Dec. 23, 1958 W. KRÄMER ET AL 2,865,348

PISTON

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Fig. 1

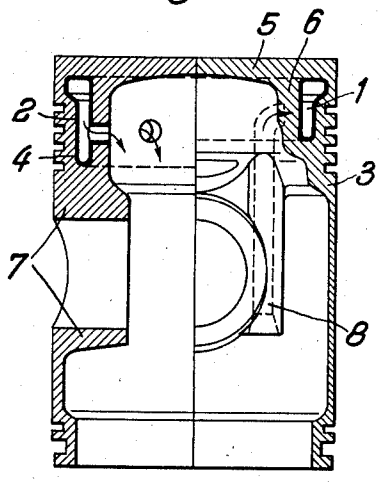



Fig. 2

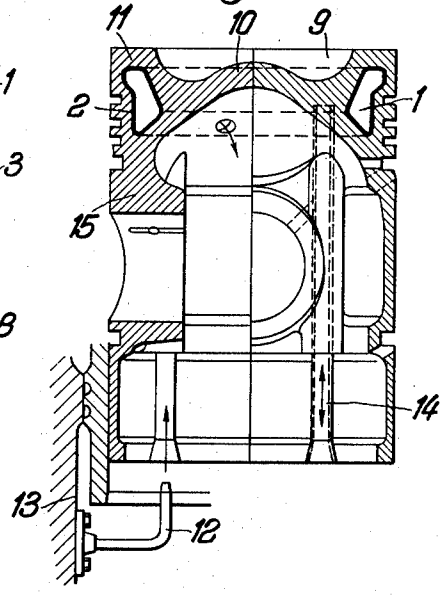



Fig. 3

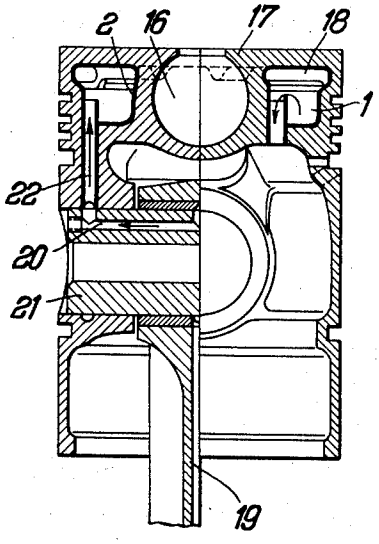
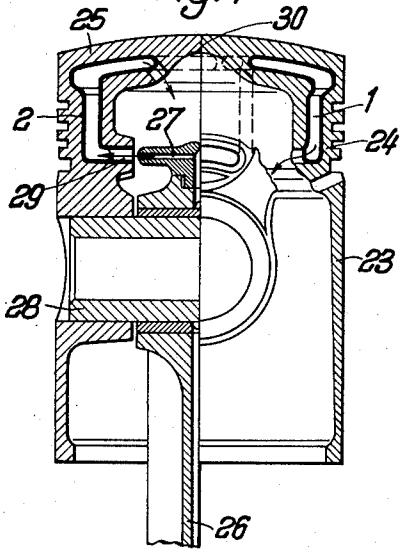



Fig. 4




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Fig. 5

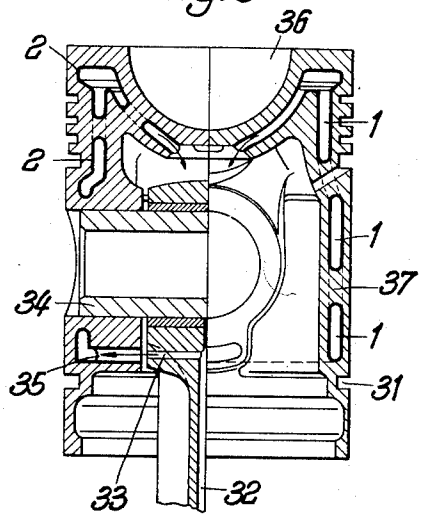
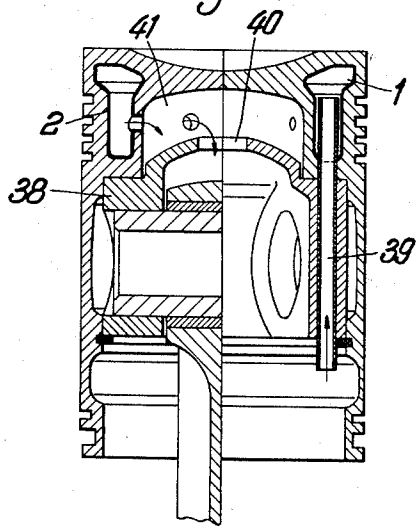



Fig. 6




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# PISTON

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3 Claims. (Cl. 123—41.35)

This invention relates to an oil-cooled piston for internal combustion engines. In particular, the invention is directed to a piston for either a stationary or vehicle mounted diesel engine.

For many years, oil-cooled pistons have been used successfully in large diesel engines. Either oil or water is pumped through a hollow space between the ring section and the crown of the piston head. In one-piece pistons, tubular coils have been cast in the pistons for the passage of the cooling fluid. However, the casting of such coils with a plurality of convolutions requires considerable care, and moreover, necessitates a special piston construction with a large area required for the coils, which in many instances is not desirable.

In pistons having thickened piston pin bosses, the same have been used to cover the cooling space. In pistons for heavy engines, arrangements have been made for feeding the coolant under pressure, use being made of a telescopic tube or so-called trombone tube. In the case of high speed engines, a jointed tube is used. In medium-sized engines, the coolant for the pistons is delivered through a bore in the connecting rod. In such constructions, elastic packings are frequently necessary in the cooling chamber of the piston when the coolant is fed under pressure. The oil is discharged from the piston into the crank case through one or more ports.

In small engines with cylinders having a diameter of from about 80 to 150 mm., it is difficult to provide proper cooling for the pistons. Although it has been attempted to direct a spray of coolant passing through a bore in the connecting rod onto the hot portions of the piston interior, nevertheless it has not been possible to direct the cooling oil into the cooling chamber precisely onto the portions in most need of cooling.

It is well known from experience that in heavily stressed engines, the temperature in the top ring groove must not exceed from 180° to 200° C., since otherwise, irrespective of the operational system of the engine, ordinary commercial lubricating oils are likely to evaporate and deposit residues in the piston ring grooves, thus preventing the correct functioning of the same. It is also known that the viscosity of a lubricating oil at 200° C. is so low that it no longer forms an effective lubricating film. Therefore, it is necessary to provide the most effective cooling for the top compression piston rings in the case of high-stressed plunger pistons. In small pistons, it has not heretofore been possible to feed the cooling oil in the manner customarily used in large pistons for heavy engines unless use is made of a multi-part construction piston.

The objects of the instant invention are to provide a relatively small cooling chamber behind the ring section of a piston head for oil-cooled pistons in stationary and vehicle mounted diesel engines; to provide a cooling space in which there is a pulsating or intermittent flow of cooling oil; and to produce a cooling chamber in a one-piece piston.



In general, to accomplish these objects, a cooling chamber is constructed in the form of a ring or annulus composed of thin-walled sheet metal having a higher melting point than the piston body. This annular chamber is cast in the piston adjacent the ring section at the time the one-piece piston is cast. The annular chamber can be formed by bending and compressing the metal sheets, or can be formed by profiled bands which may be held together by welds until they are inserted into the casting mold. The cooling oil in the tube or passages are connected to the tube or chamber in such a manner that the cooling oil first impinges on the ring section of the piston head and then flows over the hotter portions of the head. These feed tubes or passages may be constructed in accordance with the advantageous forms employed in large diesel engines.

The means by which the objects of the invention are obtained are described more fully with reference to the accompanying drawings, in which:

Figures 1 to 6, respectively, are cross-sectional views through several embodiments of the invention.

In all modifications, the cooling chamber **1** is composed of a thin-walled metal sheet **2** bent to form a hollow ring which is embedded in the one-piece piston during the casting of the same. Cooling chamber **1** is larger than the volume of cooling oil it contains at any instant, so that the pulsating or intermittently flowing oil only partially fills the chamber and is splashed in the chamber to effect the cooling of the piston.

As shown in Figure 1, a plunger piston **3** for a two-stroke diesel engine has a relatively narrow cooling chamber **1** behind the ring section **4**, said chamber being in contact with the crown **5** of the piston head over only a small area. The combustion pressure is transmitted partly through the outer piston cross-section, and for the greater part, through the inner wall **6** to the piston pin bosses **7**. Oil is introduced through a cast-in jet tube **8** leading into chamber **1** in such a manner that the cooling oil first reaches the hottest portion of the piston head. The length of chamber **1** parallel to the longitudinal axis of the piston can be made so large, depending upon the thermal load on the piston, that either the entire annular portion **4** or only a part of the same is subject to direct cooling.

In Figure 2, the piston for a four-stroke engine has a hollowed out Hesselmann type combustion chamber **9** in the piston head **10**. In this type of piston, very high thermal stresses are often produced not only in the ring section, but also in the peripheral section **11** of the piston head. Cooling chamber **1**, consequently, is shaped so that efficient heat removal takes place over the entire thermally overstressed region. A thin, sharp jet of oil is supplied from the nozzle **12** secured to the crank case **13** into a bore or tube **14** cast into the piston and communicating with chamber **1**, the oil being fed during the running of the engine. One or more tubes **14** can be provided for feeding cooling oil and also removing the oil from chamber **1**, the tubes being arranged so that the oil discharged from chamber **1** does not wet the interior of the piston.

However, in the pistons shown in Figures 1 and 2, it is possible to permit the oil discharged from chamber **1** to flow directly into the interior of the piston through suitable bores. In addition, occasionally it is advantageous to combine simultaneously the intensive piston pin lubrication in the piston pin bosses **15** with the cooling oil tubes **14**, preferably use being made of the cold feed oil. However, if the oil discharged from chamber **1** is not at a very high temperature, it can be used also for lubricating the piston pin.

The piston in Figure 3 has a spherical combustion

chamber **16**. This type of piston has to withstand a high thermal load both in the ring section and in the portion **17** of the piston head adjacent the combustion chamber **16**. Therefore, cooling chamber **1** is shaped so that the portion **17** and the ring section are cooled by oil moving to and fro in chamber **1**. To increase the cooling action and to strengthen the piston head, ribs **18** extending as far as possible radially are provided on the undersurface of the piston head, a greater area of cooling surface thus being formed. In this type of piston, it is possible to introduce the cooling oil through a bore in connecting rod **19**, the oil being then passed through corresponding holes **20** in the piston pin bearing **21**, and then passing through cast-in tube or passage **22** communicating through hole **20** and chamber **1**. Tube **22** and the corresponding discharge tubes can be extended so far into chamber **1** that when the piston is at rest, a corresponding amount of cooling oil is retained in chamber **1**.

The piston **23** in Figure 4 is not only very highly stressed in the ring section **24**, but also becomes so hot in the piston head **25** that cooling of the latter is absolutely necessary. The cooling oil is supplied through the hollow bore in connecting rod **26** from which oil is supplied through nozzles **27** extending parallel to piston pin bearing **28**. The oil enters chamber **1** through an arcuate or crescent-shaped slits **29** while the engine is running. Slits **29** are shaped so that with a maximum movement of about 30° of the connecting rod, the jet of oil enters chamber **1** regardless of the speed of the piston.

In order to direct the cooling oil in a suitable path in the piston of Figure 4, both vertical and radially extending ribs are provided in chamber **1**. The heated oil can be discharged from chamber **1** both near the center **30** of the piston head, and at right angles to the slits **29** at the lower edge of chamber **1**.

In Figure 5, the piston has a double-walled skirt extending as far as the bottom scraper ring groove **31**. Cooling oil is introduced through a hollow bore in connecting rod **32**. The spray nozzle **33** is located beneath the piston pin bearing **34** and parallel thereto, and introduces the oil into arcuate slit **35** having a length of about 30°, said slit communicating with chamber **1**. Due to the oscillating or jolting action of the oil in chamber **1**, the cooling oil is accelerated toward the piston head at the end of each connecting rod stroke. The cooling oil can therefore be discharged from chamber **1** beneath the undersurface of combustion chamber **36** and drained back into the interior of the piston.



To provide for the greatest possible stability in pistons of this type, the cooling chamber **1** can be stiffened by partitions **37**, of circular or other shape, which are inserted in the piston skirt and at points where bores are provided to return lubricating oil from the piston ring groove to the interior of the piston. The partitions are constructed so that the pendulum or jolting movement of the cooling oil is not substantially affected in chamber **1**.

The piston of Figure 6 has a solid skirt and a piston pin trunnion **38**. The cooling oil is also provided in chamber **1** adjacent the ring section of the piston head by the jolting or pendulum movement of the oil. The oil is introduced through tube **39** or through a bore in the connecting rod. A port **40** in trunnion **38** serves to discharge the cooling oil from chamber **1** and chamber **41** beneath the piston head, the oil being drained into the crank case by way of the connecting rod.

Having now described the means by which the objects of the invention are obtained,

We claim:

1. An oil-cooled piston comprising a piston body with a piston head having a crown and a ring section, a circular sheet metal cooling oil splash chamber molded in the piston head and extending as a single opening from said crown to along at least half the length of said ring section, and oil inlet and discharge passages communicating with said chamber through said piston body for partially filling said chamber with cooling oil.

2. An oil-cooled piston as in claim 1, said oil inlet and discharge passages comprising tubes projecting at least partially into said chamber.

3. An oil-cooled piston as in claim 1, said piston head having a combustion chamber.

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