C. L. LAWRANCE.

LUBRICATING SYSTEM FOR HIGH SPEED ENGINES.

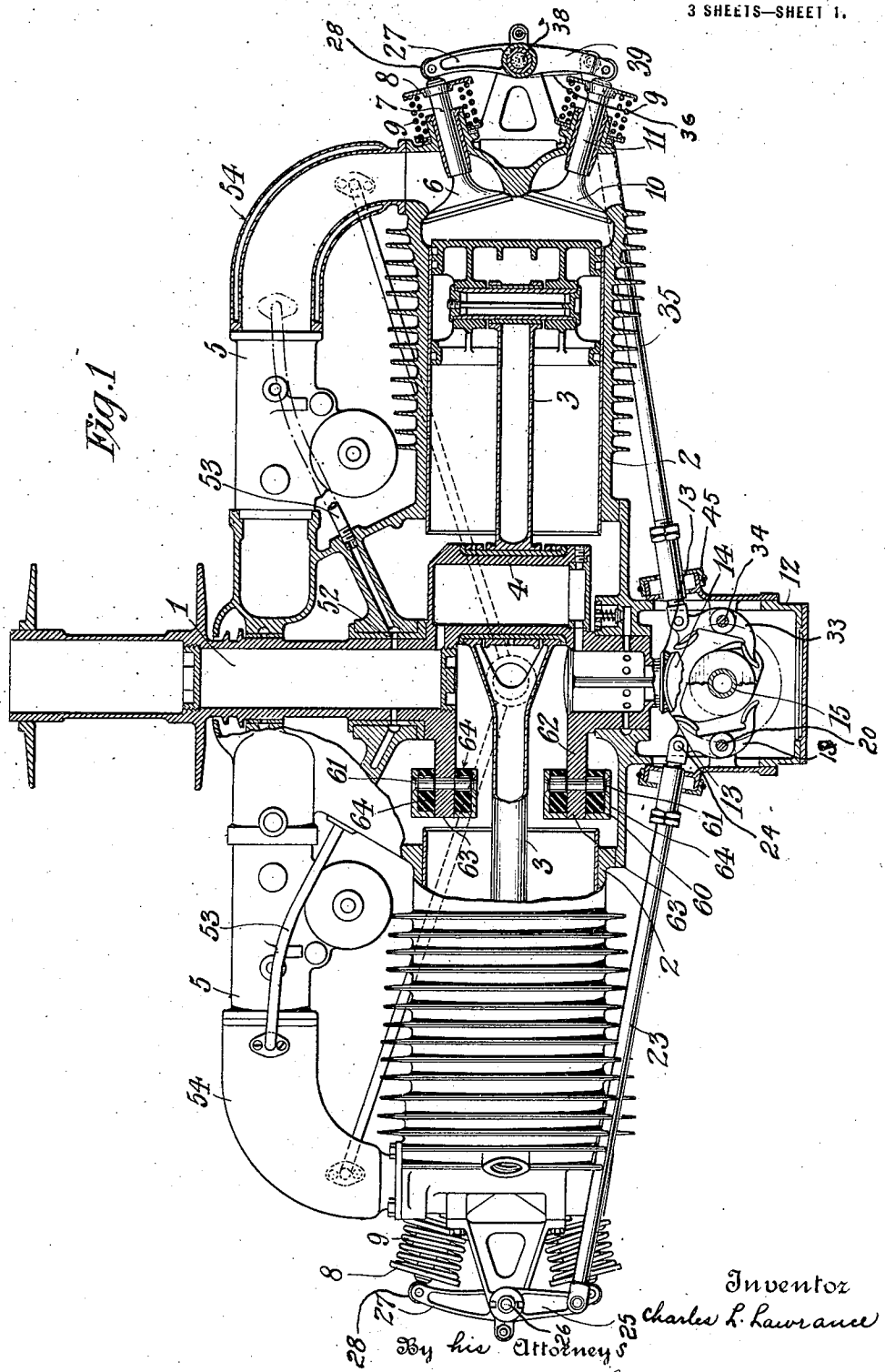
APPLICATION FILED SEPT. 6, 1918.

1,338,310.

Patented Apr. 27, 1920.

3 SHEETS—SHEET 1.

Fig. 1.



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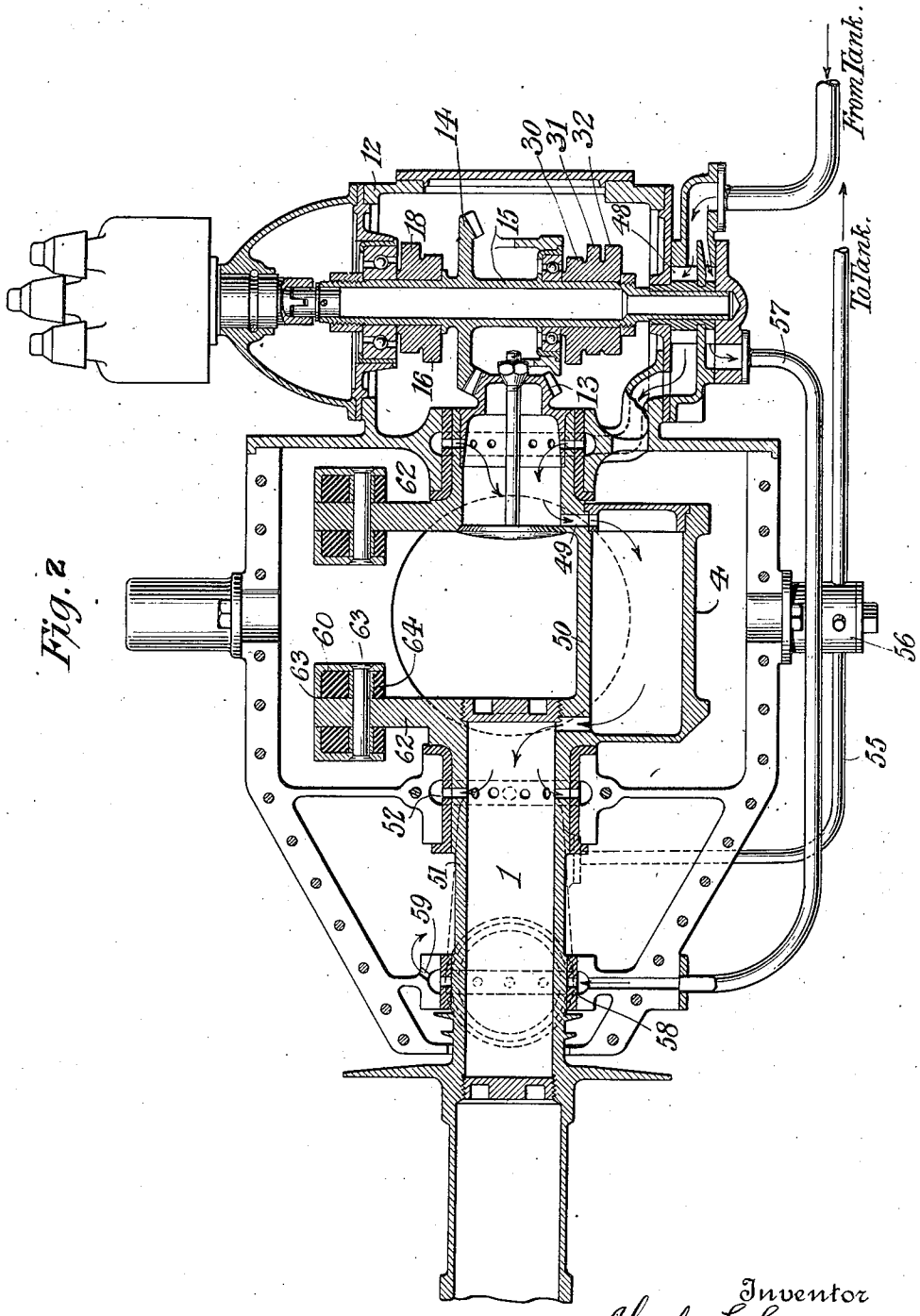
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3 SHEETS—SHEET 2.

Fig. 2



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3 SHEETS—SHEET 3.

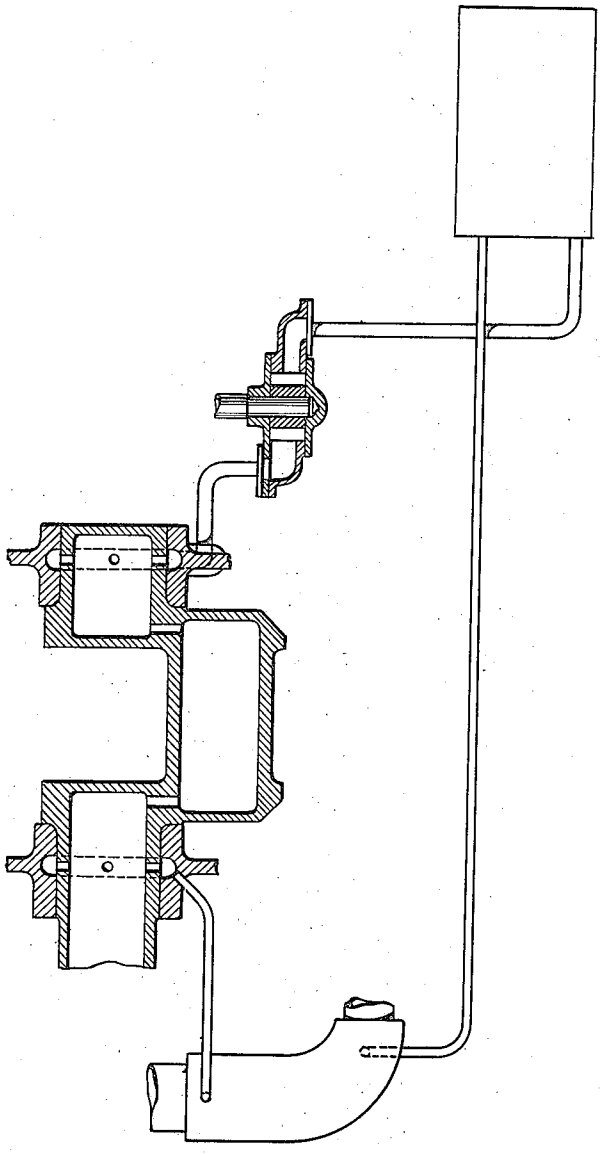


Fig. 3.

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UNITED STATES PATENT OFFICE.

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LUBRICATING SYSTEM FOR HIGH-SPEED ENGINES.

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Application filed September 6, 1918. Serial No. 252,845.

To all whom it may concern:

Be it known that I, CHARLES L. LAWRANCE, a citizen of the United States, residing in Bay Shore, Long Island, New York, have invented certain new and useful Improvements in Lubricating Systems for High-Speed Engines, of which the following is a complete specification.

My invention relates to the art of high speed engines for aircraft and like uses.

High speed machines of the crank type have given trouble, prior to my invention, owing to the heating of the crank pin. This has been specially the case where space has been economized by placing two or more connecting rods in the same plane transverse to the shaft.

The principal object of my invention is to provide novel and efficient means of cooling the bearings of a high speed engine.

Other objects of my invention will appear from the following description and claims.

According to my invention, I avoid danger of heating the crank pin by using a hollow crank and crank pin and forcing sufficient oil through them to conduct away the excess heat.

Having the foregoing objects in view, I have described hereinbelow the preferred embodiment of my invention.

In the accompanying drawing which forms a part of this specification,

Figure 1 is a plan view, partly in section, of an internal combustion engine embodying my invention.

Fig. 2 is a vertical sectional view through the shaft of the engine shown in Fig. 1.

Fig. 3 is a diagrammatic view showing the course of the circulation of the cooling oil.

In separate views the same part is designated by the same reference character.

Referring more particularly to the drawing, 1 is the shaft of an engine having two opposed cylinders, such as 2, which are arranged in axial alinement, the connecting rods, such as 3, being connected to a crank pin 4.

Intake pipes for the cylinders are shown at 5, each intake leading to an inlet valve, such as 6, which has a stem 7, mounted to reciprocate in the head of the cylinder, the stem 7 carries a disk 8, and a closing spring 9 is provided which acts in compression between the cylinder head and the disk 8 to hold the valve 6 normally closed. On the opposite sides of the cylinders from the intake valves, are two exhaust valves, such as 10, having stems 11 mounted similarly to the stem 7 of the inlet valves, and having similar closing springs. The rear end of the shaft extends into a cam box 12 and carries within said box, a gear 13, which meshes with the gear 14 to drive the cam shaft 15 at half the engine speed. Mounted on the shaft 15 are two sets of cams, one for the inlet valves and one for the exhaust valves. Connecting the proper cam and each of the inlet valves, such as 6, is a system of gearing comprising rock arms, such as 19, mounted on pivots, such as 20, within the cam box 12. The arms 19 are provided with contact toes for coöperating with the cams.

The opening gear for the inlet valves also comprises a rod, such as 23, which extends through the wall of the cam box and is pivoted to the rock arm 19 at 24, the other end of the rod 23 being pivoted to one end of an arm 25 carried at one end of a short shaft 26. At the other end of shaft 26 is an arm 27, extending in the opposite direction from the arm 25 and carrying in its outer end a roller 28 for pressing on the head of the valve stem 7 to open the valve.

In the gear for the exhaust valves, I provide a rock shaft, such as 33, for operating the gear of the right-hand exhaust valve 10, said rock arm being mounted within the box 12 on pivot 34. A rod 35 connects the rock arm 33 with a lever 36 on a shaft 38, the other end of the shaft carrying a lever 39, having a contact roller thereon for forcing open the valve 10 by pressure against the end of the stem 11. It will be seen that levers or arms 36 and 39 extend in the same direction from their shaft, whereas the levers or arms 25 and 27 of the inlet valve gear extend in opposite directions from their shaft. The crank or arm 33 is provided with a toe 40, which contacts with the opening cam 30, and a toe 41, which cooperates with the cam 31, for moving the gear in the direction to permit the corresponding spring 9 to close the valve 10. The left hand valve 10 is operated by a gearing similar to the righthand valve, except that the rock arm 42 is not identical with the arm or lever 33, member 42 having a toe 43 adapted to contact with the intermediate closing cam 31, and a lower toe 44 arranged to contact with the lower opening cam 32,

It will be seen that the exhaust valves require two opening cams and a single closing cam, the closing toes for the respective exhaust valves being in the same plane transverse to the shaft 15, whereas the opening toes are respectively above and below the said plane.

Where the valve operating rods 23 and 35 pass through the walls of the cam box 12, I provide a stuffing box, such as 45.

In order to economize space, I have arranged the cylinders in the same plane transverse to the driving shaft 1, thus giving a short crank pin. In order to prevent heating of the pin, I have arranged a combined lubricating and cooling system comprising a gear pump, such as 48, at the lower end of the shaft 15, which receives oil from a suitable reservoir and forces the same through a bearing into one end of the hollow crank shaft as indicated by the arrows in Fig. 2. The oil passes from the shaft through apertures such as 49, into a hollow crank pin 50, and thence through similar apertures at the other end of the pin into a second hollow portion 51 of the shaft. From the part 51 the oil passes out from bearing 52 into pipes such as 53, shown in Fig. 1, and thence to jackets such as 54, surrounding the intake pipes for the cylinders. From the jackets 54 the oil passes back through pipes such as 55, to a sump 56, from which it is returned to the reservoir. By providing the jackets 54 around the intake pipes 5, the heated oil from the crank and bearings is cooled at the same time serving to warm the explosive mixture. In order to provide cooling oil within the crank case I also arrange for a pipe 57 which connects with the lower portion of the pump 48, and with a bearing 58, from which there is an opening 59, into the interior of the crank case, the sump 56 receiving oil from the interior of the case from whence it is returned to the reservoir. It will be understood that the volume of oil forced through the bearing and crank is not only sufficient to provide lubrication, but also in great enough volume to afford a material cooling of the crank pin, thus increasing the capacity of the pin for high unit loads and high speeds.

Having thus described my invention, I claim:

1. The method of cooling a high speed hollow crank shaft having main and pin bearings, comprising forcing into said shaft an excess of oil above that required for lubricating the bearings supplied through said shaft, and taking said excess oil direct from said shaft and cooling said excess oil before injecting it into said shaft again.

2. The combination in a high speed engine of a hollow crank shaft and bearings receiving their supply of lubricating oil through said shaft, a pump connected to force oil into said shaft and adjusted to supply oil in excess of that required for lubricating said bearings, a cooler, connections between said shaft and said cooler for conducting said excess oil to said cooler, connections between said cooler and said pump, and connections for returning oil used in lubricating to said pump.

3. The combination in a high speed engine having a crank case, of a hollow crank, and bearings which receive oil through the interior of the crank and discharge lubricating oil into said case, a pump connected to deliver oil to the interior of said crank shaft and adjusted to deliver an excess of cooling oil above that required for lubricating the bearings supplied through said crank shaft, and a cooler connected to receive said excess oil from said crank shaft.

4. The combination in a high speed engine of a hollow crank shaft having main and pin bearings, of a pump for circulating oil through said shaft, two of said main bearings being so constructed that oil may be forced into the hollow of the shaft through one and out through the other without passing along bearing surfaces.

5. The combination in a high speed engine, of a hollow crank shaft having main and pin bearings, of a pump for circulating oil through said shaft, two of said main bearings being so constructed that oil may be forced into the hollow of the shaft through one and out through the other without passing along bearing surfaces, and a cooler connected to the one of said main bearings from which the oil discharges.

CHARLES L. LAWRANCE.