FUEL-EFFICIENT ENGINE DESIGN EXCLUDING TETRAETHYL LEAD

Technical field

The present invention relates to the field of additive manufacturing and, more specifically, to a method and system for incorporating security features into **3**-dimensional printed parts.

Background Art

The technical background of the innovation pertains to the development of an advanced aircraft engine system. The engine features a unique configuration with two banks of cylinders arranged in a flat, opposed layout. This design is coupled with a crankshaft that incorporates paired throws, enhancing the overall balance and performance of the engine. Additionally, the integration of an air charge compressor and cooler assembly, along with liquid engine and oil cooler assemblies, addresses the critical cooling requirements of the engine's components.

Furthermore, the innovation encompasses a comprehensive approach to reducing vibration and rocking moments, crucial for the smooth operation of the engine. This is achieved through the utilization of a balance shaft and a specialized "paired-throw" configuration of the crankshaft. The engine cooling strategy is a key focus, with a universal approach for air-cooled aircraft designs, utilizing lightweight aluminum cooling elements to efficiently manage heat dissipation within the constraints of the aircraft's cowling.

The intake and exhaust systems are meticulously designed, incorporating turbochargers, intercoolers, and precise fuel delivery mechanisms such as high-pressure fuel pumps, regulators, and injectors. The engine's internal components, including the cylinder head, pistons, and cam drive mechanism, are engineered to optimize performance and durability. Moreover, the incorporation of a water/oil heat exchanger and a shroud for air circulation further demonstrates the comprehensive nature of the innovation.

In conclusion, the technical background of this innovation represents a significant leap in aircraft engine design, addressing critical challenges related to balance, cooling, and overall performance. The integration of advanced features and a holistic approach to engine design sets a new standard for efficiency and reliability in aircraft propulsion systems.

Summary of the invention

The invention pertains to a horizontally opposed, piston-driven engine that does not depend on tetraethyl lead fuel. This engine achieves a high specific power output while being lightweight, thanks to the innovative design. It features air-cooled radial engines and incorporates the shortest crankshaft available, utilizing a single-throw, master-slave rod configuration. Additionally, the engine includes an arrangement that ensures effective cooling of crucial engine components, enhancing its overall performance and durability.

Brief description of the drawings

Detailed description

Step **800** of figure **0** involves the method of manufacturing a horizontally opposed, piston-driven engine system. This method includes the provision of an engine design that does not depend on fuel containing tetraethyl lead. The engine design is optimized to achieve high specific power output while maintaining a lightweight package. This optimization ensures that the engine system delivers efficient performance without the need for tetraethyl lead in the fuel composition.

In step **801**, the design of the engine system is tailored to enhance its specific power output within a lightweight structure. This optimization process focuses on maximizing the power output of the engine while minimizing its overall weight. By achieving a high specific power output in a lightweight package, the engine system can operate efficiently without compromising on performance or reliability.

Step **900** involves the development of air-cooled radial engines to facilitate the effective cooling of vital engine components. The radial engine design allows for efficient dissipation of heat generated during engine operation, ensuring that critical components remain within optimal temperature ranges. This cooling mechanism enhances the overall performance and longevity of the engine system by preventing overheating and related issues.

In step **902**, the method includes the incorporation of the shortest crankshaft available, which features a single-throw, master-slave rod arrangement. This unique crankshaft design optimizes the engine's mechanical efficiency by reducing rotational mass and frictional losses. The single-throw configuration, coupled with the master-slave rod arrangement, enhances the engine's operational smoothness and power delivery, contributing to its overall fuel efficiency and performance.

The method described in the invention focuses on combining innovative design elements to create a fuel-efficient engine system that does not rely on tetraethyl lead. By optimizing the engine design for high specific power output in a lightweight package, developing air-cooled radial engines for effective component cooling, and incorporating a specialized crankshaft configuration, the manufacturing process aims to produce an efficient and environmentally friendly engine system for various applications.

The present invention relates to a horizontally opposed, piston-driven engine system that is designed to be fuel-efficient and does not rely on fuel containing tetraethyl lead. The engine system comprises a unitary structure that includes several key components. These components consist of a horizontally opposed piston arrangement with multiple cylinders, a crankshaft featuring a single-throw, master-slave rod configuration, an air charge compressor and air charge cooler assembly for supplying air to the engine, a liquid engine cooler assembly for effective engine cooling, and a liquid oil cooler assembly for cooling the engine oil. Importantly, the engine is specifically designed to operate without the need for fuel containing tetraethyl lead, making it more environmentally friendly and compliant with modern fuel standards. In one aspect, the air charge compressor and air charge cooler assembly are configured as a turbocharger, enhancing the engine's performance and efficiency. Additionally, the engine system includes a fuel injection system for injecting fuel into the cylinders, ensuring precise fuel delivery and combustion. The liquid engine cooler assembly is designed as a radiator, effectively dissipating heat from the engine. Furthermore, the engine system incorporates an exhaust gas recirculation (EGR) system for recirculating a portion of the engine's exhaust gas, contributing to reduced emissions and improved efficiency. The engine is engineered to operate within a specific compression ratio range of **8**:**1** to **12**, optimizing its performance and fuel efficiency. Moreover, the engine system includes an electronic control unit (ECU) responsible for controlling various engine parameters, ensuring precise and efficient operation. Additionally, the engine is designed to operate with a variable valve timing system, further enhancing its performance and efficiency. The engine system also features a dual overhead camshaft (DOHC) configuration for actuating the valves in the cylinders, contributing to precise and efficient valve operation. In conclusion, the horizontally opposed, piston-driven engine system presented in the claims is a fuel-efficient and environmentally conscious design that excludes the use of tetraethyl lead in fuel. It incorporates various advanced components and systems to optimize performance, efficiency, and environmental impact, making it a significant advancement in engine technology.

The present invention pertains to a fuel-efficient engine design that eliminates the use of tetraethyl lead, an additive traditionally utilized in internal combustion engines. The engine design integrates advanced technologies and materials aimed at optimizing fuel combustion efficiency and reducing harmful emissions. The removal of tetraethyl lead contributes to environmental sustainability while enhancing engine performance and longevity.

A significant feature of the fuel-efficient engine design is the implementation of a high-pressure direct fuel injection system. This system facilitates the delivery of fuel directly into the combustion chamber at elevated pressure, thereby ensuring precise fuel metering and distribution. The control of the fuel-air mixture allows for optimal combustion efficiency, which results in improved fuel economy and diminished emissions.

Another component of the engine design is the incorporation of advanced engine management software. This software employs algorithms to continuously monitor and adjust various engine parameters, including fuel injection timing, air-fuel ratio, and ignition timing. The dynamic optimization of these parameters based on driving conditions enables the engine to operate efficiently and effectively, thereby enhancing fuel efficiency and performance.

The fuel-efficient engine design also utilizes lightweight materials and advanced engineering techniques to minimize overall engine weight and frictional losses. The reduction of internal friction and inertia allows for smoother and more efficient engine operation, which translates into improved fuel economy and decreased wear on engine components.

Additionally, the engine design features an exhaust gas recirculation (EGR) system that recirculates a portion of exhaust gases back into the combustion chamber. This process contributes to lower combustion temperatures and mitigates the formation of nitrogen oxides (NOx) emissions. The management of emissions without the inclusion of tetraethyl lead enables compliance with environmental regulations while maintaining optimal performance.

The fuel-efficient engine design further incorporates catalytic converter technology aimed at reducing harmful emissions. The catalytic converter employs a combination of precious metals and high-surface-area substrates to facilitate the conversion of harmful pollutants into less harmful substances. This efficient treatment of exhaust gases ensures adherence to emission standards while maximizing fuel efficiency.

Moreover, the engine design includes a variable valve timing (VVT) system that optimizes the operation of intake and exhaust valves based on engine speed and load. The adjustment of valve timing for optimal performance under varying operating conditions enhances fuel efficiency and power output. The VVT system contributes to engine flexibility and responsiveness while minimizing fuel consumption.

The fuel-efficient engine design presented herein provides a sustainable and high-performance alternative to traditional internal combustion engines that utilize tetraethyl lead additives. The integration of technologies such as direct fuel injection, engine management software, lightweight materials, EGR systems, catalytic converters, and VVT systems results in superior fuel efficiency, reduced emissions, and enhanced performance while maintaining environmental sustainability.

We Claim:

1. A horizontally opposed, piston-driven engine system, comprising:

   a. a unitary structure including at least the components of;

   b. a horizontally opposed piston arrangement comprising a plurality of cylinders (**803**);

   c. a crankshaft having a single-throw, master-slave rod configuration (**805**), the shortest crankshaft available in the engine;

   d. an air charge compressor and air charge cooler assembly (**806**) for providing air to the engine;

   e. a liquid engine cooler assembly (**807**) for effective cooling of the engine; and

   f. a liquid oil cooler assembly (**808**) for cooling the engine oil; characterized in that the engine is not reliant on fuel containing tetraethyl lead.

2. The horizontally opposed, piston-driven engine system of claim **1**, wherein the (**806**) air charge compressor and (**806**) air charge cooler assembly comprise a turbocharger.

3. The horizontally opposed, piston-driven engine system of claim **1**, further comprising a fuel injection system for injecting fuel into the (**803**) cylinders.

4. The horizontally opposed, piston-driven engine system of claim **1**, wherein the (**807**) liquid engine cooler assembly comprises a radiator.

5. The horizontally opposed, piston-driven engine system of claim **1**, further comprising an (EGR) exhaust gas recirculation (EGR) system for recirculating a portion of the engine's exhaust gas.

6. The horizontally opposed, piston-driven engine system of claim **1**, wherein the engine is configured to operate with a compression ratio between **8**:**1** and **12**:

7. The horizontally opposed, piston-driven engine system of claim **1**, further comprising an electronic control unit (ECU) for controlling various engine parameters.

8. The horizontally opposed, piston-driven engine system of claim **1**, wherein the engine is configured to operate with a variable valve timing system.

9. The horizontally opposed, piston-driven engine system of claim **1**, further comprising a dual overhead camshaft (DOHC) configuration for actuating the valves in the (**803**) cylinders.

10. A method for manufacturing a horizontally opposed, piston-driven engine system (800), the method comprising:

a. - providing an engine design that is characterized by not relying on fuel containing tetraethyl lead;

b. - optimizing the design for high specific power output in a lightweight package (**801**, **900**);

c. - developing air-cooled radial engines for effective cooling of vital engine components (**903**);

d. - incorporating the shortest crankshaft available, characterized in that it comprises a single-throw, master-slave rod arrangement (**902**).

11. The method of claim **10**, further comprising configuring the engine design to include a dual magneto ignition system (not mentioned in the components list) for redundancy and reliability.

12. The method of claim **10**, wherein the engine design includes a counter-rotating crankshaft (**902**) to reduce gyroscopic effects.

13. The method of claim **10**, wherein the engine design includes a pressurized lubrication system with an oil cooler (**905**) for improved engine reliability and longevity.

14. The method of claim **10**, wherein the engine design includes a dual carburetor setup for balanced fuel distribution to each cylinder.

15. The method of claim **10**, wherein the engine design incorporates a forged aluminum piston (not mentioned in the components list) for reduced weight and improved strength.

Abstract

A horizontally opposed, piston-driven engine designed to operate without fuel containing tetraethyl lead, achieving high specific power output in a lightweight configuration. This engine features a development of air-cooled radial engines and incorporates the shortest crankshaft available, utilizing a single-throw, master-slave rod arrangement. The design facilitates effective cooling of critical engine components, enhancing performance and reliability. The arrangement of the throws is coplanar and adjacent, optimizing the engine's operational efficiency and compactness.

Objective of Invention

A horizontally opposed, piston-driven engine designed to operate without fuel containing tetraethyl lead, achieving high specific power output in a lightweight configuration. This engine features a development of air-cooled radial engines and incorporates the shortest crankshaft available, utilizing a single-throw, master-slave rod arrangement. The design facilitates effective cooling of critical engine components, enhancing performance and reliability. The arrangement of the throws is coplanar and adjacent, optimizing the engine's operational efficiency and compactness.

Figures