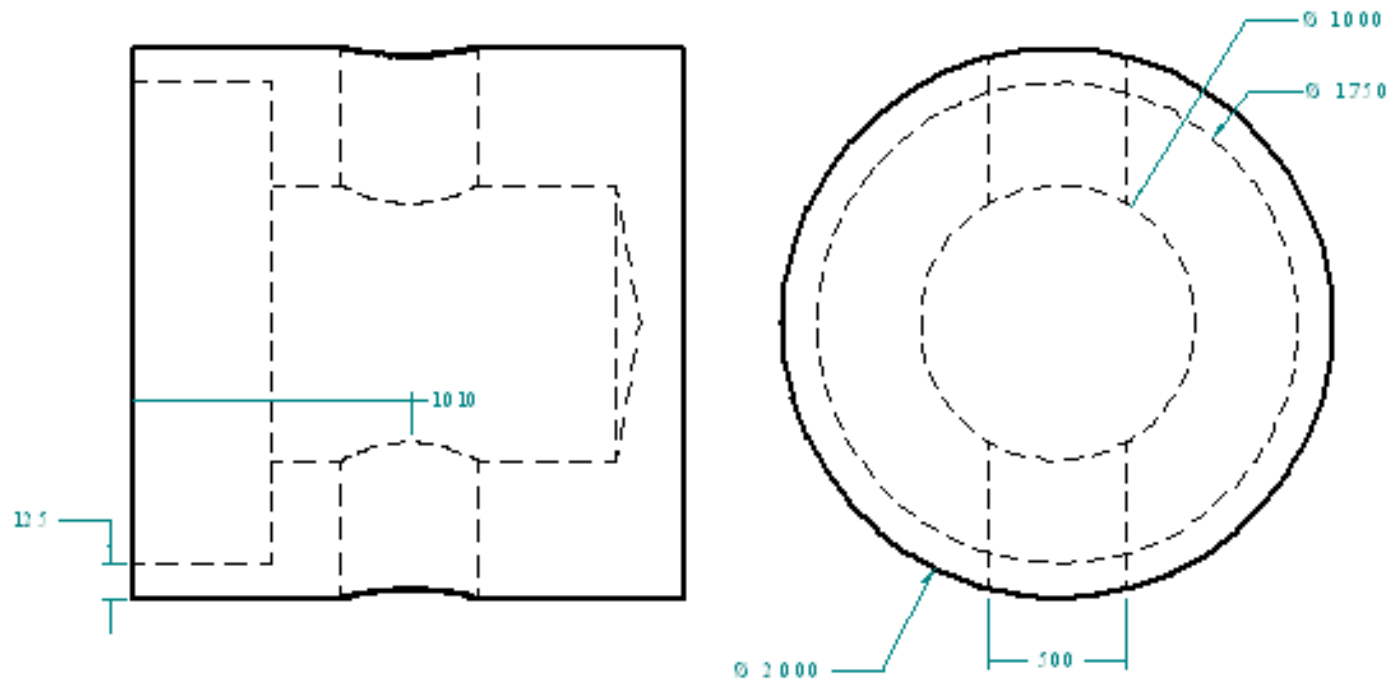
Con Rod – Turned and Milled



Connecting Rod Journal End



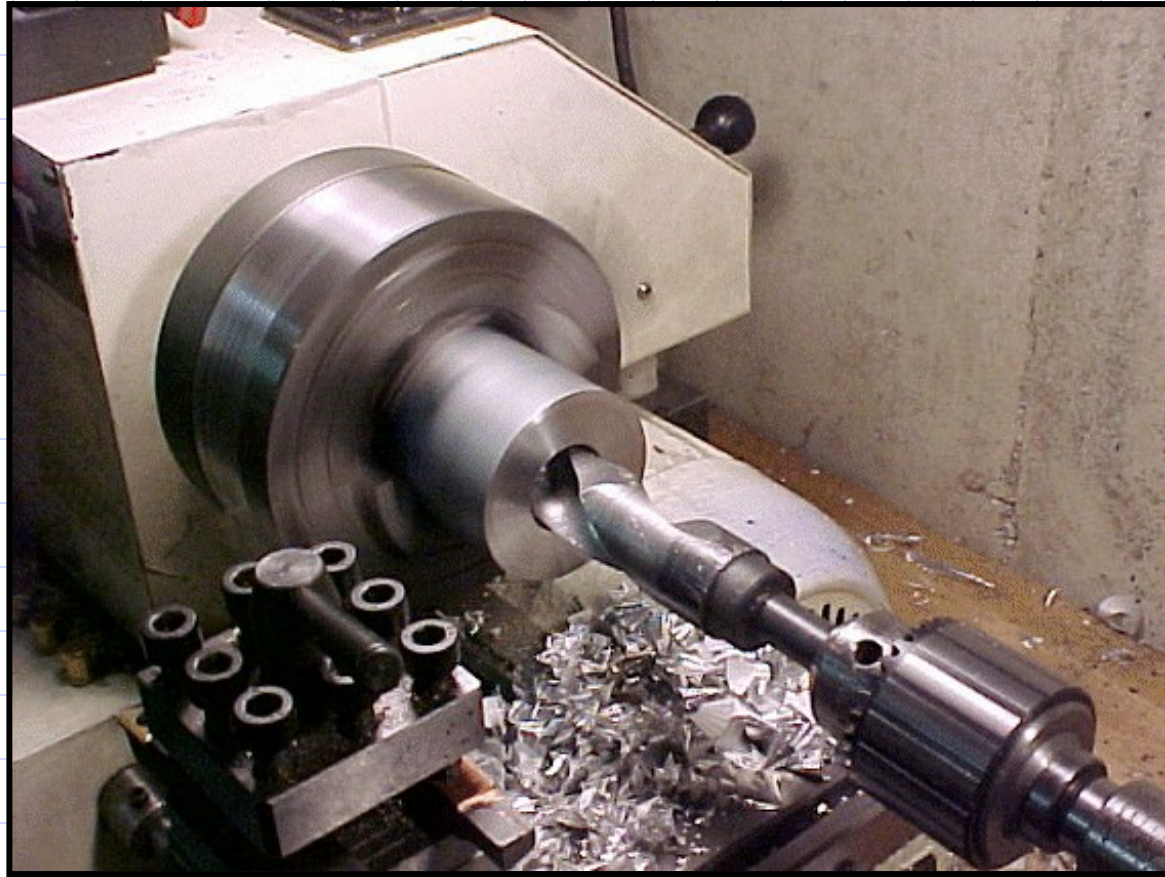
Piston



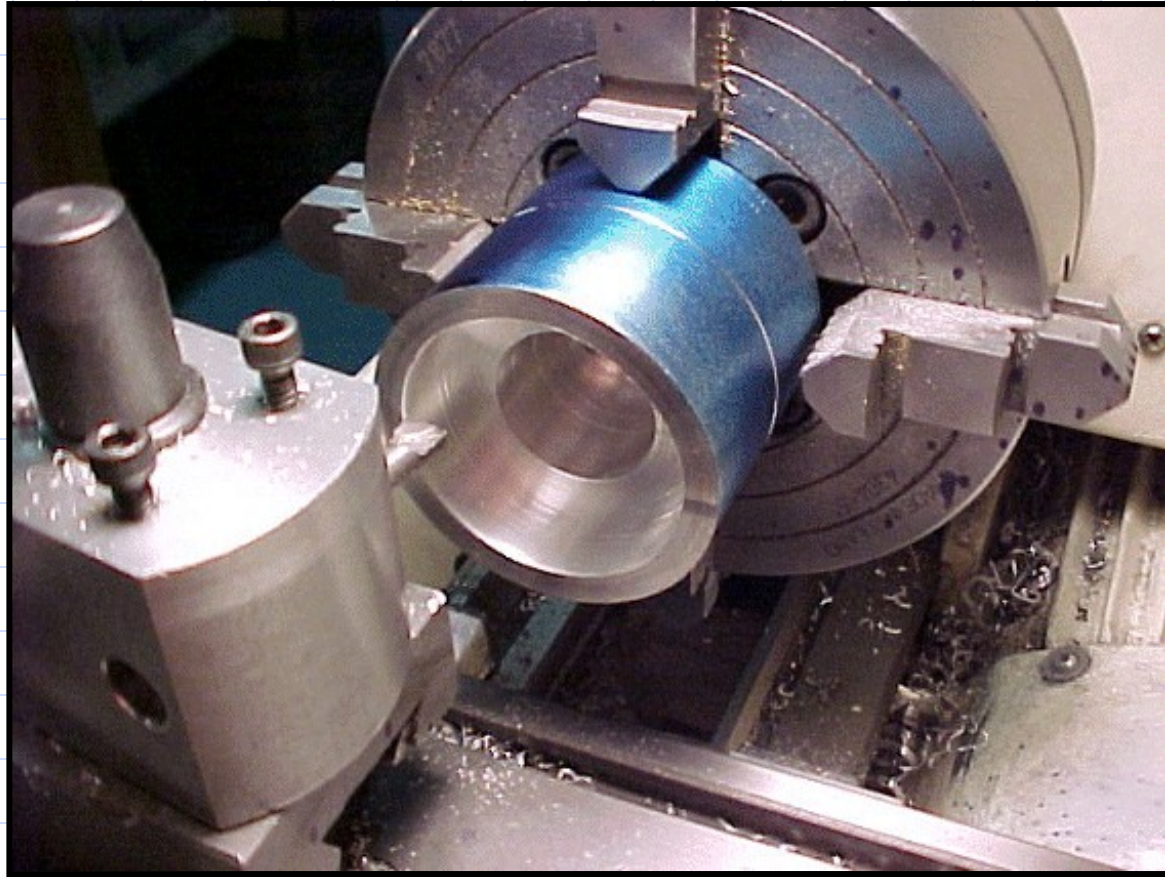
Wright Engine Model Piston



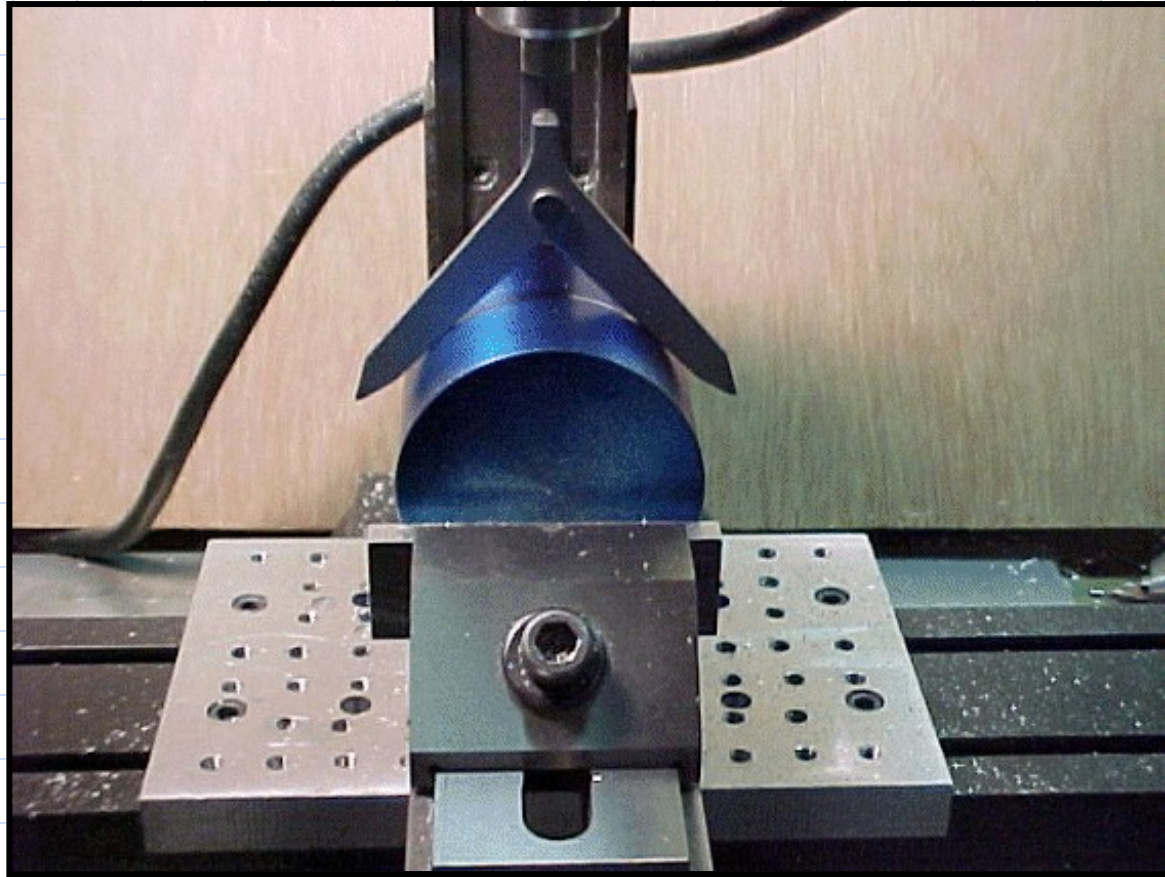
Piston Bore 1



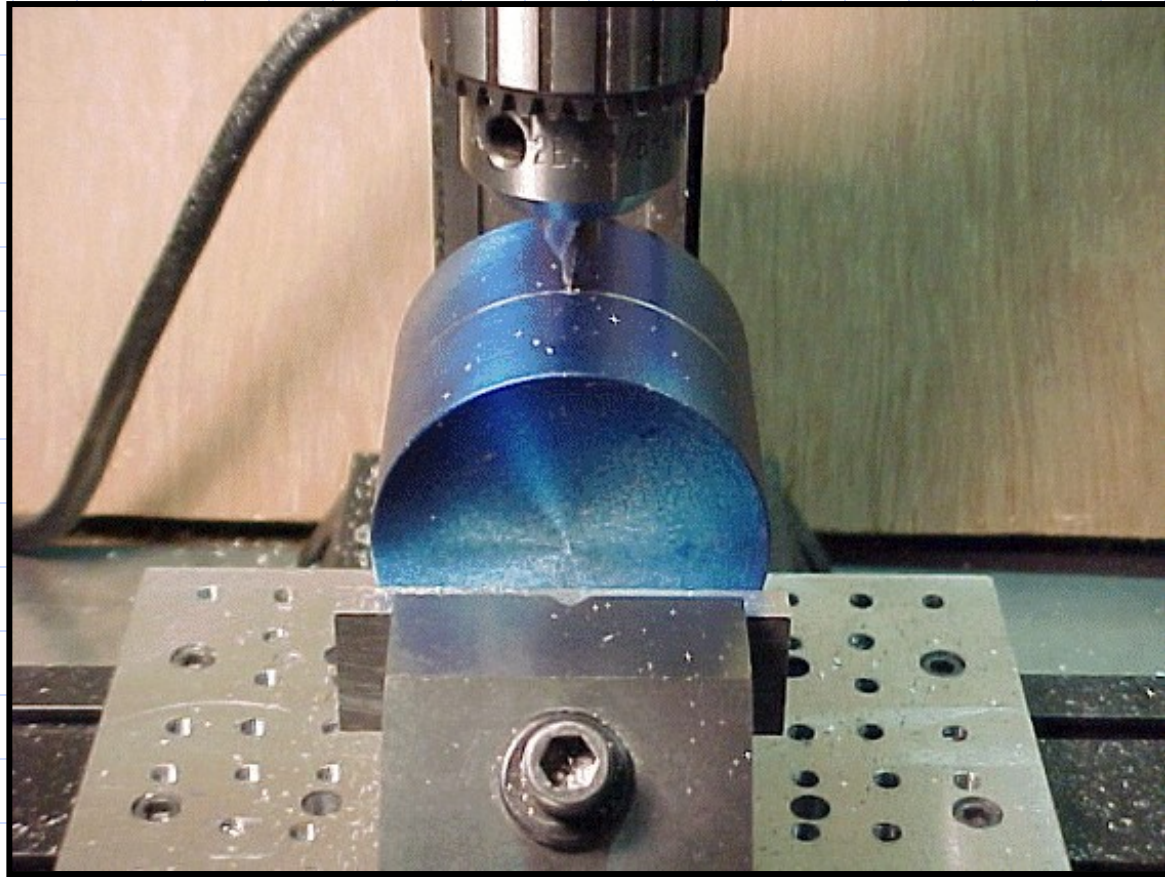
Piston Bore 2



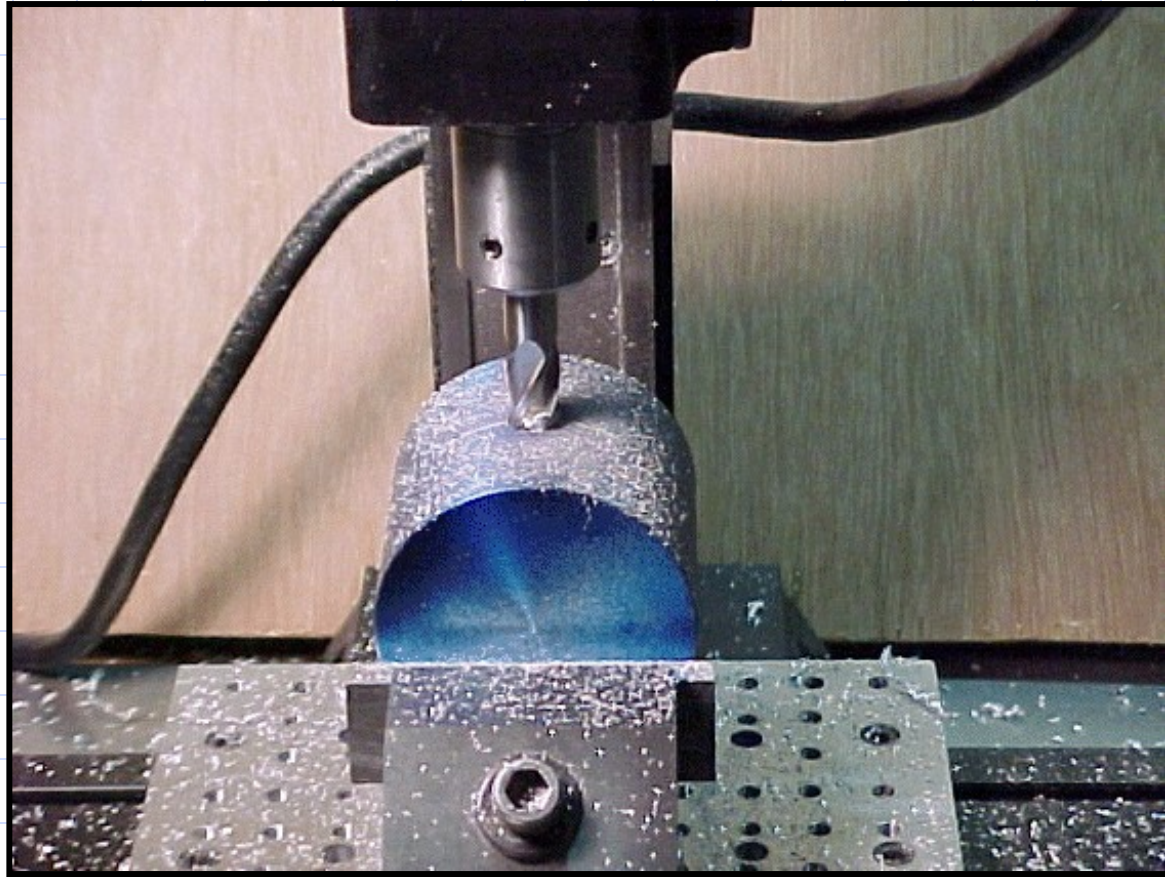
Piston Center



Piston Center



Piston Bore 3



Piston Rough In



Piston Assembly 1



Piston Assembly 2



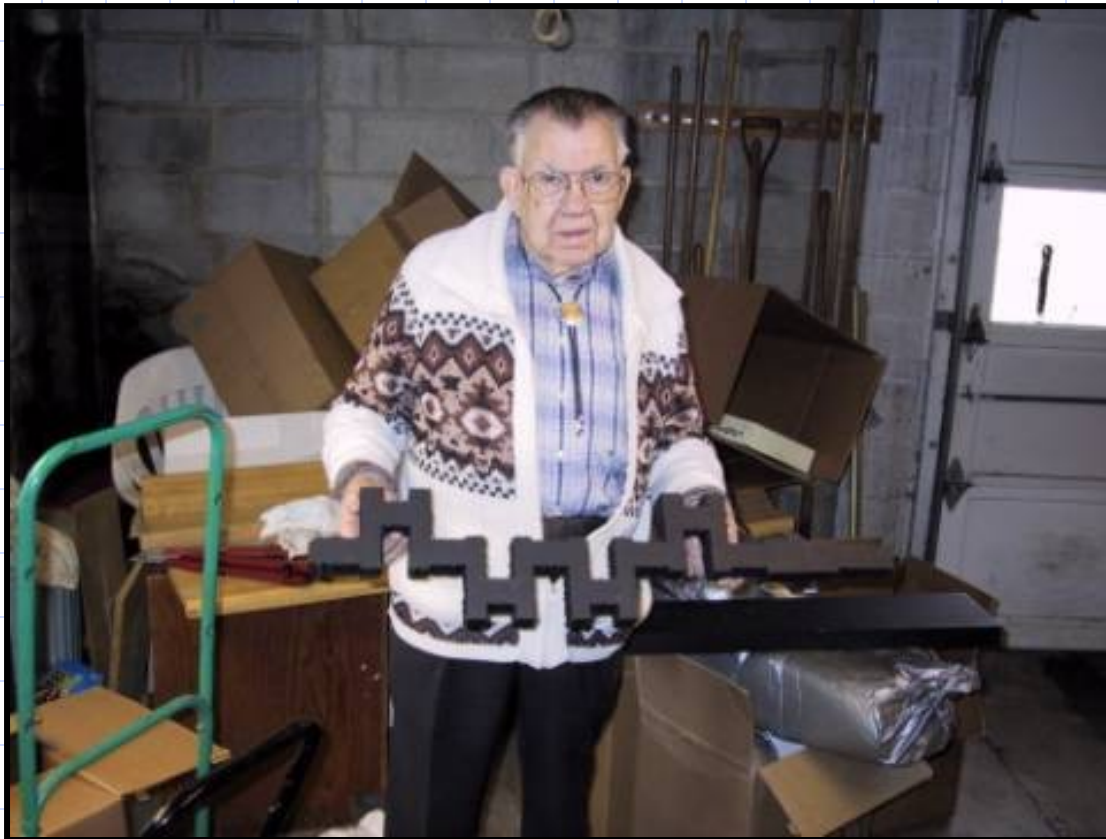
Four Pistons



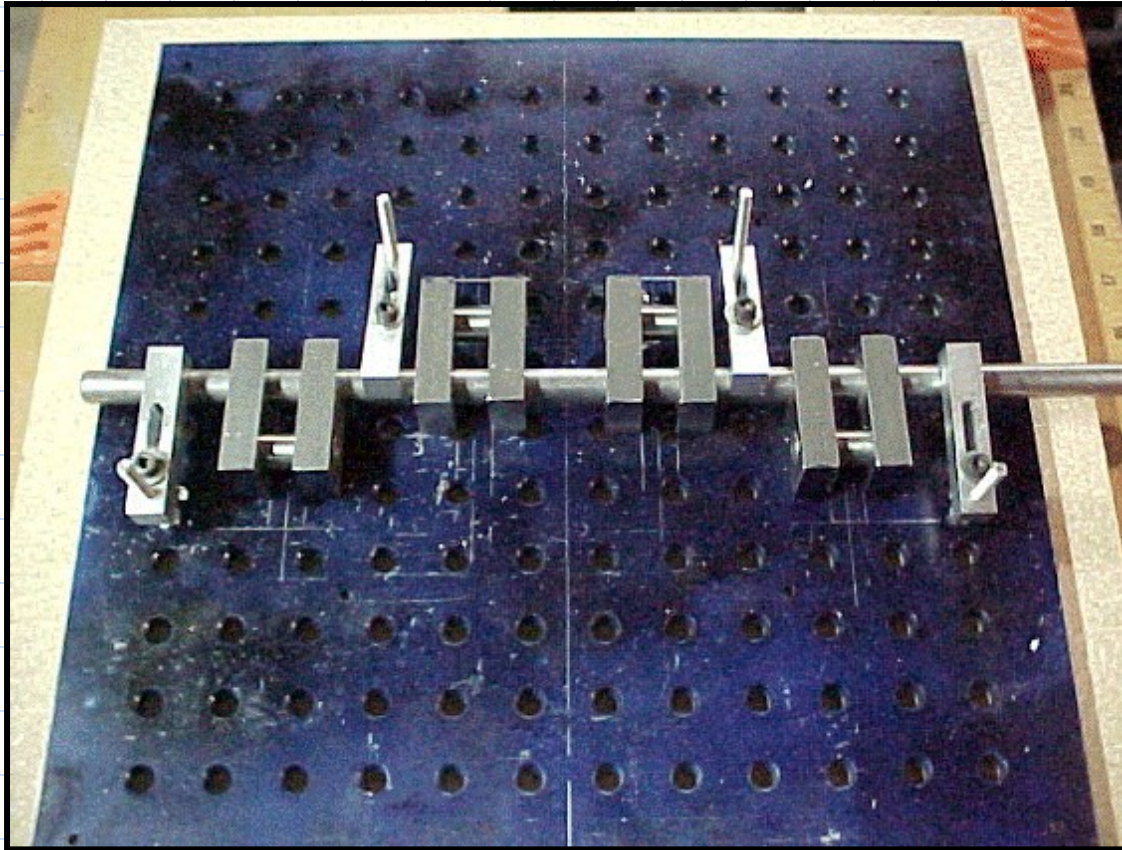
Simulated Crank Shaft Blank



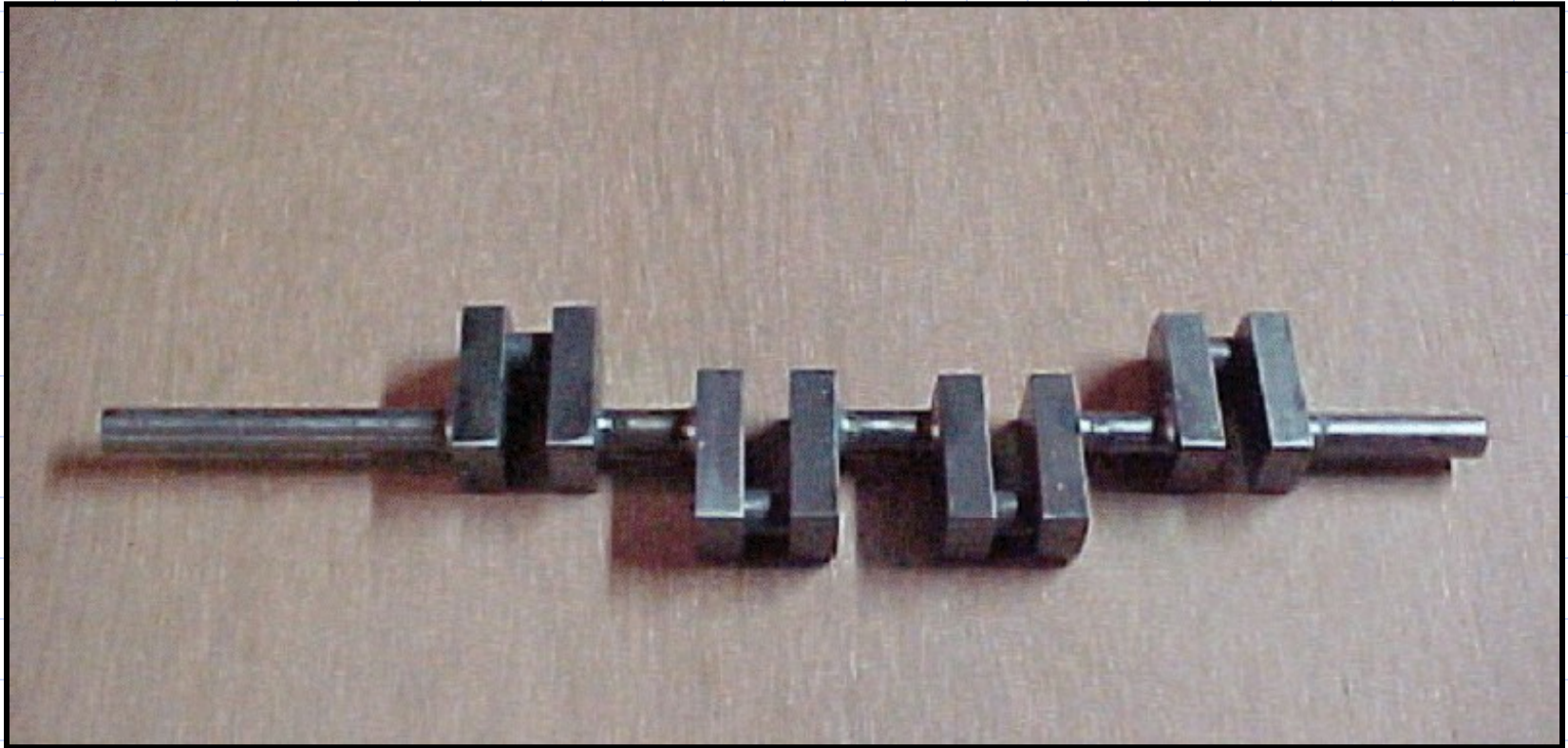
Simulated Crank Shaft – First Cut



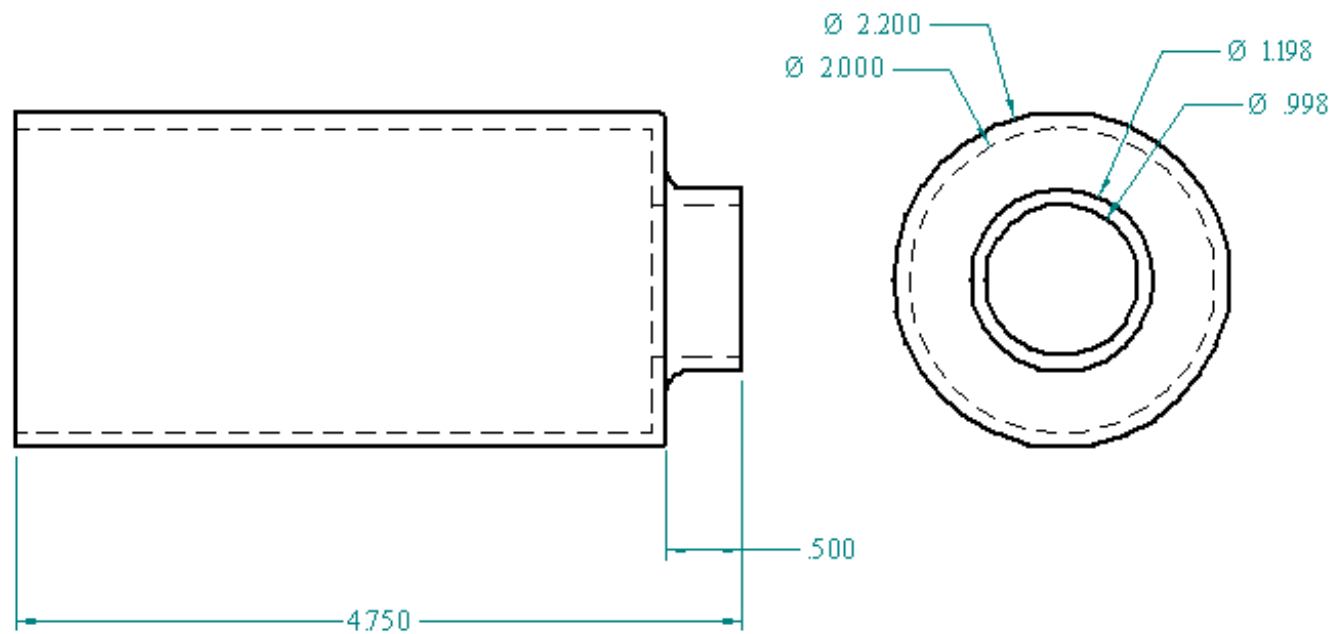
Crank Shaft Assembly Fixture



$\frac{1}{2}$ Scale Crank Shaft



Cylinder Sleeve



Model 1903 - Cylinder



Original Engine Block #6



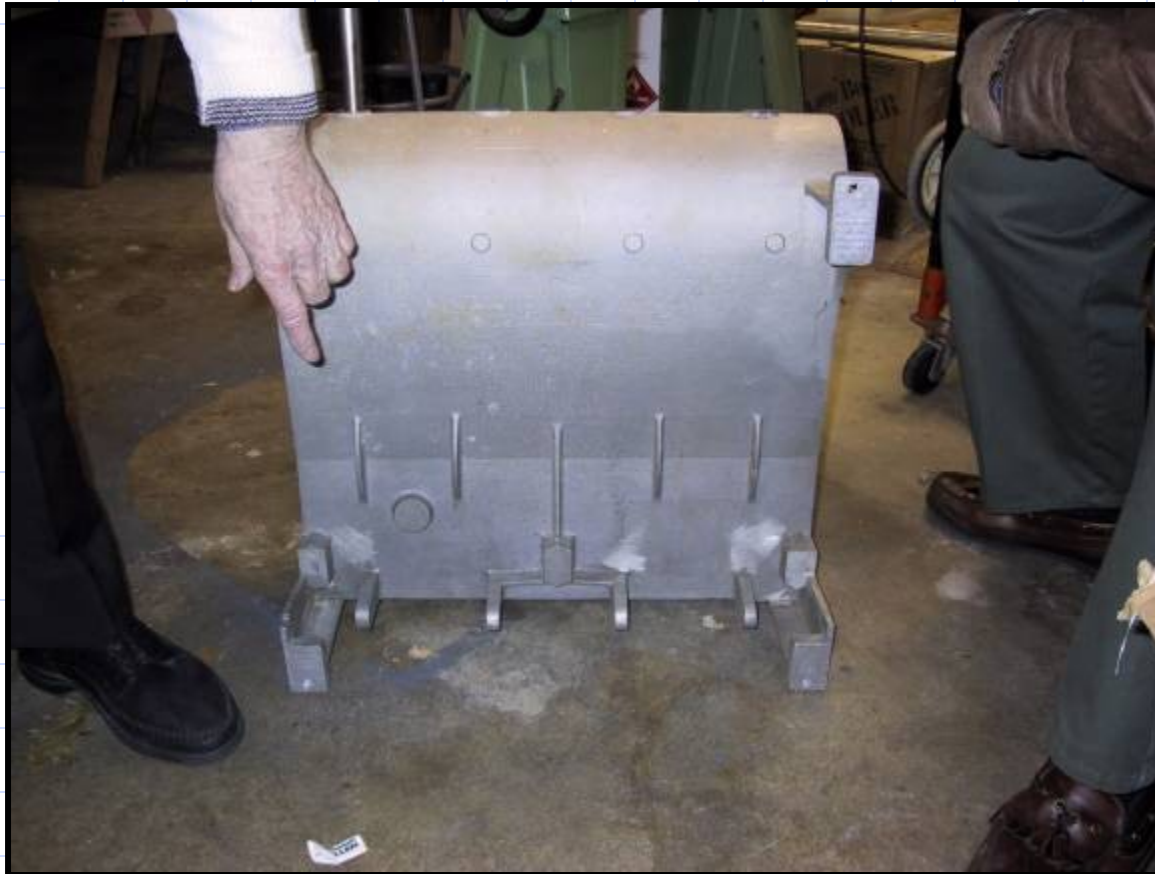
Casting Forms



Original Engine Casting #6



Block # 6 - Bottom



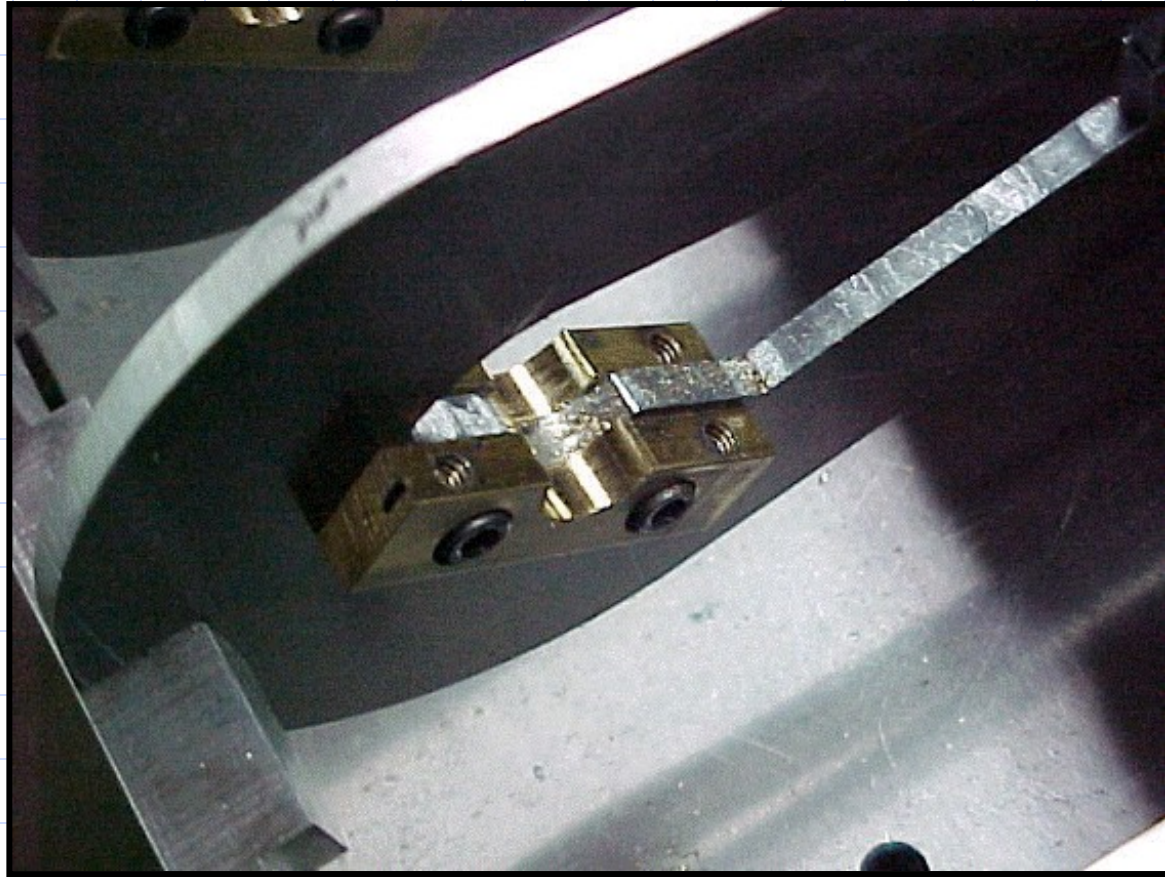
Block # 6



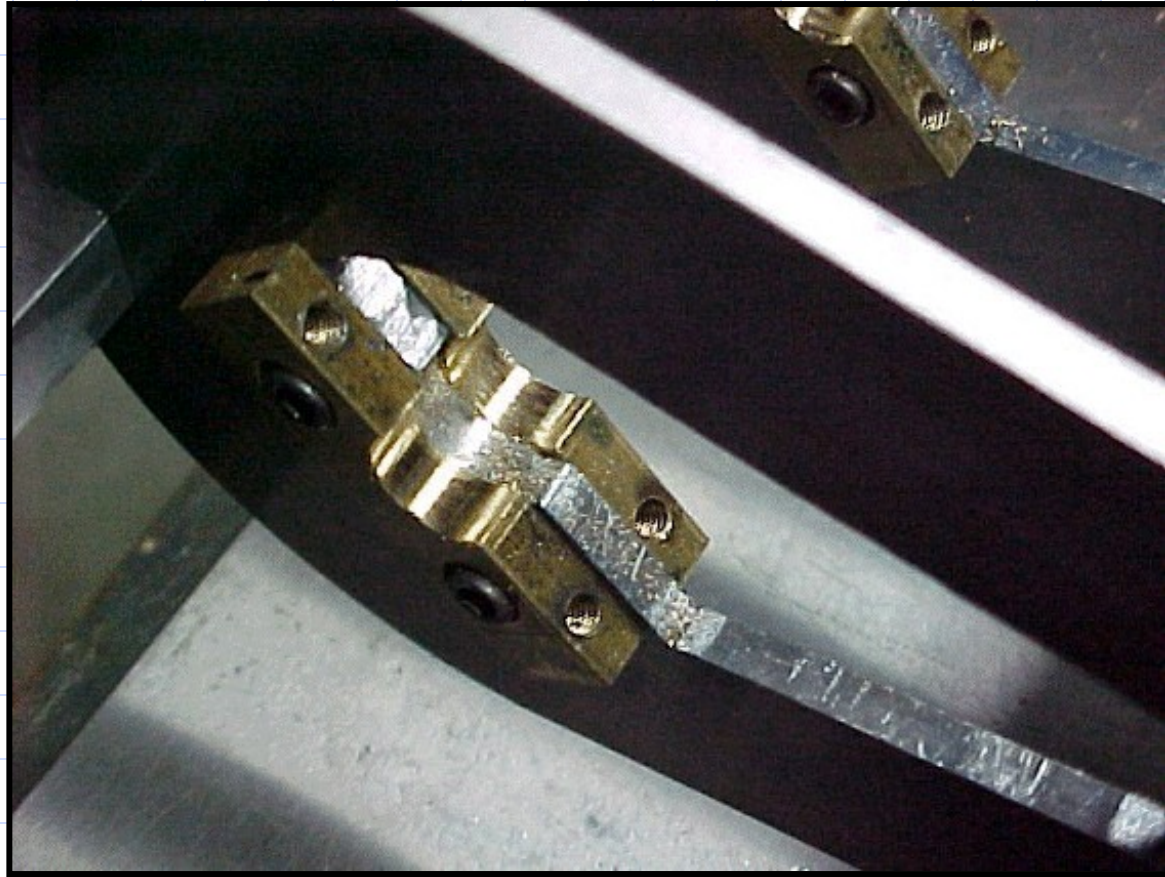
Outside Journal Bearing



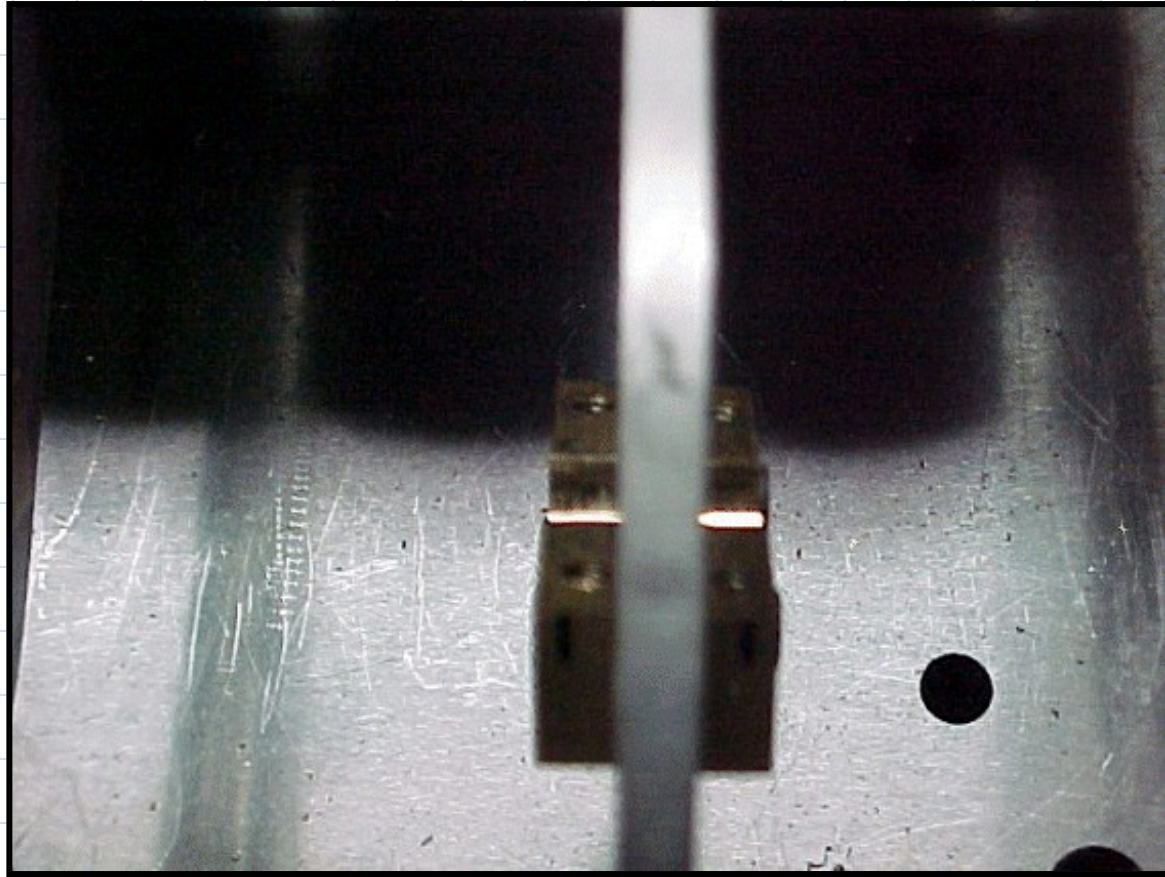
Model Journal Bearing Detail 1



Journal Bearing Detail 2



Journal Bearing Detail 3



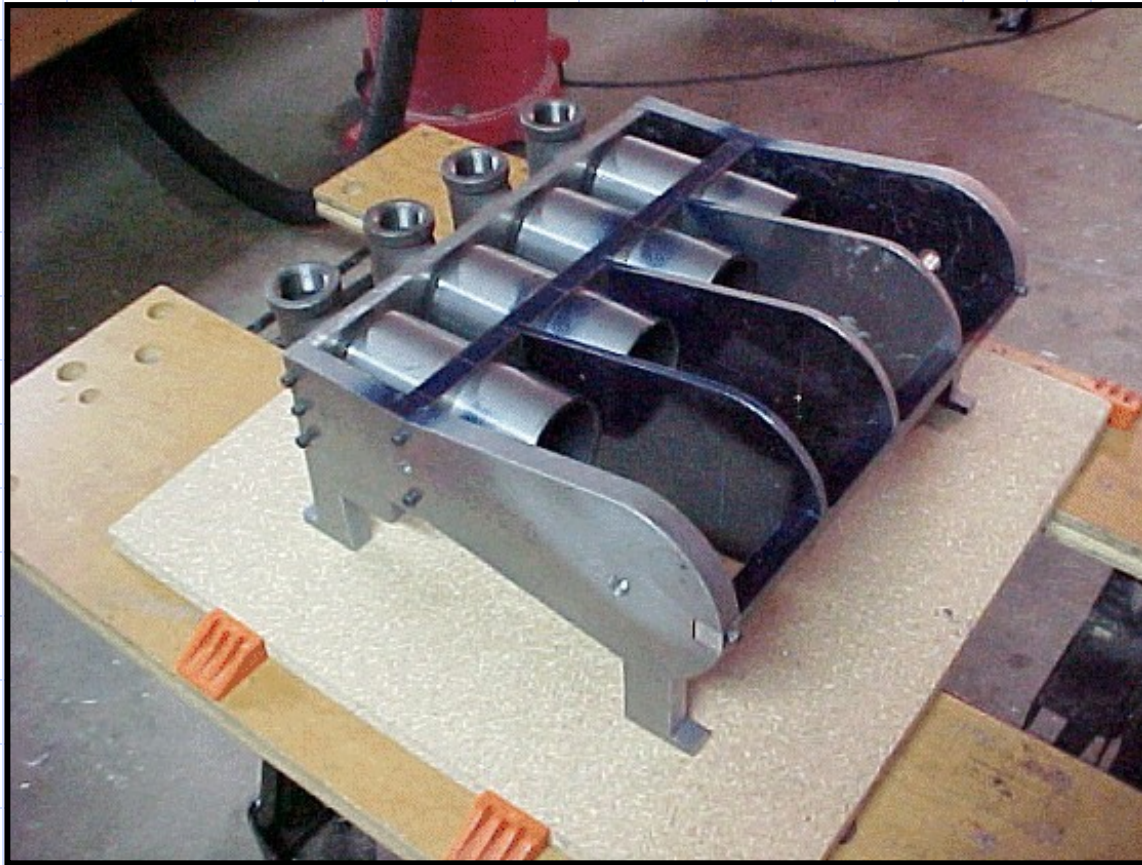
Cylinder Bore



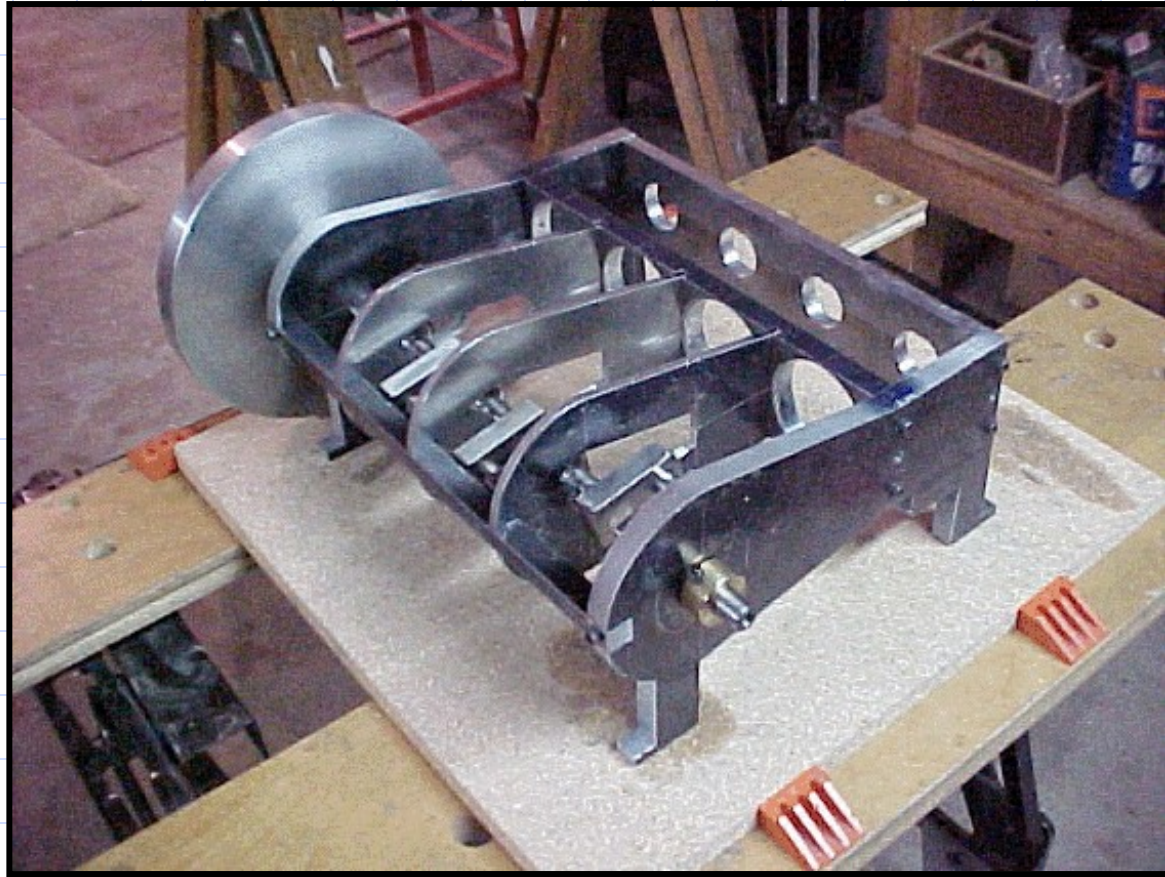
Engine Assembly



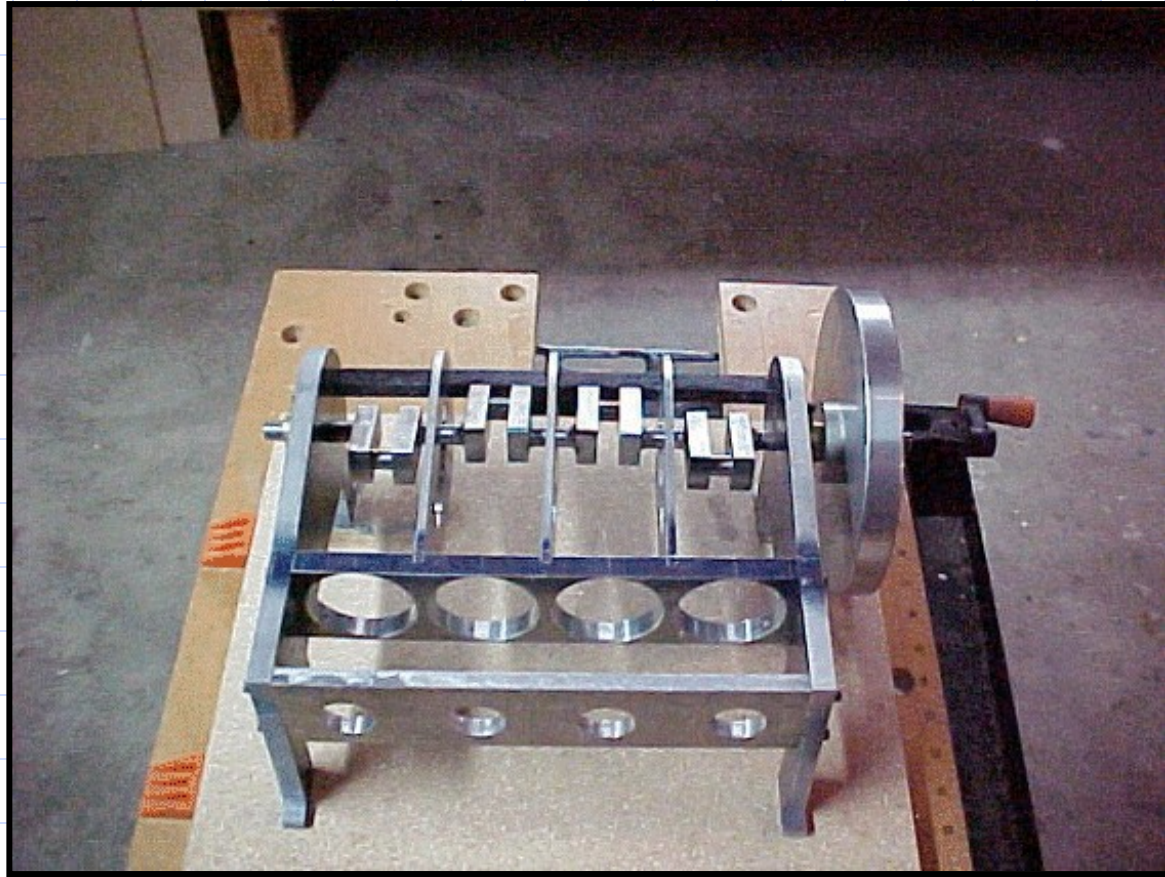
Block With Cylinders



Block With Crankshaft



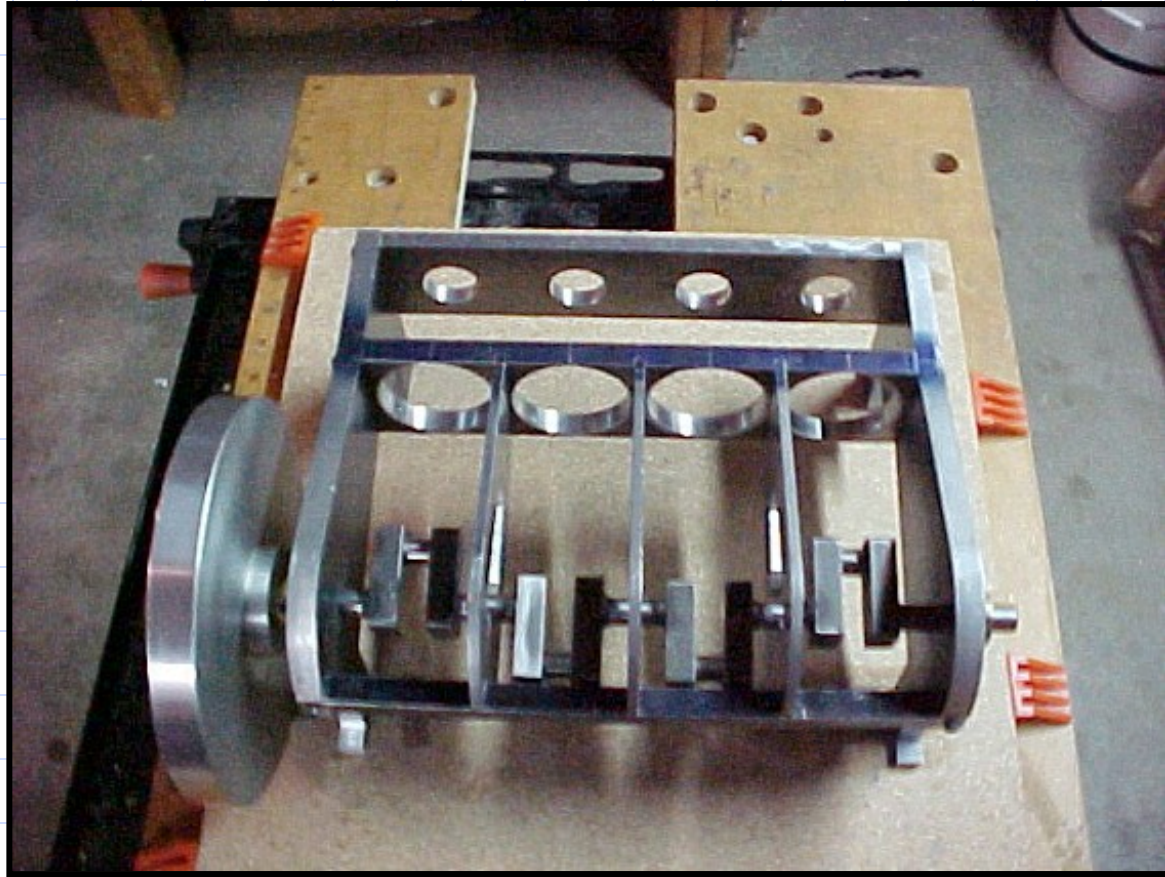
Block With Crankshaft 2



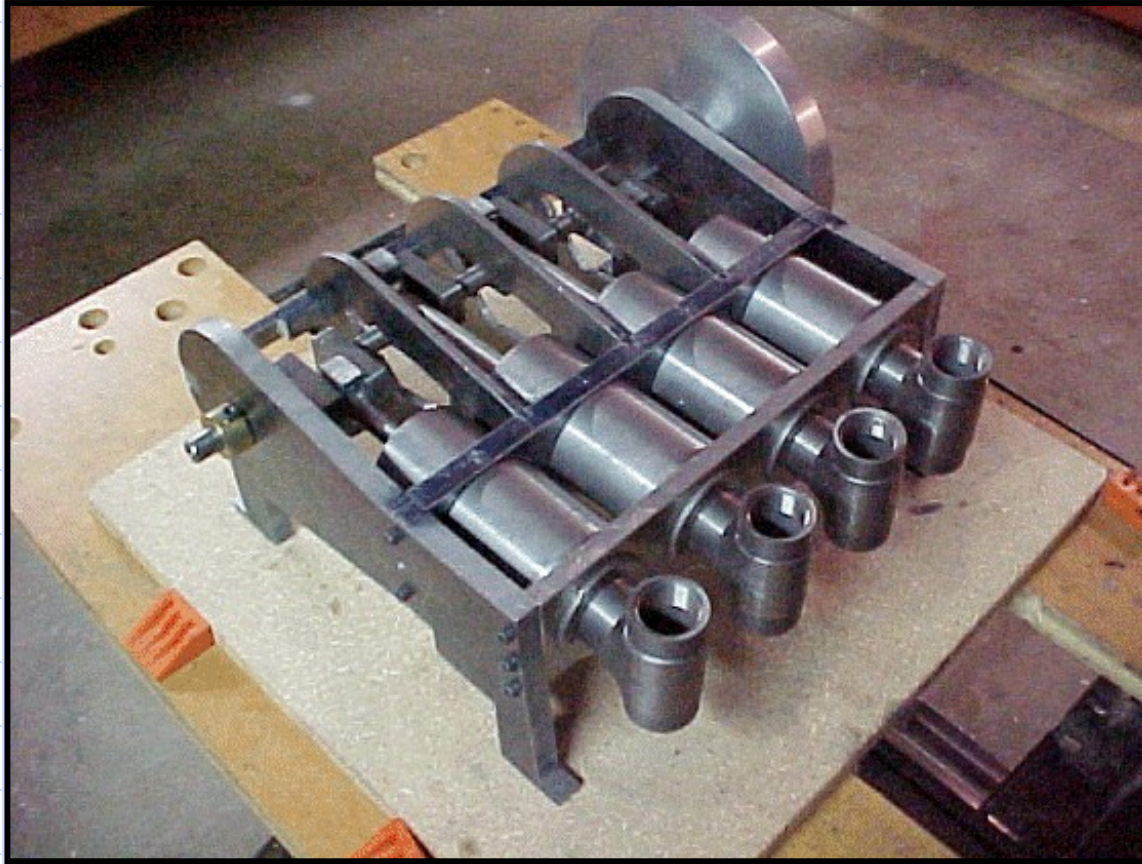
Block # 6



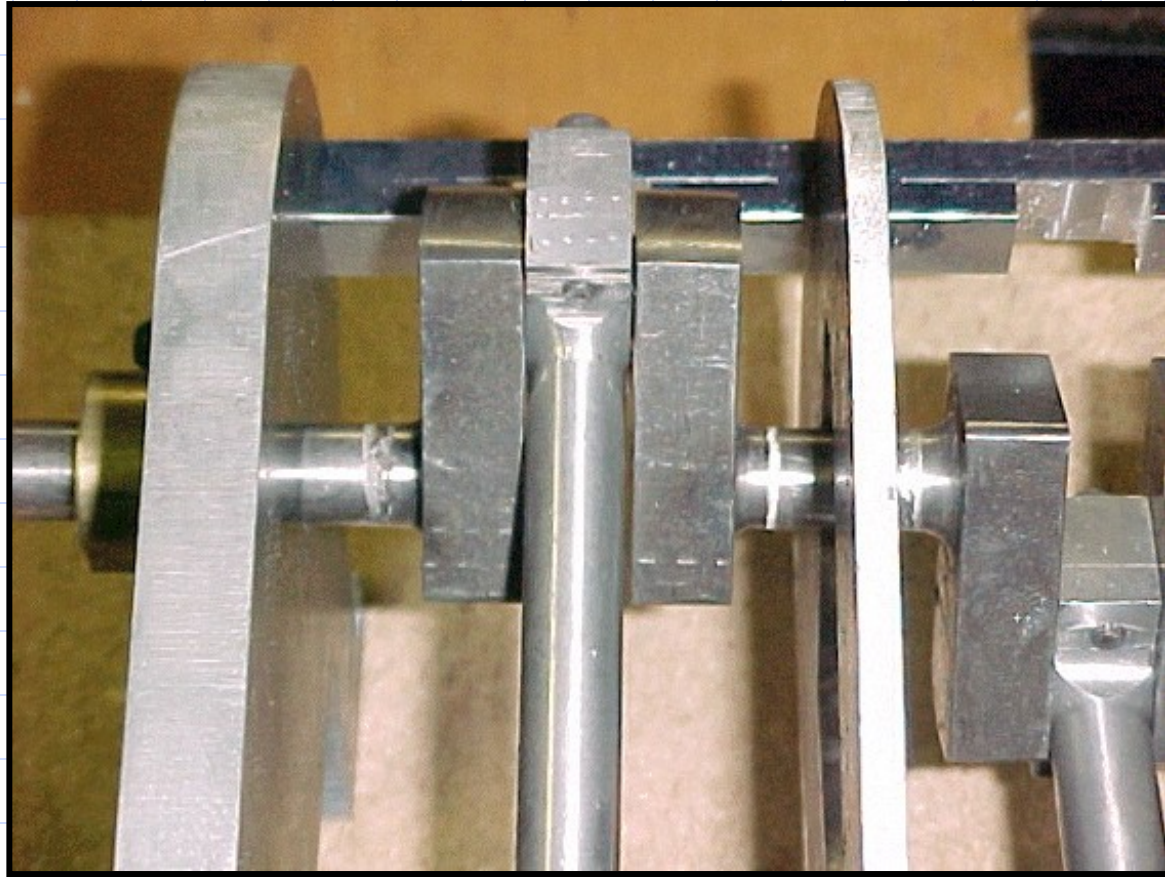
Block With Crankshaft 3



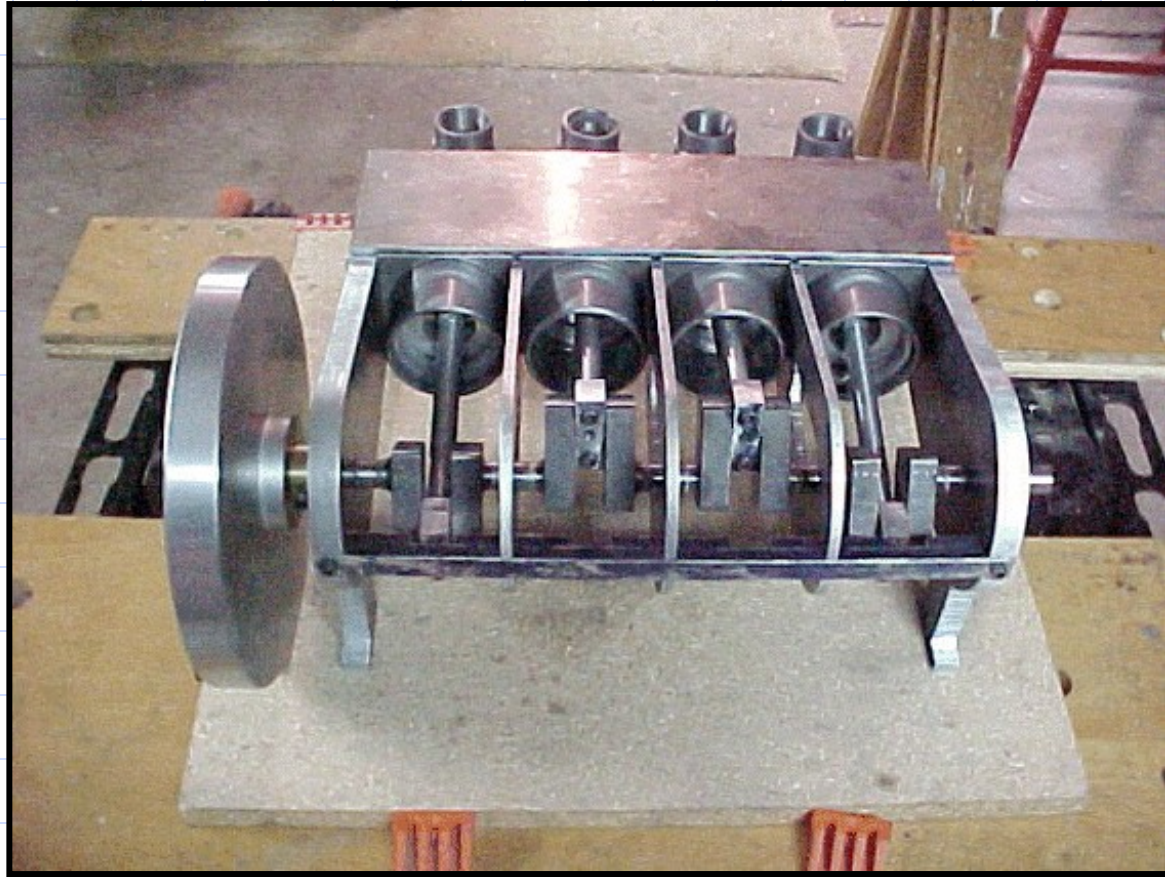
Block With Combustion Chambers



Crankshaft Detail



Block With Cylinder Cover



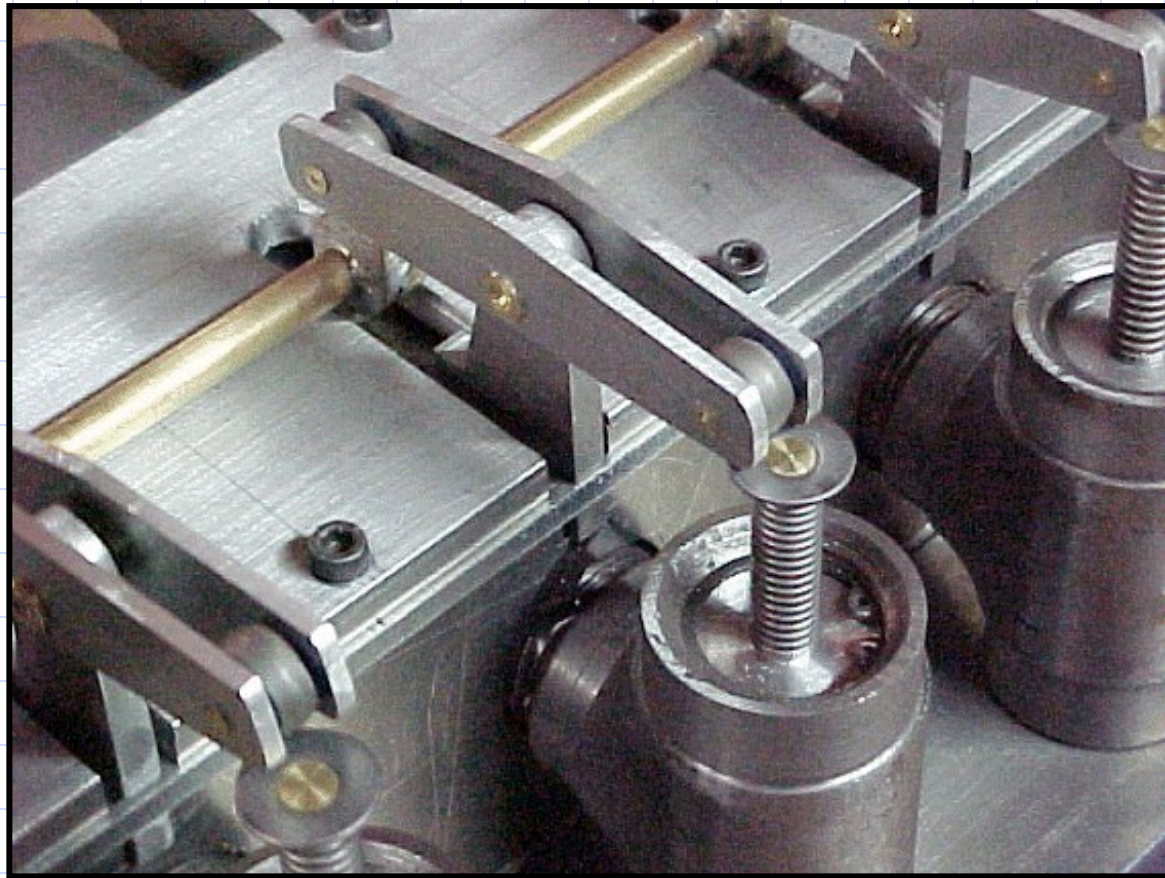
Block With Vapor Plate



Combustion Chambers



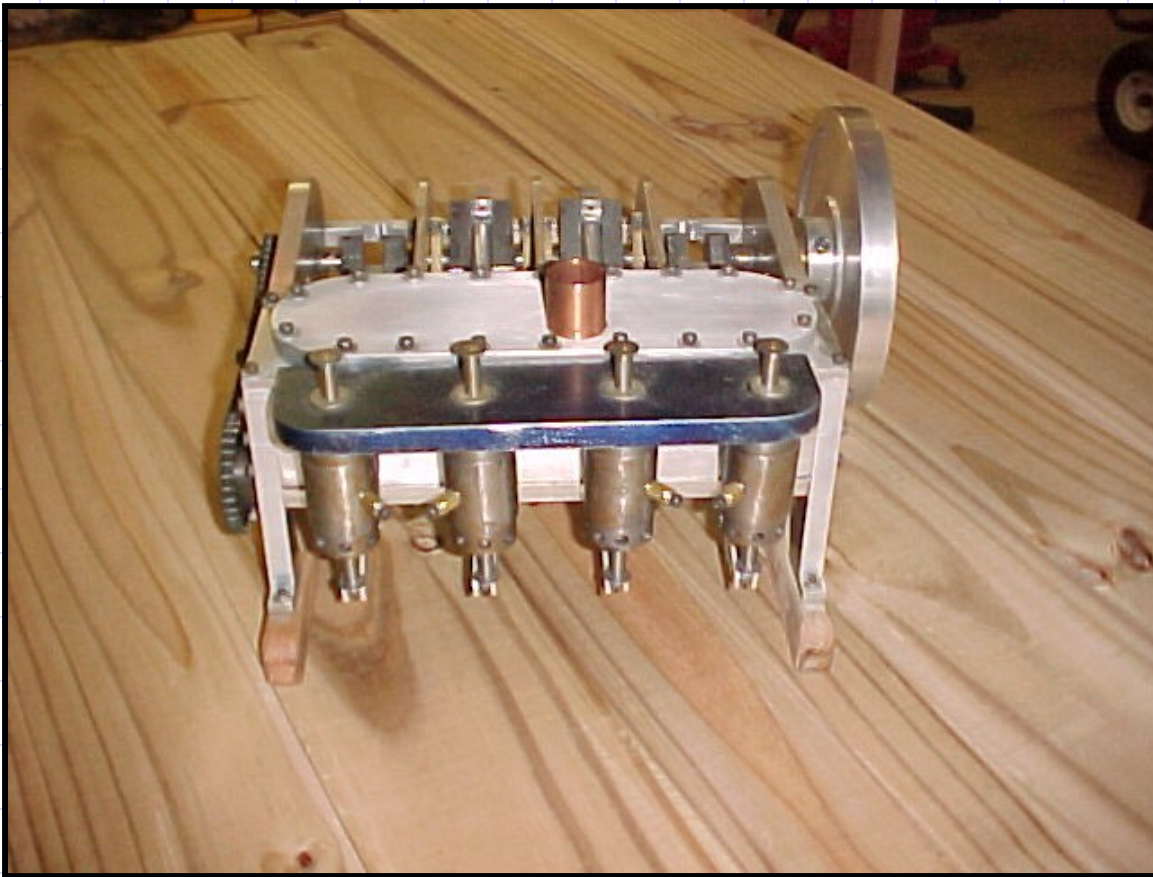
Rocker Arm Detail



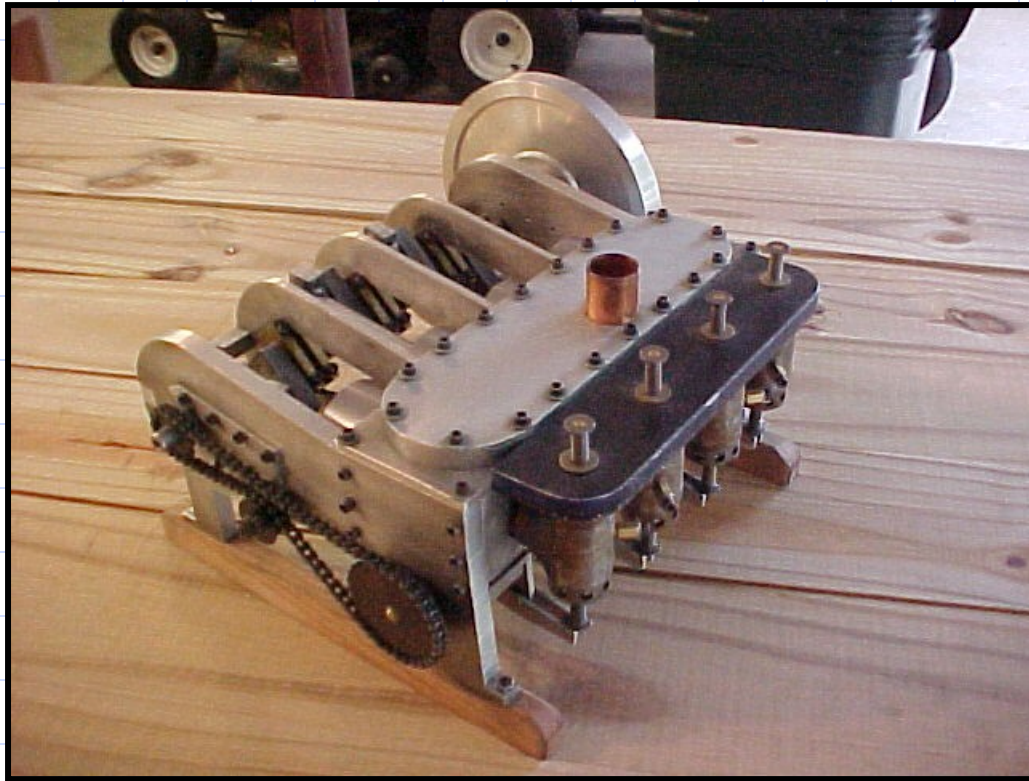
Cam Detail



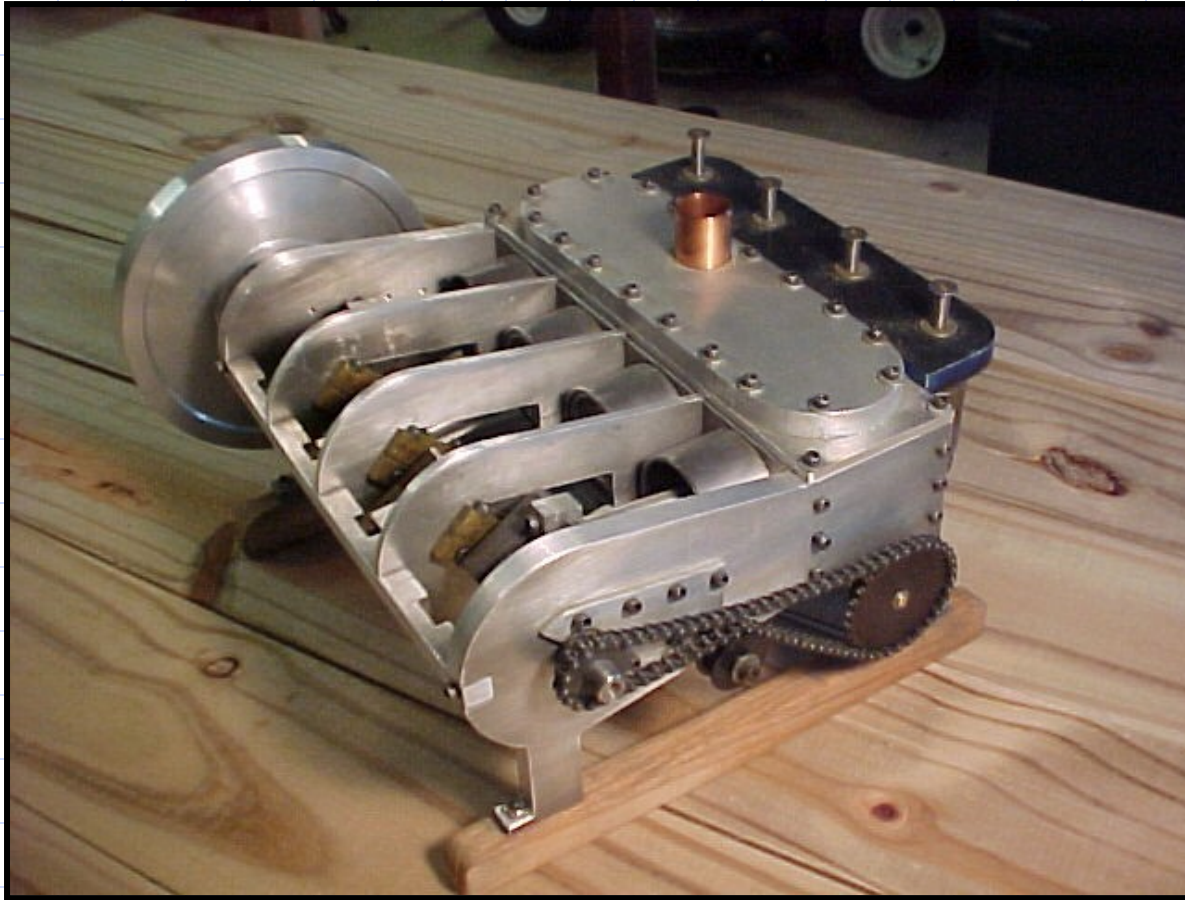
Engine Rear View



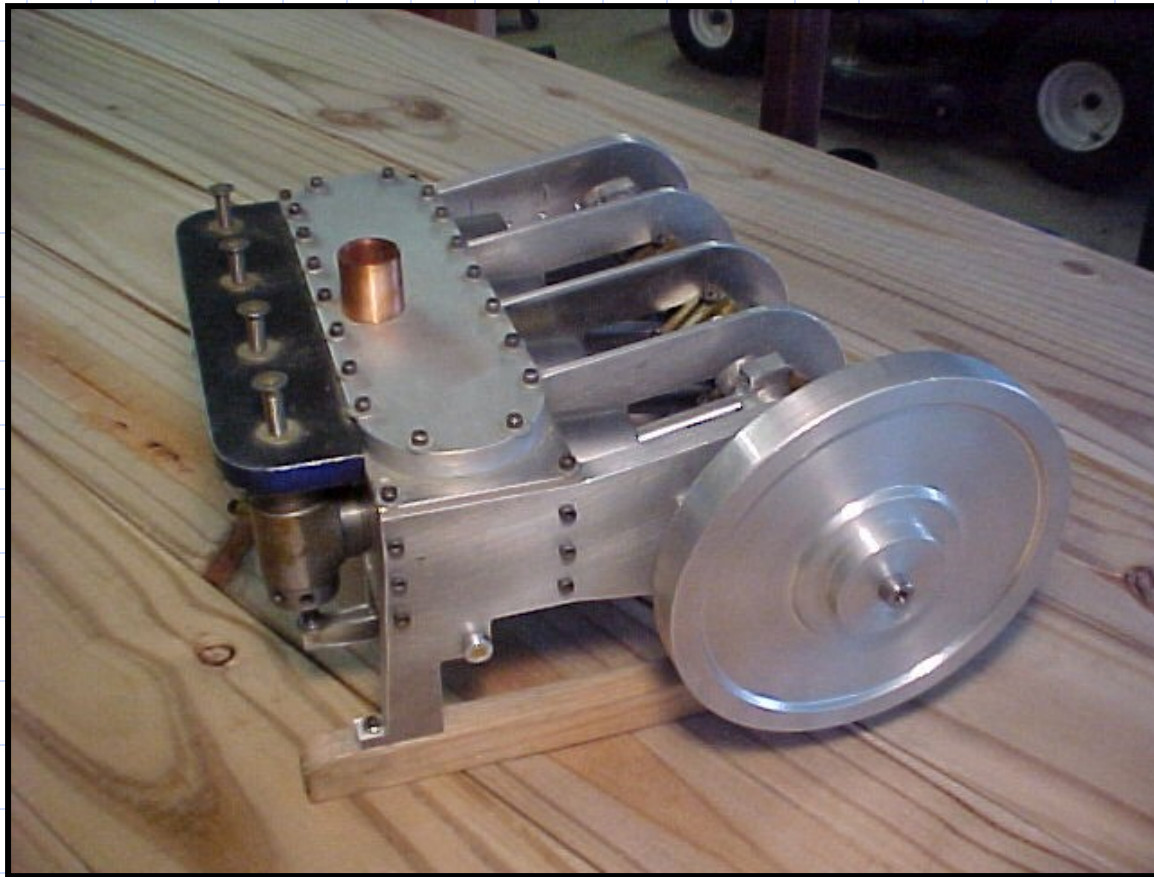
Engine With Intake Plenum



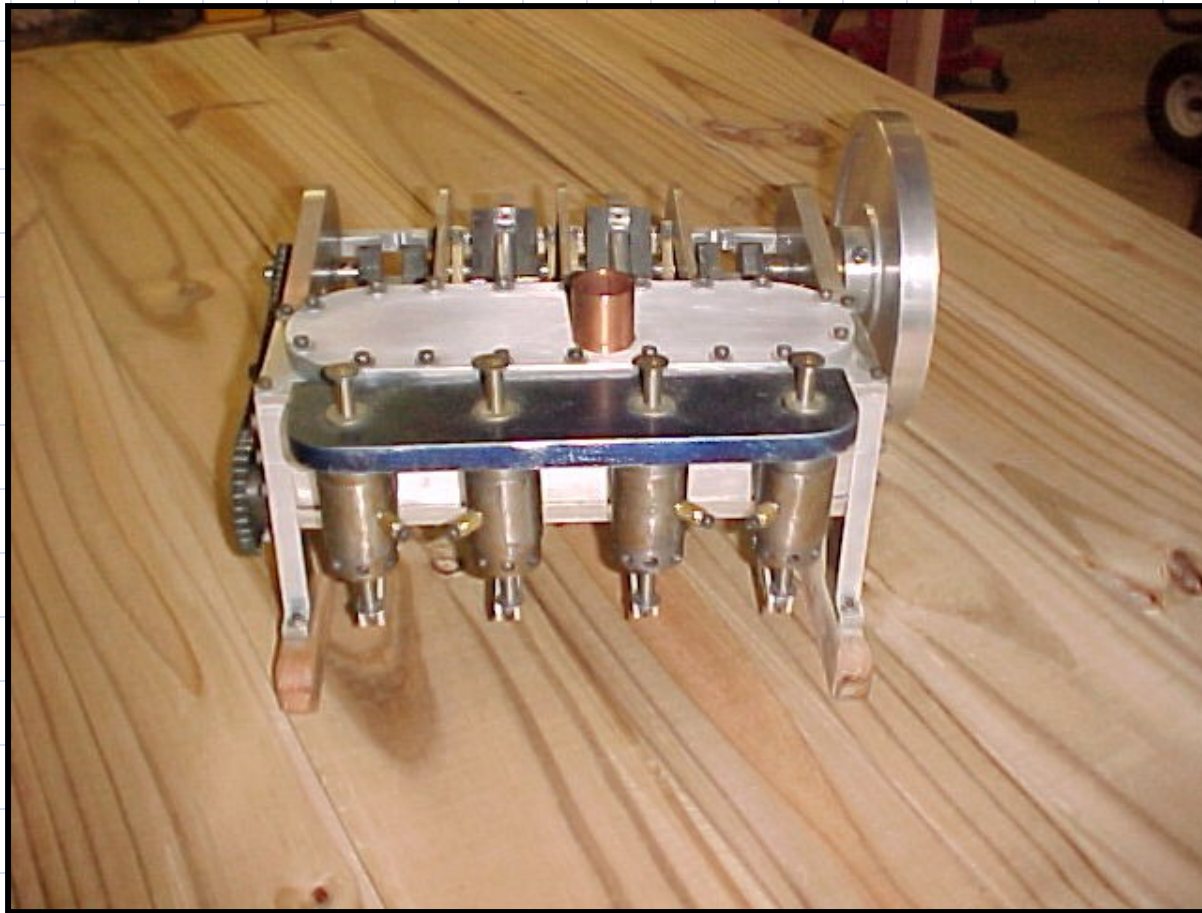
End View With Timing Chain



Engine Top View



Engine Rear View



Conclusion

- ◆ The Wright Brothers find that three conditions were necessary for flight:
 - Structured for lift (cambered wings);
 - a controlling or steering mechanism (3-axes of rotation-roll, pitch and yaw);
 - and a Method of propulsion – the Engine.



The dispute over the first flight ended, in 1943

- ◆ “Orville and Wilbur Wright, by original scientific research, discovered the principals of human flight. As inventors, builders and flyers, they further developed the aero plane, taught men to fly and opened an era of aviation”.



Bibliography

- Charles E. Taylor, The Wright Brothers Mechanical
Howard DuFour
- The Bishop's Boys – Tom Crouch
- Grand Eccentrics – Mark Bernstein
- Kill Devil Hill – Martin Caidin
- Wright From The Start – James F. Aldridge
- How We Invented The Airplane – Orville Wright
- Twelve Seconds To The Moon – Young and Fitzgerald
- The Wright Brothers – Fisk and Todd



Questions?



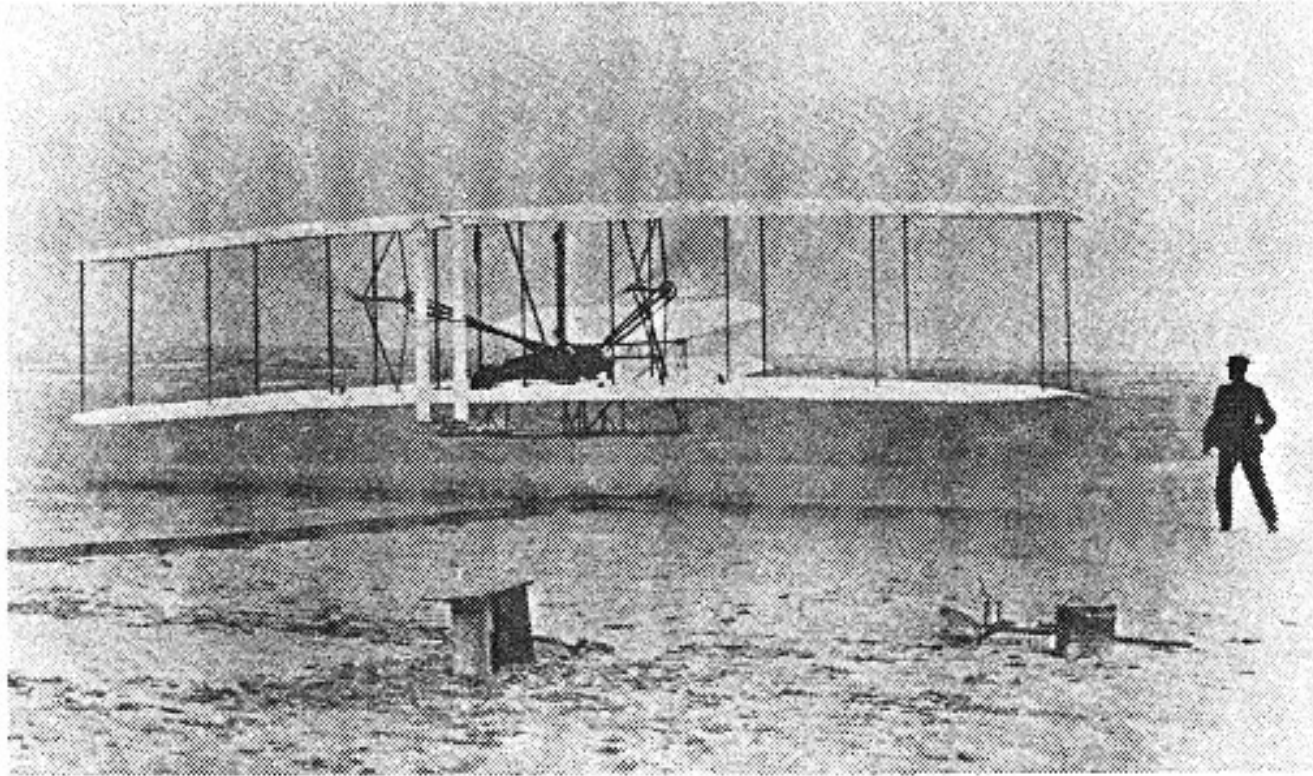
Thank You



Dayton Amateur Radio Association

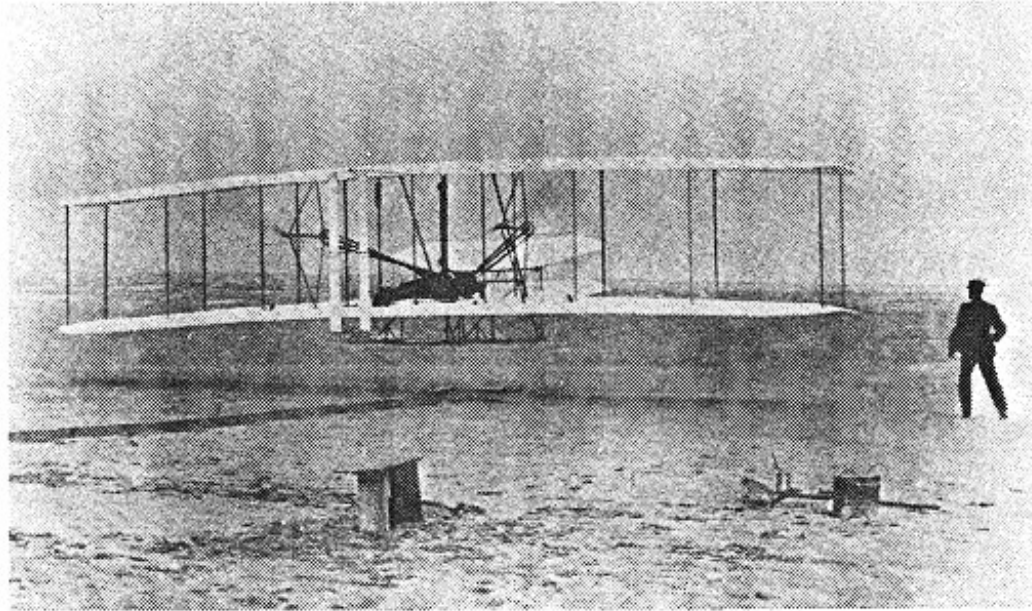
W8BI

The Engine That Powered Flight



Tawasi

Dayton, Ohio



TA-WA-SI
Friend and Helper



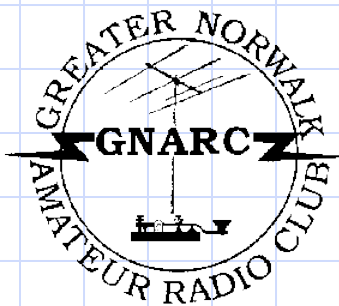
AUVSI
Wright Patterson
Air Force Base
Dayton, Ohio



AUVSI *Online*
Association For Unmanned Vehicle Systems International

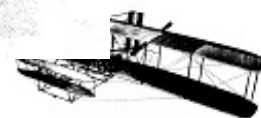
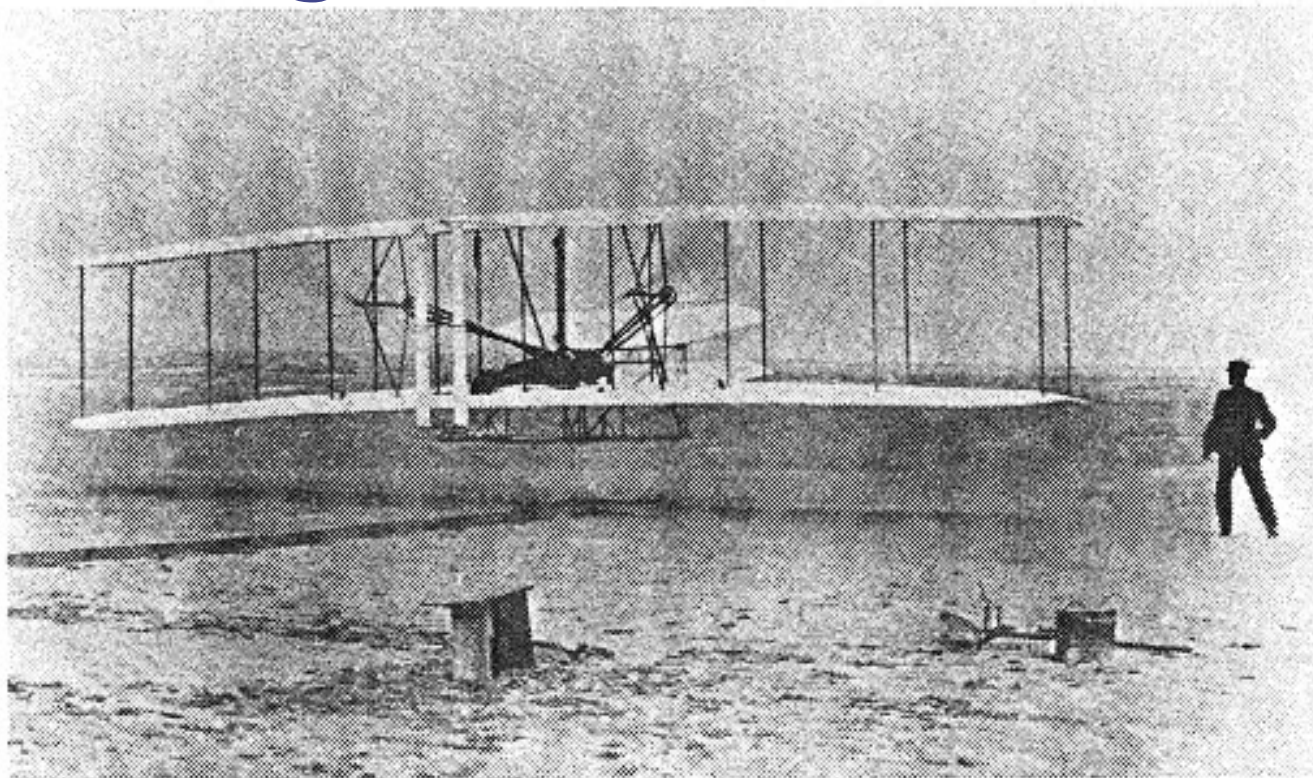


W1NLK

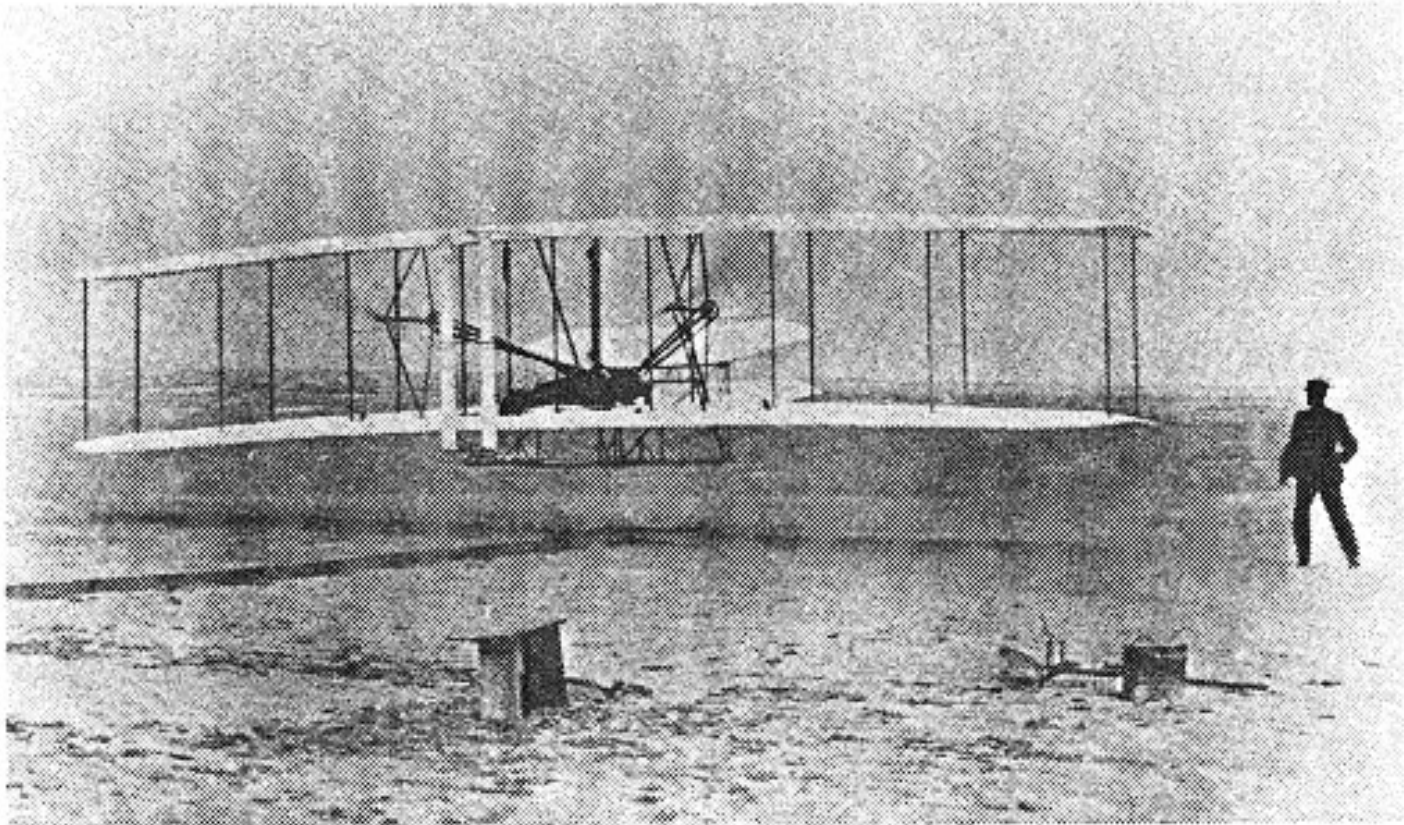


N1EV

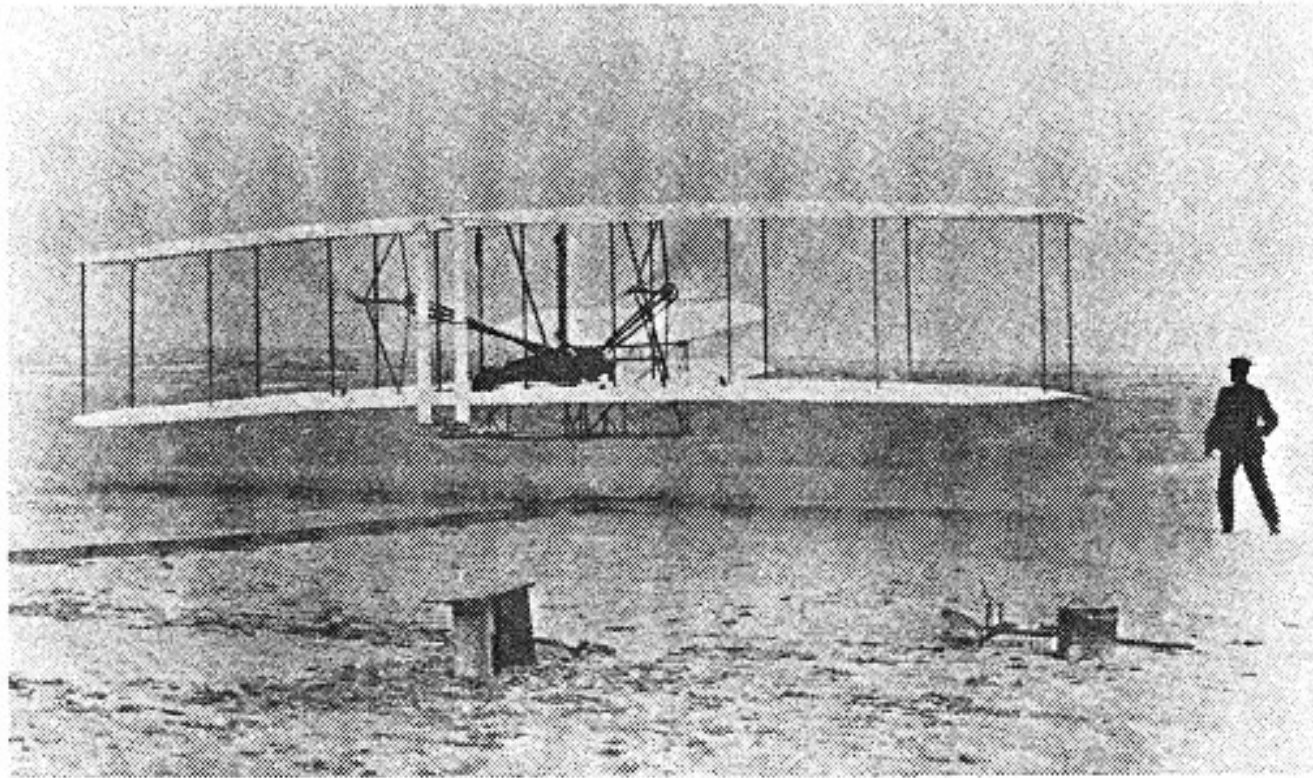
The Engine That Powered Flight



◆ Greene County Historical Society Xenia, Ohio

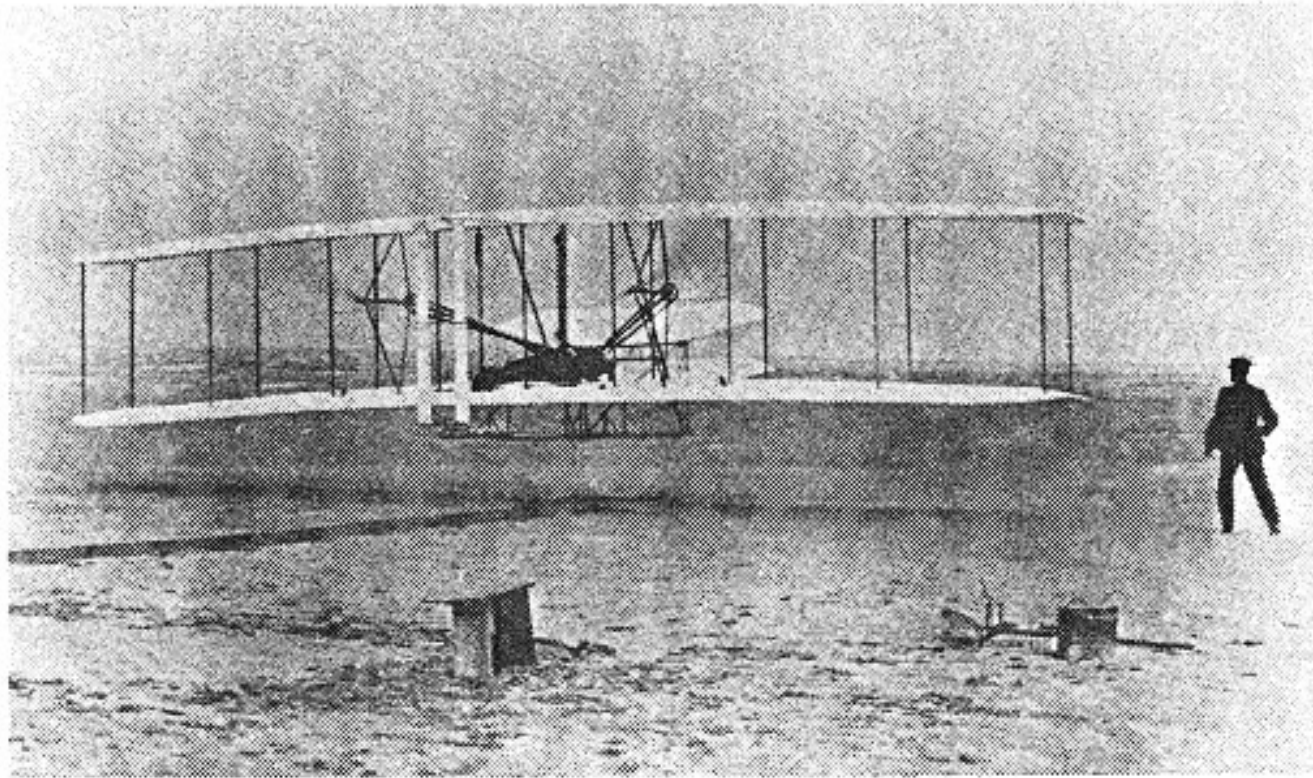


Western Connecticut Industrial Council 2003 Annual Meeting



Association for Facilities Engineers

Western Connecticut – Chapter # 83

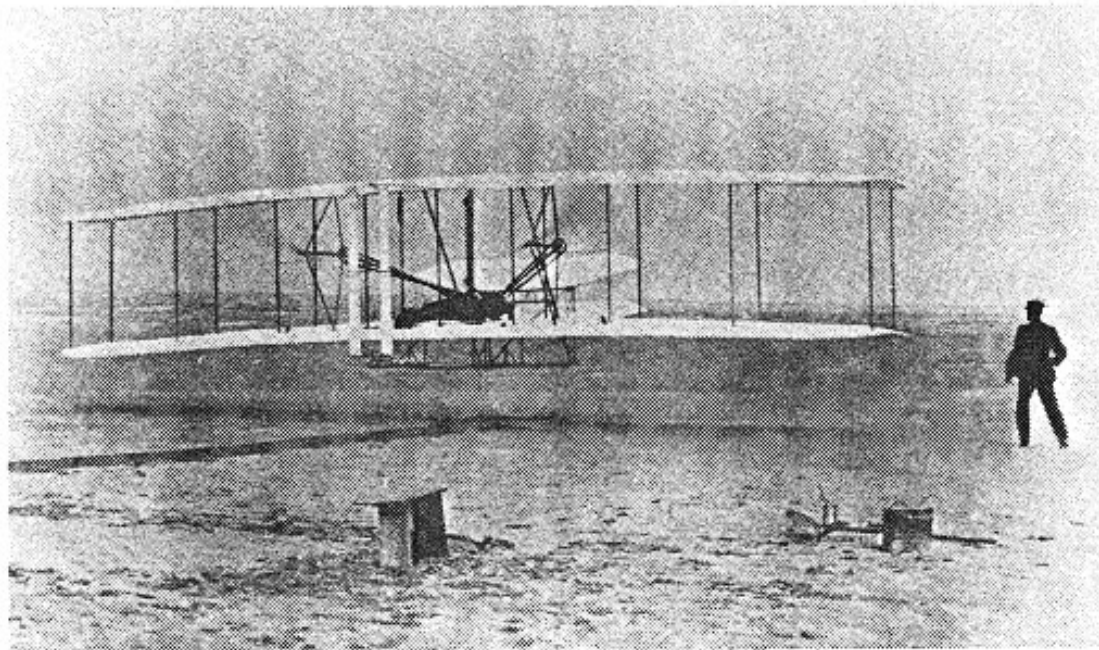




The Dayton Engineers Club – August 7, 2008

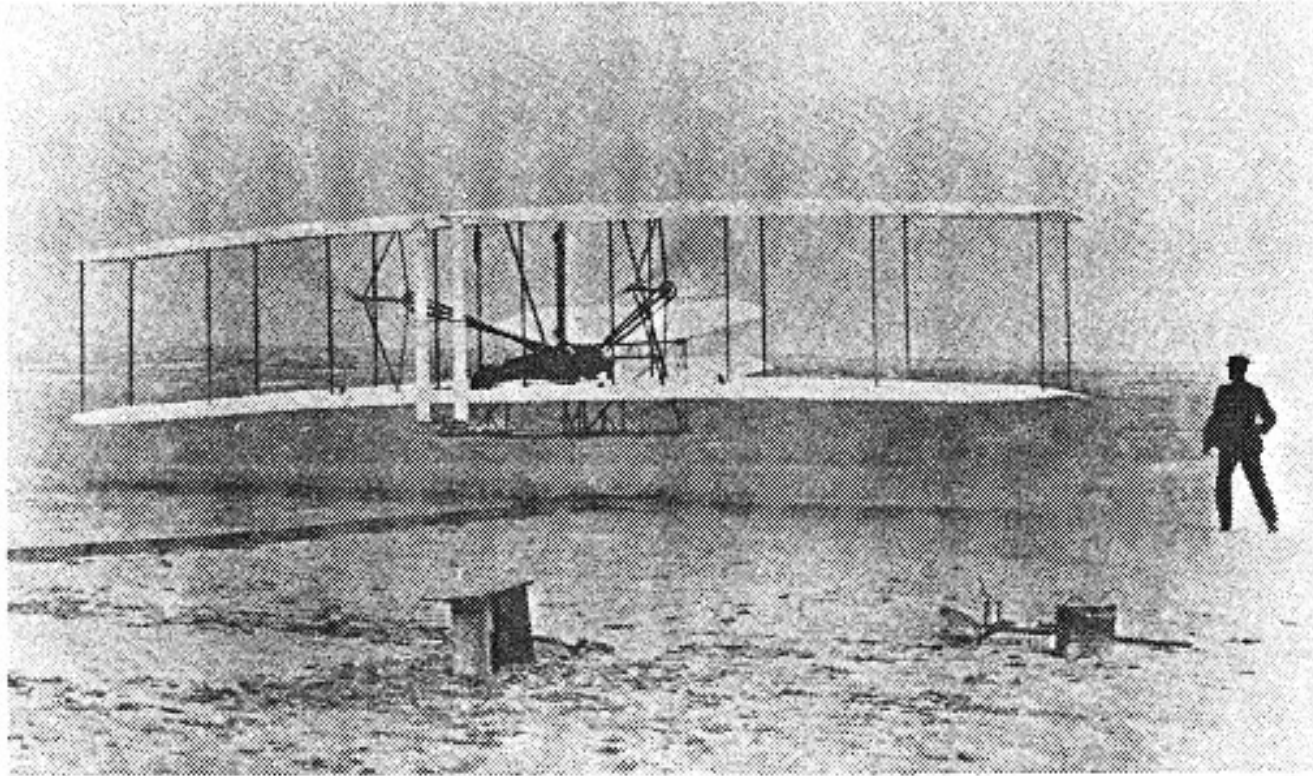
S.T.E.M.

The Engine That Powered Flight





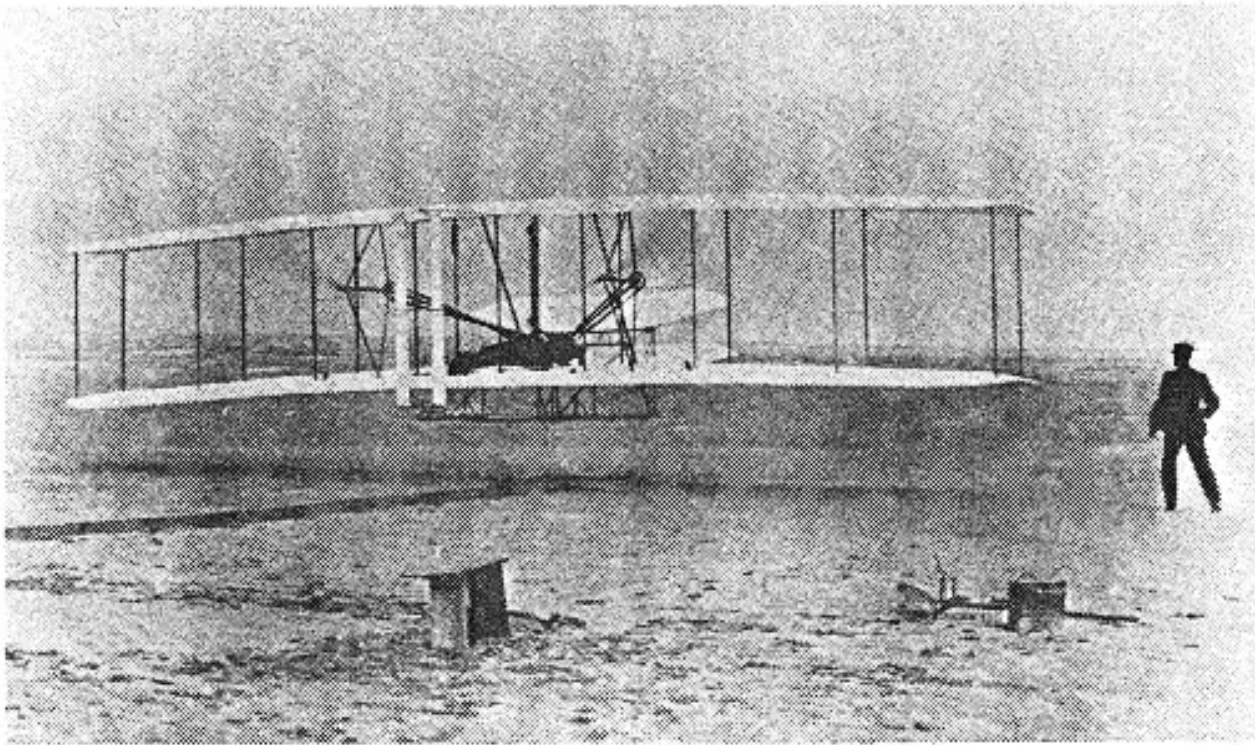
The Engine That Powered Flight





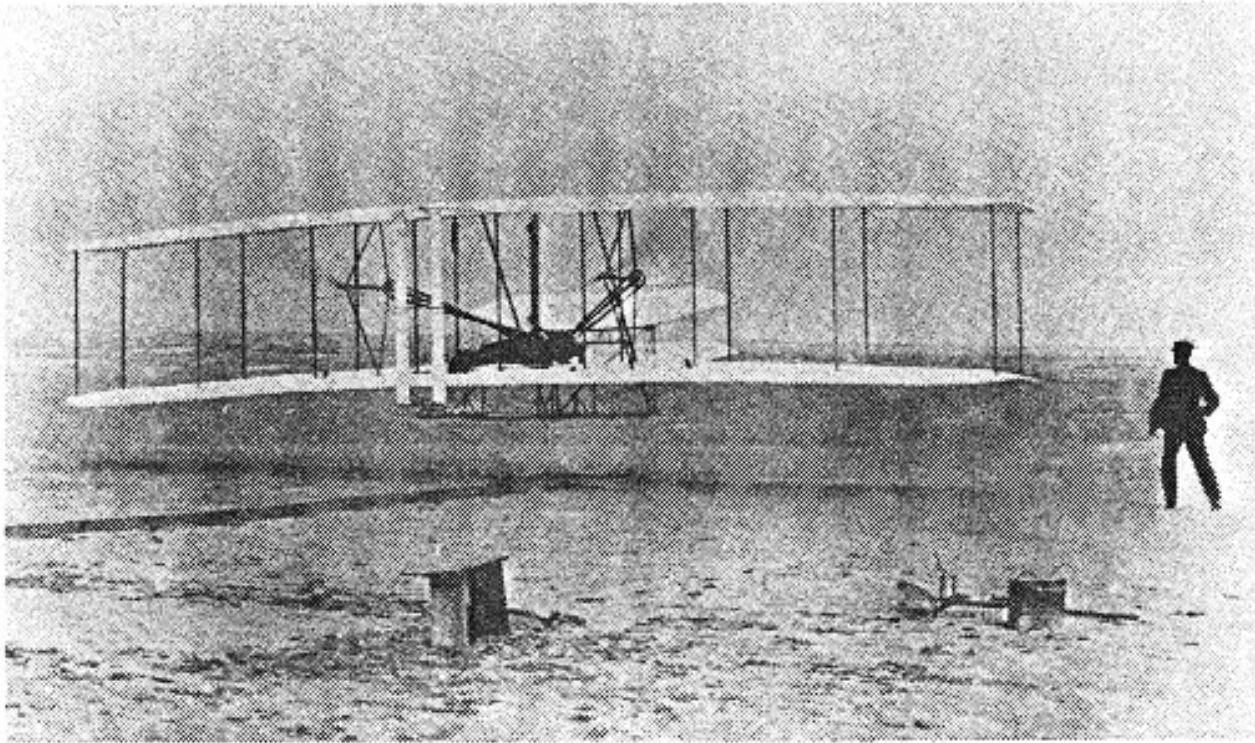
The Dayton Engineers Club – April 24,
2007 and May 5, 2009

The Engine That Powered Flight



5 March, 2010 – Fairborn Ohio

The Engine That Powered Flight

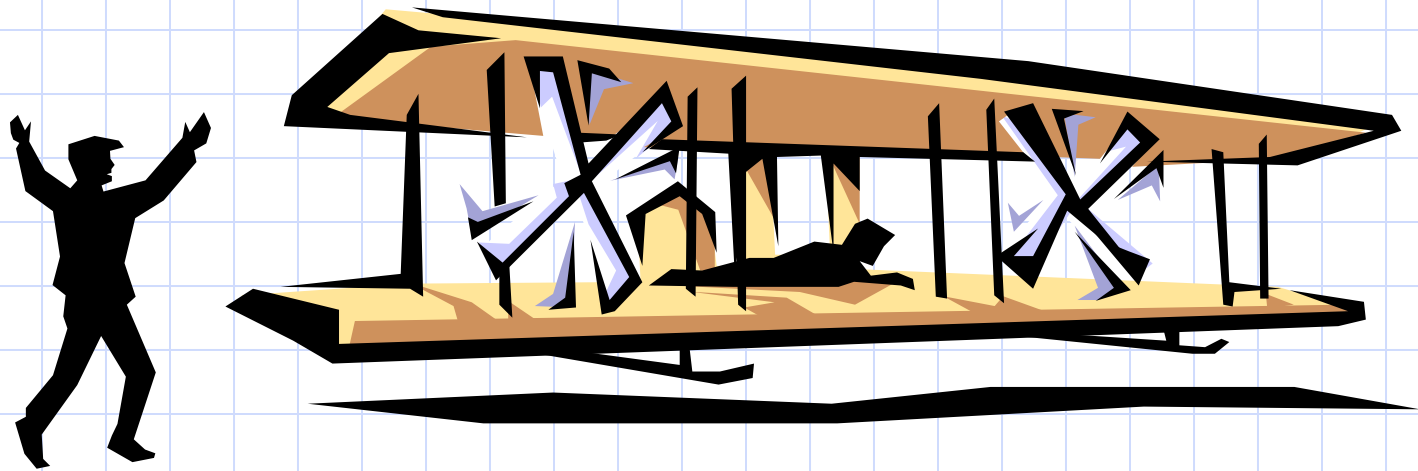


Inventions in Dayton

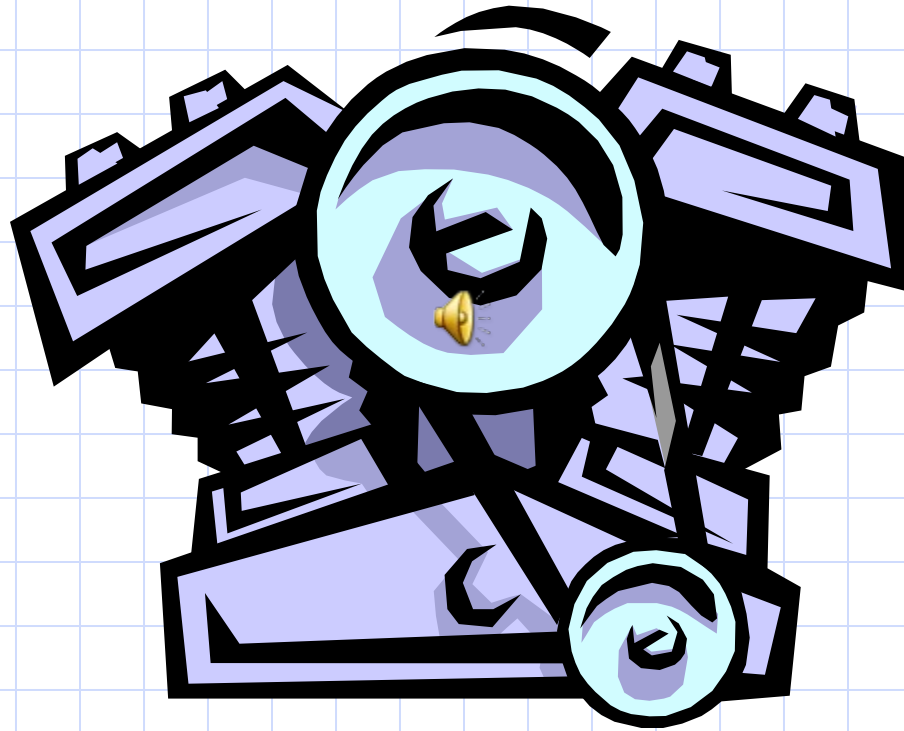
◆ Can you name 10 popular inventions from Dayton and the Inventor ?



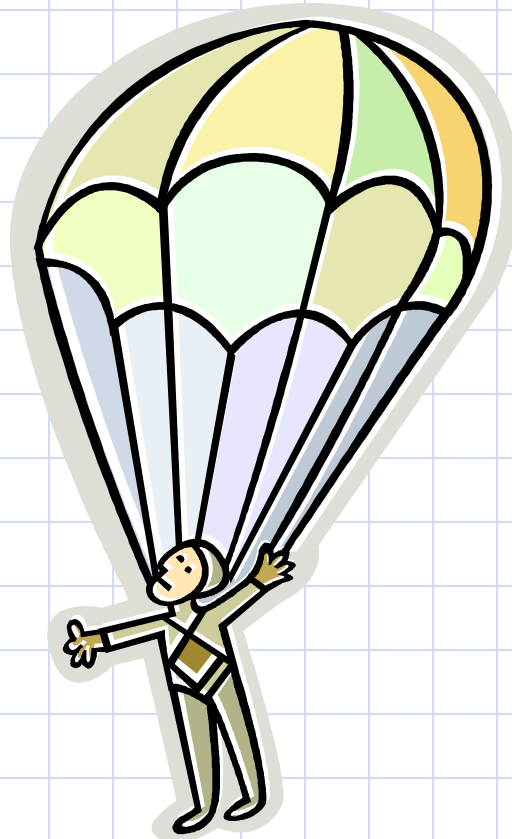
Aero plane – Wilber and Orville



Aero plane Engine - Taylor



Parachute – US Army Air Corps



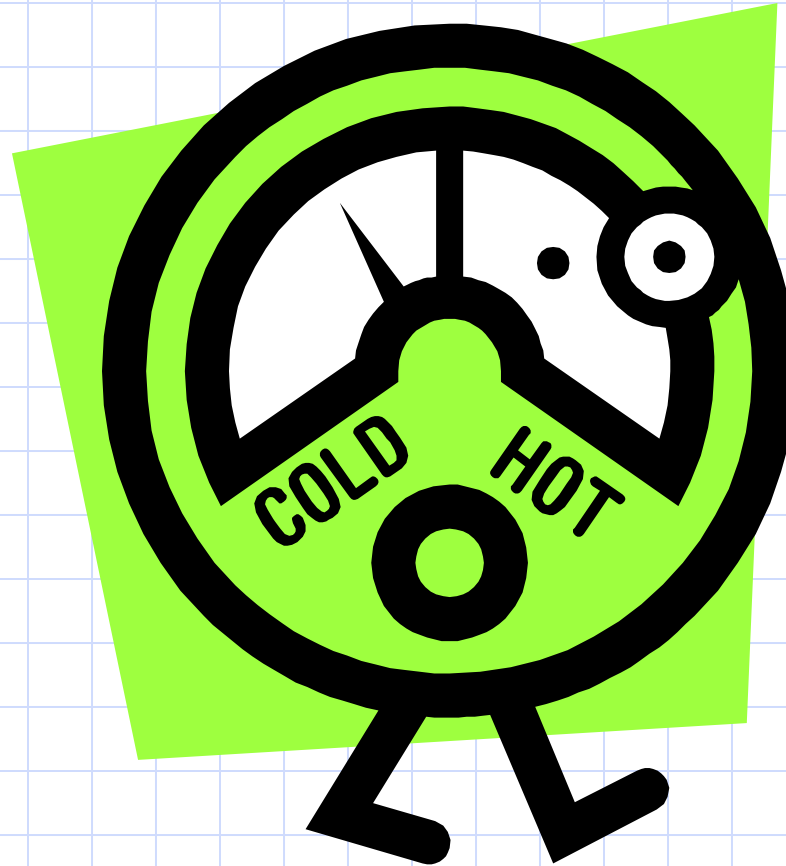
Automotive Starter - Kettering



Leaded Gasoline - Kettering



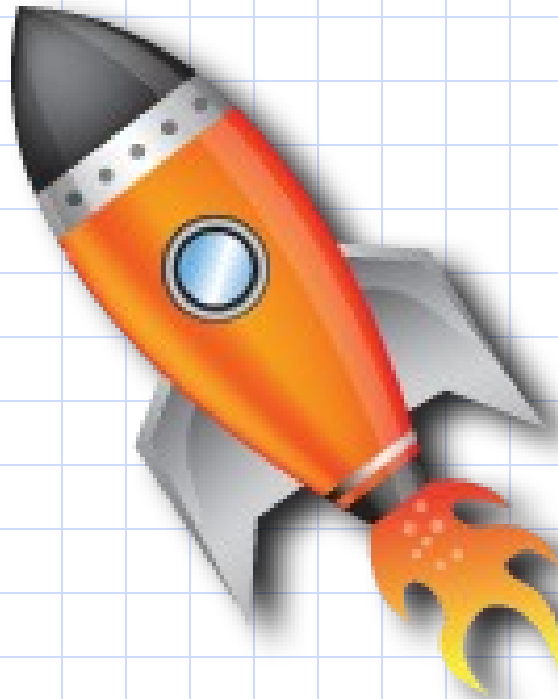
Automotive Thermostat - Vernet



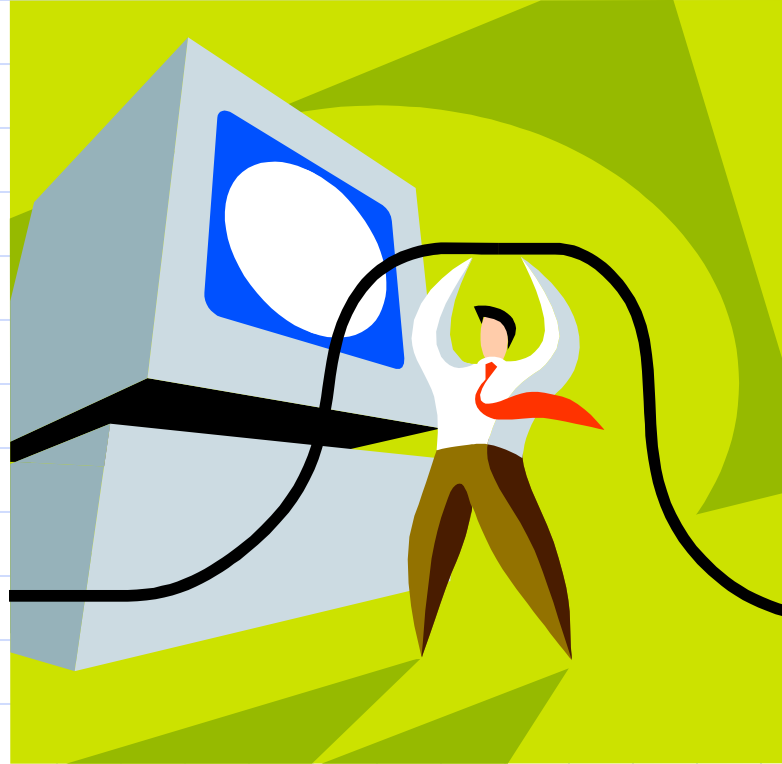
Pop-Top Can - Frazee



Space Probe Atomic Power – DOE Mound



Computer - NCR



F-22 Viper – Your USAF

