

UNITED STATES PATENT OFFICE

2,142,175

PISTON COOLING

Horace J. Buttner, Indianapolis, Ind., assignor to
General Motors Corporation, Detroit, Mich., a
corporation of Delaware

Application February 19, 1937, Serial No. 126,593

4 Claims. (Cl. 123—176)

This invention relates to a means of cooling the piston of an internal combustion engine by dissipating the heat thereof to a suitable cooling medium.

5 It relates particularly to the cooling of the piston by directing a stream of lubricating oil against the underside of the head of the piston.

10 It is becoming increasingly important to provide some adequate means of dissipating the heat from the pistons of internal combustion engines as engine speeds are increased, and the problem has become particularly acute in the case of two cycle Diesel engines for instance, in which the pistons are exposed to twice the rate of heat development of a similar four-cycle engine.

15 Heretofore it has been proposed to pump the engine lubricating oil to the small end of the connecting rod, to be directed through holes against the underside of the piston head.

20 It has been found, however, that the column of oil projected in this manner towards the piston is acted upon by velocity effects and inertia forces to such an extent that a definite minimum pressure varying directly as the speed, is required to cause the oil to flow.

25 The actual quantity of oil which will flow at a given pressure is dependent to a large extent on its viscosity as might be expected.

30 The effect of the foregoing factors influencing the rate of oil flow is to reduce the rate of flow per cycle of movement of the piston and connecting rod, as the speed of the engine increases; in some instances it may reach the point where the actual rate of flow per minute is lessened as the speed of the engine increases.

35 Such a reduction in the rate of oil flow per cycle of movement of the piston and connecting rod as the speed of the engine is increased is obviously contrary to the requirements, and when there is sufficient oil flow at the higher speeds there is an unnecessarily large flow at the lower speeds and considerable wastage of the oil.

40 The object of the invention is to increase the rate of oil flow per minute as the speed of the engine is increased, in a system of the foregoing type.

45 A further object of the invention is to increase the rate of oil flow per cycle of movement of the piston and connecting rod as the speed of the engine is increased.

50 The above and other objects of the invention will be apparent as the description proceeds.

According to the invention, a check valve is placed at the bottom or big end bearing end of the column of oil in the connecting rod to re-

tain the column of oil in the connecting rod during that part of the piston stroke when velocity and inertia effects tend to cause the oil to flow in a direction contrary to that required. The check valve should have a small mass in order that its opening at the required time will not be prevented by its inertia, and so that it will be quickly responsive to the movements of the column of oil in the connecting rod.

10 In this way the volume of the column of oil which would otherwise be lost in each cycle of movement of the connecting rod is added to the smaller quantity which would otherwise be discharged.

15 The check valve therefore increases the quantity of oil flow at the higher speeds, to an amount above that which would otherwise be obtained, while in addition it restricts the oil flow at slow speeds.

20 In addition according to the invention the check valve is preferably spring loaded. A spring can be selected which will give any desired variation in spring load between the closed and open positions of the valve in order to give a rate of oil flow of the character required. The spring may be such as to prevent the opening of the valve under the combined effect of the oil pressure and the inertia forces until a certain engine speed is reached with automatic regulation of the rate of oil flow at all higher speeds.

25 It will be appreciated that a check valve without spring loading would have to have a considerable mass which might actually have to be several times that of the connecting rod in order to prevent opening of the valve until a certain engine speed is reached and that the inertia of such a check valve would delay its closing as well as its opening movement even if it were otherwise practicable.

30 The drawing shows the application of the invention to one piston of a vertical two-cycle Diesel engine.

In the drawing

35 Fig. 1 is a view in sectional elevation of one cylinder of a two-cycle Diesel engine, showing a piston, connecting rod and crankpin to which the invention has been applied.

40 Fig. 2 is an enlarged sectional view on line 2—2 of Fig. 1.

45 Fig. 3 is a perspective view of the constituent parts of the check valve shown in separated relationship.

50 The cylinder 1 is provided with inlet and/or exhaust ports 2 controlled by the piston 3, having

a connecting rod 4 to the crankpin 5 of the crankshaft of the engine.

The piston 3 has a tubular wrist pin 6 around which are needle bearings 7, having an outer race 8 suitably held in the bore 9 at the small end of the connecting rod.

Within the bore 9 is an annular groove 10 connected with the drilled oil duct 11 of the connecting rod. From the groove 10, at a point facing the underside of the head of the piston, there is an outlet 12 to a nozzle or spray tip 13 having holes 14, through which oil can be projected.

Lubricating oil under pressure from a pump (not shown) is fed in known manner through the crankshaft and thence through two ducts 15 and 16 at 90° to each other in the crankpin 5, to the crankpin bearing consisting of two half shells 17 and 18.

Grooves 19 and 20 in the bearing surfaces of the half shells 17 and 18 and extending each through an arc of 90° divided equally on either side of the split line of the bearing are provided, and there is thus a circumferential separation of 90° between the two grooves.

Holes 21 and 22 through the upper half shell 17 of the bearing respectively connect the grooves 19 and 20 with a groove or channel 23 formed in the connecting rod 4 at the back of the half shell 17.

One or other of the ducts 15 and 16 is always in communication with one of the grooves 19 and 20 whatever the relative positions of the crank and connecting rod may be, and hence there is a continuously open path for the flow of oil under pressure through the crankshaft and the crankpin bearing and into the groove 23.

The drilled duct 11 in the connecting rod is counterbored where it is connected with the groove or channel 23, to form a pocket 24.

Within the pocket 24 is the check valve assembly, which, as shown most clearly in Figs. 2 and 3, comprises a tubular housing 25 for a cup type check valve 26 resiliently urged on to its seating 27 by the coil spring 28. The check valve and spring are retained in the member 25 by a washer 29 which is clamped on to the shoulder 30 of the member 25 by the turned over edge of the top thereof.

The member 25 with its assembled parts is a press fit in the pocket 24, and is provided with a groove 32 to coincide with the groove 23. The bore of the member 25 below the seating 27 is conveniently screw threaded in order to facilitate its withdrawal when necessary by means of any suitable screw threaded drawing tool.

When the check valve 26 is on its seating 27,

the bore 31 through the member 25 is closed by the bottom face of the valve 26.

To an extent depending on the oil pressure and the rate of the spring 28 combined with the velocity and inertia effects, the oil, continuously supplied under pressure to the groove 23, can lift the valve 26 off its seating, to flow through ports 32' in the side wall of the valve, up through the connecting rod, around the annular groove 10, and out through the spray holes 14 which are suitably disposed to spray the cooling oil over the underside of the head of the piston. The underside of the head of the piston is preferably provided with fins 33 arranged in the path of the cooling oil to facilitate the cooling of the piston by that oil which is sprayed thereon.

I claim:

1. In combination, a piston, a crankpin on a crankshaft, a connecting rod with a small end bearing in the piston, and a big end bearing on the crankpin, a duct to carry oil under pressure along the connecting rod, from the crankpin to a nozzle at the small end of the connecting rod, to be projected therefrom against the underside of the head of the piston to cool the piston, a check valve in the duct at that end thereof adjacent to the big end bearing to prevent velocity and inertia force effects on the column of oil in the duct from causing a backward flow of the oil therein during certain parts of the cycle of movement of the connecting rod, and spring means resiliently resisting the opening of the check valve; said check valve being effective to increase the flow of cooling oil per minute, particularly at higher speeds of the crankshaft and connected parts, and said spring means being effective to reduce the oil flow at lower speeds; whereby the rate of flow of cooling oil per minute will automatically increase as the speed of the crankshaft and connected parts is increased.

2. The combination according to claim 1, in which the check valve is of the cup type, consisting of a hollow cylinder open at one end and with ports in its sides.

3. The combination according to claim 1, in which the spring means is such that the flow of oil per cycle of movement of the connecting rod is increased as the speed of the crankshaft and connected parts is increased.

4. The combination according to claim 1 in which the spring means is such as to prevent the opening of the valve under the combined effect of the oil pressure and the inertia forces until a certain engine speed is reached, with automatic regulation of the rate of oil flow at all higher speeds.

HORACE J. BUTTNER.