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Froede et al.

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[54] **ROTARY PISTON COMBUSTION ENGINE WITH OIL-COOLED PISTON**

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[58] **Field of Search** 418/84, 87, 88, 94

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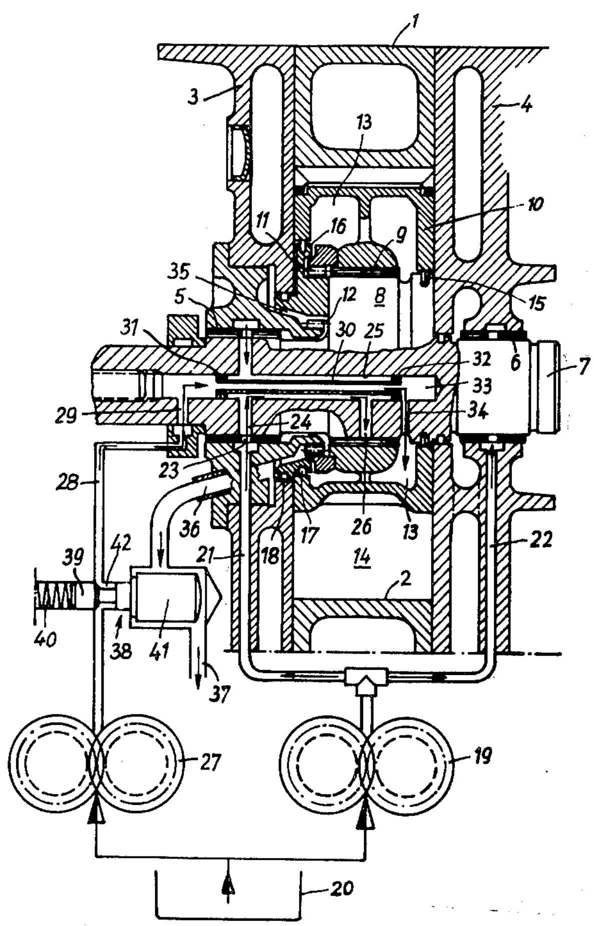
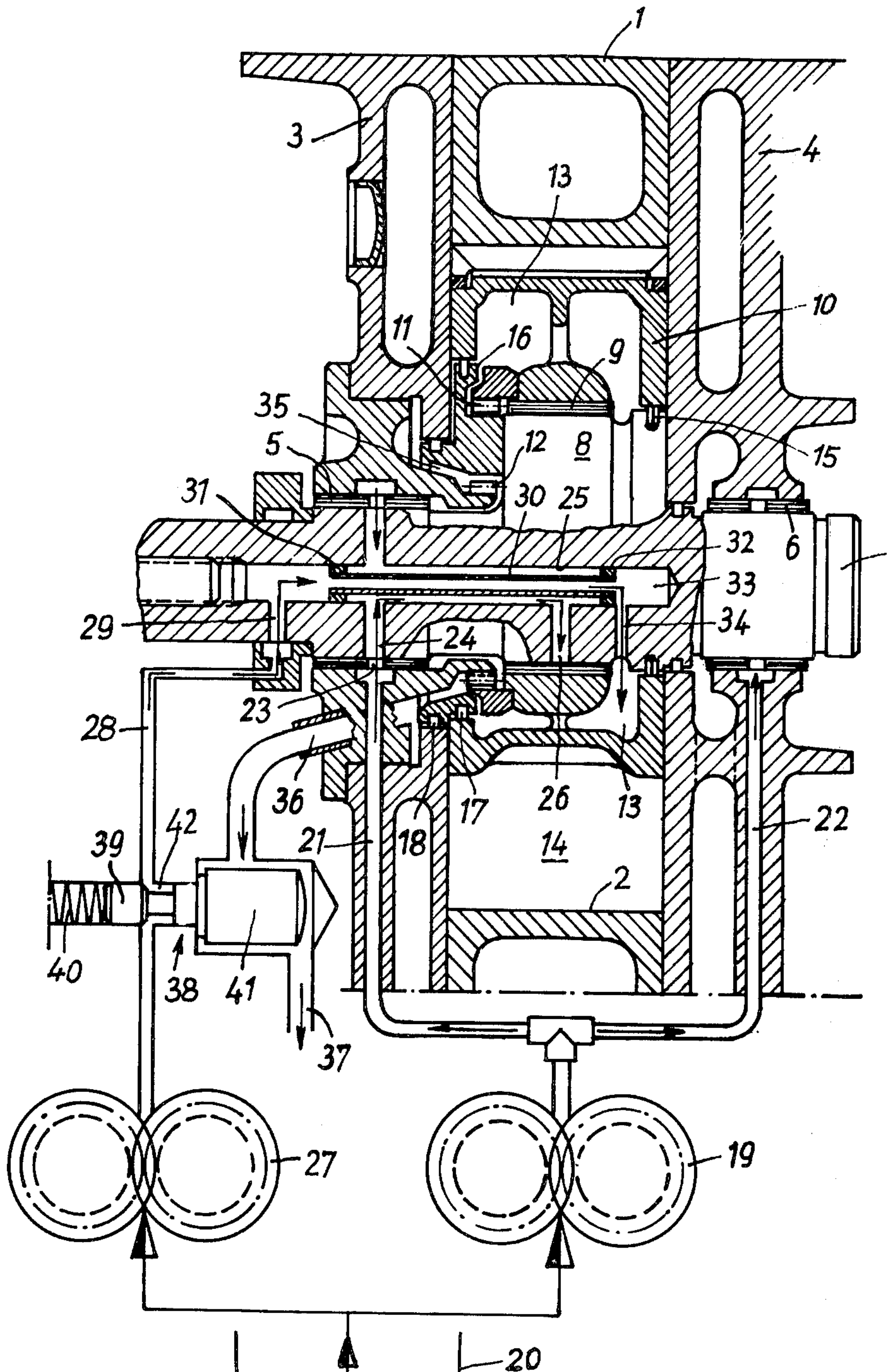
[57] **ABSTRACT**

A rotary piston combustion engine is provided with two separate oil circulating systems. One supplies cooling oil through the piston, while the other serves to lubricate the shaft and piston bearings. Each system has its own oil feed pump with the pump of the lubricating system having a small delivery volume at high pressure, and the pump for the cooling oil system having a large delivery volume at low temperature.

1 Claim, 1 Drawing Figure

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ROTARY PISTON COMBUSTION ENGINE WITH OIL-COOLED PISTON

BACKGROUND OF THE INVENTION

The invention concerns a rotary piston combustion engine with an oil-cooled piston which is pivoted on the eccentric of an eccentric shaft mounted in the housing of the combustion engine.

In rotary piston combustion engines of this type, the oil used both for lubricating the shaft and piston bearings and for cooling the piston is supplied through a hole in the eccentric shaft from where channels lead to the individual bearings. The cooling of the piston takes place thereby by means of leak oil coming from the piston bearing and forced into the hollow spaces of the piston and/or by means of spray nozzles which are supplied from the hole in the eccentric shaft and spray the cooling oil directly into the hollow spaces of the piston. Upon flowing through the hollow spaces of the piston, the cooling and the leak oil is collected in receivers and then fed into a tank from where it is drawn off by means of a feed pump. Upon flowing through an oil cooler and an oil filter this oil is again fed into the hole in the eccentric shaft. It may happen that in the case of this type of lubrication and piston cooling the pressure at low speeds will be too low for ensuring a sufficient lubrication of shaft and piston bearings, since the spray nozzles due to their open cross-section prevent the build-up of the required high pressure.

SUMMARY OF THE INVENTION

The object of this invention is to eliminate this disadvantage. For this purpose, the invention proposes that separate oil circulating systems be provided for the cooling oil flowing through the piston and for the oil serving to lubricate the shaft and piston bearings. As a result, the amount of oil and the oil pressure in each oil circulating system may be optimized in accordance with the given requirements.

The present invention makes it possible to adjust the amount of cooling oil flowing through the piston according to the given load of the engine. It has been found that fuel consumption is relatively high at low loads and low speeds. This can be explained by the fact that the working chambers of rotary piston combustion engines as compared to reciprocating engines have a relatively large heat-emitting surface and thus do not reach their operating temperature within the above-mentioned working range. In providing a separate oil circulating system for the oil flowing through the piston, the optimal piston temperature at any operating condition can be achieved by providing in the pipe to the piston a valve which is controlled depending on the temperature of the cooling oil in the return pipe and which shuts off the feed pipe should the temperature fall below a certain value. Accordingly, the cooling of the piston will be reduced and a higher piston temperature obtained. This will have a favorable effect on the fuel consumption, since especially in the case of rotary piston combustion engines of the trochoidal design, the carburated gas is prepared for combustion on reaching the piston when the latter is hot. In principle, the described valve in the cooling oil supply pipe could be also controlled by speed or load. Thus, the temperature of the cooling oil as it flows out of the piston is a more simple and a more reliable indication of the piston temperature.

In arranging separate oil circulating systems for the cooling oil and the lubricating oil, it becomes possible to provide a separate feed pump for each of the two systems. Hitherto the oil for piston cooling and for lubrication was fed by one single pump which had to have a relatively high delivery volume and a high feed pressure, since bearing lubrication requires a relatively high pressure, while on the other hand, piston cooling requires a relatively large delivery volume. An oil pump which meets both requirements must therefore show a relatively high power consumption. In arranging separate oil pumps for each of the oil circulating systems it becomes possible to use for piston cooling, a pump with large delivery volume at low pressure, while for bearing lubrication a pump is used which at a small delivery volume has a high pressure. These two pumps together consume considerably less power than the previous single pump which had to have a large feed volume at high pressure.

BRIEF DESCRIPTION OF THE DRAWING

A form of construction in accordance with the present invention shall be described in the following with particular reference to the drawing which shows a longitudinal section of a rotary piston combustion engine.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The rotary piston combustion engine has a housing which consists of a casing **1** with a double-bent inner surface **2** and side parts **3** and **4** which are parallel to each other. An eccentric shaft **7** is pivoted on friction bearings **5** and **6** in the side parts **3** and **4**. A triangular piston **10** is pivoted by way of a piston bearing **9** on the eccentric **8** of the eccentric shaft **7**. The speed of the piston **10** is at a fixed ratio to the speed of the eccentric shaft **7** by way of a transmission consisting of a hollow wheel **11** attached to the piston **10** and a pinion **12** fastened to the side part **3**. The piston **10** is provided with hollow spaces **13** through which the coolant flows. In order to prevent the coolant from overflowing into the working chambers **14**, a sealing ring **15** is provided on the right side of the eccentric **8**; this ring works together with the adjacent front wall of the piston **10.** A disc **16** is screwed to the left side of the eccentric **8.** This disc **16** carries a sealing ring **17** which works together with the adjacent piston wall as well as a sealing ring **18** which works together with the housing side part **3.**

Separate circulating systems are provided for the lubrication of the shaft bearings **5** and **6** and the piston bearing **9** on the one hand, and for the cooling of the piston **10** on the other. The lubrication system has a pump **19** which draws off the lubricating oil from the tank **20** and supplies it by way of channels **21** and **22** in the side parts **3** and **4** to the shaft bearings **5** and **6.** The shaft bearing **5** has holes **23** which are connected to one side to the channel **21** and on the other to a cross hole **24** in the eccentric shaft **7.** The cross hole **24** runs into a longitudinal hole **25** in the eccentric shaft **7** from where another cross hole **26** leads to the piston bearing **9.** In this way, the piston bearing **9** is supplied with lubricant.

The cooling oil circulating system for the piston **10** has its own pump **27** which likewise draws off oil from the tank **20** and feeds cooling oil by way of a pipe **28** to a cross hole **29** in the eccentric shaft **7.** The cross hole **29** runs into the longitudinal hole **25**. A pipe **30** is inserted into the said hole **25**. This pipe **30** ends before the end of the longitudinal hole **25** and is sealed at **31** and **32** against the wall of the hole **25**. This space **33** between the end of the pipe **30** and the end of the hole **25** is connected to the hollow spaces **13** of the piston by way of a cross hole **34**. The cooling oil is fed by the pump **27** into the hollow spaces **13** of the piston by way of the pipe **28**, the cross hole **29**, the pipe **30**, the space **33** and the cross hole **34**. The removal of the cooling oil takes place by way of the ring-shaped space **35** between the hollow wheel **11** and the disc **16** as well as by way of the channel **36** in the side part **3** and the return pipe **37** which leads back to the tank **20**. The leak oil coming out of the bearings **5** and **9** is likewise returned to the tank **20** by way of the channel **36** and the pipe **37**, while the leak oil from the bearing **6** runs directly back to the tank **20** by way of a channel (not shown in the drawing) in the side part **4**.

A valve **38** is provided in the feed channel **28** for the cooling oil. The control piston **39** of the valve is spring-loaded by means of the spring **40** which tends to hold the piston **39** in a position which partially shuts off the feed pipe **28**, as shown in the drawing. The valve **38** is controlled by a temperature responsive device **41** which responds to the temperature of the cooling oil as it flows through the return pipe **37**.

When the engine is cold, the control piston **39** will be in the position as shown in which only a partially throttled supply of cooling oil will reach the hollow spaces **13** of the piston. When the engine reaches its operating temperature which will be indicated by a corresponding temperature of the cooling oil flowing through the return pipe **37**, the valve piston **39** will be shifted to the left in the drawing by the temperature responsive device **41** with the result that the annular tee-slot **42** in the valve piston **39** will be in the plane of the feed pipe **28** so that a larger cooling oil amount will be supplied to the piston **10**. Thus, by means of the valve **38**, the piston **10** will quickly reach its operating temperature.

Instead of a valve **38** responding to the temperature of the cooling oil in the return pipe **37** another valve responding to speed and/or load could be provided which would throttle the feed pipe **28** at low loads and low speeds.

In arranging two separate oil circulating systems, one for the cooling oil and another for the lubricant, it not only becomes possible to throttle the cooling oil supply until operating temperature has been reached, but it also offers the advantage that a sufficiently high lubricating oil pressure will be already available at low speeds. A further advantage is that in line with the requirements, the pump **19** for bearing lubrication can be designed for a small delivery volume at high pressure and the pump **27** for the cooling oil for a large delivery volume at low pressure. In a finished engine, the ratio of delivery volumes of the pumps **19** and **27** is approximately 1:4, whereby the lubricating oil pump **19** delivers with a pressure of approximately **5** atmospheres gage pressure and the cooling oil pump with a pressure of approximately **3** atmospheres gage pressure. Both pumps together consume less power than the hitherto commonly used single pump for both lubricating and cooling oil which had to be designed for a large delivery volume at high pressure.

Thus, the several aforenoted objects and advantages are most effectively attained. Although several preferred embodiments have been shown and described in detail herein, it should be understood that this invention is in no sense limited thereby and its scope is to be determined by the appended claims.

What is claimed is:

1. A rotary piston combustion engine comprising:

a housing, a shaft mounted in the housing, shaft bearings interposed between the shaft and the housing, an eccentric on the shaft, a rotary piston carried by the eccentric, a piston bearing interposed between the eccentric and the piston, the piston including hollow spaces through which a coolant flows to cool the piston, a first oil circulating system for lubricating the shaft and piston bearings, the first system including first passages for conducting lubricating oil to the bearings, a first pump for pumping lubricating oil from a source through the first passages to the bearings, said first pump having a capacity to deliver oil in small volume and at a high pressure, a second independent oil circulating system for directing an oil coolant to the piston, the second system including second passages for conducting the coolant to the piston hollow spaces to cool the piston, a second pump for pumping the coolant from a source through the second passages to the piston hollow spaces, said second pump having a capacity to deliver the coolant in large volume and at low pressure, a return passage for receiving and directing the coolant from the piston hollow spaces, a valve in one of the second passages and being adapted to be shifted to an adjusted position to regulate the amount of coolant passing through the second passages, a condition responsive control means coupled with the valve for shifting the valve to an adjusted position for adjusting the amount of coolant passing through the second passages into the piston hollow spaces to thereby permit throttling the amount of coolant passing into the piston hollow spaces, and the condition responsive means being coupled with the return passage for sensing temperature of the coolant in the return passage for adjusting the valve.

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