Sept. 4, 1934. L. M. WOOLSON 1,972,467

INTERNAL COMBUSTION ENGINE

Filed Oct. 25, 1930 2 Sheets-Sheet 1

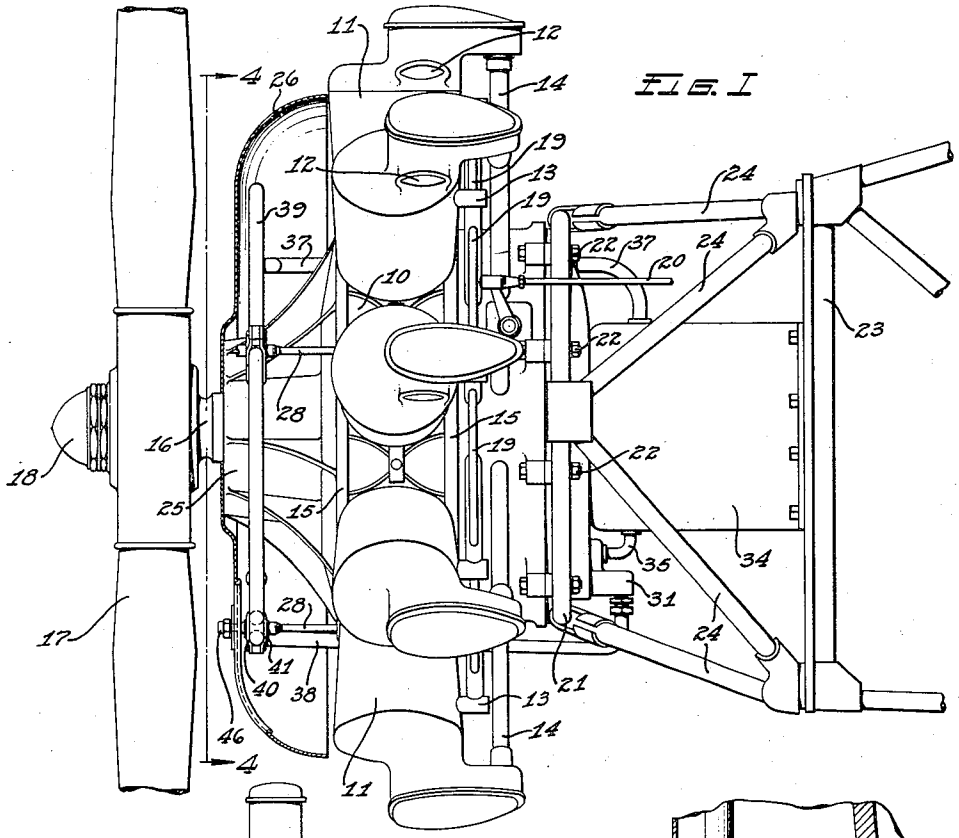

FIG. I

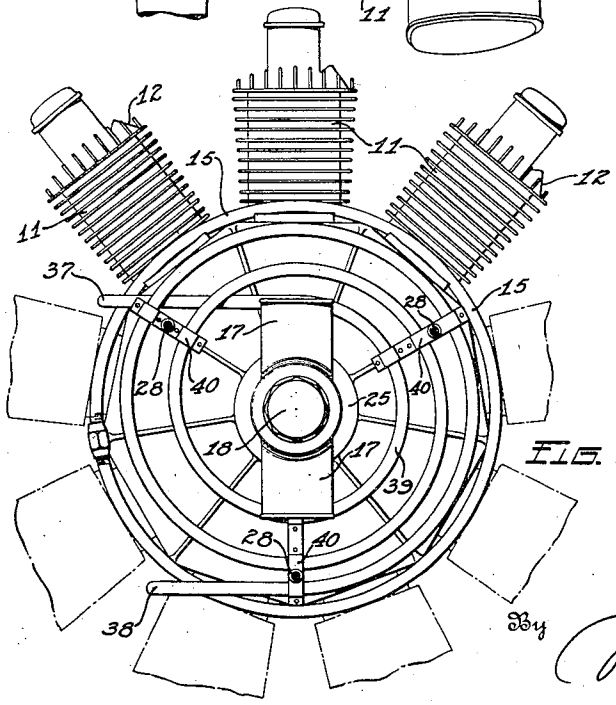

FIG. 2

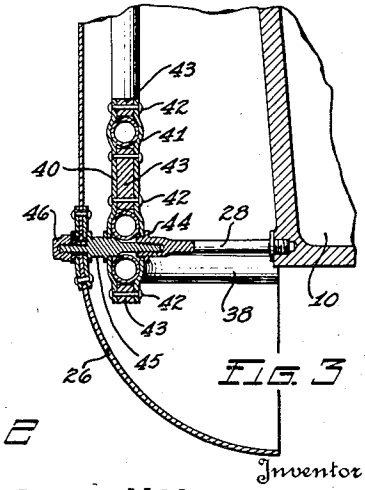

FIG. 3

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INTERNAL COMBUSTION ENGINE

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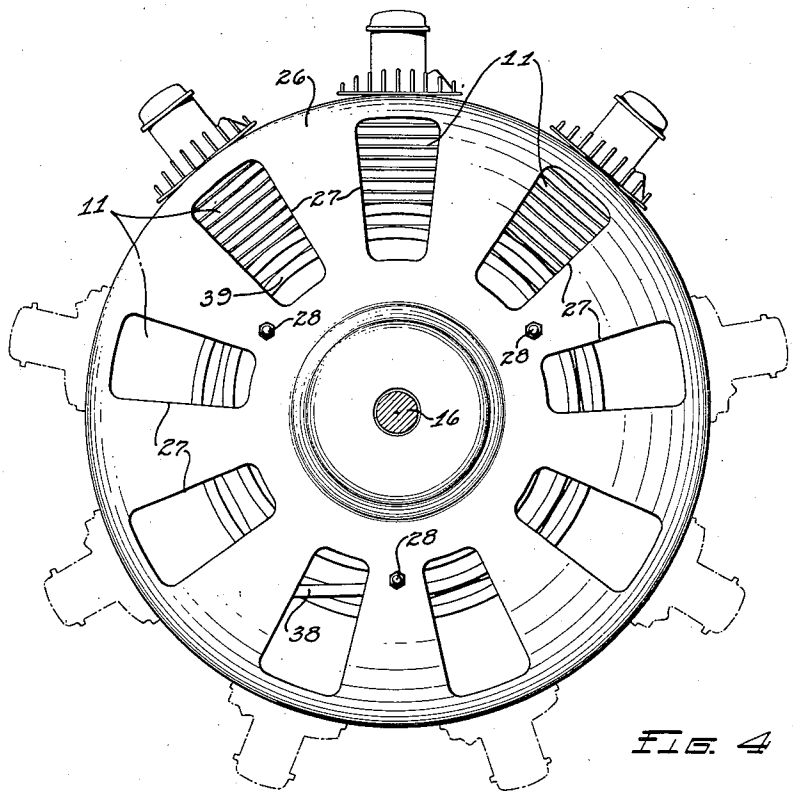

FIG. 4

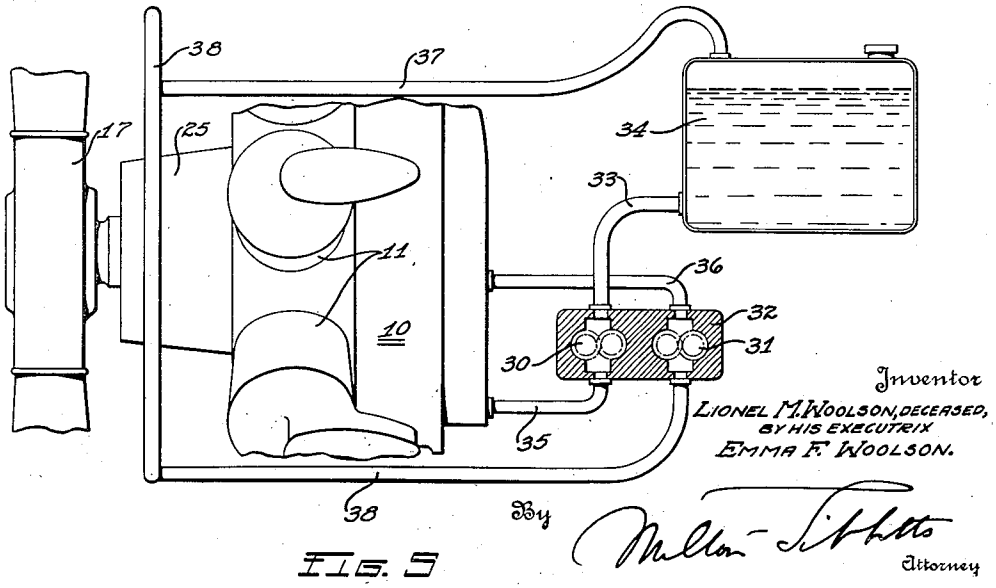

FIG. 5

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UNITED STATES PATENT OFFICE

1,972,467

INTERNAL COMBUSTION ENGINE

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Application October 25, 1930, Serial No. 491,250

7 Claims. (Cl. 184—104)

This invention relates to internal combustion engines and more particularly to the cooling of circulating lubricant in an aeroplane engine.

An object of the invention is to provide a circulating lubricating system for aeroplane engines having a cooling portion arranged in the air stream in a relation such that it will not offer any additional resistance to progress through the air beyond that of the engine proper.

Another object of the invention is to provide an inexpensive and efficient cooling system for a circulating engine lubricating system.

A further object of the invention is to provide a radial aeroplane engine in which a portion of the lubricating system encircles the crank case intermediate the propeller and the cylinders thereby forming an efficient, compact, cooling apparatus.

Still another object of the invention is to provide a radial aeroplane engine with a circulating lubricating system having a conduit cooling portion encircling the forward end of the crank case, protected by the engine cowling and supported by the cowling support.

These and other objects of the invention will appear from the following description taken in connection with the drawings, which form a part of this specification, and in which:

Fig. 1 is a plan view of the fore-part of an airship showing the engine and the lubricating system associated therewith;

Fig. 2 is a front elevation of the engine with the propeller blades and cowling removed;

Fig. 3 is a fragmentary sectional view of the engine showing the cowling support and the cooling coil securing means;

Fig. 4 is a sectional view of the engine taken on line 4—4 of Fig. 1;

Fig. 5 is a diagrammatic illustration of the engine lubricating system.

Referring to the drawings by characters of reference, 10 represents the cylindrical crank case of an internal combustion engine, preferably of the Diesel type, from which a plurality of cylinders 11 extend radially. The cylinders are each provided with a single port 12 serving as both the air inlet and the exhaust outlet, and a fuel oil injection device 13 is preferably associated with each cylinder. These devices each preferably include a nozzle and a plunger which is actuated by means of mechanism extending into the crank case to transmit motion through an engine driven element (not shown). A valve controls the inner end of each of the ports 12 and such valves are actuated by mechanism extending through housings 14 and into the crank case where suitable engine driven means is associated therewith. The cylinders are secured to the crank case by a pair of bands 15 which engage the cylinders adjacent portions bearing against the crank case, such bands being in tension which is initially greater than that produced therein by explosion forces during operation of the engine.

The crank shaft 16 extends axially through the crank case and is provided at its forward end with a propeller 17, there being a suitable driving connection between the crank shaft and propeller and a securing means 18 for retaining the propeller axially upon the crank shaft. The fuel injection devices are connected by conduits 19 and fuel oil is supplied thereto from a suitable source of supply. The engine is controlled by a lever 20 which actuates mechanism within the crank case to regulate the strokes of the fuel injection plungers and thereby determine the quantity of the fuel charges. Further details of the engine so far described can be found in my Patent No. 1,896,387, dated February 7, 1933, the application for which was co-pending herewith.

The rear end of the crank case is secured to a supporting ring 21 by means of bolts 22, and such ring is supported at the front of the fuselage 23 by struts 24. The forward end 25 of the crank case extends in advance of the cylinders, and a disk-shaped cowling 26 is secured thereto by bolts 28, such cowling being formed with a plurality of openings 27 disposed centrally in front of each of the radially extending cylinders. When the propeller is being rotated or when the airship is in flight, air will pass through the openings 27 and serve as the cooling means for the cylinders, there being conventional heat transfer ribs formed around the cylinders.

The lubricating system comprises a circulating system through which the lubricant is moved by a pair of pumps 30 and 31 arranged in the casing 32 and driven by suitable mechanism from the crank shaft. A conduit 33 connects the pump 30 with the reservoir 34, while a conduit 35 connects the pump 30 with the ducts arranged interiorly of the engine and leading to the elements to be lubricated. Excess lubricant collects in a sump in the engine in the conventional gravity manner, and is drawn therefrom by the pump 31 through the conduit 36. The pump 31 and the reservoir are connected by a conduit means which consists of an upper tube 37 connected to the reservoir, a lower tube 38 connected to the pump 31 and a cooling coil portion 39 connecting

the tubes 37 and 38. The pumps and reservoir are arranged at the rear of the engine, while the coil 39 encircles the forward end 25 of the crank case, in advance of the cylinders. The coil is enclosed by the cowling and lies within the circumference of the crank case so that it does not add in any degree to resistance to flight. The lubricant is forced through the coil by the pump 31, after being drawn from the engine, and is subjected to the cooling effect of air which passes through the openings 27 in the cowling.

The cowling supports are utilized for securing the cooling coil in position. Spaced brackets composed of plates 40 and 41 are arranged on opposite sides of the coil and are clamped rigidly thereagainst by rivets 42 which also pass through spacers 43. The rods 28 extend through the brackets, and the plates 41 engage a flange 44 on the rods. The rods 28 are formed in two sections; the rear section is screwed into the crank case and the front section extends through the associated bracket and screws into the front end of the rear section. The front sections are formed with a flanged portion 45 which with the flanges 44 clamp the brackets in a fixed position. The front rod sections extend through the cowling and nuts 46 secure the cowling against the flanged portion 45 of the rod. With this manner of securing the brackets the cooling coil can be readily assembled and disassembled relative to the engine, and will be rigidly mounted when assembled.

It will be seen that only a few loops of tubing are required for an efficient cooling of the circulating lubricant, thus providing an inexpensive structure both with respect to manufacturing and material cost. Furthermore, the cooling coil is compactly arranged and presents no frontal surface extending beyond that of the engine.

While there has been herein described in some detail a specific embodiment of the invention, which is deemed to be new and advantageous and may be specifically claimed, it is not to be understood that the invention is limited to the exact details of the construction, as it will be apparent that changes may be made therein without departing from the spirit or scope of the invention.

What is claimed is:

1. In a radial internal combustion engine for aeroplanes, a crank case having a reduced forwardly extending portion, and a circulatory lubricating system for the bearings of said engine, including a lubricant cooling coil encircling the forwardly extending portion of the crank case, said coil lying wholly within a zone defined by an axial extension of the largest peripheral portion of the crank case.

2. In a radial cylinder internal combustion engine for aeroplanes, a crank case having a forwardly extending reduced portion, a cowling for the front end of the engine, said cowling having openings in front of each cylinder, and a lubricant circuit including a cooling pipe loop encircling the forwardly extending portion of the crank case and enclosed by the cowling, said loop being exposed to air passing through the cowling openings and lying wholly within a zone in advance of and bounded by an axial extension of the largest peripheral portion of the crank case.

3. In an internal combustion engine for aeroplanes, a crank case having radially extending cylinders, a cowling at the front of the crank case, means securing the cowling to the crank case, and a circulatory lubricating system for the bearings of said engine, including a lubricant cooling coil between the cowling and the engine, and supporting means for the coil fixed to the cowling securing means.

4. In an internal combustion engine for aeroplanes, a crank case having radially extending cylinders, a cowling at the front of the crank case having openings in advance of the cylinders, rods securing the cowling to the crank case, and a circulatory lubricating system for the bearings of said engine, including a lubricant cooling coil housed by the cowling in the path of air passing through the openings, and means including brackets removably securing the coil as a unit to the rods.

5. In an internal combustion engine for aeroplanes, the combination of an engine having a crank case and having radial air-cooled cylinders, a cowling arranged in front of the engine and having openings directly in front of the cylinders and part of the crank case, and a circulatory lubricating system for the bearings of said engine, including an oil cooling line comprising pipes arranged between parts of said openings and the crank case.

6. In an internal combustion engine for aeroplanes, the combination of an engine having a crank case and having radial air-cooled cylinders, a cowling arranged in front of the engine and having openings directly in front of the cylinders and part of the crank case, and a circulatory lubricating system for the bearings of said engine, including an oil cooling line comprising pipe coils within the periphery of the crank case and between the crank case and said openings.

7. In an internal combustion engine for aeroplanes, a crank case having radial cylinders, a cowling space in front of the crank case with suitable air openings for the cylinders, and a circulatory lubricating system for the bearings of said engine, including lubricant cooling means arranged between the crank case and parts of said openings, and a common supporting means for the cowling and the cooling means on the crank case.

EMMA F. WOOLSON,
Executrix of the Estate of Lionel M. Woolson, Deceased.