

The Genesis of  
American  
Air-Cooled Fixed Radials

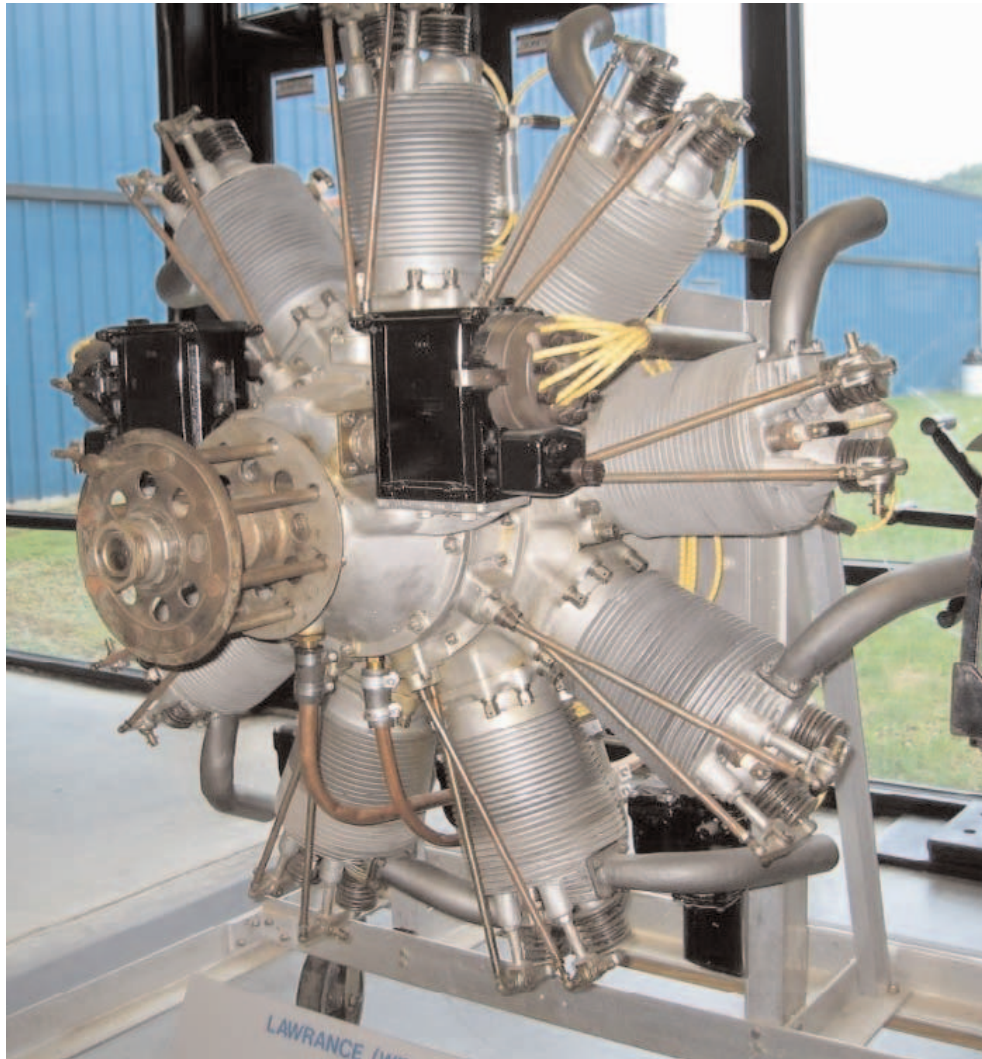
by

Kimble D. McCutcheon

and

Randy Huff

# NEAM's Lawrance J-1



# Charles Lanier Lawrance



Born 30 Sep 1882

Died 24 Jun 1950

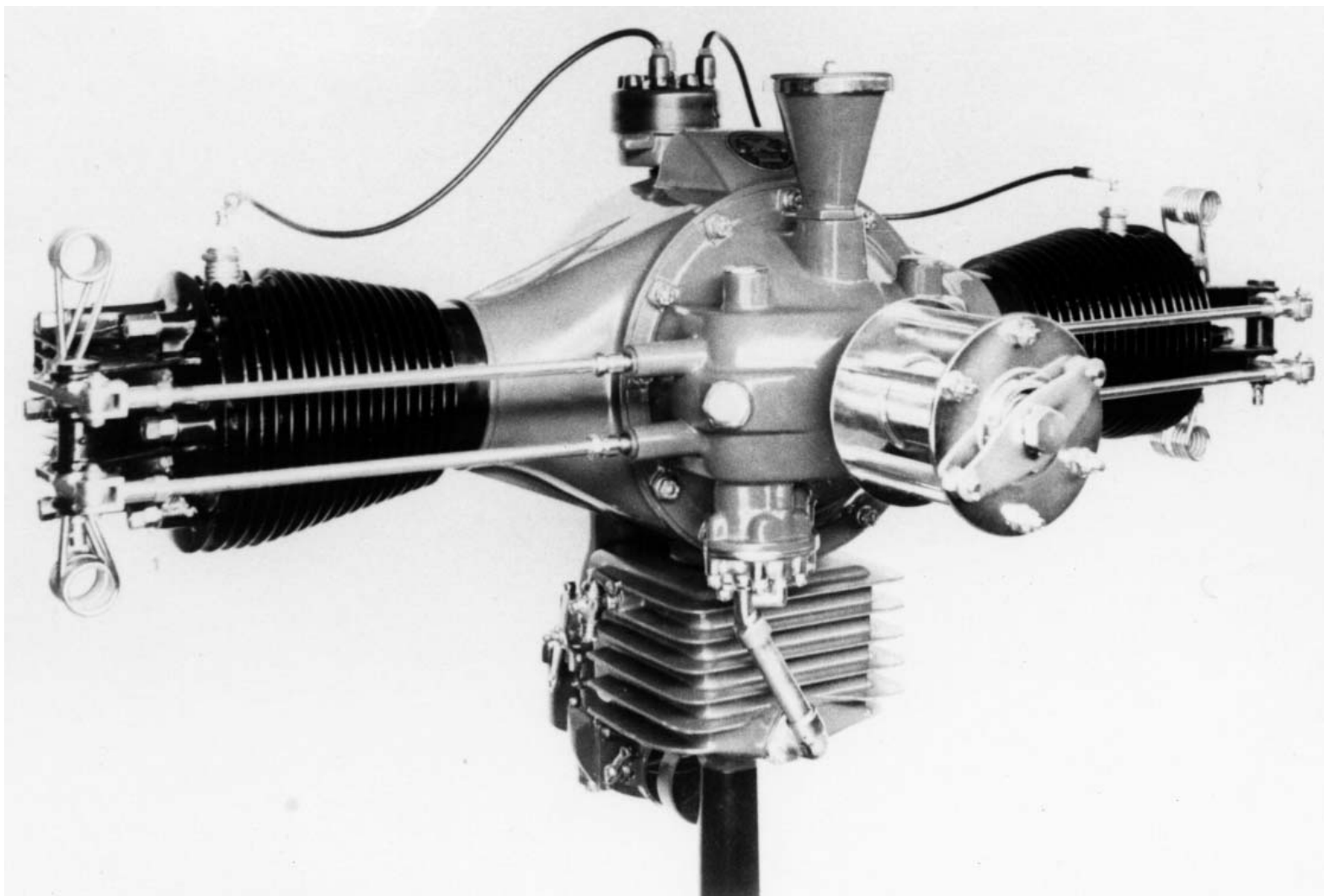
Yale University Graduate

Studied Aeronautics in  
Paris around 1908

Designed Automobile  
and Aeronautical  
Engines

Returned to U.S. in 1914

# Lawrance A-3



# Lawrance A-3 Characteristics

Bore=4.00", Stroke=6.00"

Displacement = 150.8 in<sup>3</sup>, 75.4 in<sup>3</sup>/cylinder

28 hp @ 1,400 rpm, 14 hp/cylinder

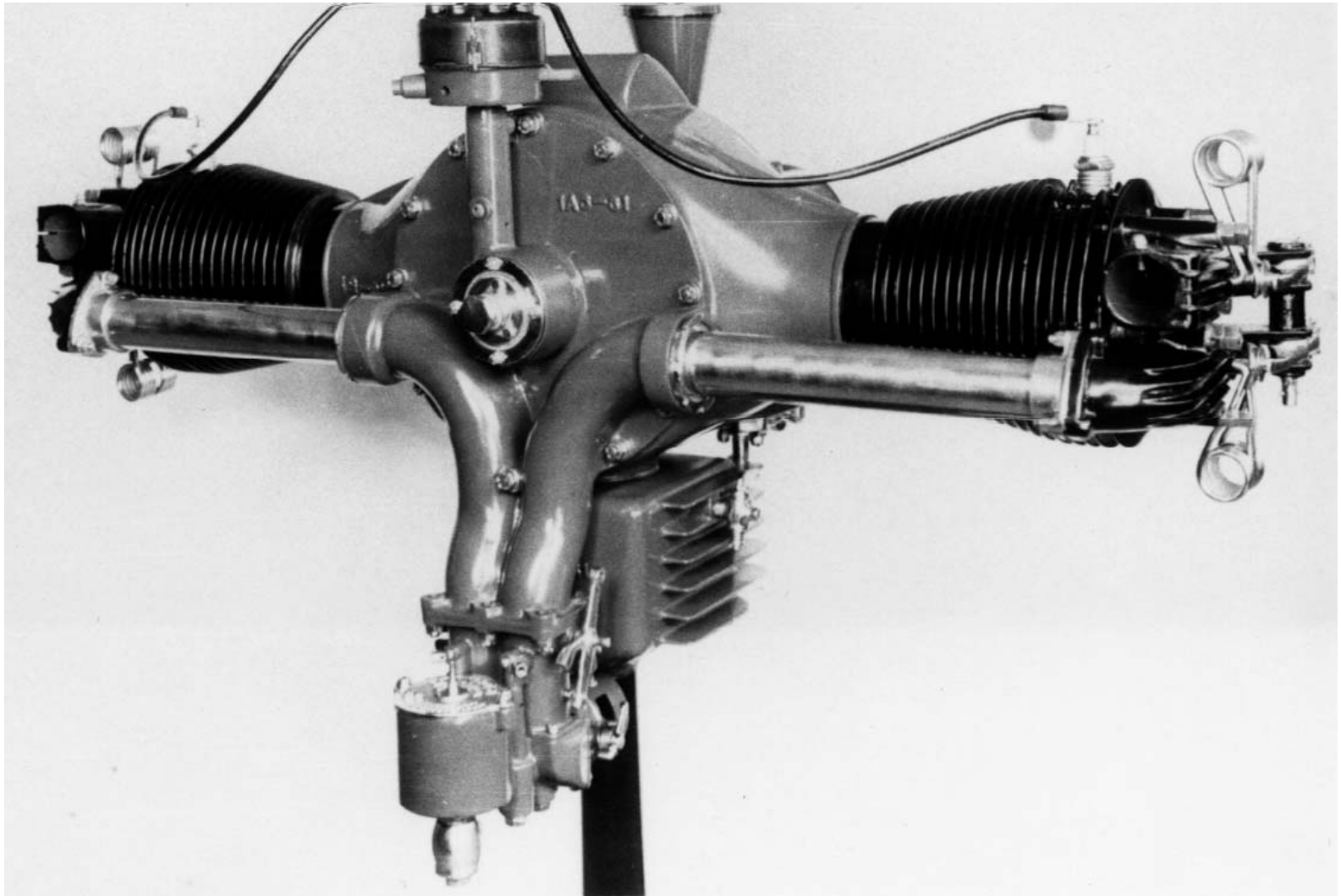
Weighed 148 lb, or 0.19 hp/lb

Both Connecting Rods on One Crankpin

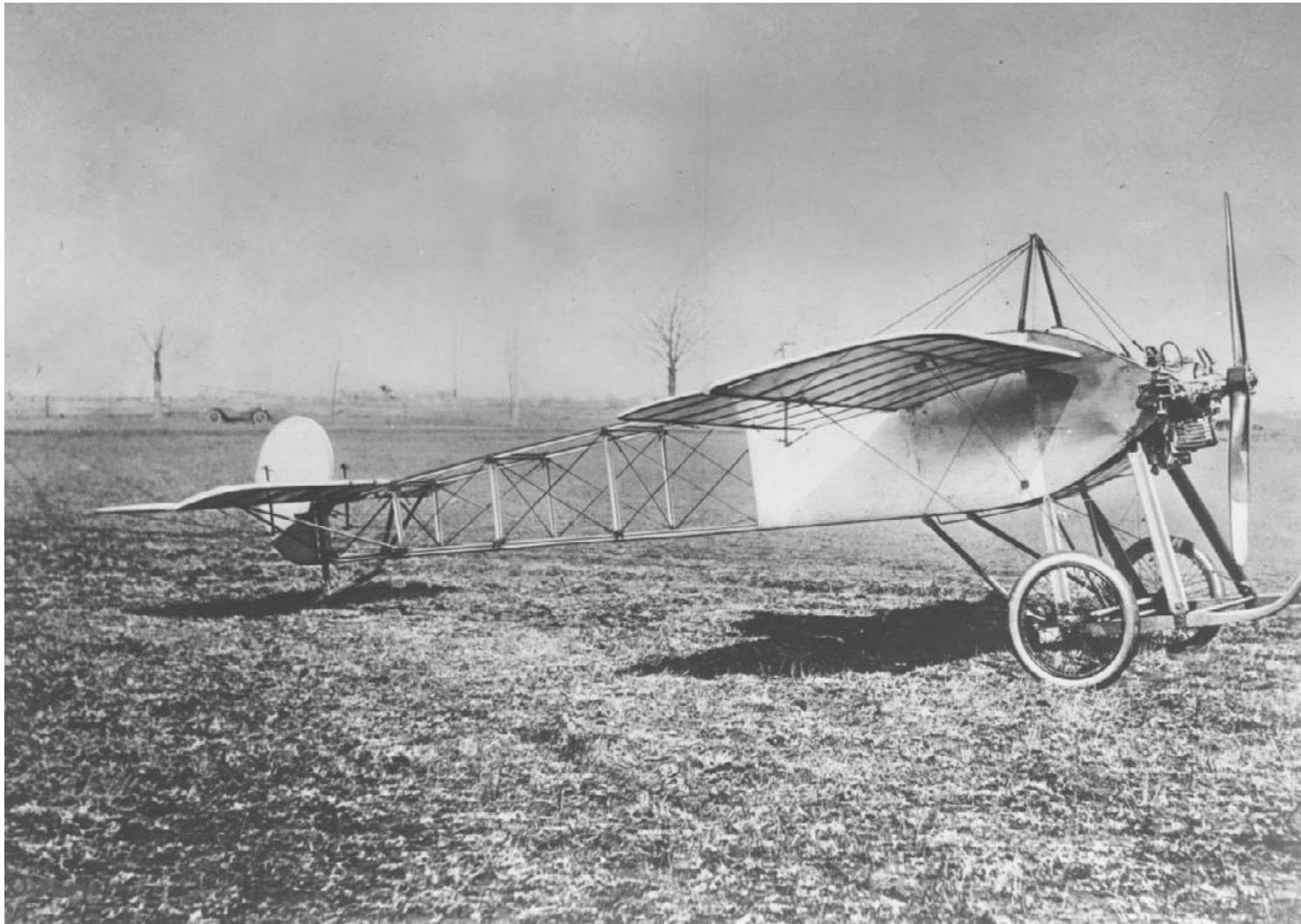
Shook Badly

Hairpin Valve Springs

# Lawrance A-3



# Breese Penguin



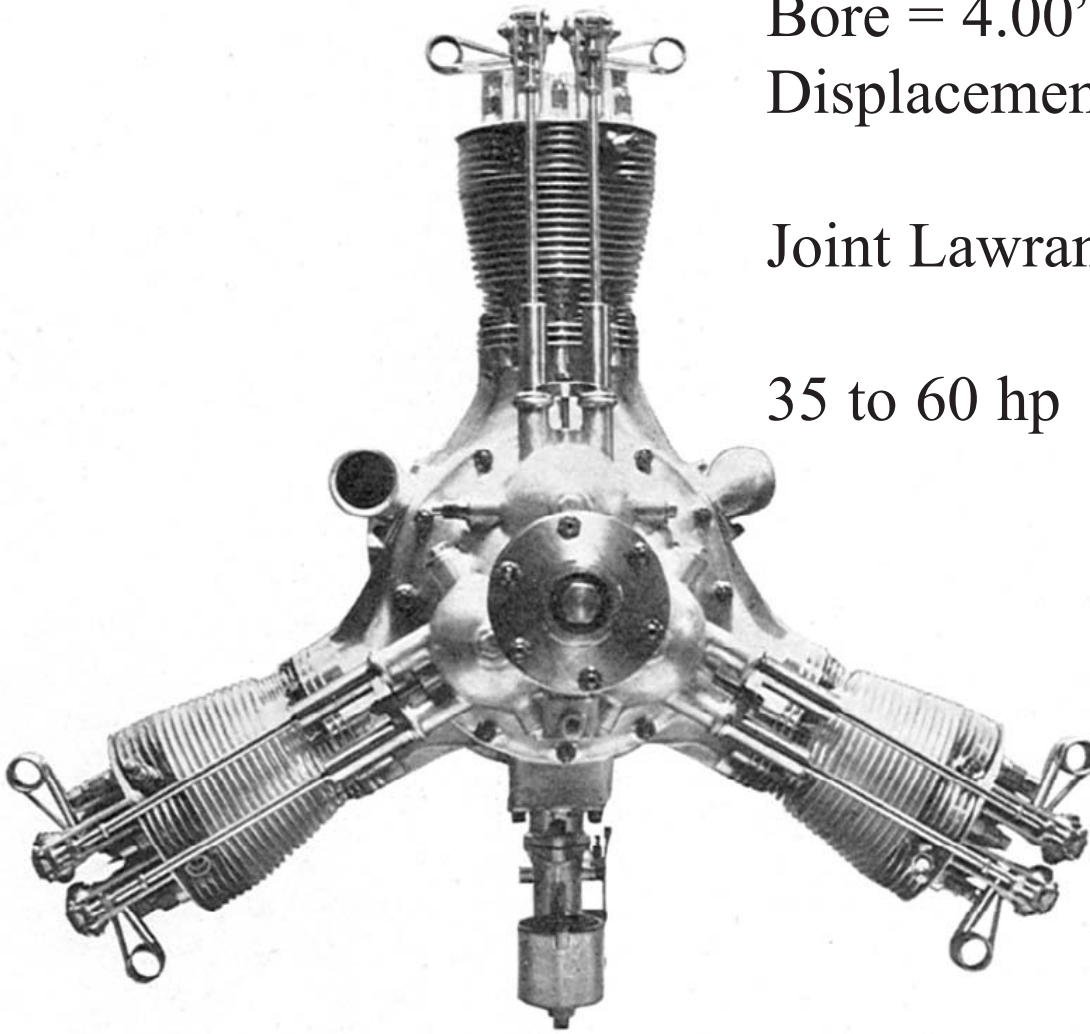
# Lawrance B

Bore = 4.00" ?, Stroke = 6.00" ?

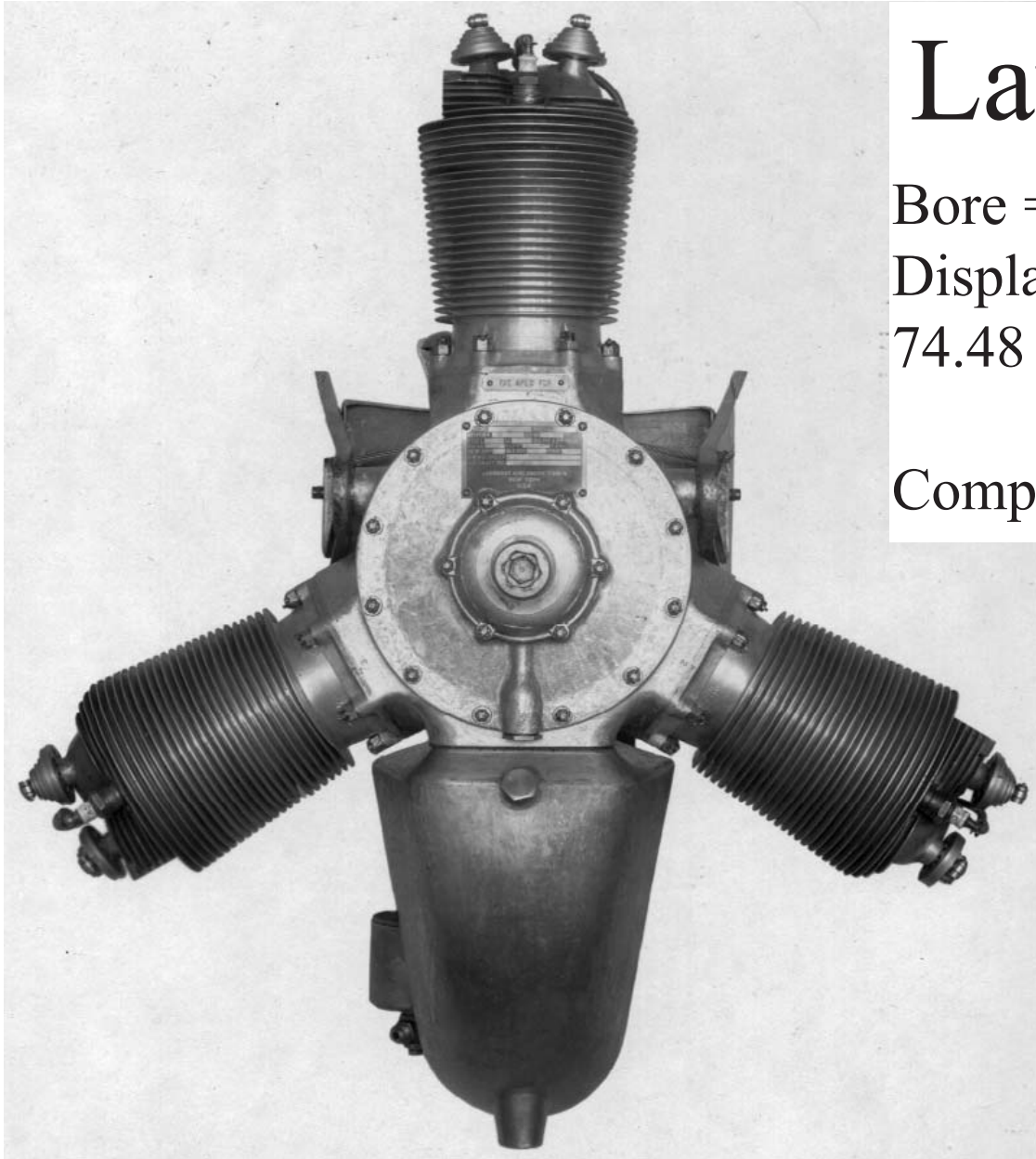
Displacement = 226.2 in<sup>3</sup> ?

Joint Lawrance/Navy Development

35 to 60 hp







# Lawrance L-2

Bore = 4.25", Stroke = 5.25"

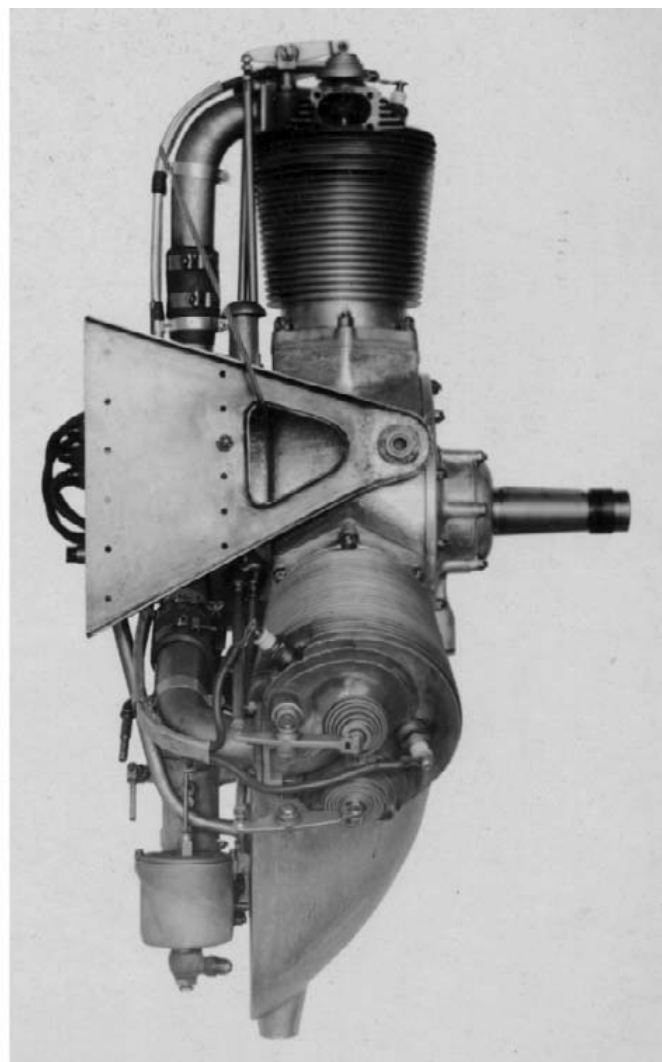
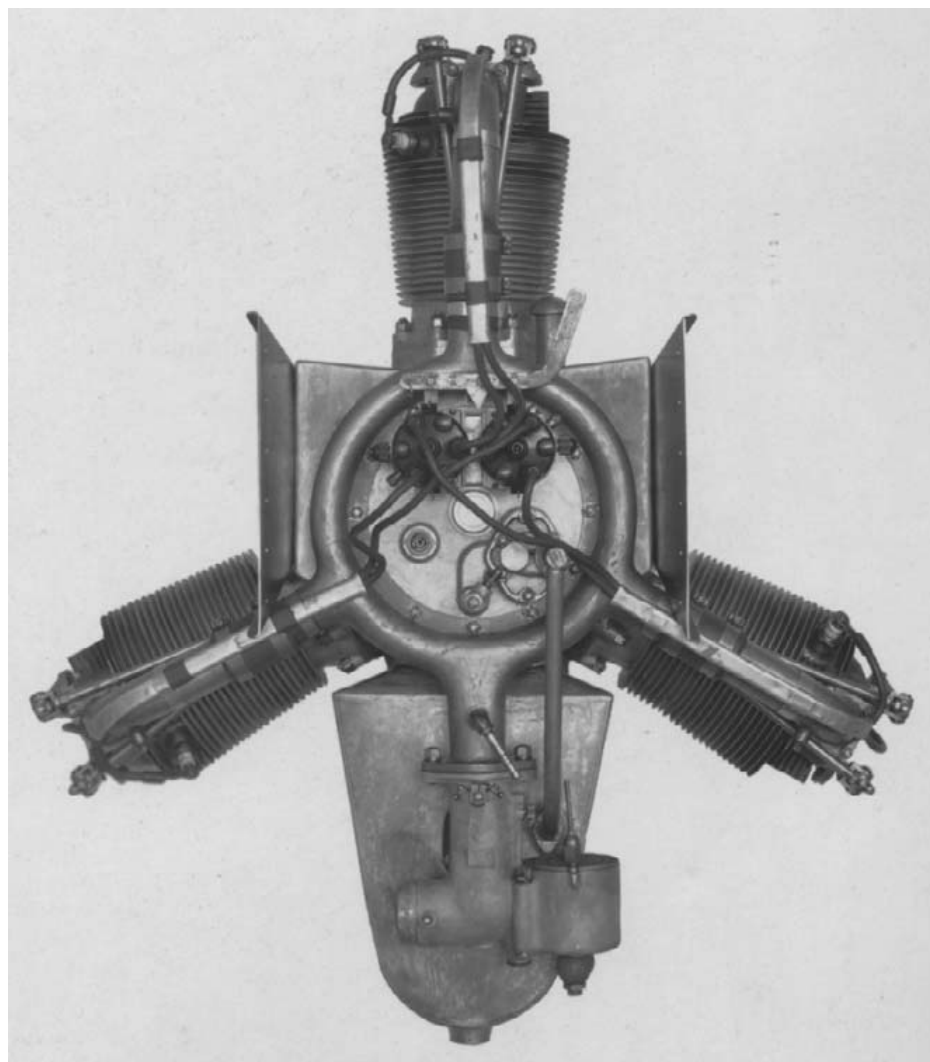
Displacement = 223.4 in<sup>3</sup>,  
74.48 in<sup>3</sup>/cylinder

Compression Ratio = 5.14:1

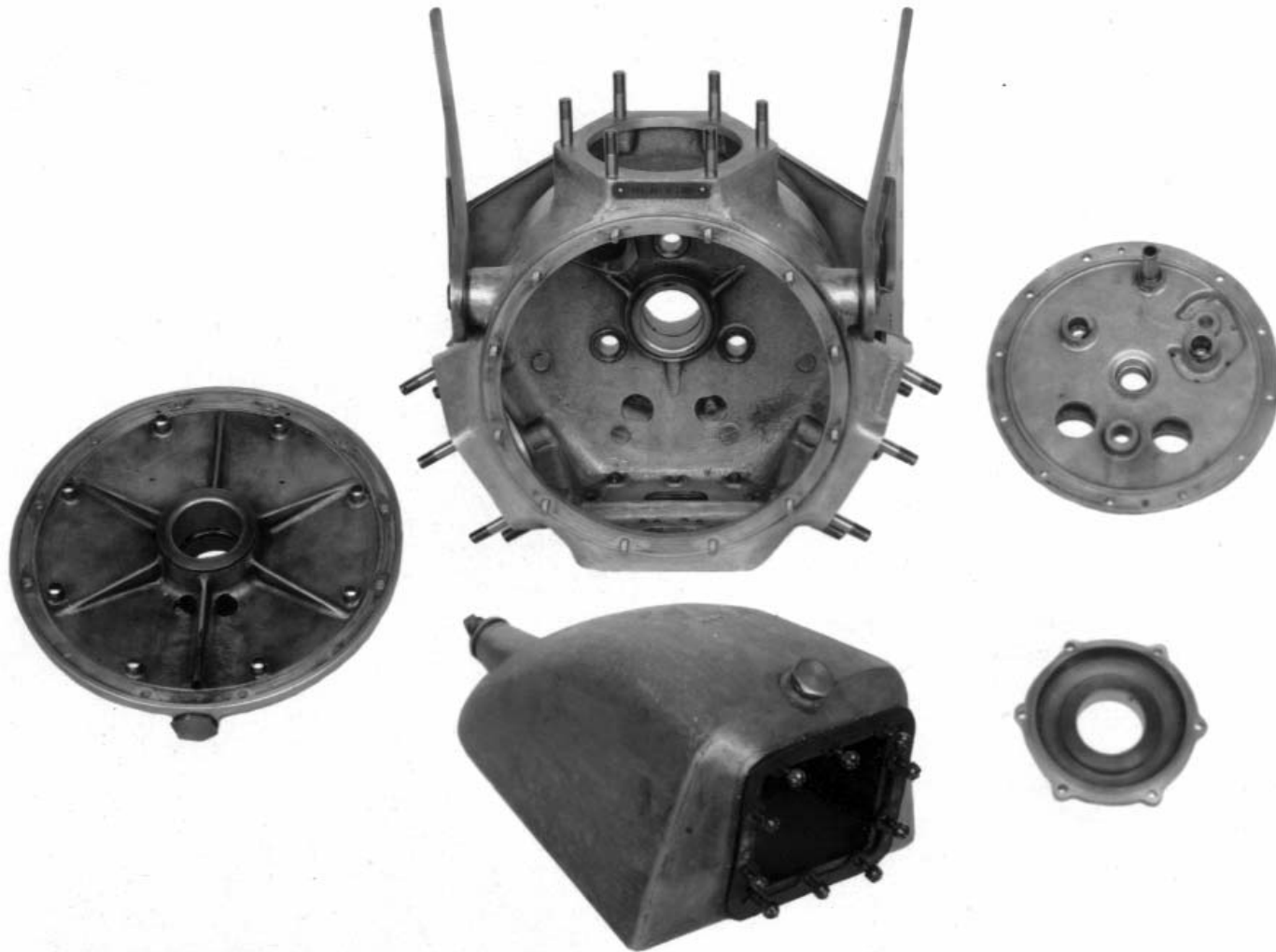
50 hp @ 1,600 rpm,  
16.7 hp/cylinder

Weighed 147.4 lb,  
0.34 hp/lb

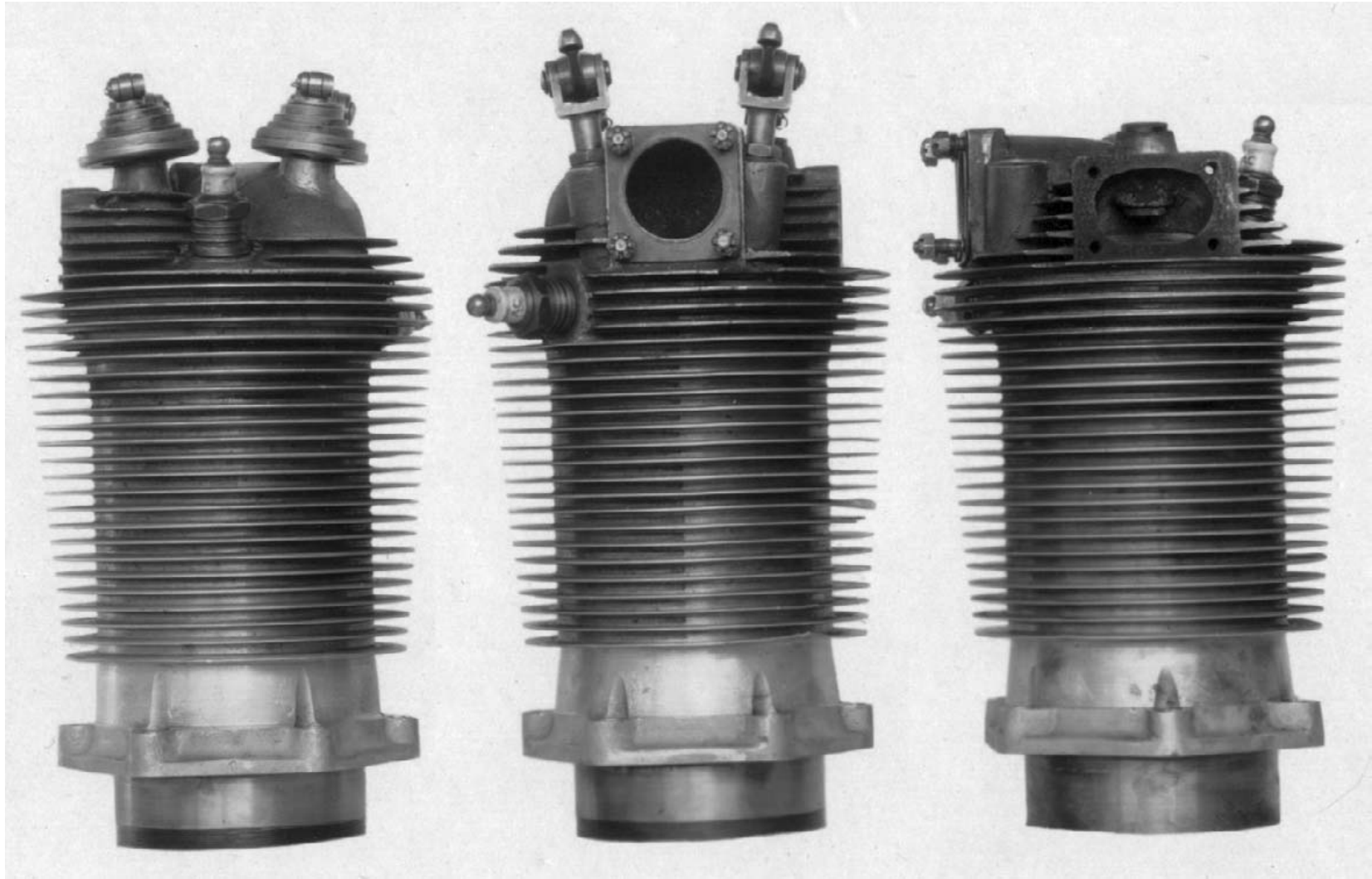
# Lawrance L-2



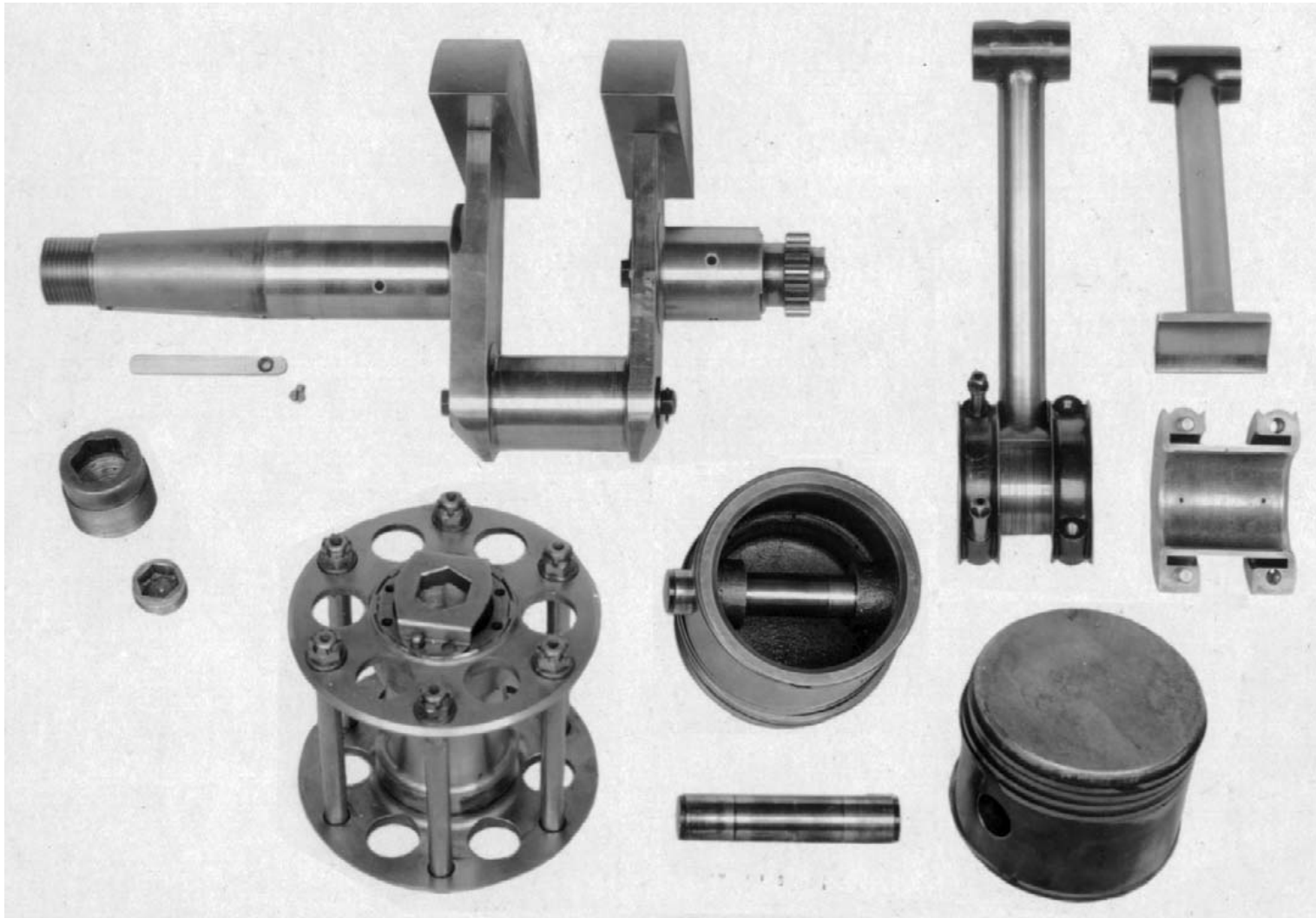
# Lawrance L-2 Crankcase



# Lawrance L-2 Cylinders



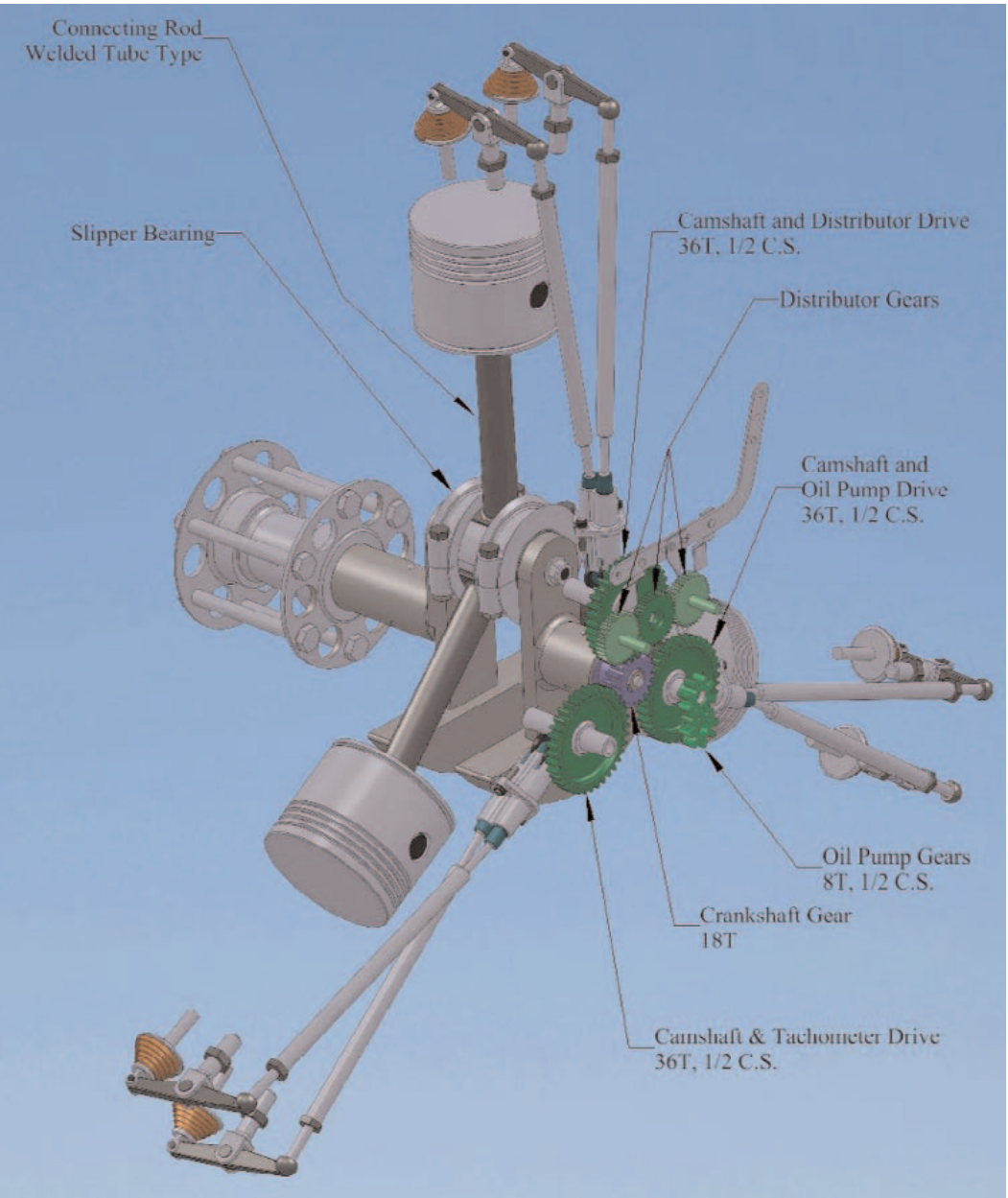
# Lawrance L-2 Crankshaft, etc.

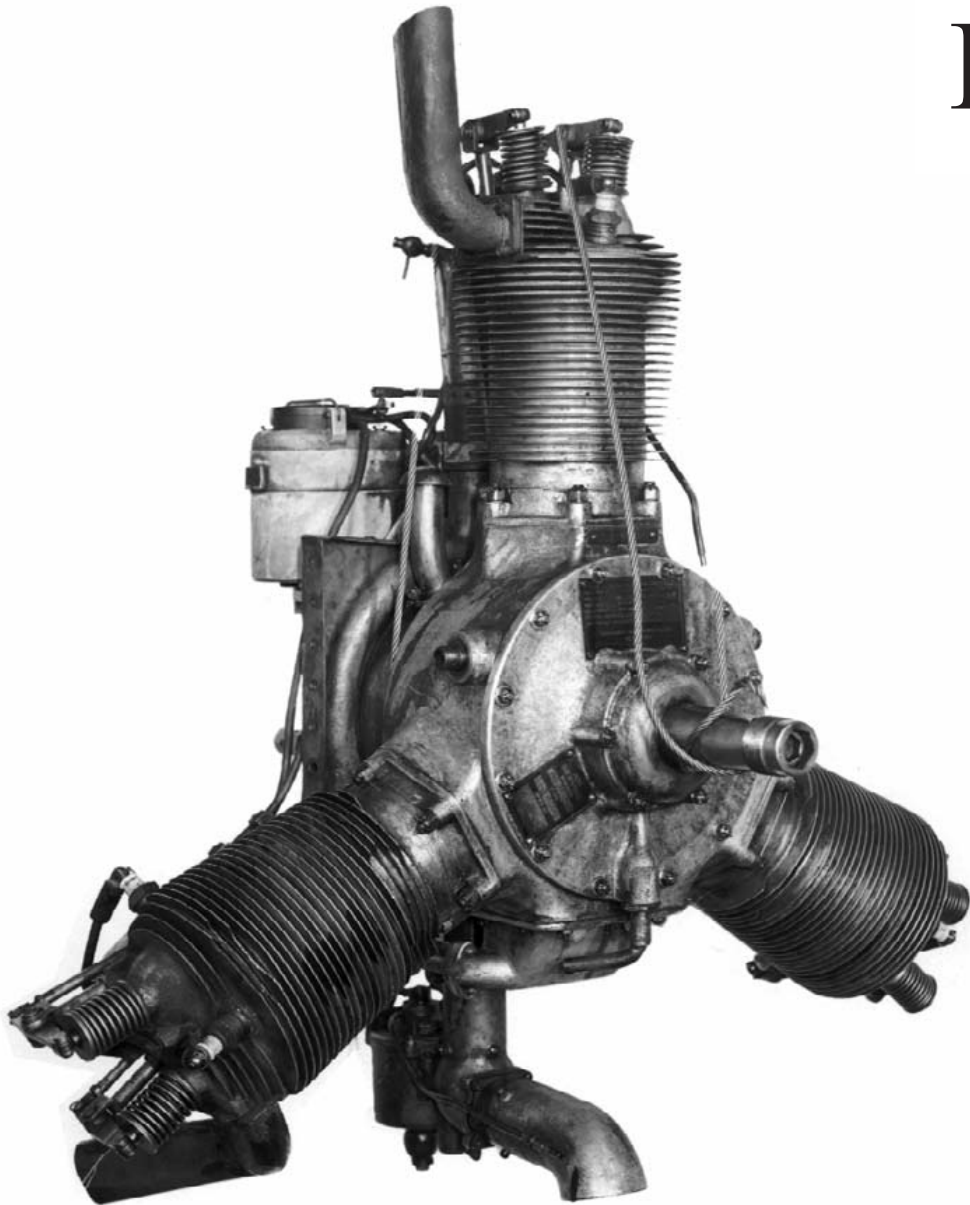


# Lawrance L-2 Valve Gear



# Lawrance L-2 Internals





# Lawrance L-3

60 hp @ 1,800 rpm,  
20 hp/cylinder

Oil Sump Eliminated in  
Favor of Separate Oil  
Tank

Cylinders Refined

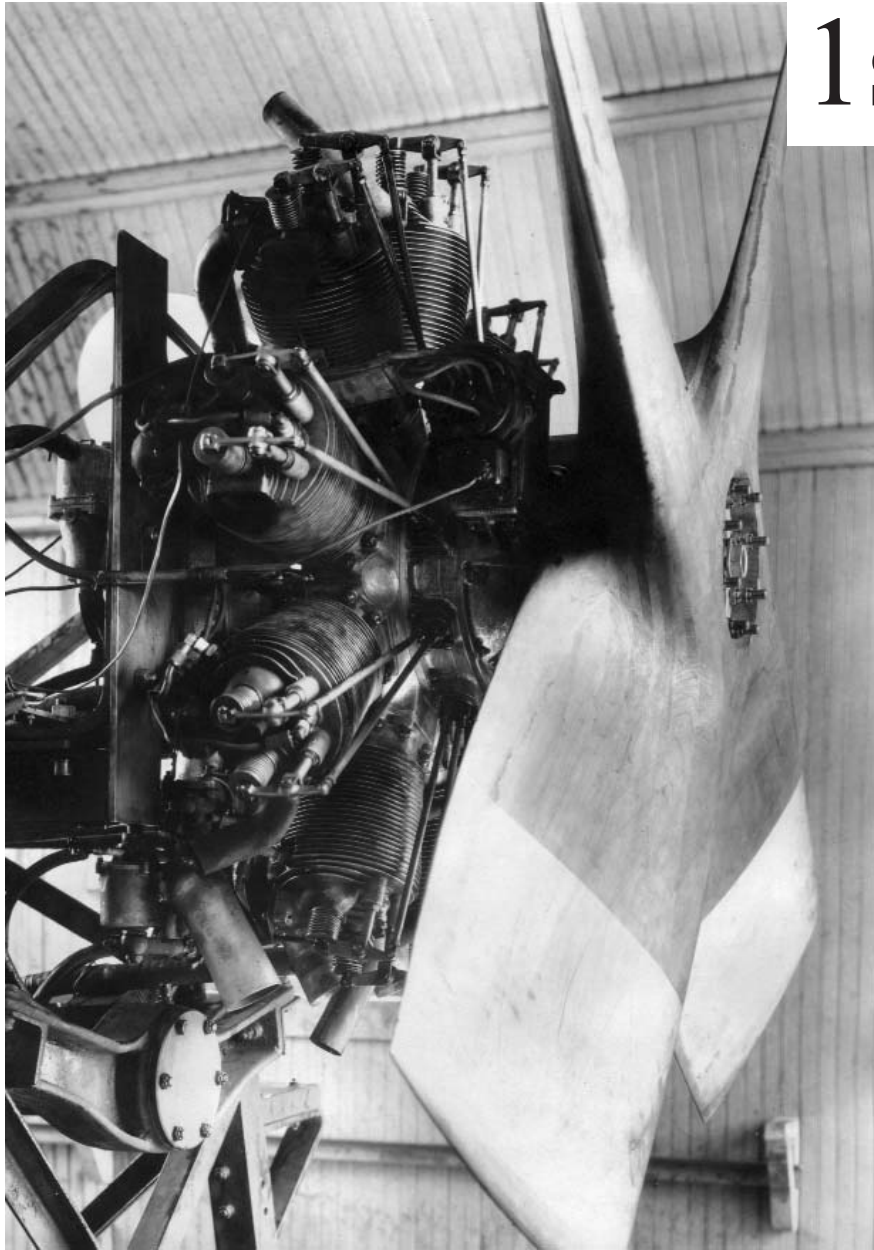
Helical Valve Springs

Longer Valve Stems



# Sperry M-1





# 1st Lawrance R-1

Bore = 4.25", Stroke = 5.25"  
Displacement = 670.3 in<sup>3</sup>,  
74.5 in<sup>3</sup>/cylinder

150 hp @ 1,600 rpm,  
16.7 hp/cylinder

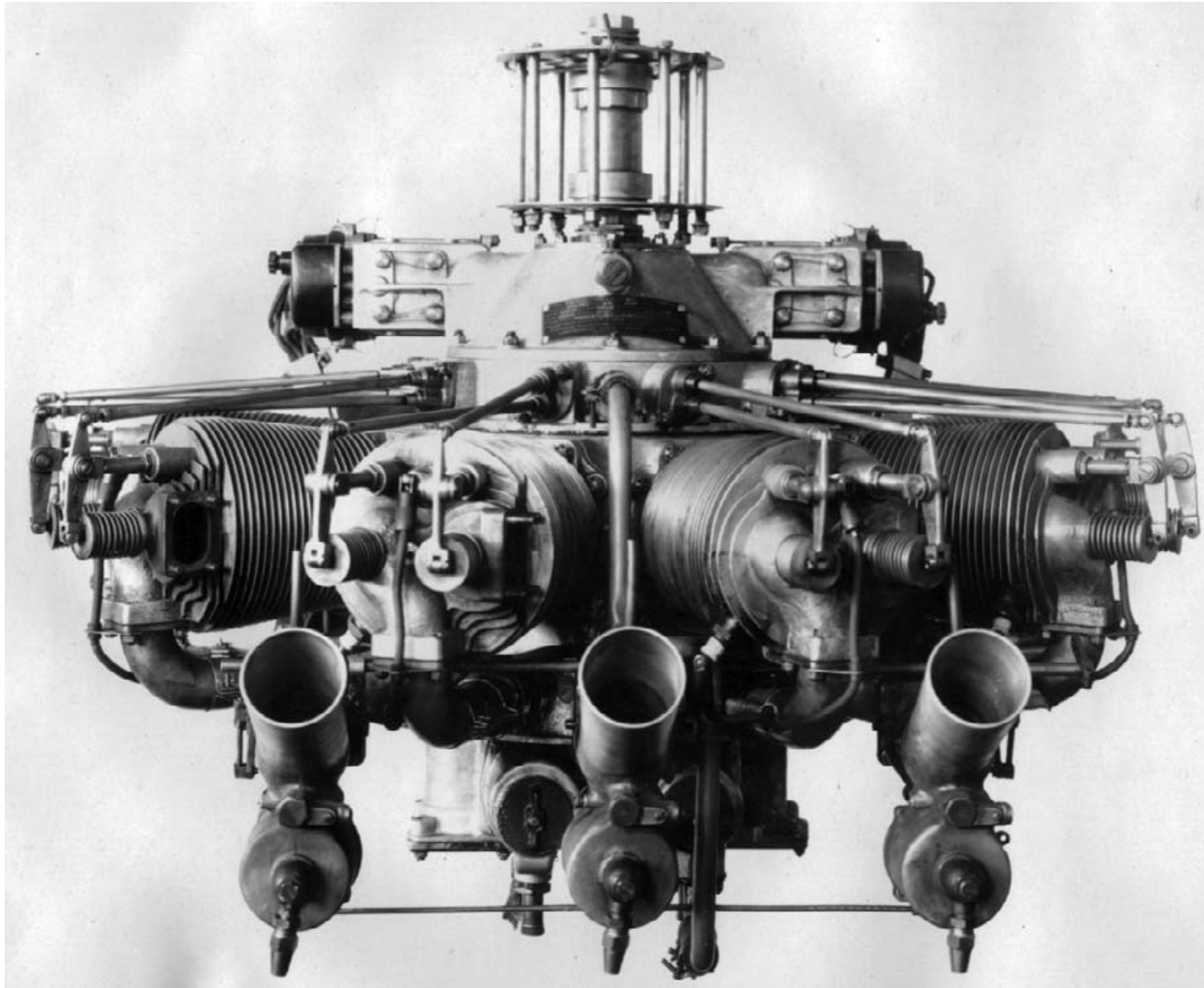
Weighed 428 lb, 0.35 hp/lb

Same Cylinders as L-3

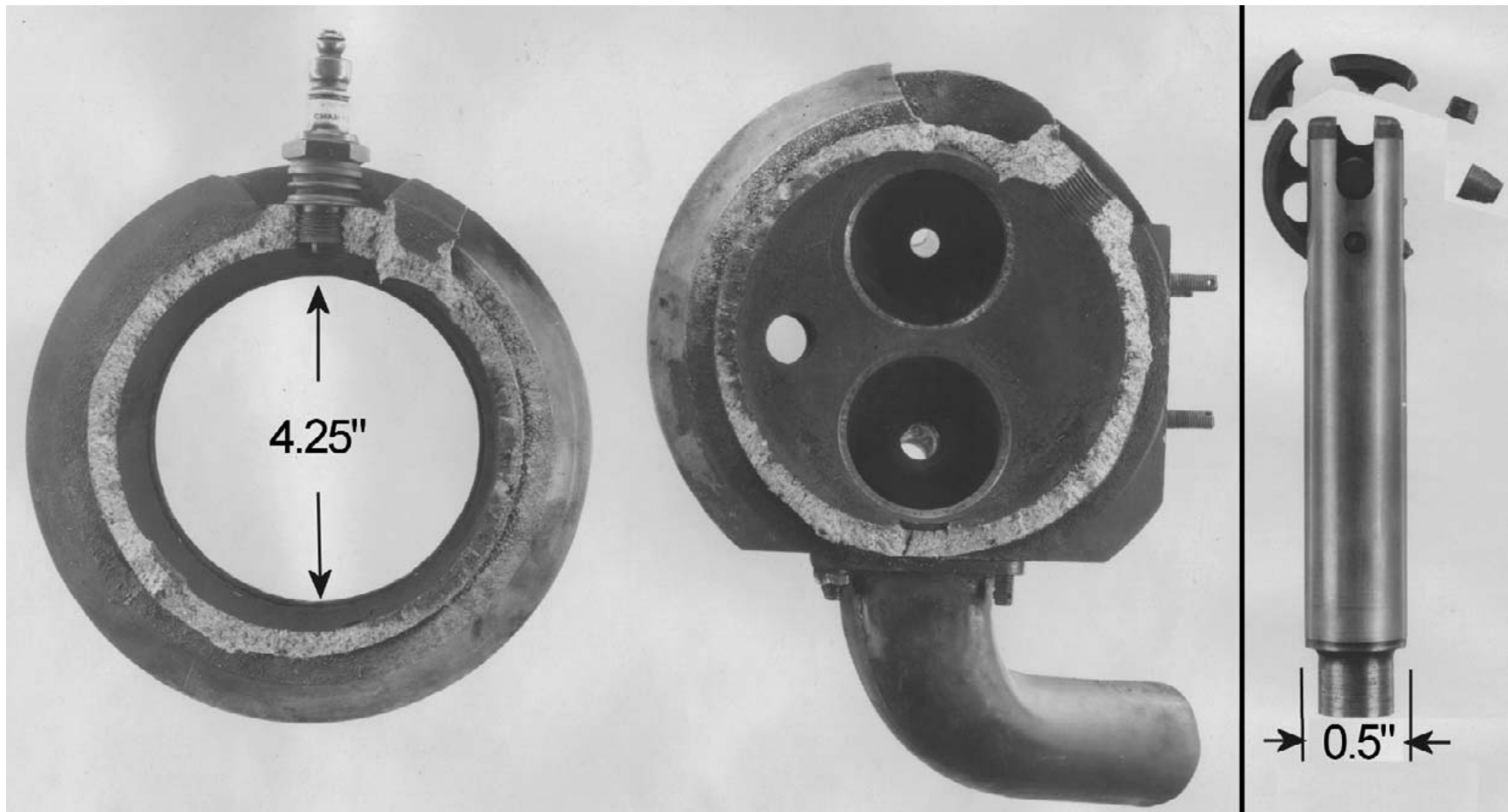
Three Stromberg M-4 Carbs

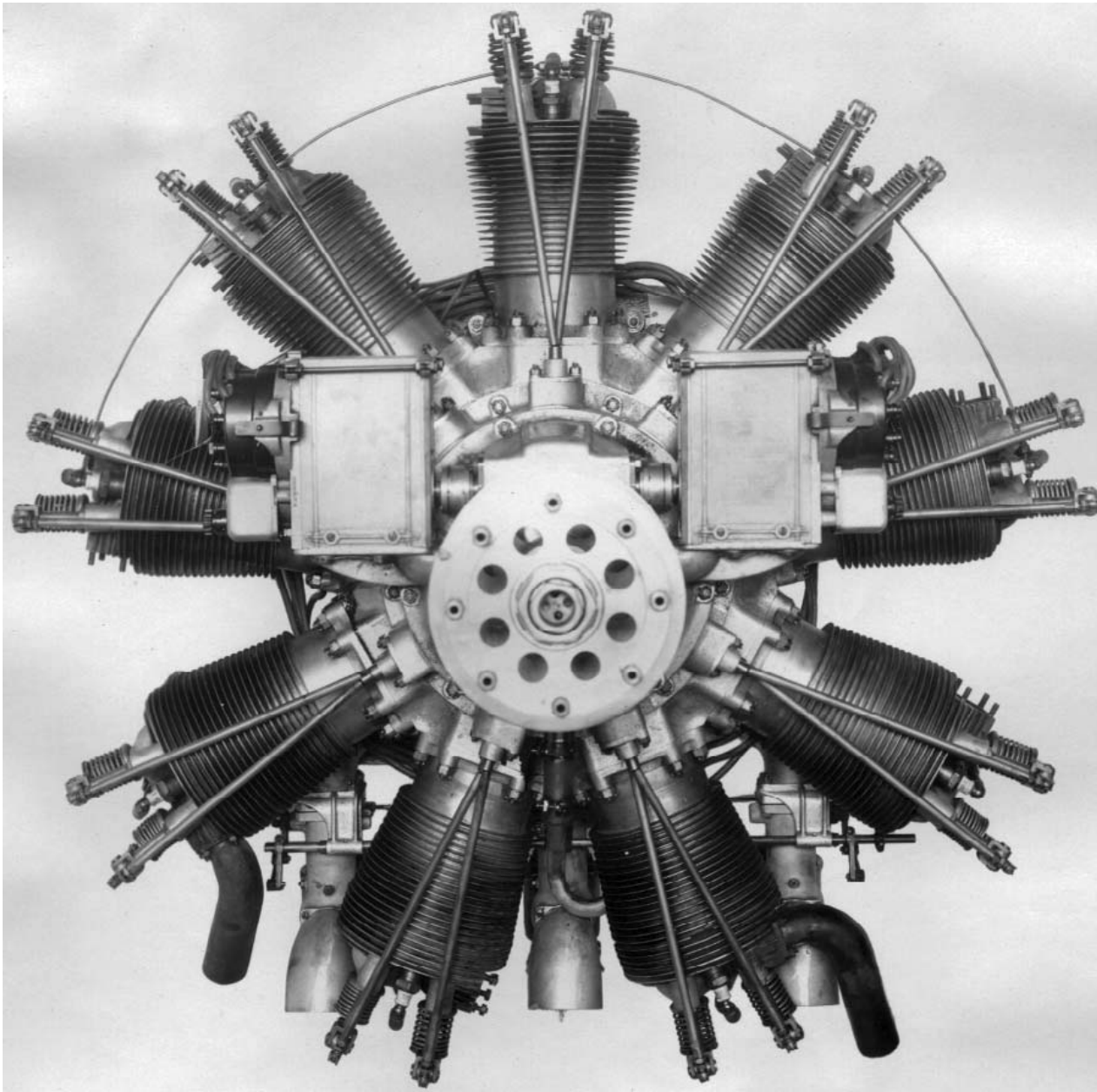
Two Dixie Magnetos

# 1st Lawrance R-1



# 1st Lawrance R-1 Broken Parts



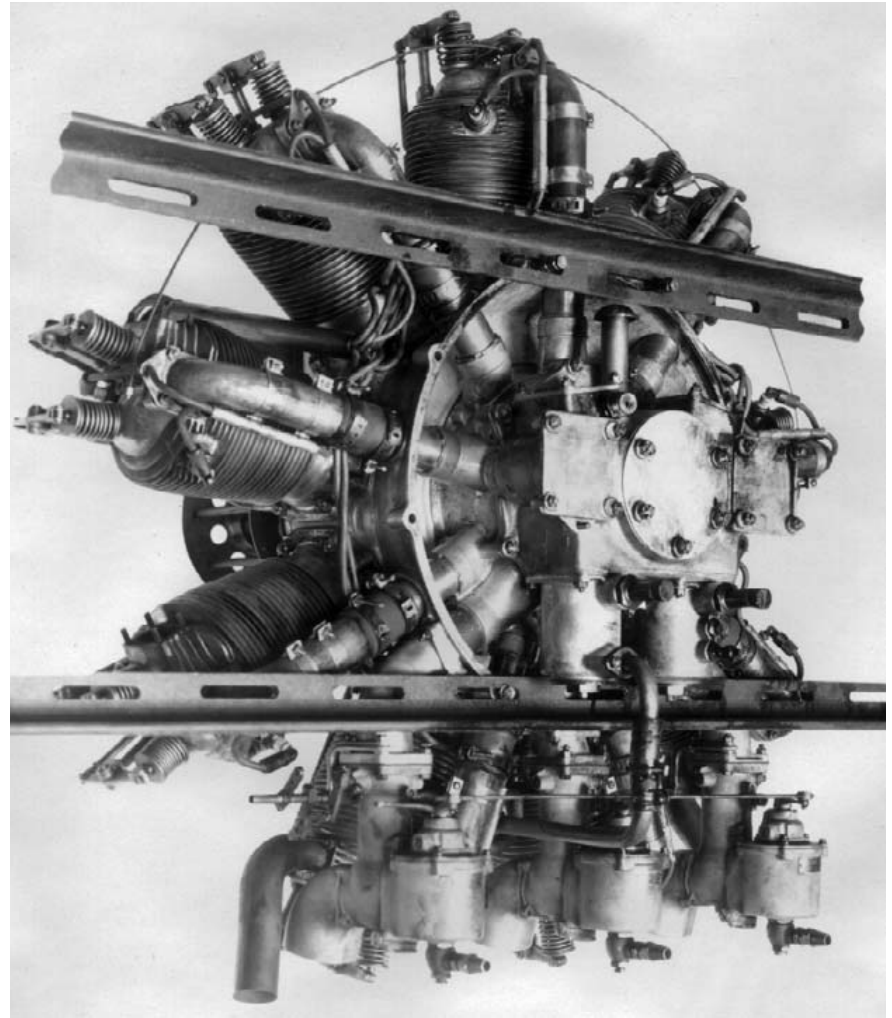
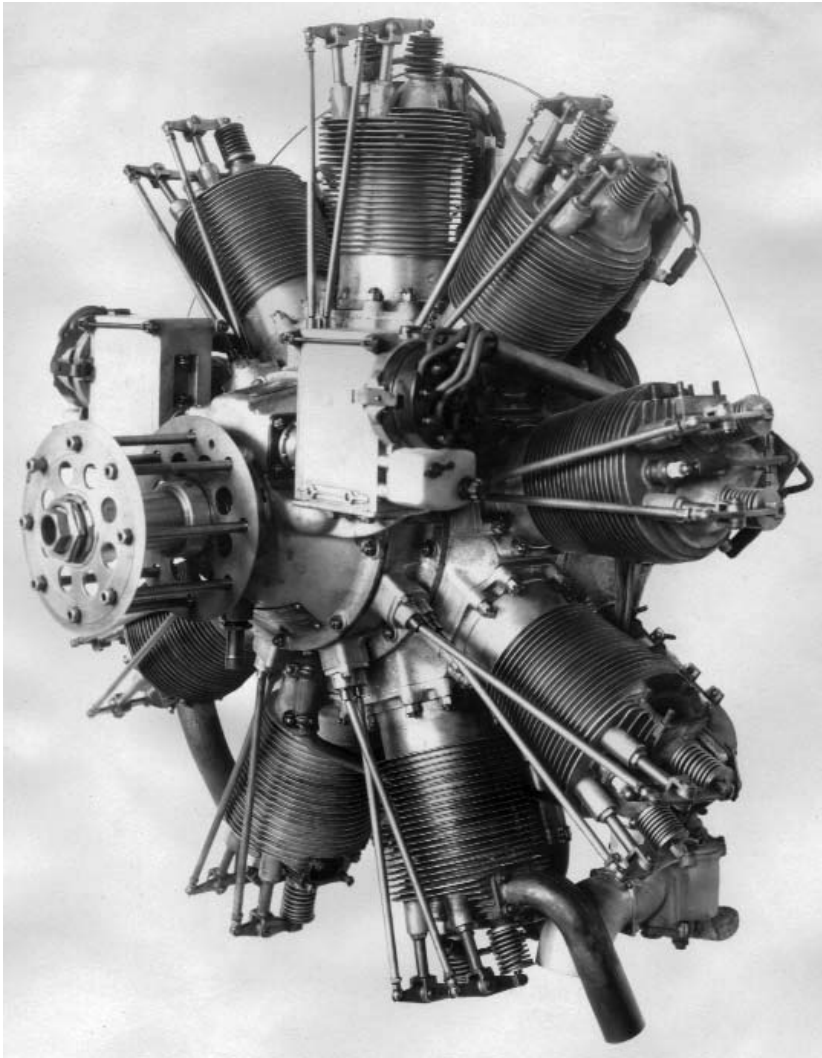


## 2nd R-1

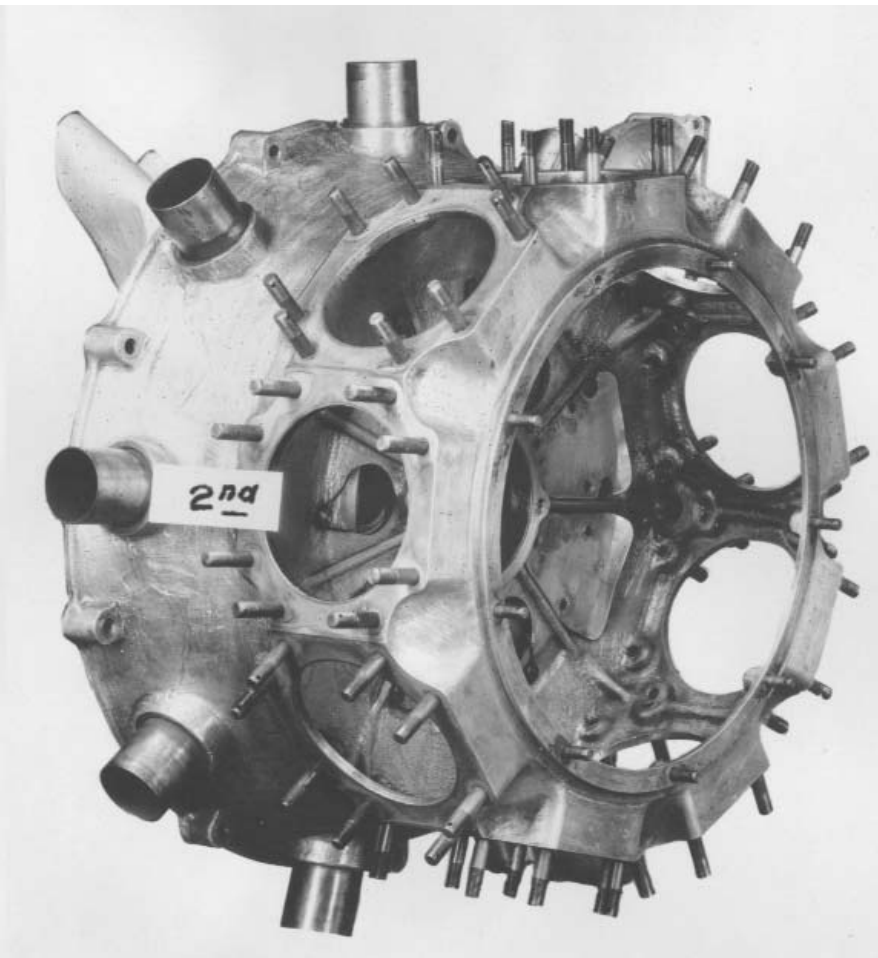
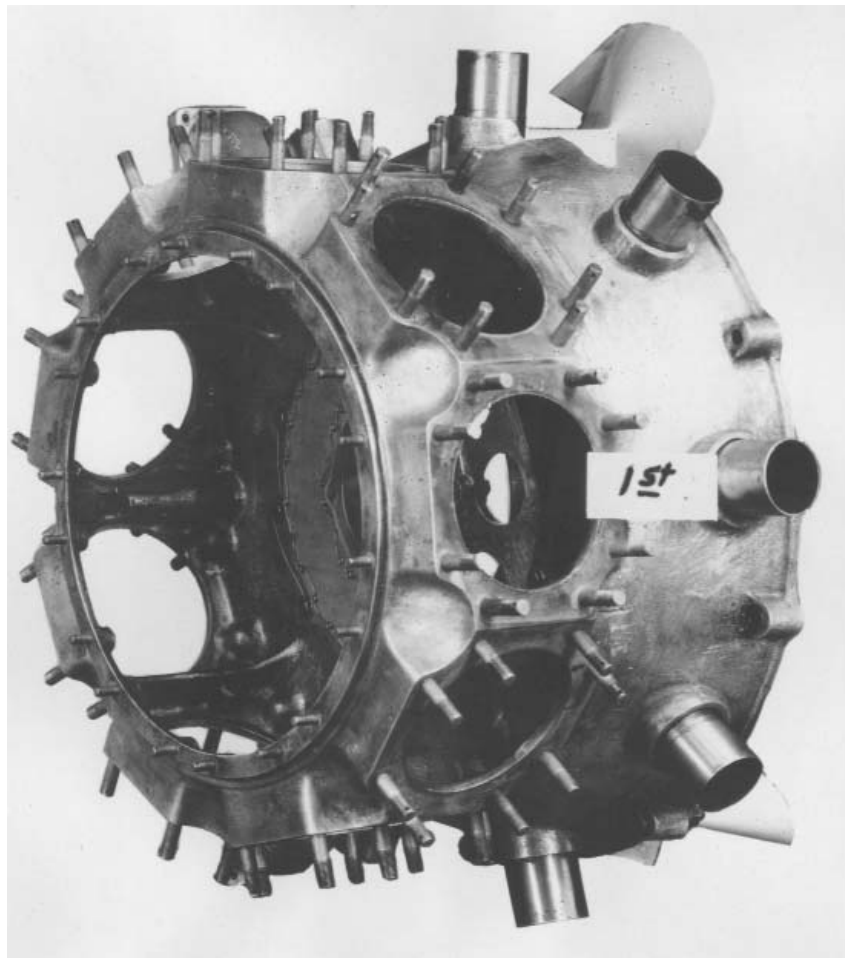
Weighed 398 lb,  
0.38 hp/lb

Almost a new  
engine in just  
under two  
months!

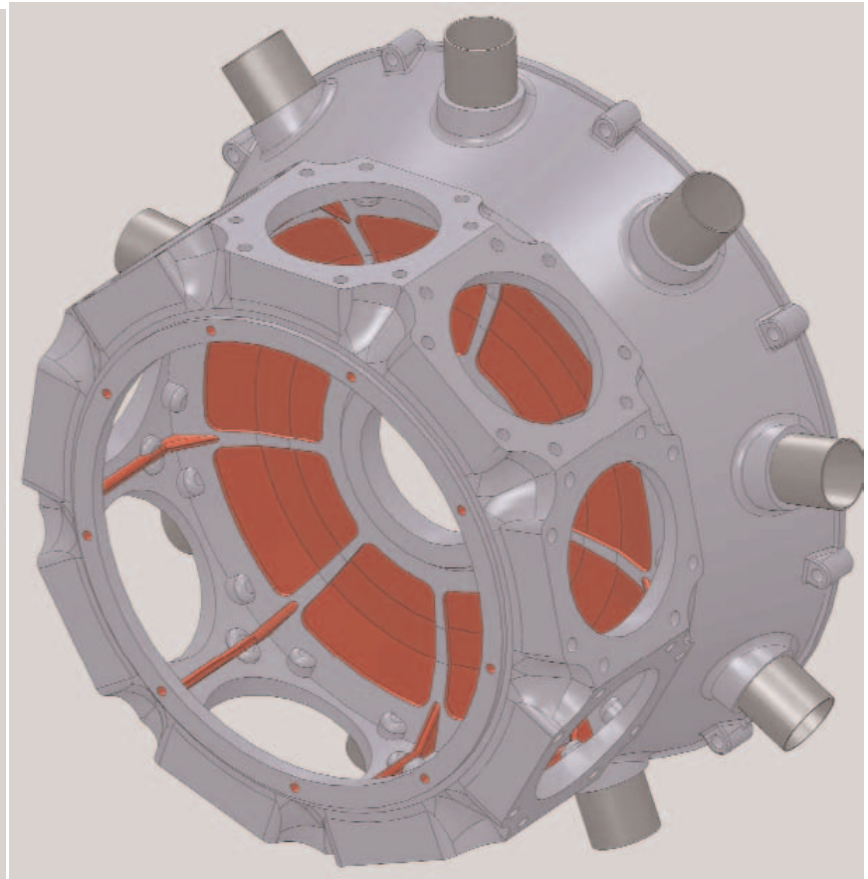
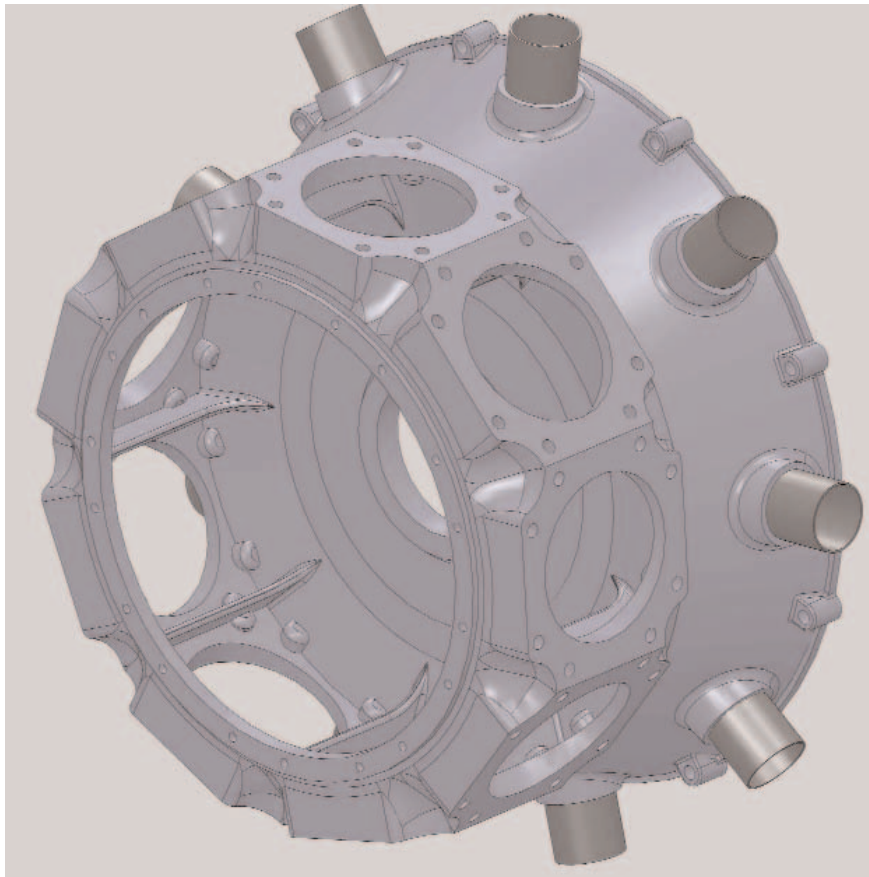
# 2nd R-1



# Crankcases

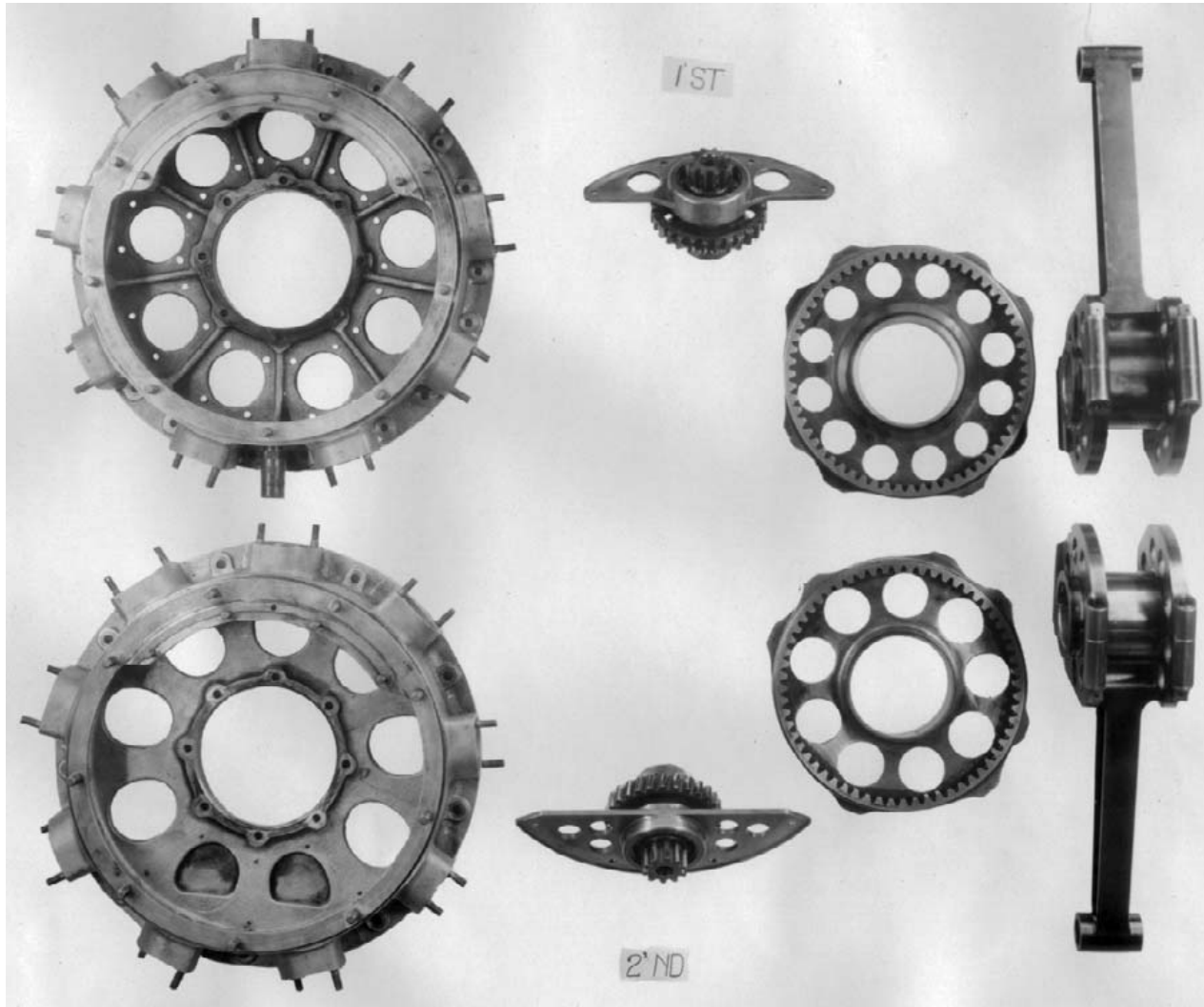


# Crankcases





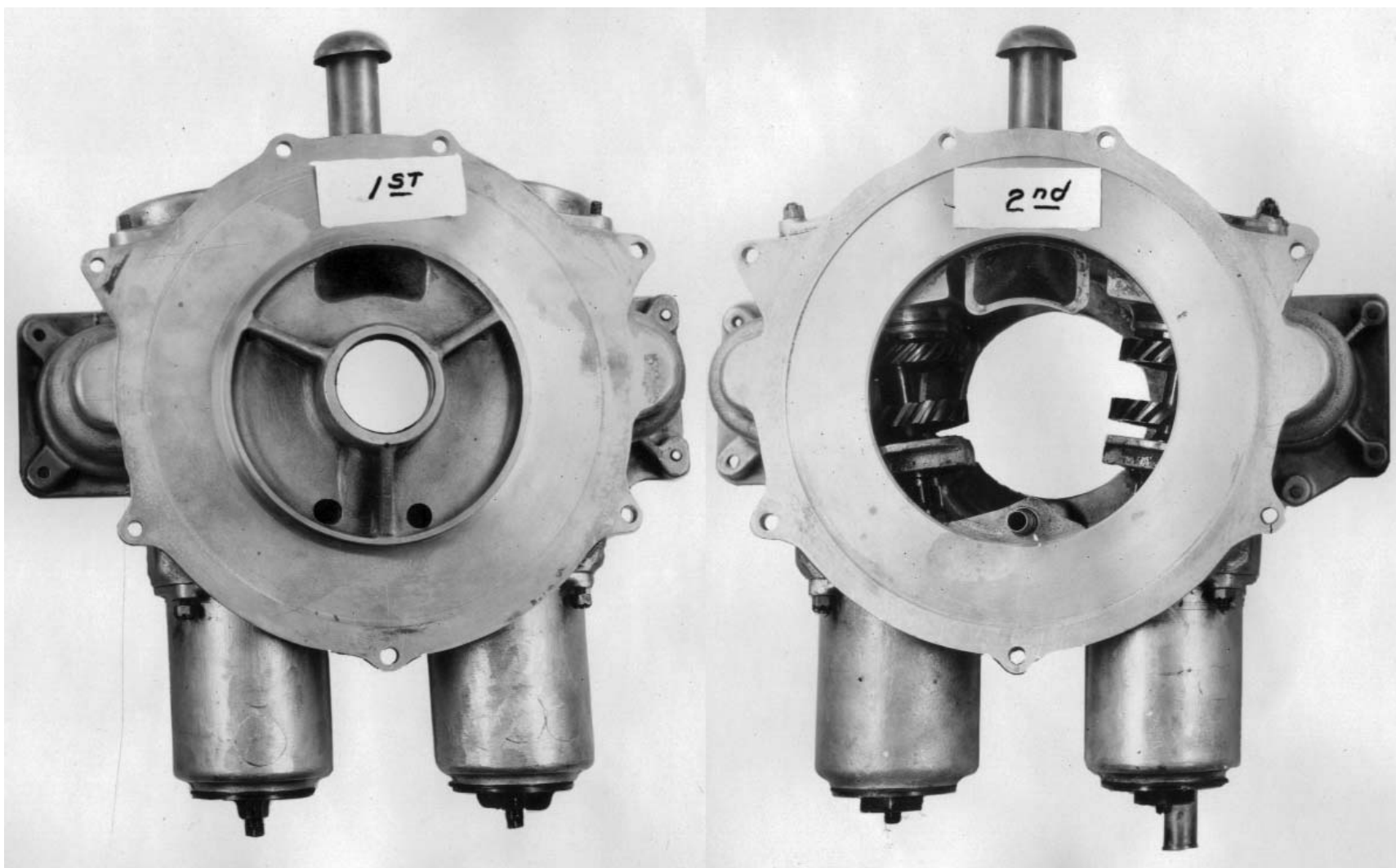
# 2nd R-1 Cam and Master Rod



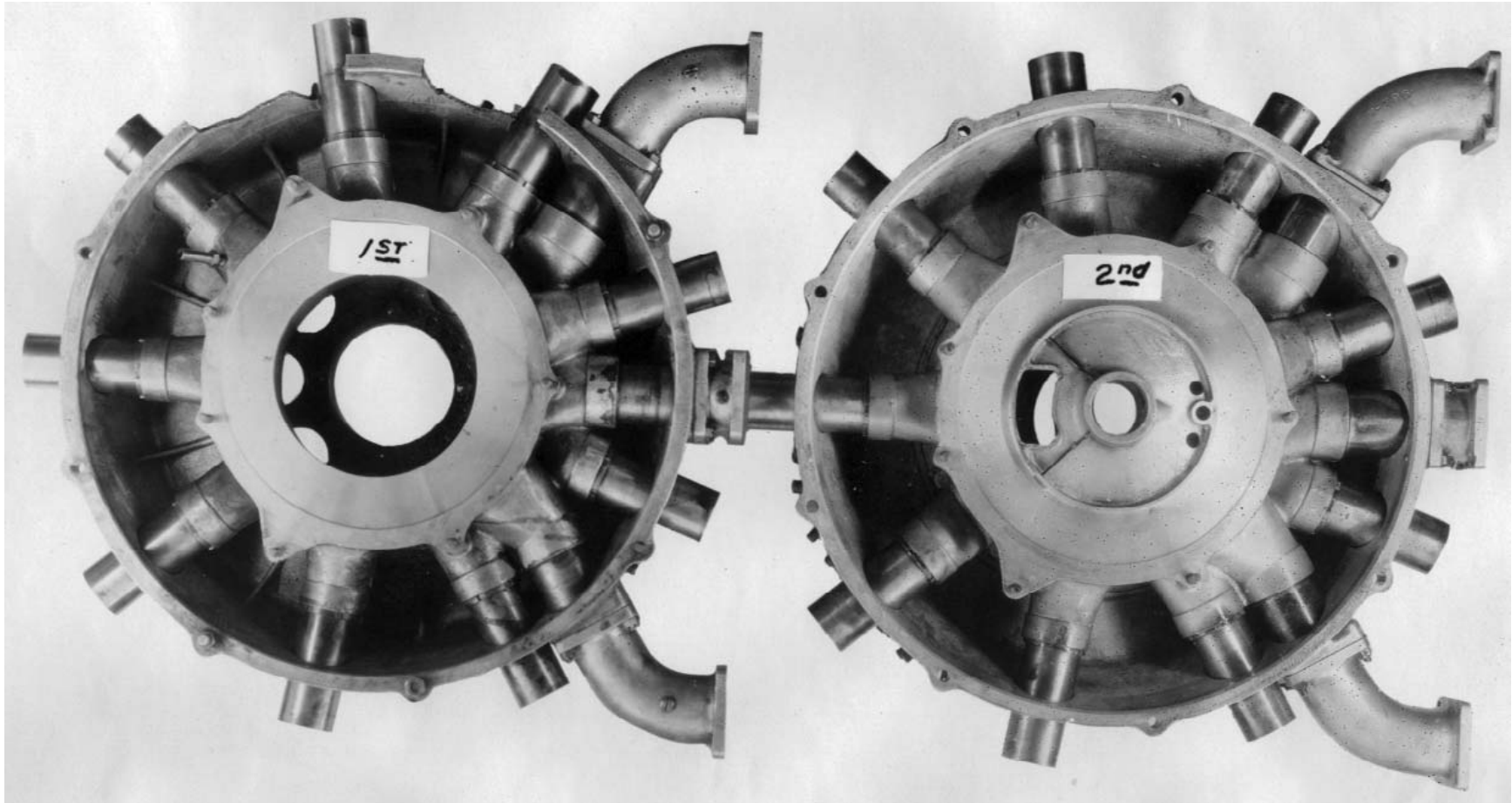
# 2nd R-1 Magneto Drive Housing



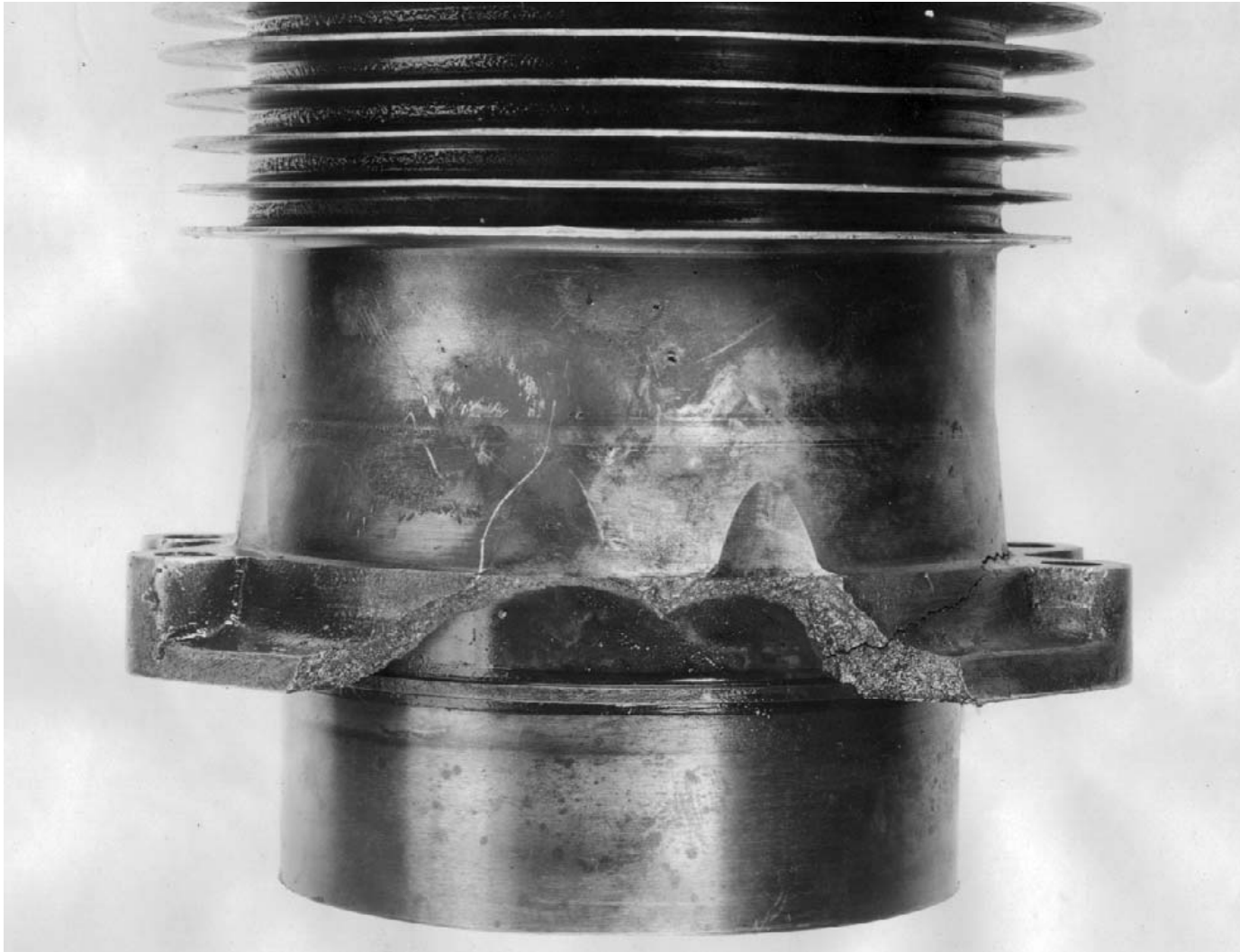
# 2nd R-1 Accessory Housing



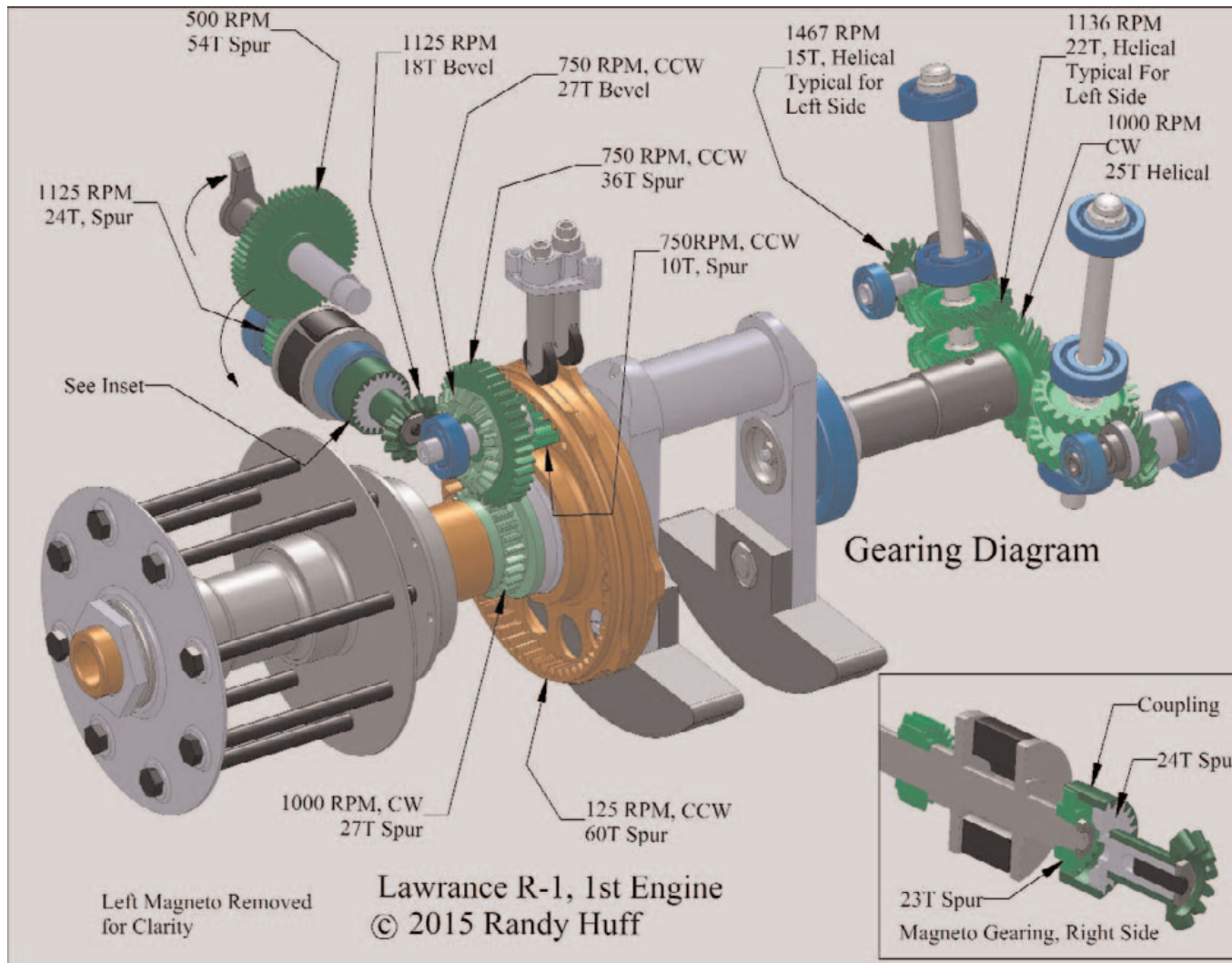
# 2nd R-1 Induction

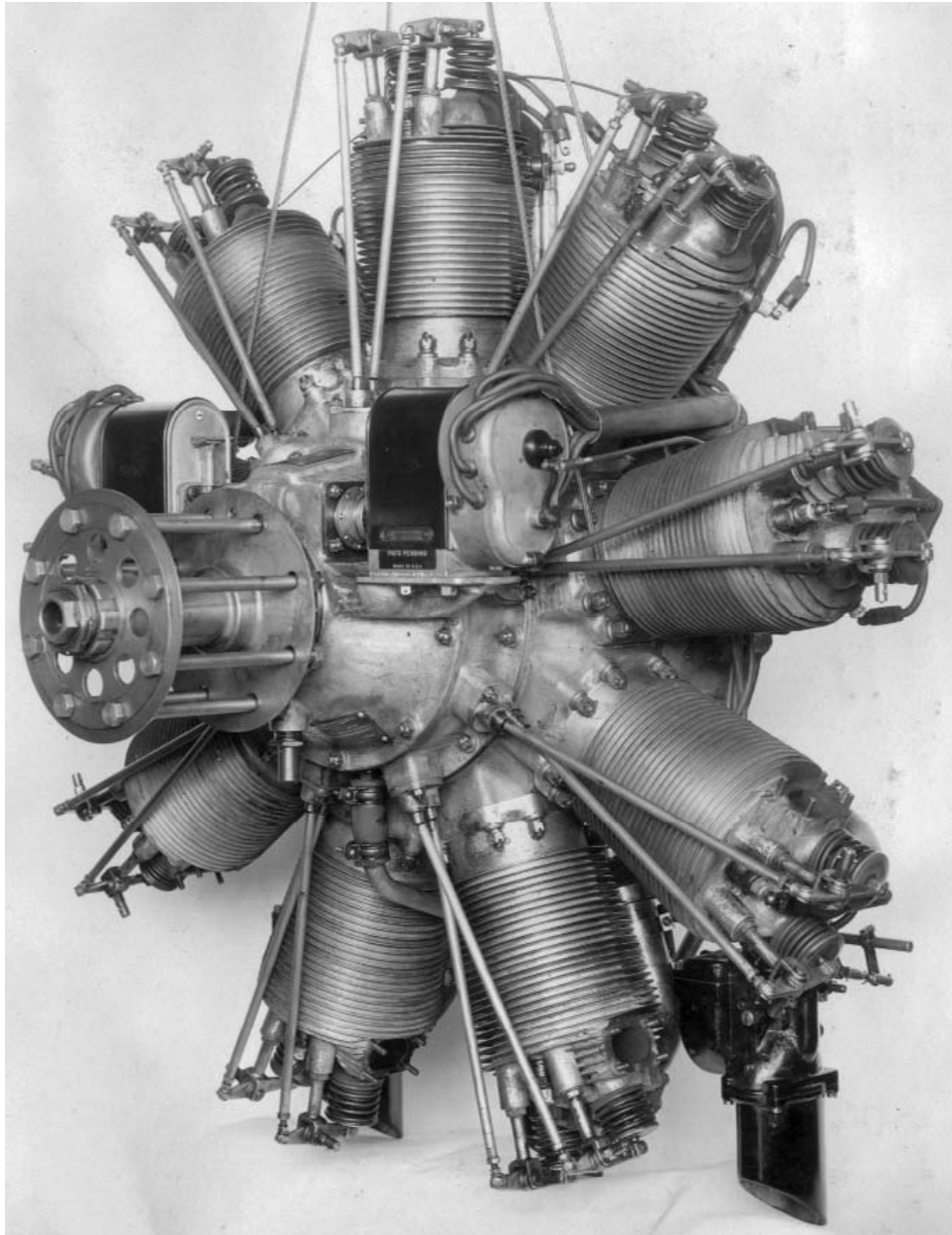


# 2nd R-1 Cylinder Failure



# R-1 and J-1 Gearing





# Lawrance J-1

Bore = 4.5", Stroke = 5.5"

Displacement = 787.3 in<sup>3</sup>,  
87.5 in<sup>3</sup>/cylinder

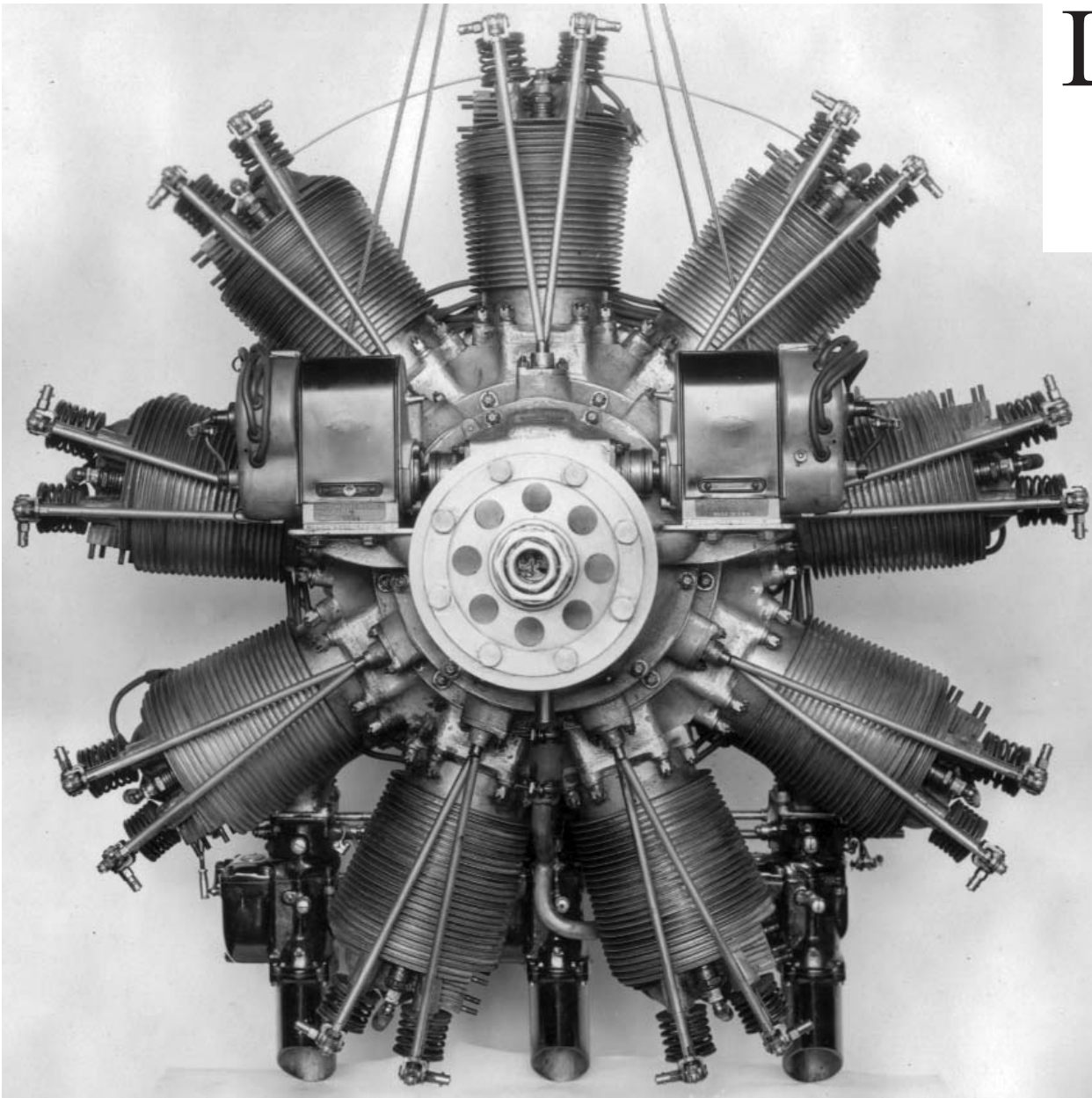
Compression Ratio = 5.17:1

200 hp @ 1,800 rpm,  
22.2 hp/cylinder

Weighed 454.6 lb,  
0.44 hp/lb

Lawrance

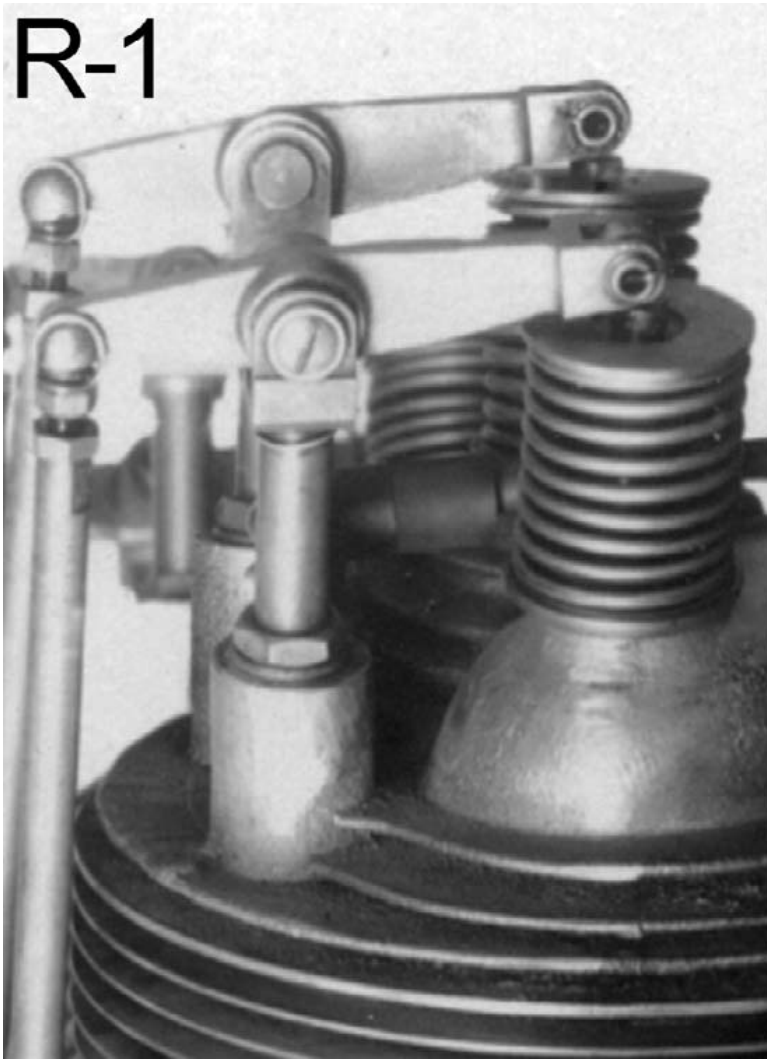
J-1





# R-1 and J-1 Cylinder Heads

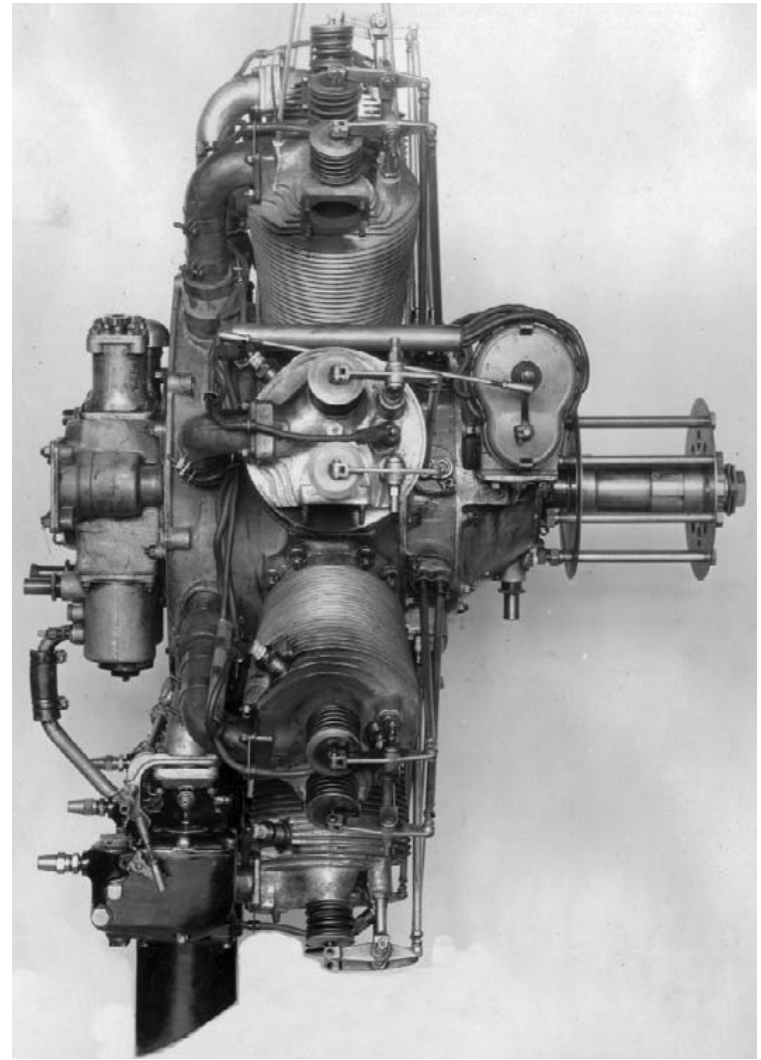
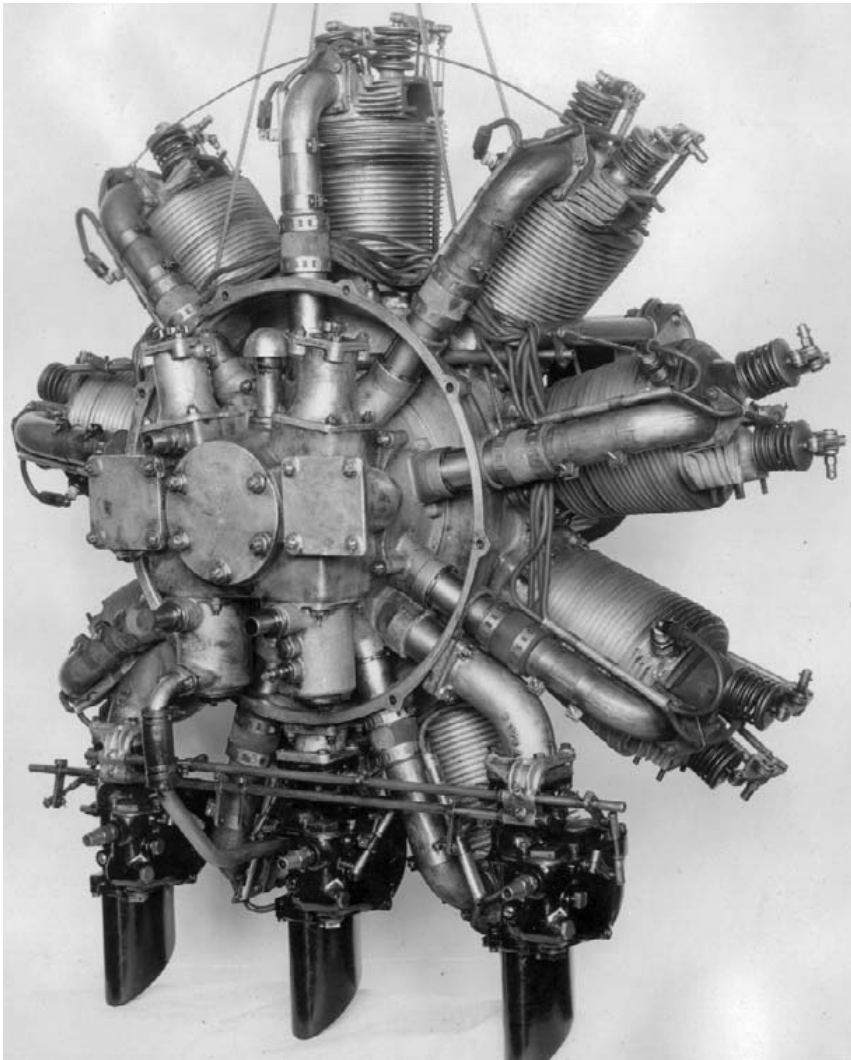
R-1



J-1



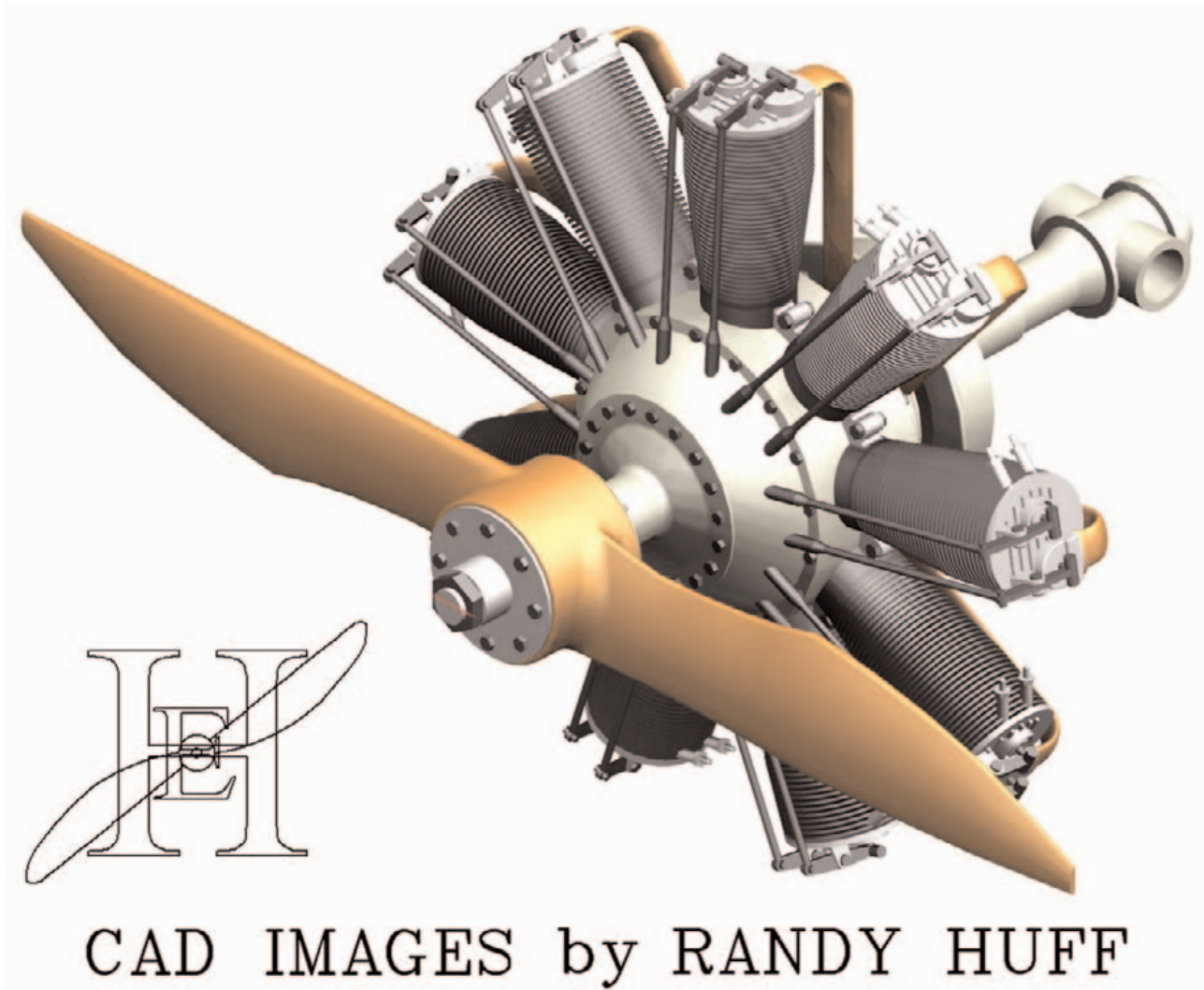
# Lawrance J-1



# N.A.F TS-1

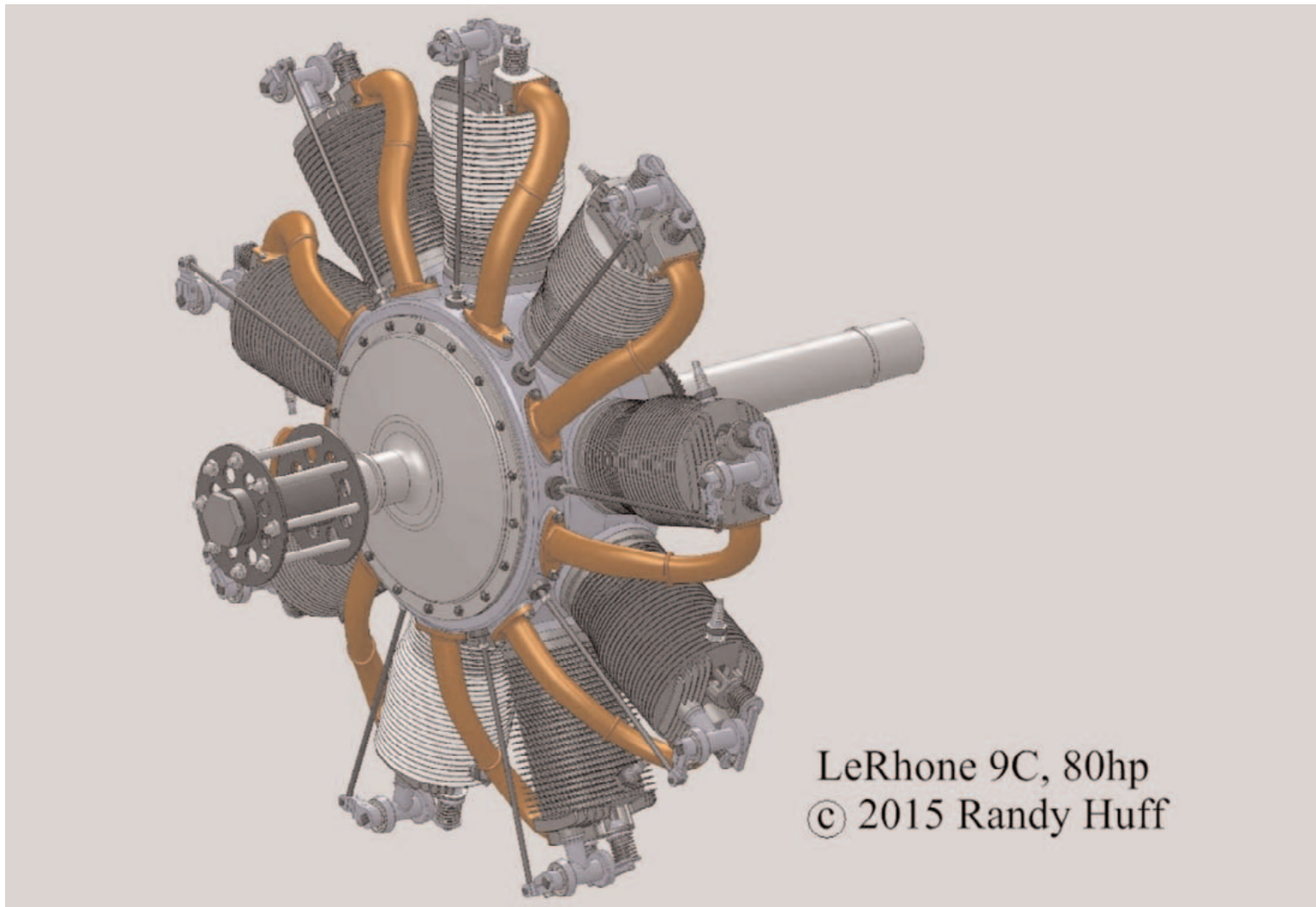


# Huffer Engines



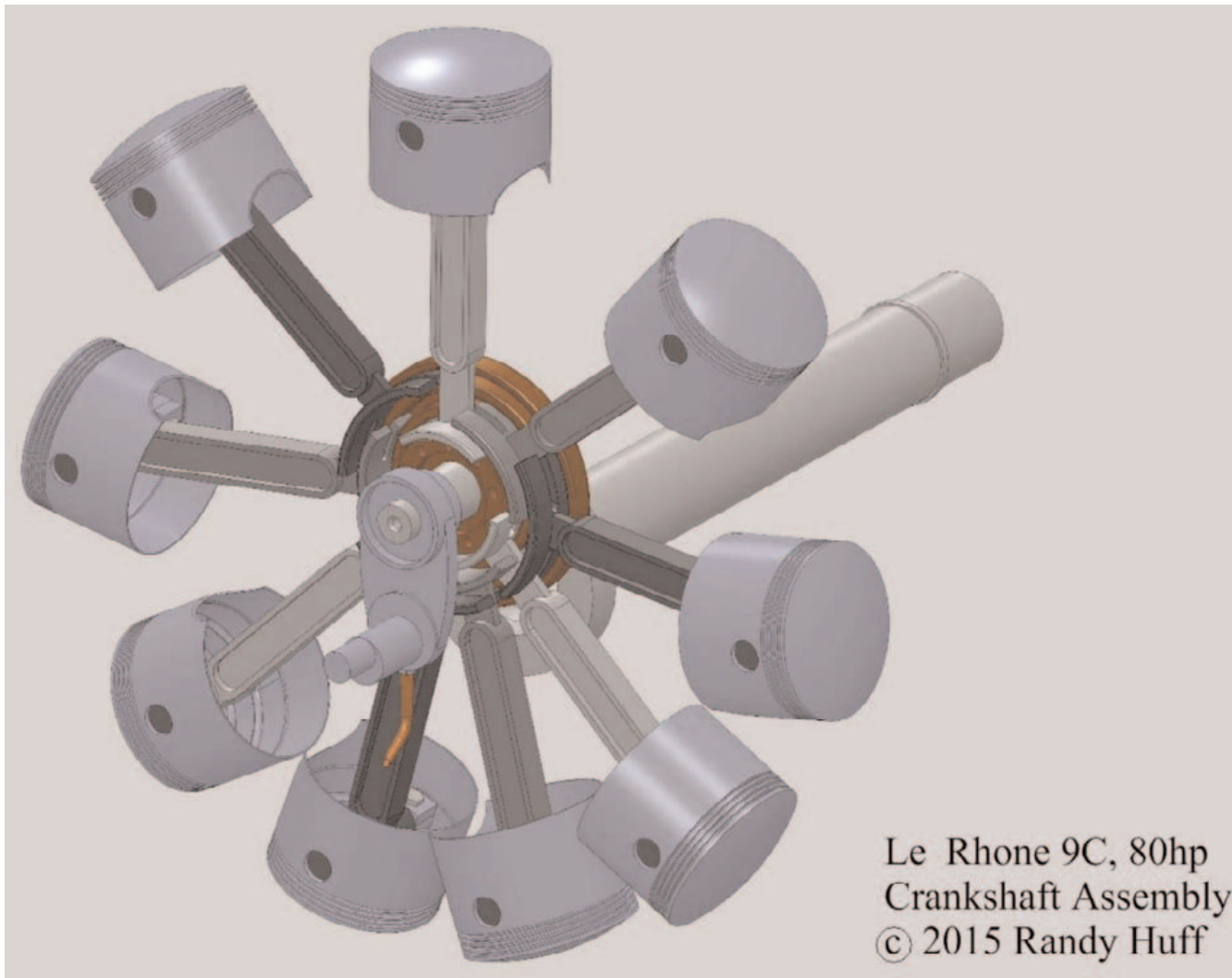


# Choosing an Engine to Model



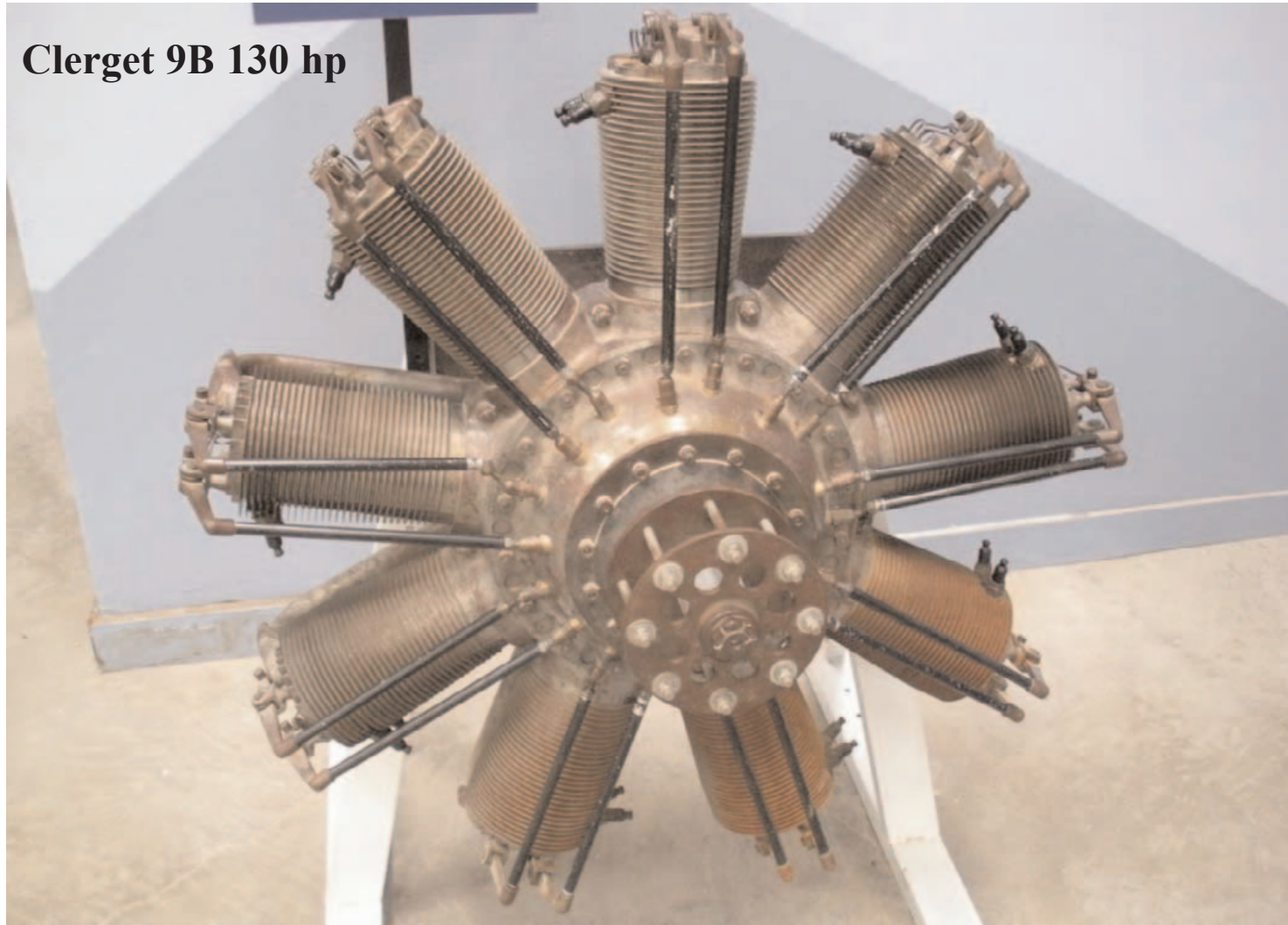
LeRhône 9C, 80hp  
© 2015 Randy Huff

# Choosing an Engine to Model



# Searching for Engine Information

**Clerget 9B 130 hp**

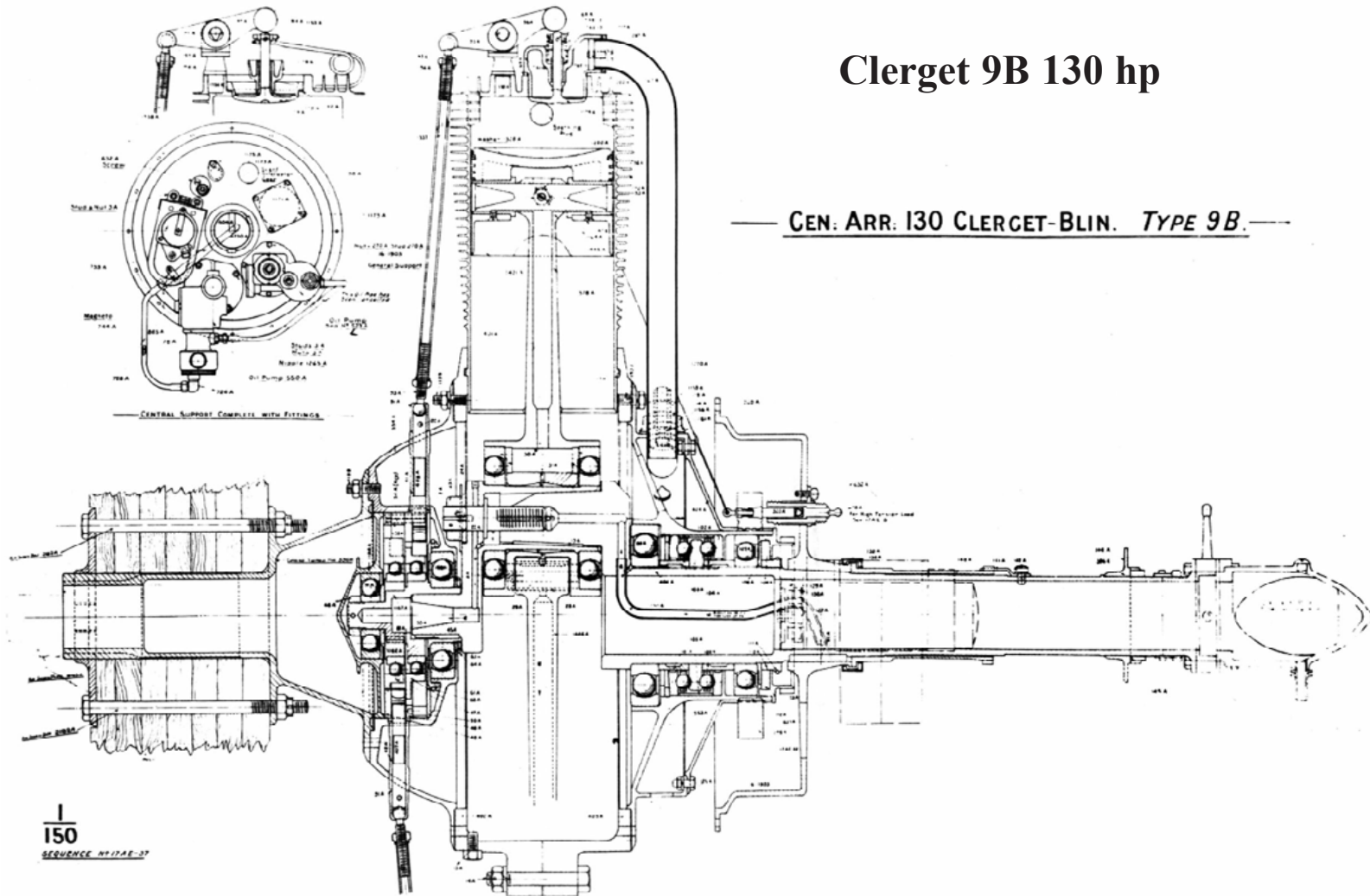




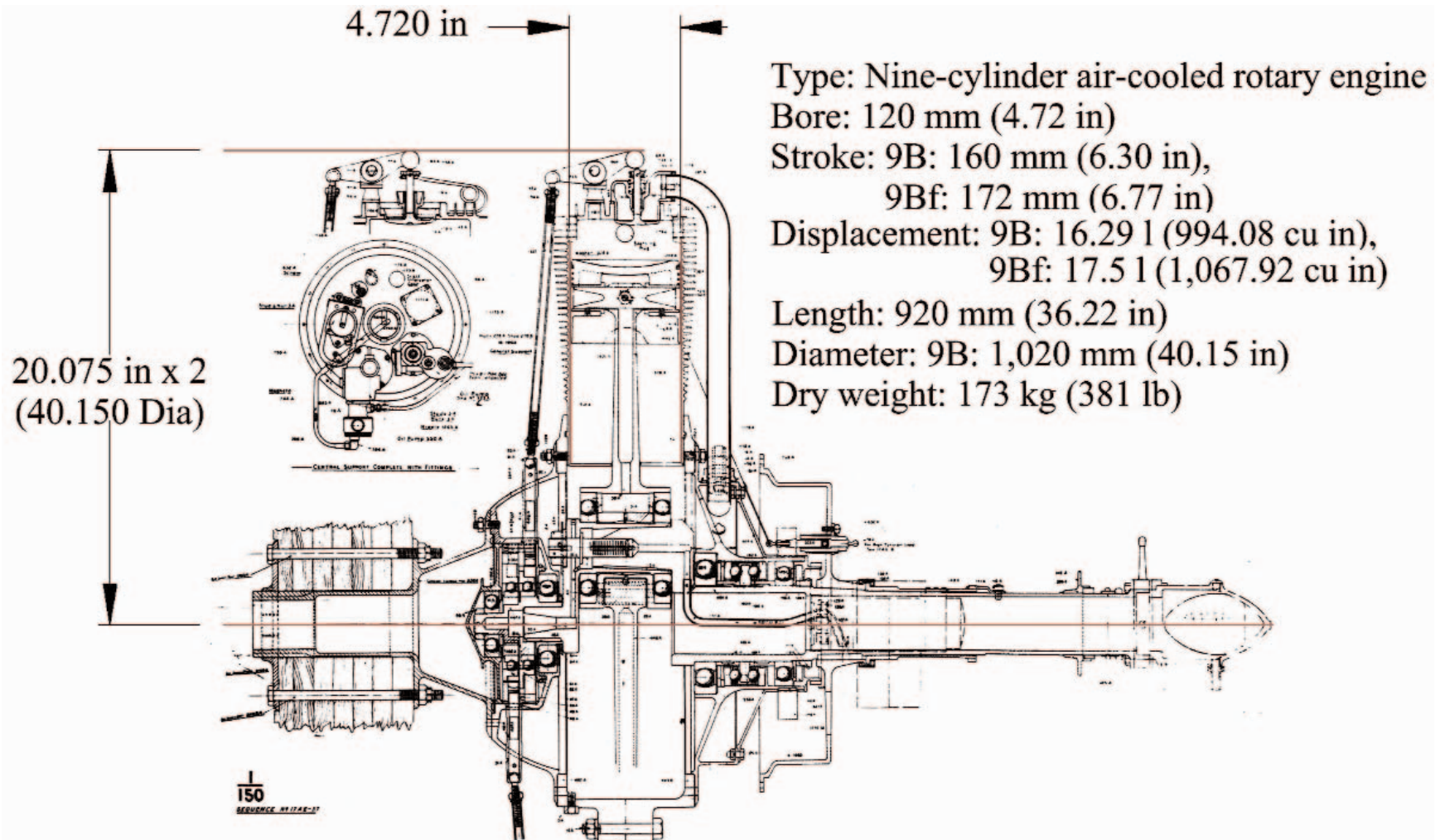
# Searching for Engine Information

Clerget 9B 130 hp

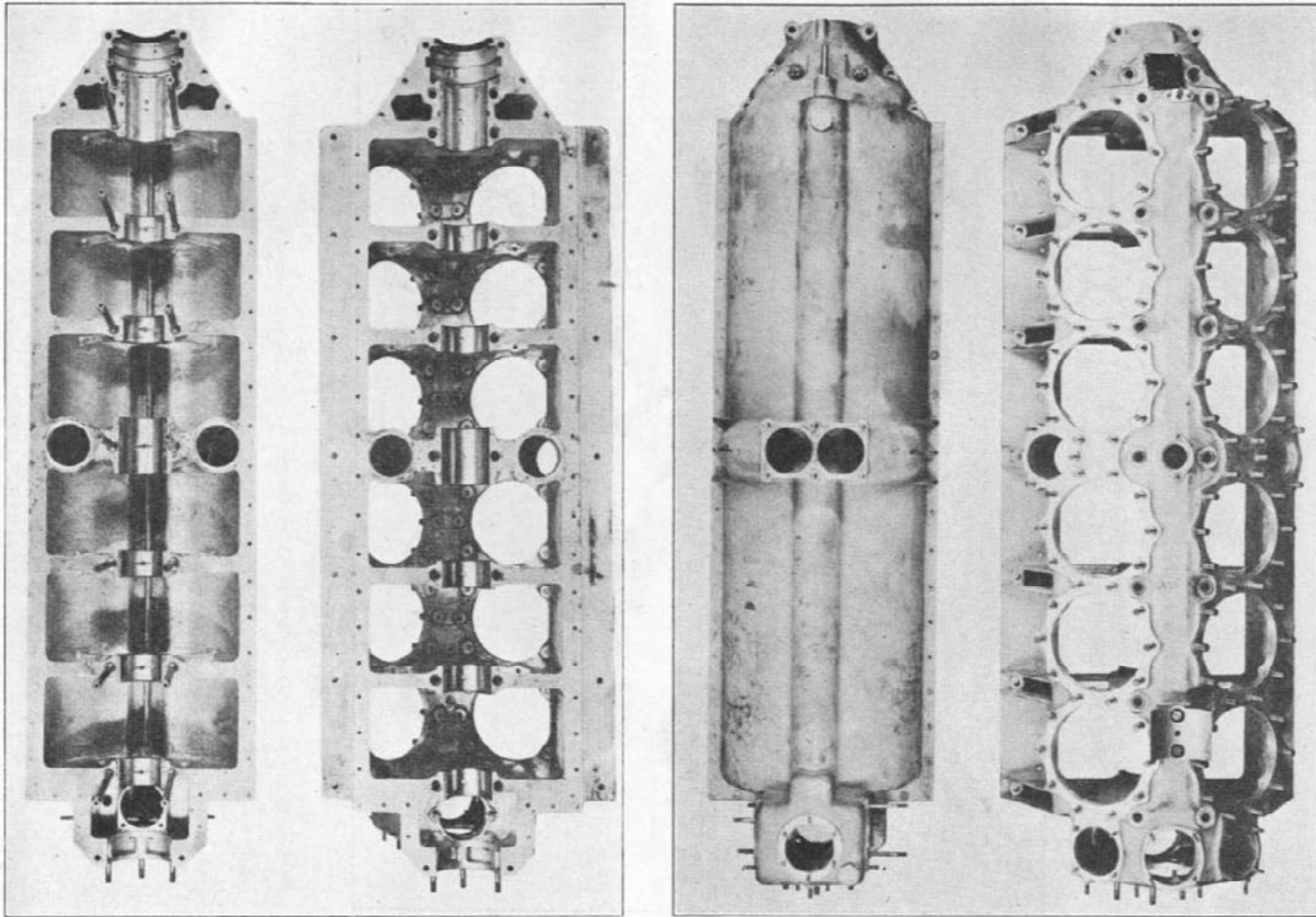
— GEN. ARR. 130 CLERGET-BLIN. TYPE 9B. —



# Clerget 9B Specifications



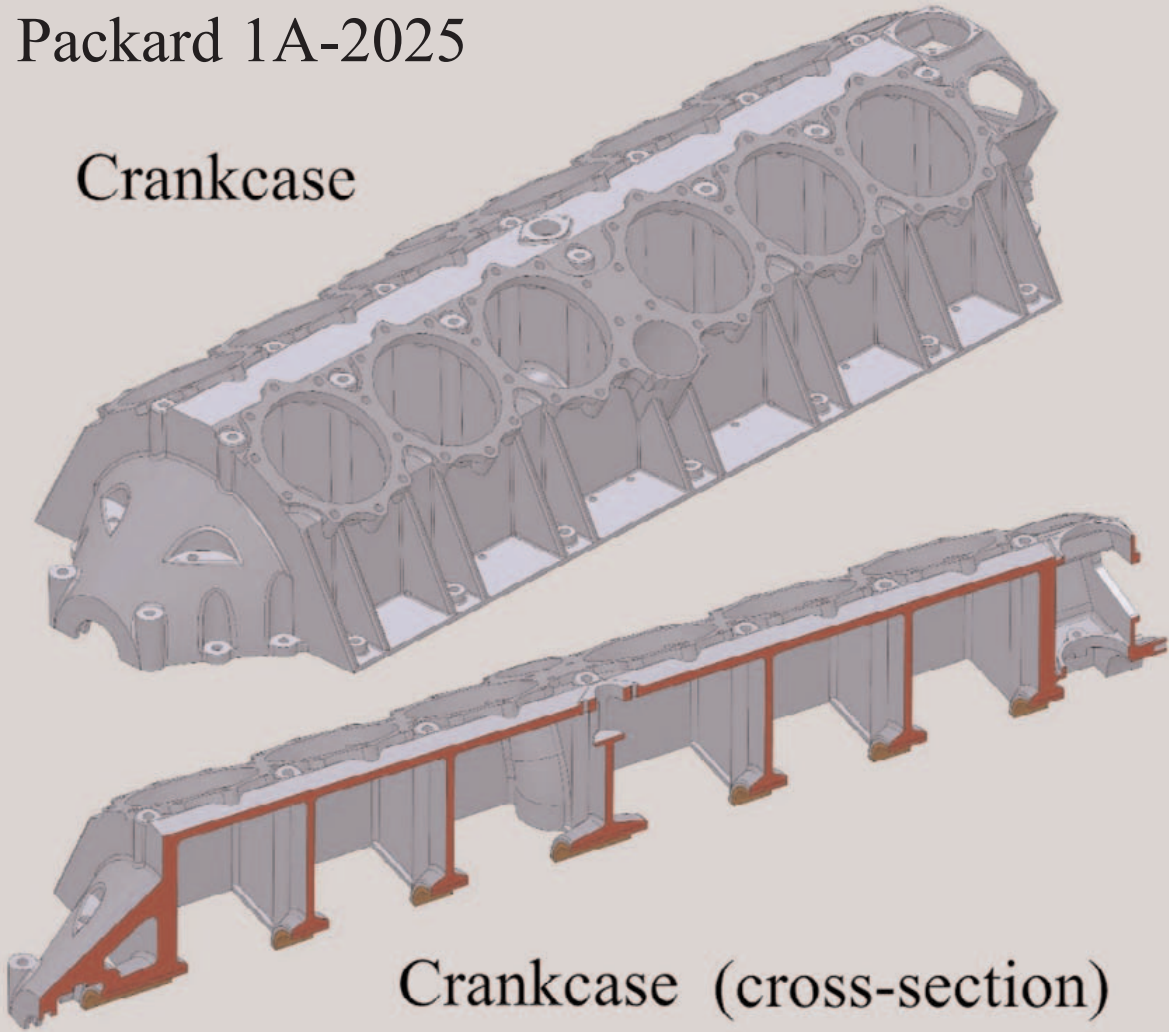
# Start by Modeling the Crankcase



# Start by Modeling the Crankcase

Packard 1A-2025

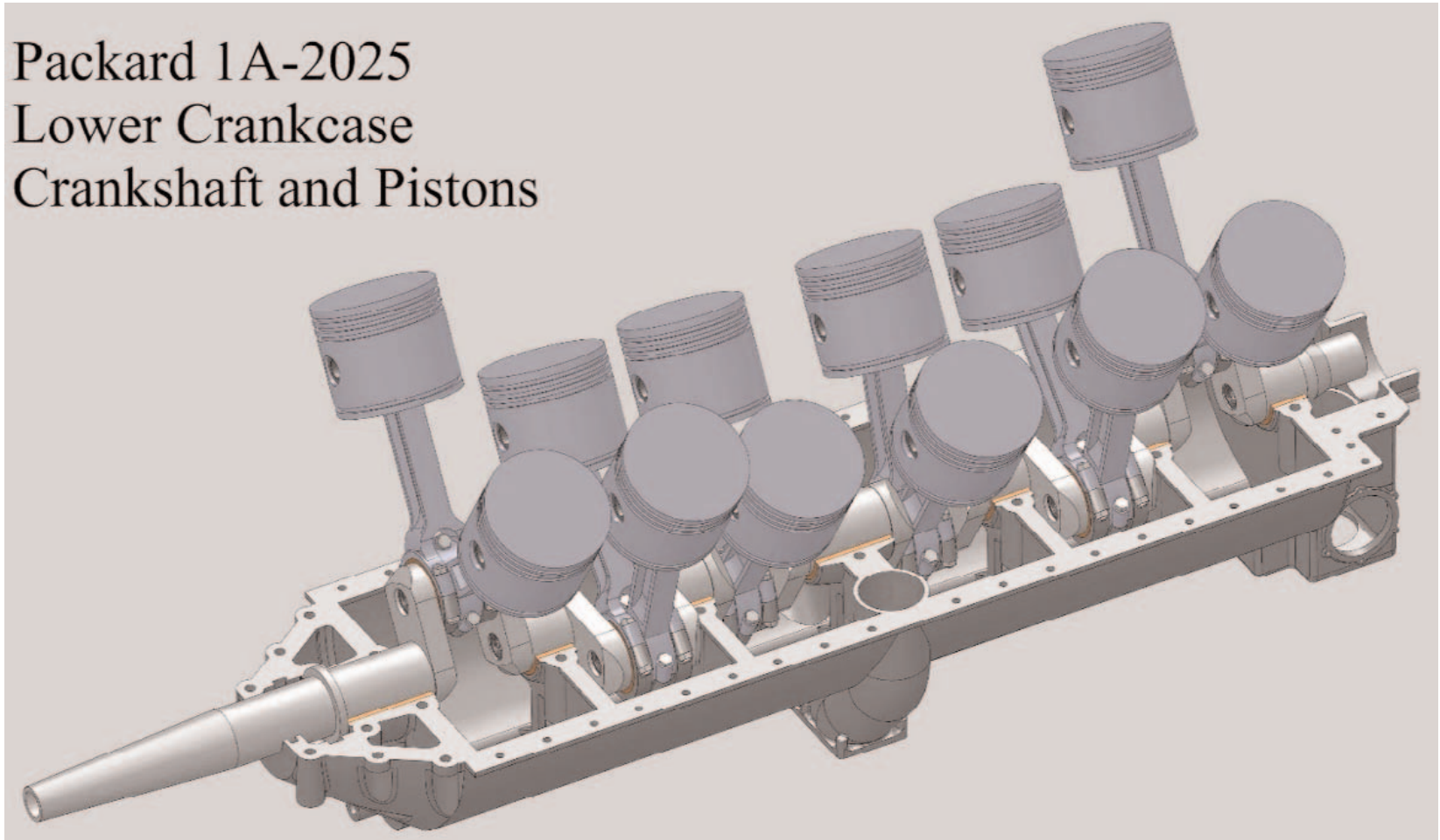
Crankcase



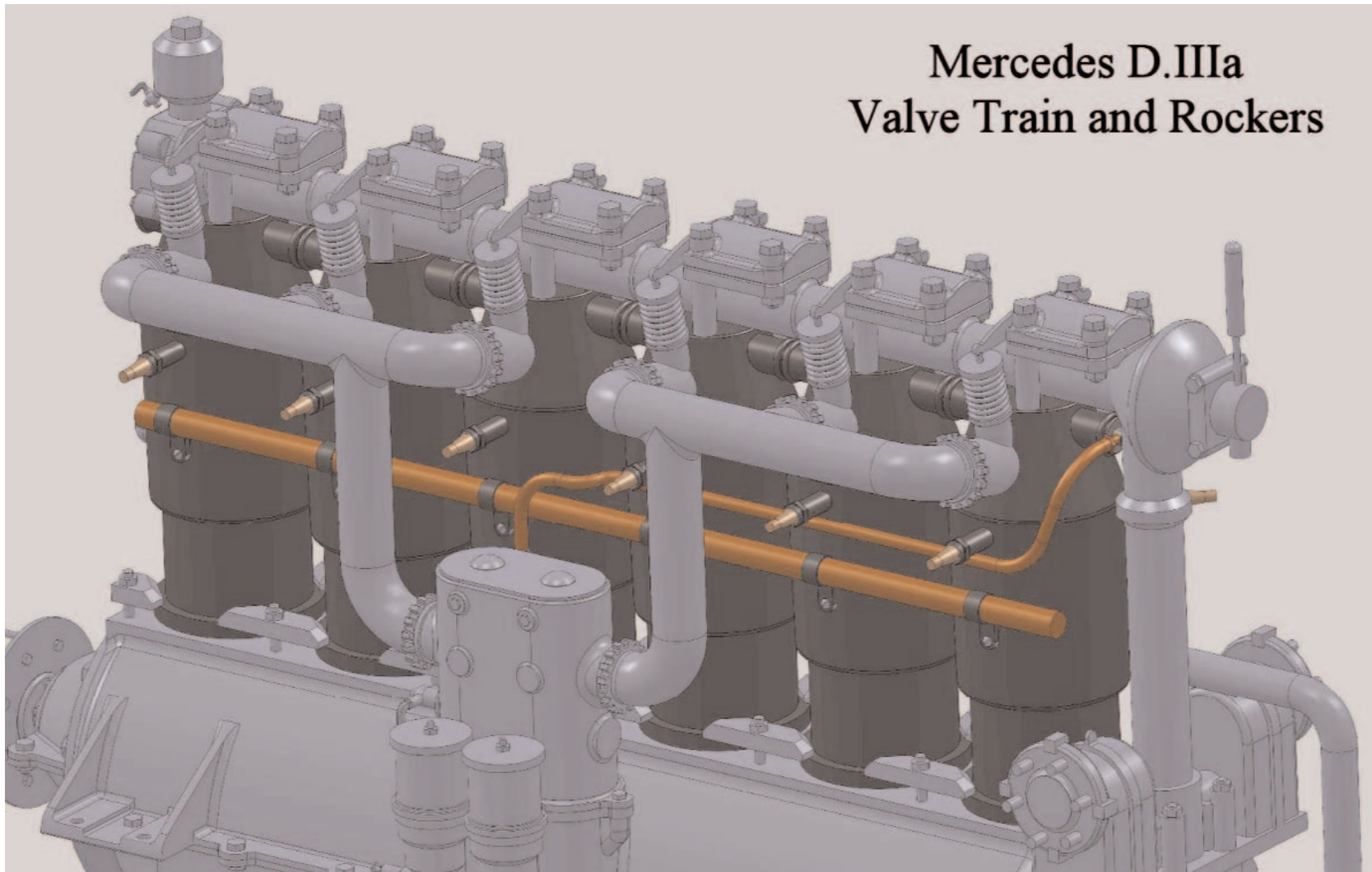
Crankcase (cross-section)

# Model and Assemble Internal Components

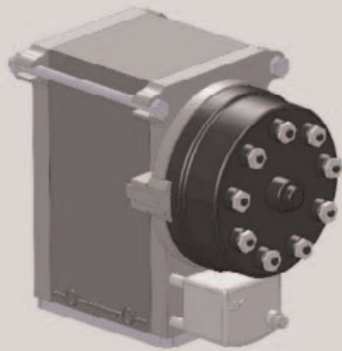
Packard 1A-2025  
Lower Crankcase  
Crankshaft and Pistons



# Create the Valve Train



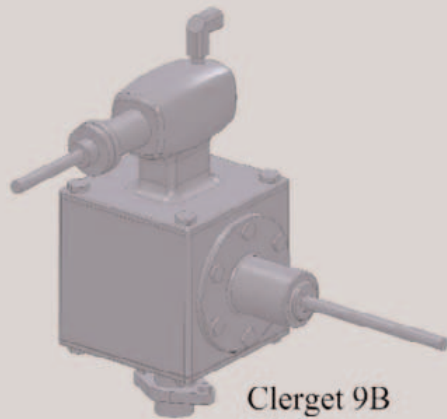
# Model the Accessories



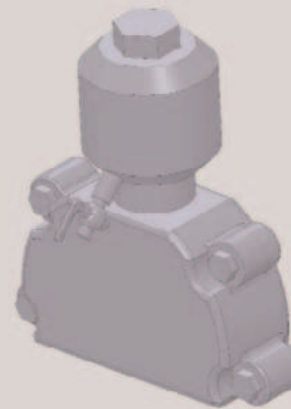
Lawrance R-1  
Dixie Magneto



Lawrance R-1  
Induction Tube

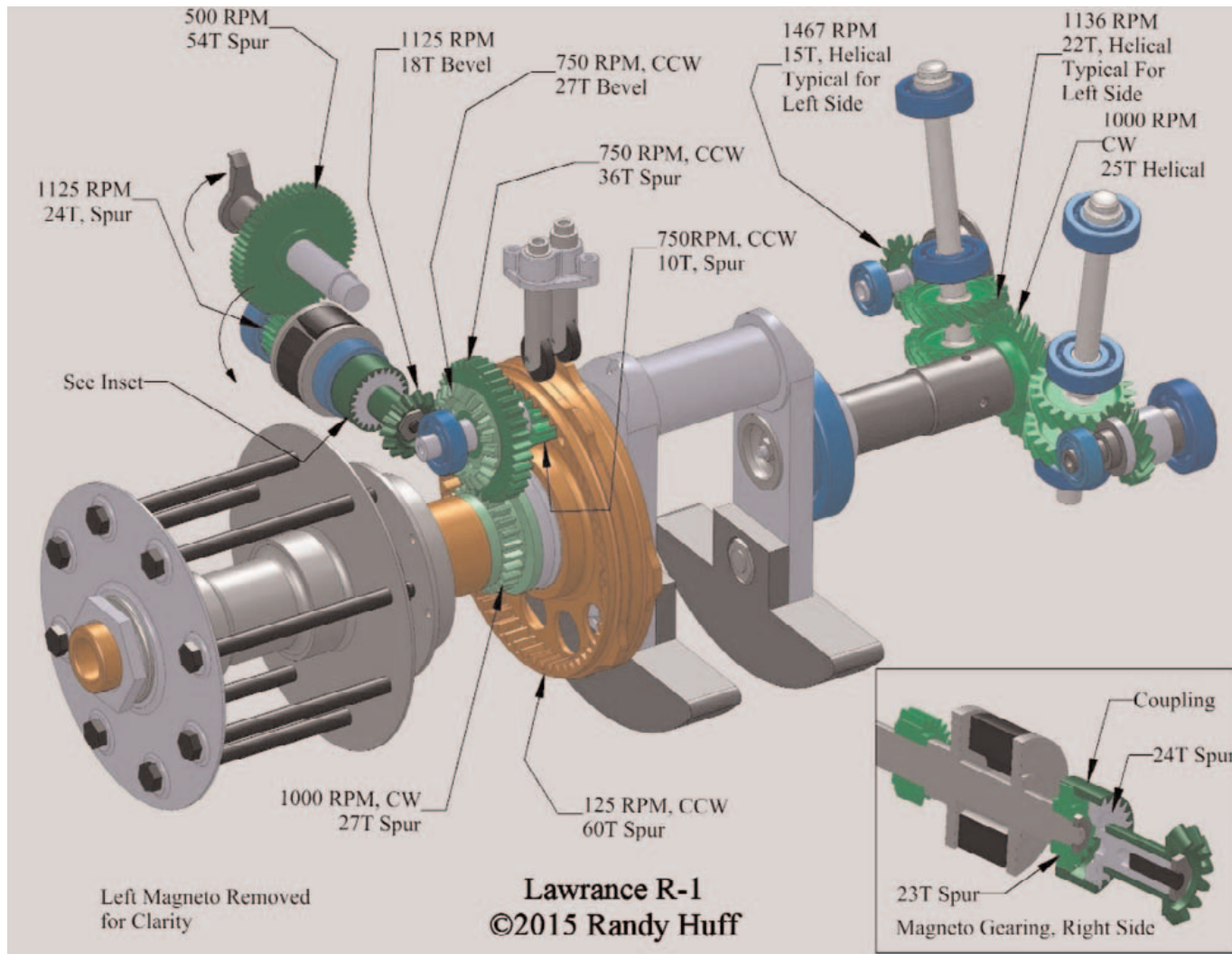


Clerget 9B  
Oil Pump



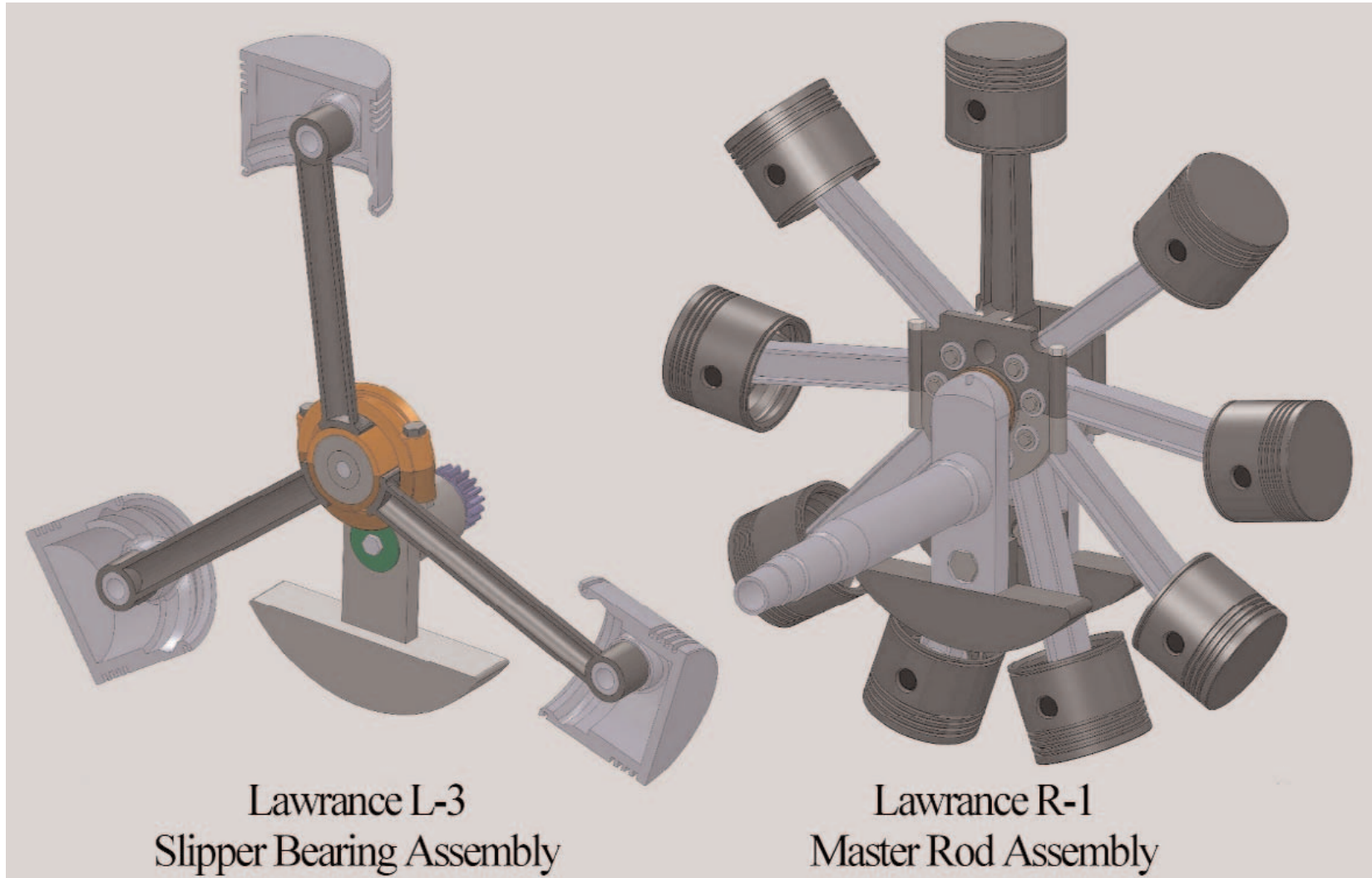
Mercedes DIII  
Air Pump  
Fwd End of Engine

# Calculate and Model Gears

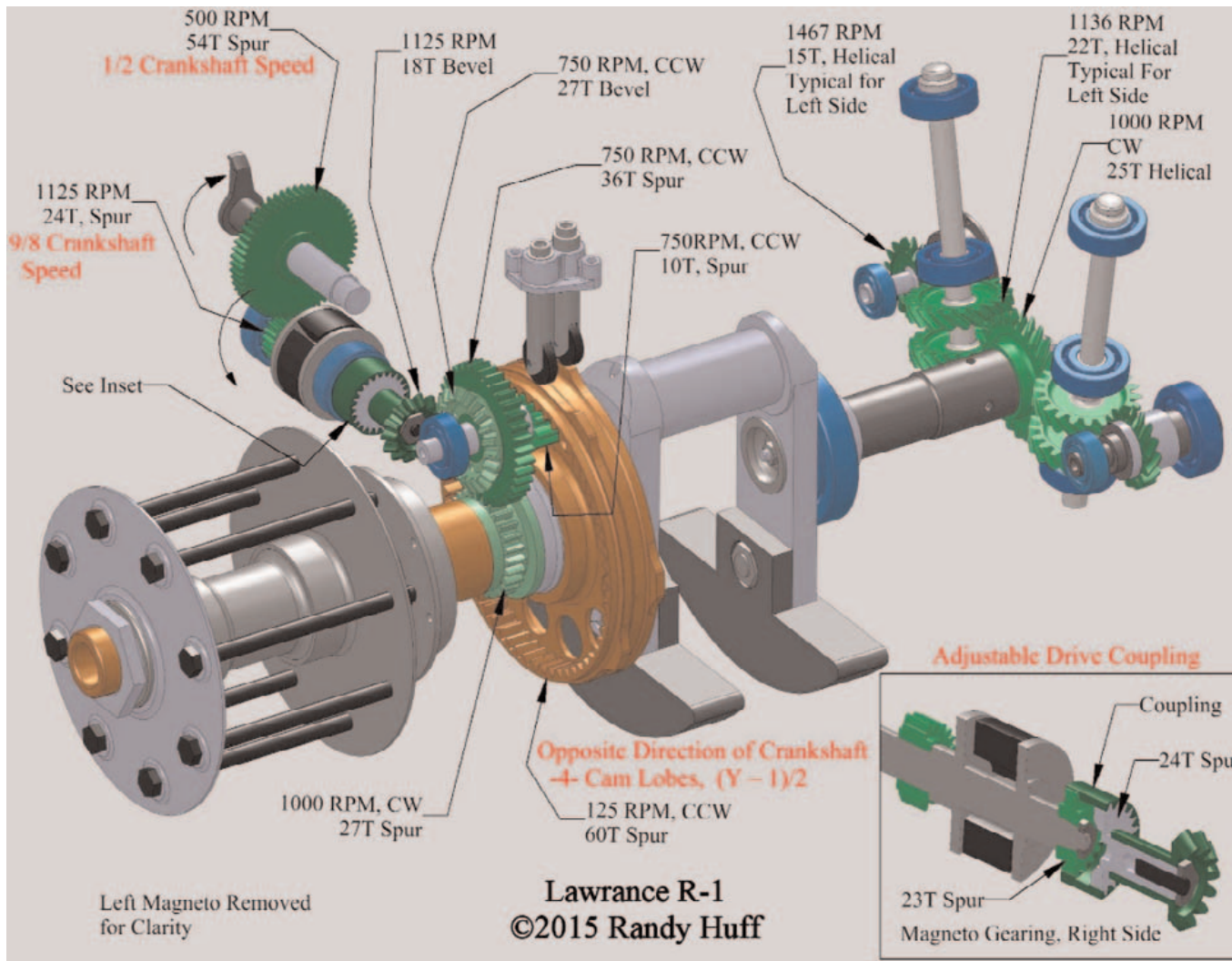




# Component Design and Evolution



# Verify Component Details



# Next Engine – Allison V-1710

