Opposed Piston Engines

Evolution, Use, and Future Applications

Jean-Pierre Pirault and Martin Flint

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Foreward

Opposed Piston Engines looks both backward and forward in time, with the view that these historical engines have relevance to future power-train challenges. Based on detailed research and discussions with relevant engineers, this book traces the evolution of opposed piston (OP) engines from the end of the nineteenth century, with the Oechelhaeuser, Junkers, and Beardmore two-stroke power units that offered the first serious challenge in thermal efficiency and specific output, to Otto and Diesel engines, and the manufacturing simplicity of these engines. In-depth descriptions are provided on many unique configurations of pioneering diesel OP engines such as the Fairbanks Morse medium speed engine, still in production in the United States more than 70 years since the first prototypes, and the Junkers Jumo 205E and 207B2 heavy duty engines—the only diesel engines to have been used regularly for commercial aircraft, with exceptional power/weight and brake thermal efficiency.

In the marine field, detailed descriptions from the United States' Marc outboard OP engine; a comprehensive review of the three crankshaft Napier Deltic, which remains unmatched in its class for power density and power/bulk; and a thorough coverage of the towering single crank Doxfords OP cathedral engines, which powered thousands of tons of merchant ships from 1923–1980 are provided. Automotive OP engine examples include the spark ignited air cooled AFRICAR light duty engine; the Rootes TS3, an iconic success as a medium duty truck in the United Kingdom in the 1960s; as well as numerous land based OP engines used in post World War II military vehicles in the Soviet Union, France, the United Kingdom, the Middle East, Iran, and India.

The general architecture and features of many of these OP engines have been reviewed holistically, specific items carefully examined, and efforts made to characterize key design and performance parameters, with comparisons to generalized four-stroke engine information where possible. A special section covers research projects, showing that opposed piston engines had been operated as early as 1941 at 6 bars absolute boost pressure and in turbo-compounding form, and achieved near 41% brake thermal efficiency as early as 1935, and 43% by 1960. A future for these types of engines is viable for small generating sets and utility engines, for light aircraft and unmanned aerial vehicles as they address the need for high power to weight and low bulk with manufacturing simplicity. The high torque capability and inherent low in-cylinder NOx potential of these two-stroke engines is highlighted and discussed in the context of heavy duty truck emissions and modern oxidation catalysts that are now capable of dealing with oil carry-over.

Martin Flint and Jean-Pierre Pirault jointly worked some 90 years in power-train manufacturing, product design, development, and research over a wide range of engine types. To write this book, they enlisted specialist reviewers with cumulative engine experience of over 500 years! In addition, many archives and museums from Germany, France, Switzerland, the United States, New Zealand, and the United Kingdom made valuable contributions to this work. Aside from the technical aspects, the engineers and corporations responsible for the conception, design, development, and manufacture of these unusual engines also provided anecdotal information.

This book is a good read, with over 500 illustrations and performance graphs, and will be a reference almanac for those interested in unusual engines, who want to know about remarkable performance and fuel economy achievements from relatively simple, robust, and cost effective power units. It is food for thought and for the future!

Tom Ryan III,

2008 SAE President

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