

May 2, 1950

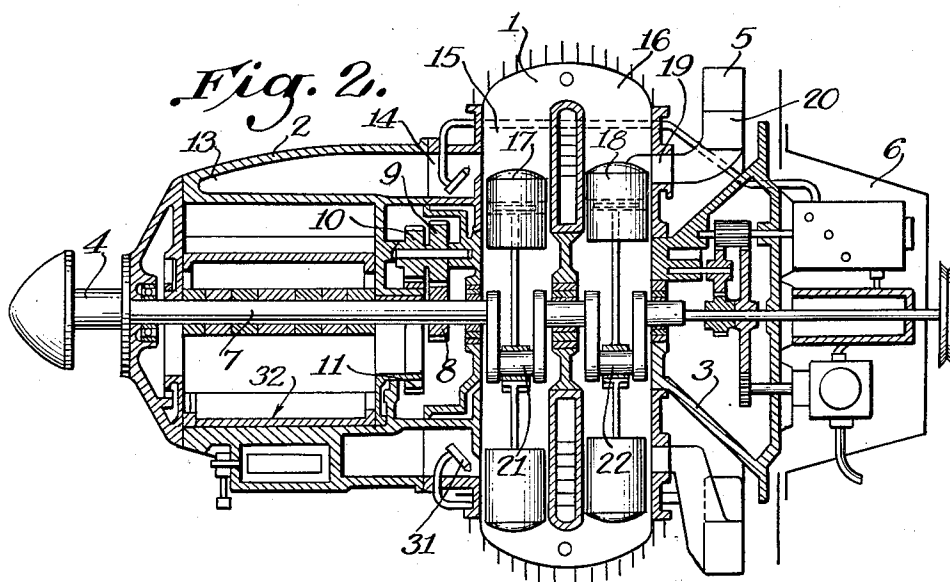
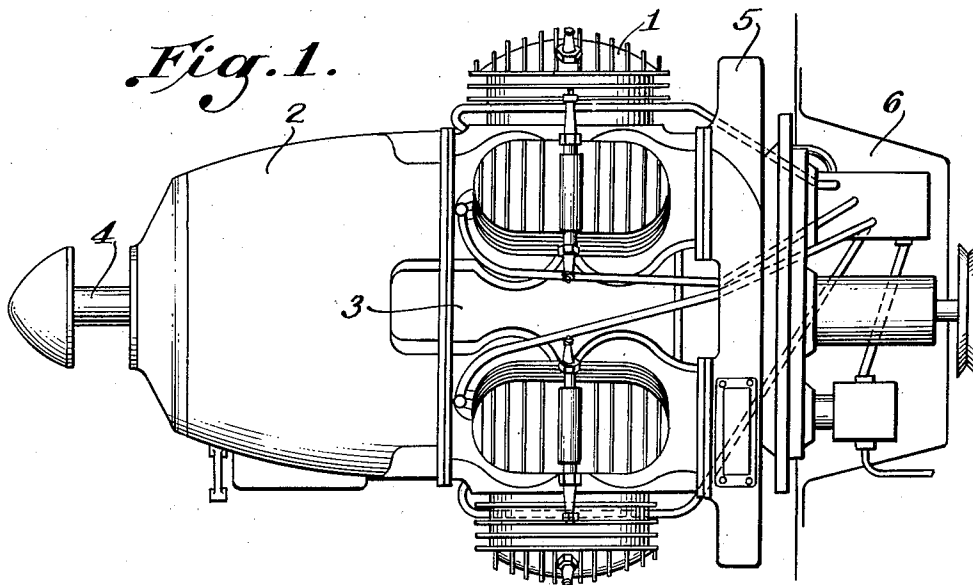
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2,506,142

TWO-STROKE MULTICYLINDER ENGINE

Filed July 10, 1945

2 Sheets-Sheet 1



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Fig. 3.

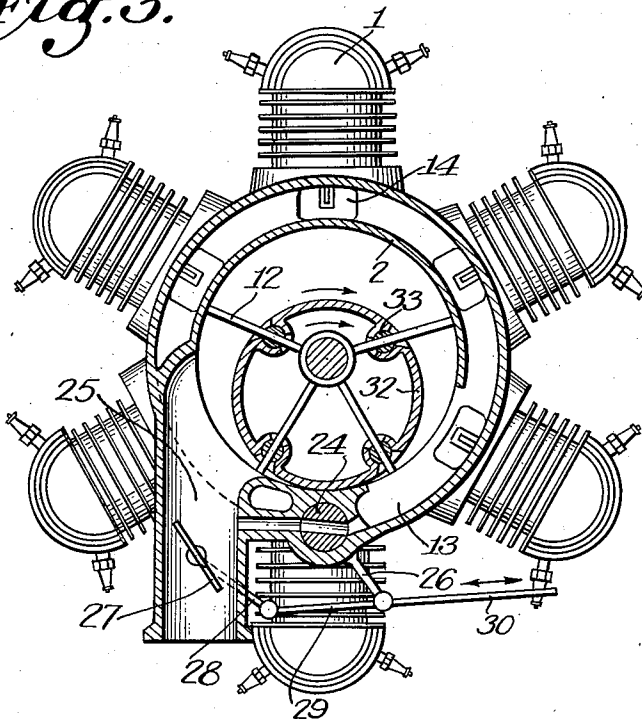
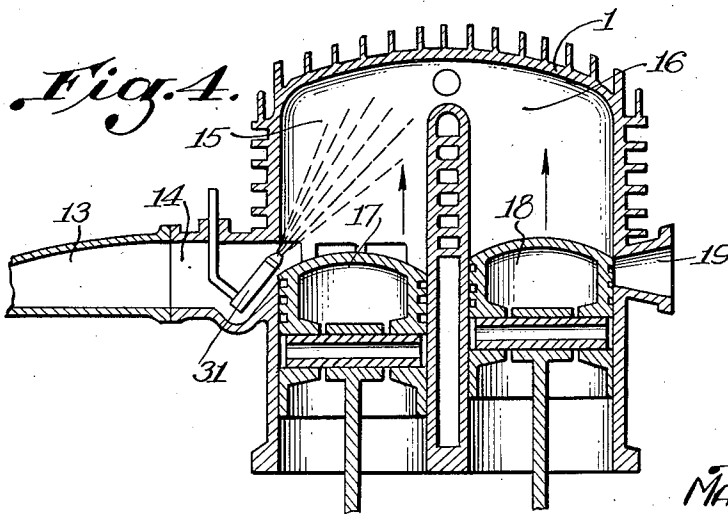


Fig. 4.



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TWO-STROKE MULTICYLINDER ENGINE

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Application July 10, 1945, Serial No. 604,111
In France July 3, 1944Section 1, Public Law 690, August 8, 1946
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1 Claim. (Cl. 123—55)

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The engine providing the subject-matter of this invention is intended primarily for use on airplanes; this however does not exclude the possibilities of all other applications for which it is suitable.

The essential qualities looked for in an airplane engine are: a low specific weight, an extreme simplicity and reliability combined with the possibility of a good streamlined cowl; in addition, a highly uniform torque and moving parts with an excellent balance are desired and so is a reduction of the fuel consumption to a minimum. Generally in aircraft engines such advantageous properties are obtained to a more or less great extent at the expense of mechanical complications involving difficult and costly machining methods.

In the engine according to this invention the desired qualities are obtained by new arrangements and combinations of some of the parts and means with a view to developing a multicylinder engine type which operates on the two-stroke cycle principle.

This cycle gives a high power-weight ratio and makes it possible to dispense with a great many delicate parts liable to get out of order, wear or break. In particular, in the four-stroke engine, the provision of valves sets a limitation on one hand to the speed of the engine for mechanical reasons and on the other hand to throttled-engine running as a consequence of the chemical action at high temperature of poor mixtures upon the metal, which has been demonstrated by experience.

In order to obtain maximum efficiency from the two-stroke cycle, this engine, which belongs to the so-called radial type, operates on the uniform principle by means of twin cylinders controlling the intake and the exhaust respectively, one head being common to both of the said parallel cylinders according to a known principle.

This arrangement, in combination with the angular displacement through a small extent of the crank pin in each group of intake and exhaust cylinders respectively allows obtaining a phase difference between the scavenging of the burnt gases and the filling with new gases at the desired relative pressure which depends on the operation of the loading and scavenging air-compressor to be dealt with hereafter. Carburetting is carried out with maximum efficiency by means of a pump.

The air-compressor is arranged co-axially with the main driving shaft in front of that cylinder

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group, which controls the intake and is nearest the propeller.

Since the compressor is rotated in the same direction as the driving shaft through the medium of a gearing, its speed relatively to said shaft is very low or null depending on the ratio of the gearing.

As a matter of fact, the rotor of the compressor rotates at a speed, which depends on the gear ratio of said gearing. By a suitable selection of the gears, it is possible to give the compressor a speed of rotation which is but little different from that of the shaft or even a speed equal to that of said shaft. As the compressor and the shaft rotate in the same direction, the consequence is that their relative speed is low or even equal to zero.

This involves unquestionable mechanical advantages as to the wear and life of the intermediate elements; the engine shaft also serves as the axle of the compressor vanes, which allows doing away with said part and saving as much weight.

The burnt gases are taken away through a two-channel annular collector which is so arranged that in a six-cylinder bank or row the three even cylinders shall discharge into the one channel and the three odd cylinders shall discharge into the other. Overpressures arising from interactions between the cylinders are thus avoided, and a possible dephasing of the acoustical impulses provides a reduction in the noise of the exhaust.

As a result of the described combination of the characteristics, locations and arrangements of the various parts, the overall dimensions and especially the front-section (maximum section) are decreased, and the ordering of the various elements lengthwise of the engine allows providing the latter with a streamlined cowl with the least possible drag. Said cowl possesses as correct an outline as the designer may desire.

At the same time the weight of the whole is lessened as a result of the decrease in the number and volumes of the parts.

An embodiment is shown in the appended drawings.

Figure 1 is a general side elevational view showing the typical grouping of the main elements and the resulting streamlined shape.

Figure 2 is a longitudinal cross-sectional view taken on the axis of the crankshaft.

Figure 3 is a diagrammatical illustration of the by-pass arrangement connecting the compressor with the carburetting members.

Figure 4 is an enlarged view of the details of a cylinder group.

1 designates the cylinder block, 2 the front casing which contains the compressor and the ring-shaped manifold leading to the front cylinders, the latter being intended to control the intake; 3 denotes the engine crankcase, 4 the hub on which the airplane propeller is to be fitted; 5 is the ring-shaped twin-channel exhaust manifold, 6 the back casing in which magnets, pumps, dynamos and like accessory apparatus are enclosed.

Rigidly secured on the driving shaft 7 as shown in Fig. 2 is the pinion 8 which meshes with a pinion 9 rigid with an additional pinion 10. Pinions 9 and 10 are rotatable about a common axis; said pinion meshes with a sunwheel 11 rigid with a rotor 32 constituted by a cylindrical member forming a rotor adapted to rotate eccentrically with reference to the driving shaft 7.

Vanes 12 rotate freely round the driving shaft 7 as shown more particularly in Fig. 3. The cylindrical rotor 32 is provided with longitudinal slots the walls of which assume a cylindrical shape, each slot holding rotatably two semi-cylindrical rods 33. Between the flat surfaces of the semi-cylindrical rods 33 is formed a passage for the free sliding of the vanes 12. The rotor 32 drives the blades 12 into rotation through the agency of the semi-cylindrical rods 33. The spacing between two successive blades 12 may be variable.

The rotational speed of pinion 11 and consequently the feed and pressure of the compressor can be altered easily by replacing 10 and 11 or 8 and 9 by two pinions having the same distance between centers but a greater or less number of teeth than the replaced pinions.

On the other hand the rotor of the compressor 32 is driven by the pinion 8 carried by the crankshaft and by the pinions 9, 10 and 11; it rotates (Fig. 3) in the same direction as said shaft and at the same speed as the latter if the ratio between the gears is suitably chosen. This speed may however be modified and then the speed of the rotor may become positive or negative with reference to the crankshaft.

As the rotor drives the compressor blades through the agency of the semi-cylindrical rods 33 and as said blades are freely mounted on the crankshaft which serves only as a support therefore, the displacement of the semi-cylindrical rods which hold the blades fast with reference to the crankshaft is limited in the case where the rotor and the crankshaft rotate at the same speed to an oscillating reciprocating movement. The blades being held on the crankshaft carried by the propeller bearing and the engine bearing and said blades not forming part of the compressor proper, said arrangement corresponds to the omission of the compressor shaft and of the bearings required for carrying same.

Visible at 13 in Fig. 2 is also the ring-shaped compressor delivery manifold which through such branch ducts as 14 leads the fluid from the compressor to such intake cylinders as 15.

As shown in the last-mentioned cross-sectional view, the two companion cylinders 15 and 16 have a common head; at the moment when piston 17 in 15 begins to close the intake port the piston 18 in cylinder 16 has almost closed the exhaust ports. As the intake port is being closed the compressor completes the filling of cylinders 15 and 16 in relation with the working pressure for which said compressor is designed.

In the case of a delayed mechanical carbureting, i. e. one that takes place following the intake of a given volume of air, the scavenging of the burnt gases is completed before the piston 18 has closed the exhaust port 19 which leads into the exhaust manifold 20. The latter collects the burnt gases from half the number of cylinders, namely, every other one.

The dephasing in the closure of the ports in cylinders 15 and 16 is brought about by the angular displacement of the related crank pins 21 and 22, crank pin 21 for instance being at its lower dead centre while crank pin 22 is already beyond the same in the direction of rotation.

A by-pass arrangement allows providing for a direct return between the delivery and the suction ends of the compressor so as to reduce automatically the output of said compressor into the engine when the latter is idling.

Visible at 23 (Fig. 3) is a region, in the delivery manifold of the compressor, which can be set into communication through the by-pass valve 24 with the space in which suction takes place. Said valve is actuated by a lever 26 connected with a flap valve 27 (or possibly a carburetor throttle valve) by lever 28 and link 29. This gear as a whole is actuated in turn by the control rod 30 connected with the hand-lever operated by the pilot or the man in charge of the engine.

It is always possible where necessary to incorporate an altimetric correcting device to the system at any desired point thereof.

The leverage 29-30 is designed in a manner such that the relative positioning of the levers 26 and 28 may provide for the opening of the by-pass valve 24 simultaneously with the closing of the flap or throttle valve 27 inserted in the suction pipe of the compressor and reversely.

The compressor may be fed by a carburetor in which case the flap valve 27 is constituted by a carburetor throttle valve of the type generally used in such cases.

When the flap valve 27 is closed partly, the compressor does not absorb suction work in a purely useless manner as, by reason of the simultaneous opening of the by-pass valve 24, the gases pass freely from the delivery end to the suction end of the compressor while the engine cylinders are fed to a gradually reduced extent.

The type of engine which is the subject-matter of this invention lends itself most advantageously to the provision of a mechanical carbureting by means of fuel pumps, whether the fuel be fed at high pressure directly into the head or be injected at low pressure.

In the latter event the low-pressure injector and atomizer 31 is located between two intake ports for the purpose of conferring homogeneity to the mixture. Besides, no counter-pressure is exerted at that point upon the injector by the compression or explosion pressures developed in the cylinders, since in the ascending stroke of piston 17 the latter covers the injector 31 at the same time as the intake ports and uncovers it in its descending stroke only after the exhaust is opened. This arrangement is a most important one since it makes it possible to do away in the injector and atomizer with cut-off needle or like valves which are very easily damageable by reason of their small size and of the high speeds attained thereby in highly rated engines.

It is only necessary to time the fuel injection accurately to ensure that the same shall take place into the cylinders subsequent to the

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scavenging by pure air which thoroughly drives out the waste gases while providing for an efficient cooling from the inside. On the other hand, the exhaust, when the fuel is being injected, must be sufficiently cut off, as a result of the dephasing, to ensure that even the smallest amount of fuel can not get into the exhaust manifold without having developed useful power.

The injection of fuel into the cylinder is performed at the end of the period of admission of air into the cylinder. The amount of air admitted into each cylinder may be superabundant, in other words the volume of air admitted may be higher than the cylinder charge; the excess amount of gases is exhausted and thus cooperates in the cooling of the inside of the cylinder.

The exhaust opening is partly closed when the injection begins and is entirely closed at the end of the injection stroke.

What I claim as my invention and desire to secure by Letters Patent is:

In an internal combustion aircraft engine having uniflow paired cylinders, a crank shaft for the cylinders and a drive shaft connected to and extending outwardly from the crank shaft, the improvement which comprises a volumetric compressor having a housing, a manifold communicating with the discharge of said compressor positioned within said housing and having ports communicating with the cylinders, said compressor housing being mounted to surround the drive shaft and extending substantially co-axially therewith, said compressor having rotatable vanes, said vanes being journalled directly on

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said drive shaft, a rotor surrounding said drive shaft and mounted eccentrically thereof to rotate said vanes on said drive shaft, and gearing between said drive shaft and said rotor to rotate said rotor at substantially the same speed and in the same direction as said drive shaft, said compressor functioning as the supercharger for the uniflow paired cylinders of the internal combustion aircraft engine.

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