# Radial engine



Radial engine in a cut-away view



Radial engine of a biplane



A <u>Continental</u> radial engine, 1944



A radial piston engine from Continental is torn down after testing, 1944



Pratt & Whitney R-1340 radial engine mounted in Sikorsky H-19 helicopter

The **radial engine** is an <u>internal combustion engine configuration</u> in which the <u>cylinders</u> point outward from a central <u>crankshaft</u> like the spokes on a wheel. This configuration was very commonly used in <u>aircraft</u> engines before being superseded by <u>turboshaft</u> and <u>turbojet</u> engines. It is a <u>reciprocating</u> <u>engine</u>.

The cylinders are connected to the crankshaft with a master-and-articulating-rod assembly. One cylinder has a master rod with a direct attachment to the crankshaft. The remaining cylinders pin their <u>connecting rods</u> attachments to rings around the edge of the master rod (see animation). <u>Four-stroke</u> radials almost always have an odd number of cylinders, so that a consistent every-other-<u>piston firing</u> <u>order</u> can be maintained, providing smooth running.

## Debate of use

The debate about the merits of the radial vs. the inline continued throughout the 1930s, with both types seeing some use. The radial was more popular largely due to its simplicity, and most <u>navy</u> air arms had dedicated themselves to the radial because of its improved reliability for over-water flights and better power/weight ratio for <u>aircraft carrier</u> takeoffs. Although inline engines offer smaller frontal area than radials, inline engines require the added weight and complexity of cooling systems and are generally more vulnerable to battle damage.

The vast majority of radial-engined aircraft designed since the <u>1930s</u> were also were fitted with <u>NACA</u> <u>cowlings</u> to reduce <u>drag</u> and to also enhance forward thrust by virtue of its airfoil effect.

#### **Multi-row radials**

Originally radial engines had but one row of cylinders, but as engine sizes increased it became necessary to add extra rows. Most did not exceed two rows, but the largest radial engine ever built in quantity, the <u>Pratt & Whitney Wasp Major</u>, was a 28-cylinder 4-row radial engine used in many large aircraft designs in the post-<u>World War II</u> period. The <u>USSR</u> also built a limited number of '<u>Zvezda</u>' 42-cylinder diesel boat engines featuring 6 rows with 7 banks of cylinders, bore of 160 mm (6.3 in), stroke of 170 mm (6.7 in), and total displacement of 143.5 <u>liters</u> (8,756 in<sup>3</sup>). The engine produced 4,500 <u>kW</u> (6,000 <u>hp</u>) at 2,500 <u>rpm</u>.

## **Modern radials**

At least three companies build radials today. <u>Vedeneyev</u> engines produces the M-14P model, 360 HP radial used on <u>Yakovlevs</u>, and <u>Sukhoi</u> Su-26 and Su-29 aerobatic aircraft. The M-14P has also found great favor among builders of experimental aircraft, such as the <u>Culp's Special</u>, and <u>Culp's Sopwith</u> <u>Pup [1]</u>, <u>Pitts</u> S12 "Monster" and the <u>Murphy "Moose"</u>. 110 HP 7-cylinder and 150 HP 9-cylinder engines are available from Australia's <u>Rotec Engineering</u>. Miniature radial engines for <u>model airplane</u> use are also available from <u>OS</u> and Saito of Japan and <u>Technopower</u>. The Saito firm is known for making three different sizes of three-cylinder radials, and a five cylinder example.

### **Diesel radials**

While the vast majority of radial engines have been produced for gasoline fuels, there have been instances of diesel powered engines. The Bristol Phoenix of 1928-1932 was successfully tested in aircraft and the Nordberg Manufacturing Company of the US developed and produced a series of large radial diesel engines from the 1940s. To improve the fire security of the aviation engines, in 1932 built the French Clerget compagnie the 14 cylindrer diesel 2 strokes 300hp "14D" and after many improvements, is the "14F2" officially registered in 1938 for 520hp at 1910 rpm cruise power with a power/weight ratio near the gasoline engines and a consumption of 166g/hp/hour.During the WWII the research continues (but no engine where built in serial because Nazi occupation) and the engine come over 1000hp at take of power with a turbo supercharger in 1943. After the war, the Clerget compagny is integrated in the SNECMA compagnie and a diesel 32 cylinders for 4000 hp is on the way, but in 1947 the piston engines are abandonned and the resarch go to turbomachines... The Nordberg engines were initially designed for electricity production in aluminium smelters. They differed from the norm of radial design in using two opposite cylinders as a double master instead of single master rod usually found and manage to run perfectly circular. The engine design also permitted even numbers of cylinders in a single rank with the cylinders being fired in consecutive order. The engines were a two-cycle design and were also available in a dual-fuel gas/diesel model. A number of powerhouse installations utilising large numbers of these engines were made in the US.<sup>11</sup>

#### See also

- <u>Vedeneyev</u>
- Megola
- <u>Technopower</u>
- Warner Scarab