COOLING CYLINDER LINERS OF INTERNAL COMBUSTION ENGINES

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Fig. 1

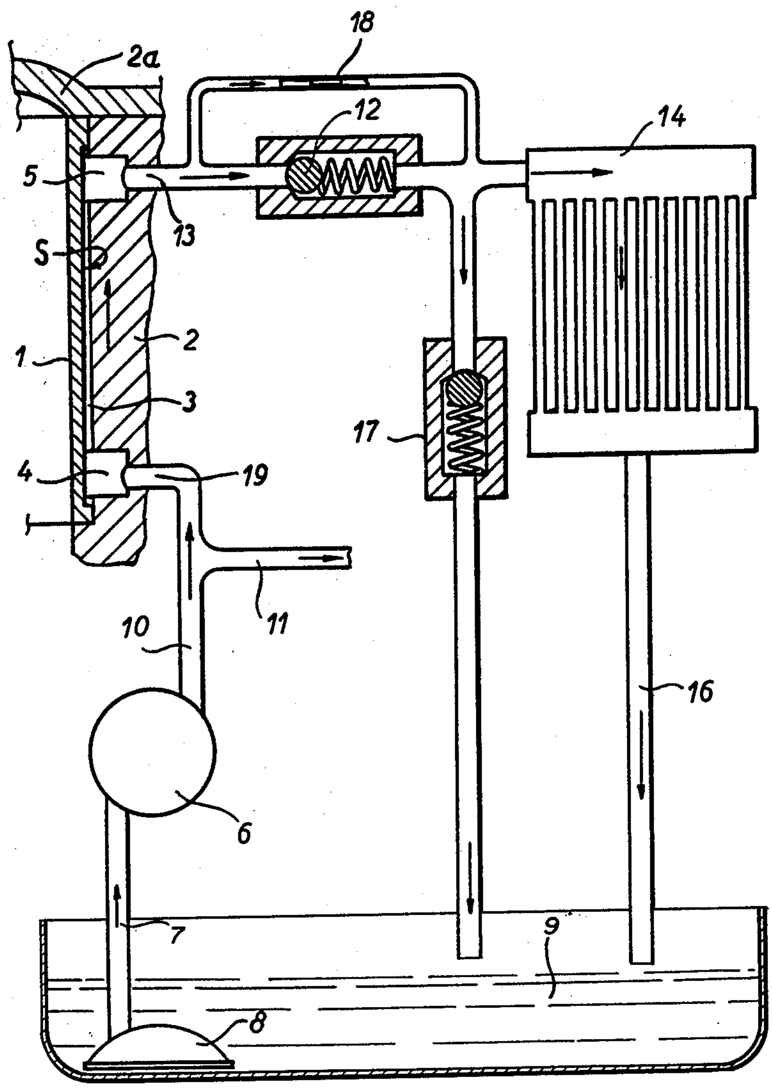

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Fig. 2

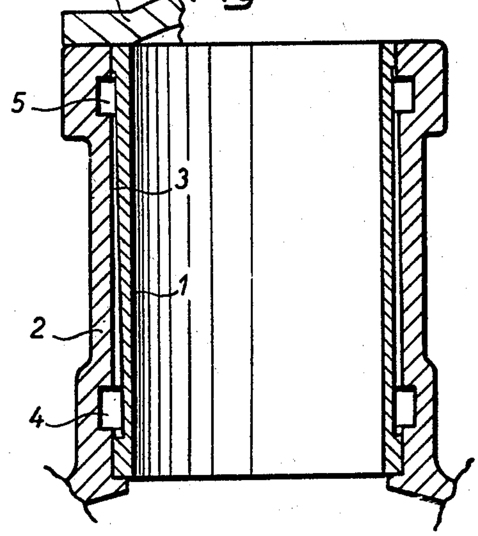
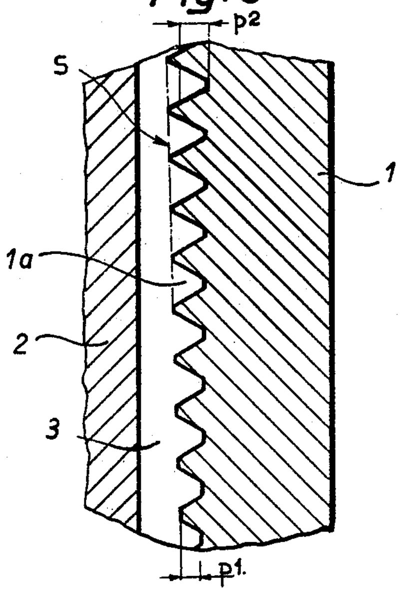


Fig. 3



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COOLING CYLINDER LINERS OF INTERNAL COMBUSTION ENGINES

Dante Giacosa and Giovanni Torazza, Turin, Italy, assignors to Fiat Societa per Azioni, Turin, Italy

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6 Claims. (Cl. 123—41.72)

This invention relates to a device for cooling the cylinder liners of internal combustion engines by means of the lubricating oil.

An object of this invention is to provide a device which affords advantages such as noiseless run of the engine of known water cooling devices having an opened or pressurized circuit, as well as advantages of quick reaching of the operational temperature of the air cooling devices, while avoiding inherent drawbacks of such known devices.

In order to be efficient the lubricating oil for cooling purposes has to flow at a high speed along the surface to be cooled.

The improved cooling device comprises annular interstices of relatively small cross section, formed around the cylinders liners, through which pressure oil derived from a branch of the lubricating circuit is circulated and then cooled in a cooler.

The cross-sectional area of oil flow should be calculated in such manner that at highest engine power the oil speed is between 1 and 2 m./sec., this being the range within which the most efficient cooling is afforded.

Further characteristic features and advantages of this invention will be understood from the appended description referring to the accompanying drawings which show an embodiment thereof:

FIGURE 1 is a diagrammatical representation of the cooling device;

FIGURE 2 is a diagrammatical vertical sectional view of a cylinder liner, and

FIGURE 3 shows an enlarged detail of FIG. 2.

A cylinder liner **1** of an internal combustion engine is provided externally and intermediately its ends with a circumferentially extending recess having a depth varying from a minimum value at one end to a maximum value at the opposite end of the liner. In the example shown, the recess is of a truncated cone shape having a surface S. The liner is fitted into the bore in an engine block **2**, in such a manner that its end having the larger base of said surface S faces the cylinder head **2***a*. Thus between the cylinder block **2** and the liner **1**, a tapering annular clearance **3** is formed, having a cross-sectional area diminishing towards the cylinder head. The annular clearance **3** extends between a lower annular channel **4** and a top annular channel **5**, both formed in the engine block.

The outer surface S of the liner **1** is preferably grooved as shown by **1***a* in a substantially circumferential direction, the grooves being for instance similar to a screw thread, in order to extend the contact surface between the liner and oil in the clearance **3**.

The depth of grooves **1***a* and annular cross-sectional area of the gap **3** should be conveniently varied along the liner to suit the heat quantity to be removed from the liner, which heat quantity increases towards the cylinder head.

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This feature is clearly visible in FIG. 3, wherein the depth of the groove **1***a* increases from the bottom portion of the liner **1**, at which the depth is $p1$ towards the top portion turned towards the cylinder head being at a higher temperature, where the depth is $p2$, and the cross-sectional area of the clearance **3** diminishes towards said cylinder head.

A conventional oil pump **6** for the lubricating circuit derives oil through a suction conduit **7** and a suction cup **8** provided with a cleaner in the oil sump **9** of the engine, and delivers pressure oil to a conduit **10** from which oil flows through a conduit **11** to the engine lubricating circuit and through an inlet conduit **19** extending substantially radially of the bore in the cylinder block to the lower channel **4** of each cylinder.

This results in a forced oil flow through the clearance **3** around the cylinder liners **1** which are cooled thereby.

From the top channel **5** of each cylinder oil reaches an outlet conduit **13** having interposed therein a pressure adjusting valve **12**. A by-pass **18** formed with a calibrated bore is arranged around the valve **12** in order to safely circulate cooling oil even at low numbers of revolution of the engine when the oil pressure is low.

Release valves **17** and an oil cooler **14** are arranged past the valve **12** and by-pass **18**. The cooler **14** connects through a discharge conduit **16** with the oil sump **9** of the engine.

The provision of grooves in the outer liner surface (FIG. 3) increases the heat exchange surface and sets the oil in whirling motion, thereby intensifying cooling of the liners by the oil.

The above described device distinguishes by noiselessness during engine operation and affords the smallest possible spacing of the walls of adjacent liners; moreover, the operational temperature is quickly reached.

With the device the advantages of engines having a sealed cooling circuit which does not necessitate anti-freeze means or the like during the cold season and avoids inherent complications and risks of ordinary or pressure water cooling circuits.

What we claim is:

1. A device for cooling the cylinder liners of internal combustion engines comprising a cylinder block having at least one cylinder bore provided with a conduit extending substantially radially of the bore at each end portion of said bore, a cylinder head on said cylinder block, a cylinder liner provided externally and intermediately its ends with a circumferentially extending recess having a depth varying from a minimum value at one end to a maximum value at the opposite end of said liner, said liner being fitted in the cylinder bore with the shallow end of the recess facing the cylinder head, so that a clearance communicating with said conduits is formed between the liner and the cylinder block, one of said conduits being connected to the pressure oil lubricating circuit of the engine, the other conduit being connected to a cooler.

2. Cooling device as claimed in claim 1, wherein the surface of the recess in the liner is formed with grooves extending substantially circumferentially in order to extend the heat exchange surface of said liner.

3. Cooling device as claimed in claim 2, wherein the grooves in the liners are of varying depth, the grooves at the deeper end of the recess being shallower than the grooves in the shallow end of said recess.

4. Cooling device as claimed in claim 1, wherein the minimum cross-sectional area of said clearance between the liner and the cylinder block is such that at highest engine revolutions the oil flowing therethrough has a speed between 1 and 2 m./sec.

5. Cooling device as claimed in claim 1, wherein an annular channel opened to the cylinder bore is provided in the cylinder block at each end portion of said cylinder bore, each channel communicating with respective conduits in the cylinder block.

6. Cooling device as claimed in claim 1, wherein a pressure adjusting valve is arranged on the connection between one of said conduits in the engine block and the cooler.

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