

Feb. 20, 1945.

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2,369,906

ENGINE COOLED PISTON

Filed Dec. 29, 1941

3 Sheets-Sheet 1

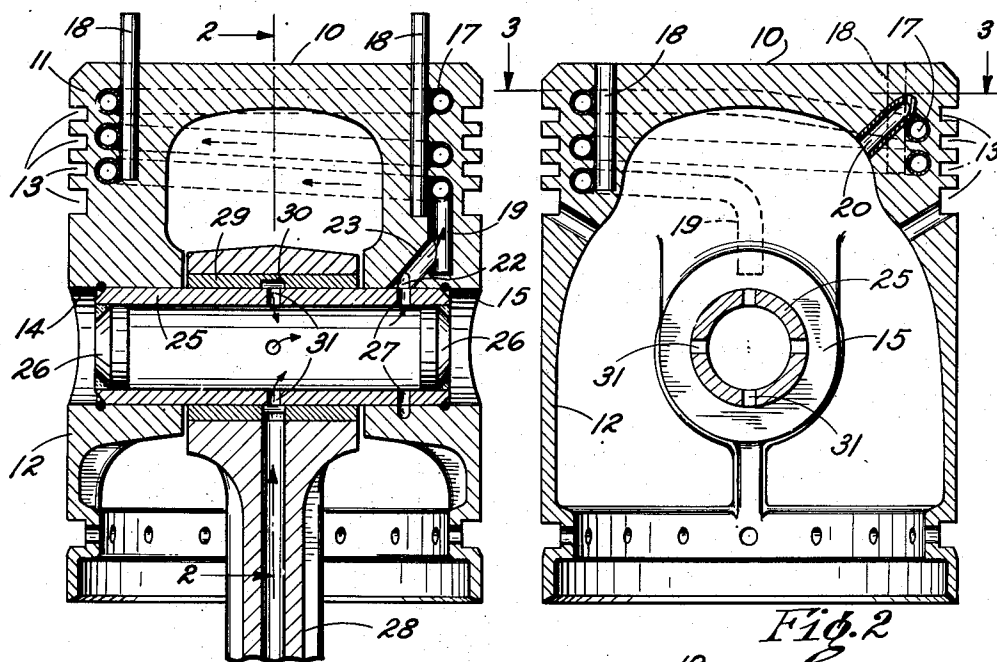


Fig. 1

Fig. 2

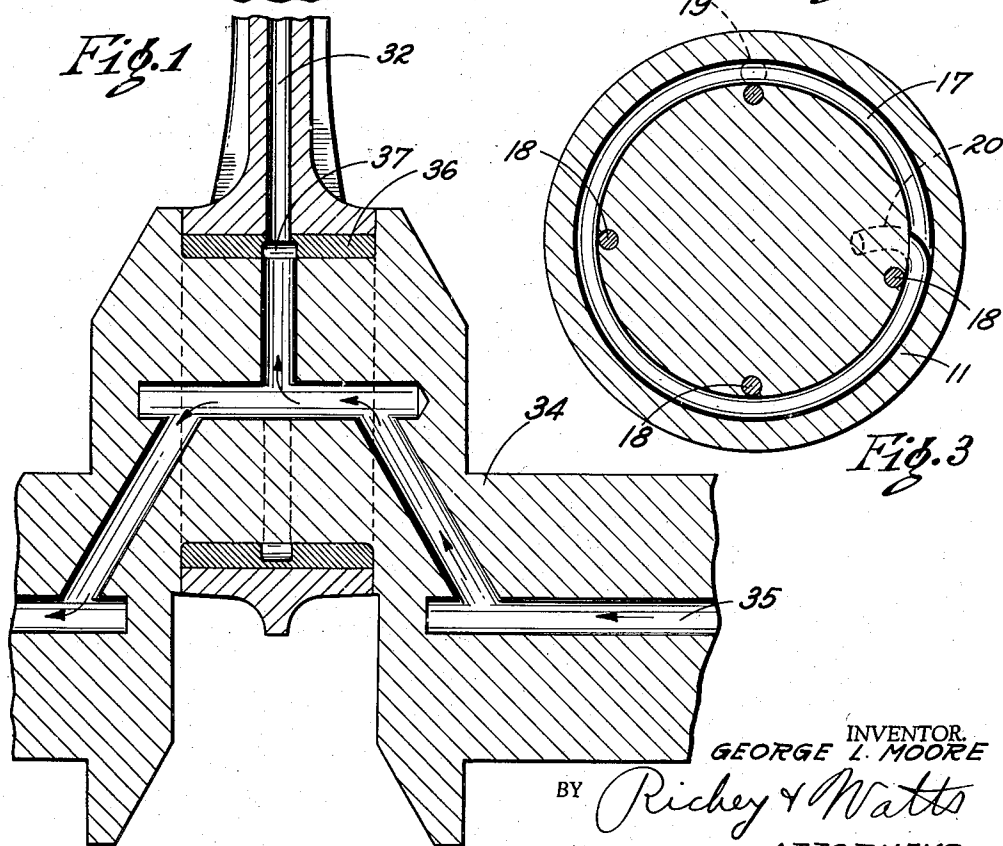


Fig. 3

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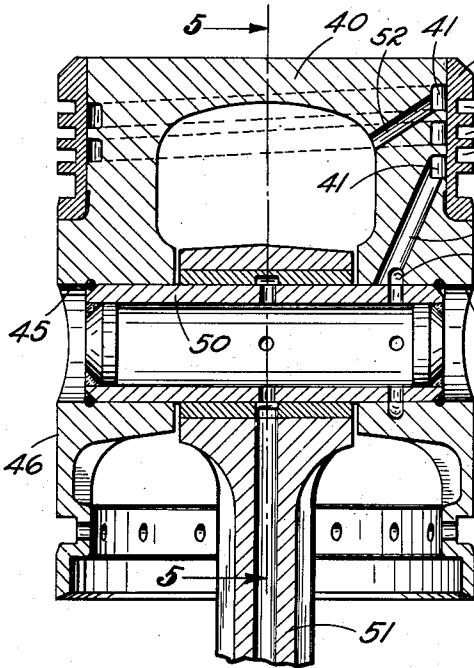
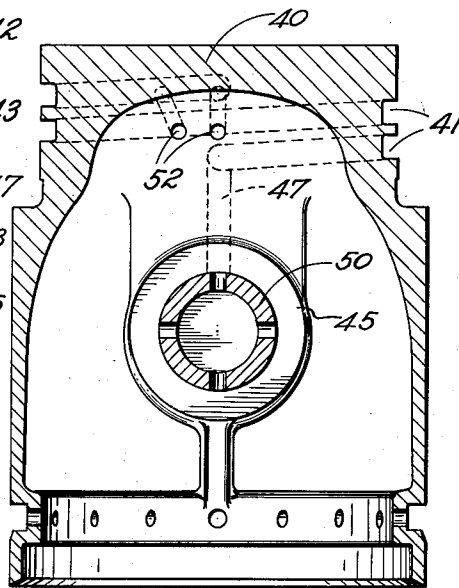
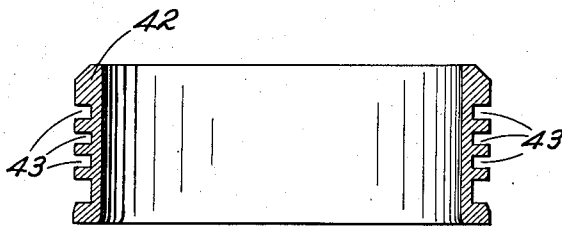
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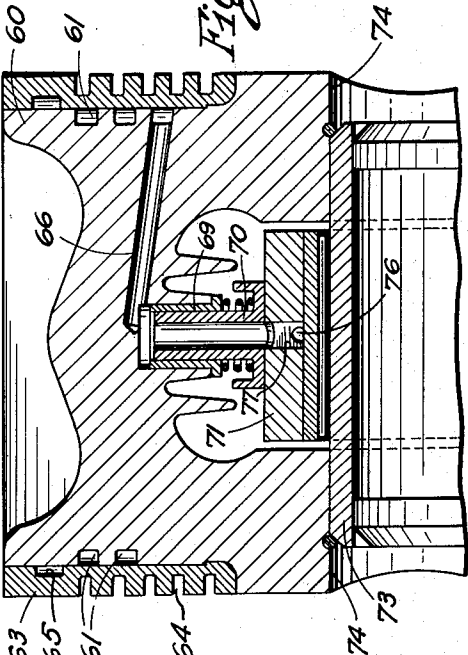
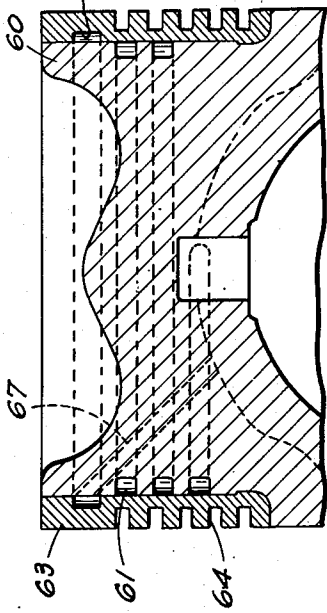
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3 Sheets-Sheet 3



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ENGINE COOLED PISTON

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10 Claims. (Cl. 123—176)

This invention relates to internal combustion engines, and more specifically to improvements in a cooling system for the pistons of such engines.

Heretofore certain efforts have been directed to the cooling of pistons for internal combustion engines by delivering a cooling medium, such as oil, to a large chamber or pocket formed in the piston, and permitting the oil to churn and splash against the head. Such constructions have not solved the problems of maintaining the piston ring flange sufficiently cool to prevent sticking of the rings in the grooves which results from excessive carbon deposits on the hot rings and ring flange. Furthermore, in pistons of this type the cooling medium within the chamber or pocket not only increases the weight of the piston, but the churning action of the coolant introduces unbalanced reciprocating forces which interfere with the proper operation of the engine at high speeds or when sufficient oil is used to attempt to carry away large quantities of heat.

The principal object of the present invention is to circulate a cooling medium, preferably lubricating oil, at a high velocity, in such proximity to the ring flange of the piston and in sufficient volume to prevent sticking of the rings or the formation of excessive carbon deposits on the rings and ring grooves, even during continuous operation with heavy loads, without substantially increasing the reciprocating mass or unbalancing the piston. Other objects of the invention are to incorporate tubes or passages for the cooling medium within the ring flange area of the piston head in a simple and sturdy manner; and to build the tubes or passages into the wall thickness of the ring flange so that they become permanent inseparable parts of the piston, without appreciably increasing the weight of the piston or impairing its strength, rigidity, or durability.

Other objects and advantages will appear in the following detailed description.

Referring to the accompanying drawings illustrating preferred embodiments of the invention;

Figure 1 is a vertical sectional view of the piston and connecting rod embodied in the present invention;

Figure 2 is a vertical sectional view of the piston with the connecting rod removed showing the tubes or passages for the cooling medium, the section being taken on line 2—2 of Figure 1;

Figure 3 is a transverse sectional view of the piston, the view being taken on a plane indicated by line 3—3 of Figure 2;

Figure 4 is an elevational view of a modified

form of piston embodying the present invention;

Figure 5 is a vertical sectional view of the piston shown in Figure 4 with the connecting rod and ring sleeve removed, the view being taken on line 5—5 of Figure 4;

Figure 6 is a vertical sectional view of the ring sleeve shown in Figure 4;

Figure 7 is a vertical sectional view of another modified form of a piston embodying the present invention;

Figure 8 is a vertical sectional view of the piston showing the inlet passage for the cooling medium, the section being taken on a plane indicated by line 8—8 of Fig. 7;

Figure 9 is a vertical sectional view of the upper portion of the piston showing the tubes or passages for the coolant; and

Figure 10 is a vertical sectional view of the head of the piston showing one of the outlet passages for the coolant.

Referring to Figure 1, the piston disclosed therein comprises a head portion 10 having a depending ring flange 11 and a skirt portion 12. A plurality of grooves 13 are formed in the peripheral surface of the ring flange 11 for the reception of the conventional piston rings, not shown. A pair of aligned wrist pin bosses 14 and 15 are formed in the skirt portion 12 for the reception of a wrist pin.

The piston is preferably composed of a light metal having a high degree of heat conductivity, such as aluminum or aluminum alloy, and may be cast in a permanent mold in the usual manner. In the casting of the piston a preformed tube or conduit 17, preferably made of steel, is embedded within the wall of the ring flange 11 in such position as to be closely adjacent the ring grooves in the finished piston. In the illustrated embodiment, the tube is wound in helical form so as to extend substantially through the height of the ring flange, although it will be understood that other shapes and arrangements may be used if desired. A plurality of pins 18 are soldered to the tube 17, prior to the casting of the piston, with the outer ends of the pins 18 arranged to extend into sockets in the base of the piston mold to retain the tube 17 in the desired position during the casting operation. After the piston has been cast, the outer ends of the pins 18 are machined off flush with the top of the piston.

The inlet end 19 of the tube 17, which is sealed to prevent the metal of the piston from flowing therein during the casting, is arranged to extend into the wrist pin boss 15, while the outlet end 20 of the tube 17 is open and arranged to communi-

cate with the interior of the piston. In finishing the piston, an annular groove 22 is cut in the bearing surface of the wrist pin boss 15 and a hole 23 is bored extending from the groove 22 into the tube 17 near its closed end 19.

Preferably the tube 17 is arranged to be supplied with oil from the usual pressure lubricating system of the piston. For this purpose, a hollow wrist pin 25 having plugs 26 welded in its ends is journaled in the wrist pin bosses 14 and 15. A plurality of circumferentially spaced openings 27 are formed in the wrist pin adjacent the end within the boss 15 and arranged to register with the annular groove 22 formed in the boss. A connecting rod 28, having a bearing 29, is journaled upon the wrist pin between the bosses 14 and 15. The bearing 29 is formed with annular groove 30 which is in communication with the hollow wrist pin 25 through circumferentially spaced apertures 31 formed in the central portion of the wrist pin. The connecting rod 28 is provided with an axial passage 32 which is arranged to register with the groove 30 in the bushing 29.

The lower end of the connecting rod 28 is journaled on a crankshaft 34 which is formed with an axial passage 35 therethrough. A bearing 36 is carried by the connecting rod and is formed with an annular groove 37 arranged to register with the axial passage 32 in the connecting rod 28, and with an outwardly extending lead from the passage 35 in the crankshaft 34.

In the operation of the embodiment disclosed, lubricating oil is forced through the passage 35 in the crankshaft 34 by a suitable pump, not shown. In accordance with the customary practice, the oil pumped through the passage 35 is led to the various crankshaft bearings to lubricate the same, and in addition the capacity of the pump and the passage 35 is made sufficiently great to supply a stream of oil through the tube 17 in each piston. As the oil is forced through the crankshaft passage 35 it enters the groove 37 in each connecting rod bearing 36 from which it flows into the axial passage 32 in each connecting rod 28. The oil in the connecting rod passage 32 is free to flow into the wrist pin 25 through the annular groove 30 in the bearing 29 and the apertures 31 in the wrist pin. From the wrist pin it flows through the openings 27 into the spiral tube 17 by way of the groove 22 and passage 23 formed in the wrist pin boss 15. The oil flows through the spiral tube 17 until it reaches the outlet end 20 where it is cascaded over the connecting rod and wrist pin to aid in the lubrication of the cylinder walls. It will be understood that the oil in the grooves 37 and 30 in the connecting rod bearings also works out into the bearing surfaces to lubricate the same.

During acceleration of the piston on the beginning of its downward stroke and deceleration at the end of its upward stroke the inertia of the column of oil between the axis of the crankshaft and the outlet end 20 of the tube 17 acts in a direction to force the oil through the connecting rod and the coil 17. Deceleration of the piston during the latter part of its downward stroke and acceleration at the beginning of its upward stroke, on the other hand, act in a direction to prevent the flow through the coil. It is found, however, that by maintaining pressure on the oil entering the crankshaft passage 35 no substantial back flow occurs although the flow may be interrupted during the lower portion of the downward stroke and the beginning of the upward stroke. The passages are made of sufficient

size to permit a relatively rapid flow of oil through the coil 17 during the latter half of the upward stroke and the first half of the downward stroke so that a substantial amount of fluid flows through the coil 17 in the wall of the ring flange 11 during the combustion of the fuel charge in the cylinder and the beginning of the expansion at which time the greatest amount of heat is applied to the piston. The temperature of the lubricating oil is maintained sufficiently low to prevent carbonizing or otherwise injuring the oil in accordance with the usual practice and thus the temperature of the oil passing through a tube 17 is substantially less than the temperature of the piston head and ring flange. By flowing a large volume of oil through the tube 17 rapidly during the time when the piston is subjected to the greatest temperature the ring flange is cooled without raising the temperature of any part of the oil to a sufficiently high degree to carbonize or injure the oil. Thus the lubricating properties of the oil returned to the crank case from the outlet end 20 of the tube 17 are not impaired and the oil may be used over and over without excessive waste.

The arrangement of the tube 17 in the wall of the ring flange and immediately adjacent the ring grooves enables the stream of oil passing through the tube to keep the temperature of the ring flange well below the temperature necessary for carbon deposits on the ring and in the ring grooves, thus overcoming the tendency of the rings to stick in the grooves.

In the modified form of the piston, Figure 4, the piston head 40 is cast with a recessed end portion as shown in Figure 5. The recessed end portion of the piston head is formed with a helical groove 41 which may be cast into the wall or may be formed by a machining operation subsequent to the casting of the piston. A sleeve 42, Figure 6, having the conventional ring grooves 43 formed therein is pressed over the recessed end portion of the piston head 40 with a shrunk fit for closing the open side of the groove 41. Preferably both the piston body and the sleeve 42 are formed of the same material, which may be aluminum alloy, so that the thermal expansion of the two parts is the same and the sleeve remains tightly fixed in position at all times. The sleeve itself may be forged instead of being cast to provide additional strength.

A pair of aligned wrist pin bosses 45 are formed in the skirt portion 46 of the piston with one of the bosses having a passage 47 formed therein. The passage 47 extends from an annular groove 48 formed in the boss to the lowermost portion of the helical groove 41. A hollow perforated wrist pin 50 is mounted within the bosses 45 with certain of the perforations registering with the groove 48 formed in the boss. A connecting rod 51 having an axial passage therethrough is journaled at one end to the wrist pin 50 in the same manner as that disclosed in Figure 1, while the other end of the connecting rod is journaled to a crankshaft, not shown. A plurality of radial openings 52 drilled in the piston head 40 are arranged to register with the uppermost portion of the helical groove 41 and constitute outlets for the coolant or lubricating oil forced through the wrist pin and spiral groove.

With this arrangement the helical groove 41 is positioned in the wall of the ring flange close to the piston rings and grooves so as to facilitate the cooling of these parts as described in connection with the embodiment shown in Figures 1 to 3.

This is accomplished without the necessity of casting in a pre-formed member, thereby facilitating the casting operation and placing the coolant in better heat conducting relationship to the ring flange.

In the modified form of the piston shown in Figs. 7 through 10, the piston head 60 is cast with a recessed end portion in the same manner as that disclosed in Fig. 5. A plurality of spaced annular passages or grooves 61 are formed in the peripheral surface of the recessed end portion with successive passages connected by steps or communicating passages 62 as shown in Fig. 9. A sleeve 63 having the conventional ring grooves 64 formed therein is pressed over the recessed end portion of the piston head 60 with a shrunk fit for closing the open side of the passages or grooves 61 and 62. The sleeve 63 is provided with an internal annular passage 65 which communicates with the uppermost passage 61 formed in the recessed end portion.

The passages 61 and 62 may be cast into the recessed end portion of the piston head or they may be formed by a machining operation subsequent to the casting of the piston. The piston body and the sleeve are preferably formed of the same material, such as aluminum alloy, so that the thermal expansion of the two parts is the same and the sleeve will remain tightly fixed in position at all times. The sleeve 63 may be forged instead of cast and the internal annular passage 65 may subsequently be machined therein. An inlet passage 66 is formed in the piston head 60 for delivering a coolant to the lowermost passage 61 formed in the recessed end portion. A plurality of openings 67, Figs. 9 and 10, drilled in the piston head 60 are arranged to register with the passage 65 formed in the sleeve 63 and constitute outlets for the coolant forced through the passages 61 and 62.

A coolant is delivered to the inlet passage 66 in any suitable manner, such as that shown in Figs. 7 and 8 wherein a pocket or chamber is formed in the piston head, and adapted to communicate with the inlet passage 66. A sleeve 69 is positioned within the pocket and a hollow cylindrical member 70 is slidably mounted within the sleeve. A connecting rod 71, having a bearing 72, is journaled upon a wrist pin 73 which is mounted within the wrist pin bosses 74. A coil spring 75 is interposed between the sleeve 69 and the base of the cylindrical member 70 for retaining said member in engagement with the upper surface of the connecting rod. The connecting rod 71 is formed with an internal annular groove 76 which communicates with the hollow cylindrical member 70 through an opening 77 in the upper surface of the connecting rod. Except as mentioned above, the connecting rod 71 is similar to the connecting rod shown in Fig. 1, having an axial passage therein similar to the passage 32 of Fig. 1, which opens into the groove 76, so that oil flowing through the axial passage in the connecting rod from the crank shaft as described in connection with Fig. 1 enters the groove 76, whence it flows into the cylindrical member 70 through the opening 77.

With this arrangement the coolant or lubricating oil is forced through the passages 61 and 62 to facilitate the cooling of ring flange and piston rings as described in connection with the structure shown in Figures 1 to 3. The formation of the uppermost passage 61 in the sleeve 63 facilitates the extraction of heat from the top of the piston head.

Although the foregoing description is necessarily of a detailed character, in order that the invention may be completely set forth, it is to be understood that many variations and modifications may be resorted to without departing from the scope of the invention as defined in the following claims.

I claim:

1. In an engine, a piston having a head, a ring flange, and aligned wrist pin bosses, said ring flange being provided with a passage therein extending around the same, one of said wrist pin bosses being formed with a conduit opening into said passage, said passage opening into the interior of the piston, a wrist pin journaled in said bosses and having an opening communicating with said conduit, and means for supplying a coolant to the opening in said wrist pin and forcing the coolant through said passage.

2. In an engine, a piston having a head, a ring flange, and aligned wrist pin bosses, said ring flange being provided with a helical passage therein extending around the same, one of said wrist pin bosses being formed with a conduit opening into said passage, said passage opening into the interior of the piston, a wrist pin journaled in said bosses and having an opening communicating with said conduit, and means for supplying a coolant to the opening in said wrist pin and forcing the coolant through said passage.

3. In an internal combustion engine a piston having head and skirt portions, aligned wrist pin bosses in said skirt portion, a conduit in the wall of said head portion having one end terminating in one of said bosses and the other end opening into said piston, a wrist pin having a connecting rod thereon mounted in said bosses, said wrist pin and connecting rod having passages there-through in communication with one another, one of said bosses having an opening therein registering with said conduit and said wrist pin passage and means to circulate a coolant through said passages and conduit.

4. An internal combustion engine piston comprising a head and a skirt portion, aligned wrist pin bosses in the skirt, one of said bosses formed with a passage therein terminating in an internal annular groove in the bearing face thereof, and a conduit provided in the wall of the head of said piston having one end communicating with the passage in said boss and the other end opening into said piston.

5. A piston including a head disc having a ring flange, a groove formed in the exterior surface of said ring flange, a sleeve having ring grooves in its exterior surface fitting around said ring flange and closing the outer side of said groove, inlet and outlet passages communicating with said groove, and means for supplying a cooling fluid to said inlet passage.

6. A piston including a head disc having a ring flange, a helical groove formed in the exterior surface of said ring flange, a sleeve having ring grooves in its exterior surface fitting around said ring flange and closing the outer side of said groove, inlet and outlet passages communicating with said groove, and means for supplying a cooling fluid to said inlet passage.

7. An internal combustion engine piston comprising a head having a recessed end portion, said head having a plurality of annular communicating grooves formed in the recessed end, a sleeve fitted on the recessed end and closing the outer side of the grooves, inlet and outlet passages com-

municating with the grooves and means for supplying a coolant to said inlet passage.

8. An internal combustion engine piston comprising a head having a recessed end portion with a plurality of annular communicating grooves formed therein, a sleeve having external ring grooves disposed on the recessed end portion and closing the outer side of the annular grooves, said sleeve formed with an internal annular groove communicating with the annular grooves in the recessed end portion, said head having an inlet passage communicating with the lowermost groove in the recessed end portion and an outlet passage communicating with the internal groove in said sleeve and means for supplying a cooling fluid to the inlet passage.

9. In an engine a piston having aligned wrist pin bosses and a head with a reduced end portion, said piston formed with a plurality of annular communicating grooves in the reduced end portion, a sleeve positioned on the reduced end portion and having an internal annular groove communicating with the grooves in the reduced end portion, a wrist pin in the bosses, a connecting rod thereon provided with an internal an-

5 nular passage, said piston having a pocket formed in the head, a sleeve supported on the connecting rod and extending into the pocket, said sleeve communicating with the passage in said connecting rod, an inlet passage formed in the head of the piston and communicating with the pocket and the annular grooves, an outlet passage formed in the head of the piston and communicating with the annular groove in said sleeve and means for supplying a cooling fluid to the passage in said connecting rod.

10. An internal combustion engine piston comprising a head having a depending ring flange and a skirt, said ring flange having a conduit for coolant formed therein, said conduit extending around the ring flange and progressing from a point adjacent said skirt to a point adjacent said head, means for supplying coolant to said conduit at said first mentioned point, and a discharge passage leading from said conduit at said second mentioned point and opening adjacent the inner surface of said head for free discharge into the cup-shaped space defined by the inner surfaces of said head, ring flange, and skirt.

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