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INTERNAL-COMBUSTION ENGINE PISTON

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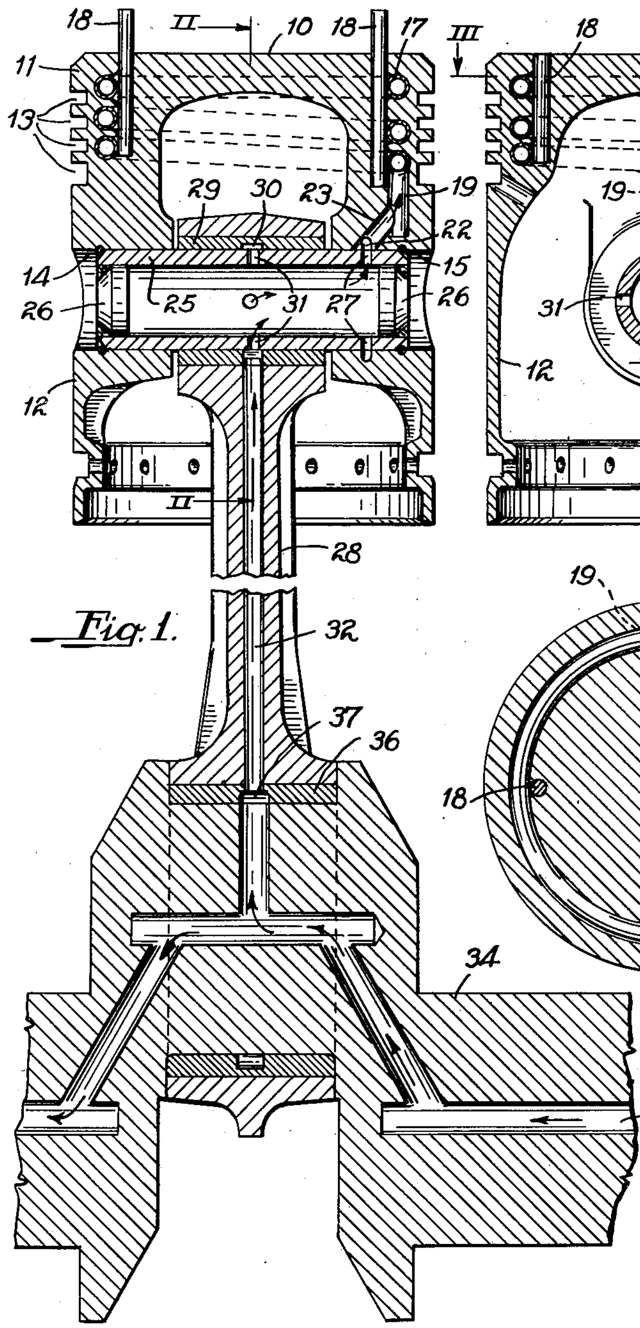

Fig. 1.

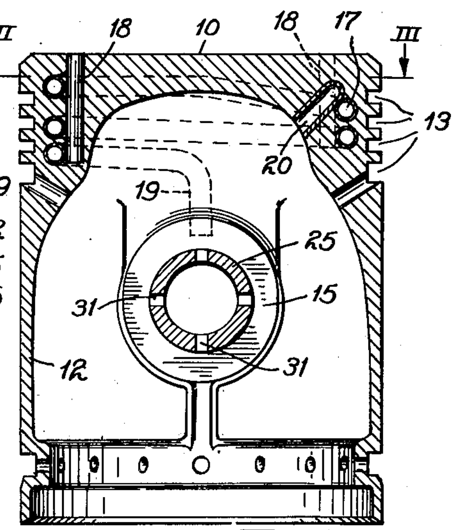

Fig. 2.

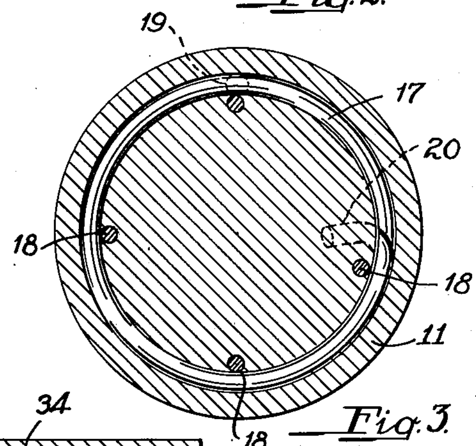

Fig. 3.

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INTERNAL COMBUSTION ENGINE PISTON

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4 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. This application is a division of my copending application Serial No. 424,699, filed December 29, 1941.

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 speed 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 meduim 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 permanently inseparable parts of the piston, without appreciably increasing the weight of the piston or impairing its stregnth, rigidity, or durability.

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

Referring to the accompanying drawing 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; and

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.

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 convention 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 communicate 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 journalled 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 journalled upon the wrist pin between the bosses 14 and 15. The bearing 29 is formed with an 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 journalled 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 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. Also, if desired, a check valve may be incorporated in the passage 32, preferably adjacent the entrance thereto to avoid any back flow of oil. 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.

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. A cast aluminum alloy piston including a head disc having an integral ring flange with ring grooves therein, a helical metal tube embedded in the wall of said ring flange, said tube extending around said ring flange and having inlet and outlet openings, and at least a portion of said tube being disposed radially interiorly of said ring grooves in said flange, and means for supplying a cooling fluid to the inlet opening of said tube.

2. A cast aluminum alloy piston including a head disc having an integral ring flange with ring groove therein, a helical metal tube cast into the wall of said ring flange and extending around the same, said tube having an outlet opening into the interior of said piston from the convolution nearest said head disc, and said piston having an inlet passage communicating with the opposite end of said tube, at least a portion of said tube being disposed radially interiorly of said ring grooves in said flange.

3. A piston including a head disc having an integral ring flange, piston ring grooves in said ring flange, a helical tube embedded within, and extending downwardly around said ring flange, from a point above the uppermost ring groove, said tube having inlet and outlet openings, and having at least a portion of the tube disposed radially interiorly of at least one of said ring grooves, and means for supplying a cooling fluid to the inlet opening of said tube.

4. A piston including a head disc having an integral ring flange, a pair of aligned wrist pin bosses, a hollow wrist pin journalled in said bosses and having an opening therein connecting the interior of the wrist pin with a conduit in one of said bosses, a helical tube embedded in, and extending around said ring flange, said tube having an inlet opening communicating with said conduit, and having an outlet thereabove, and means for supplying cooling fluid to the interior of said wrist pin.

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