Jan. 17, 1939. H. D. CHURCH 2,144,449

INTERNAL COMBUSTION ENGINE

Filed Dec. 15, 1937 2 Sheets-Sheet 1

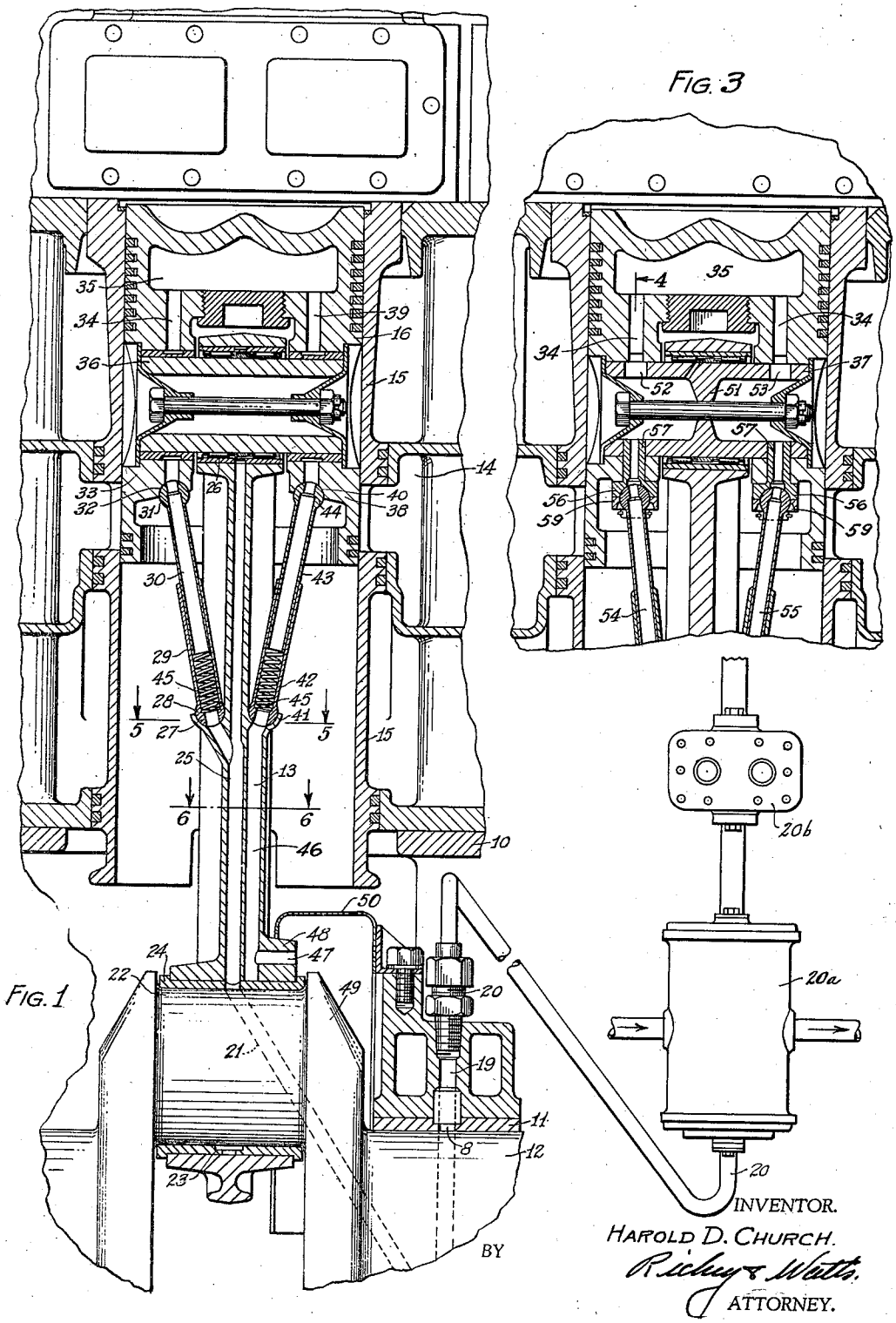


FIG. 1

FIG. 3

INVENTOR.
HAROLD D. CHURCH.
Richey & Watts.
ATTORNEY.

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FIG. 2

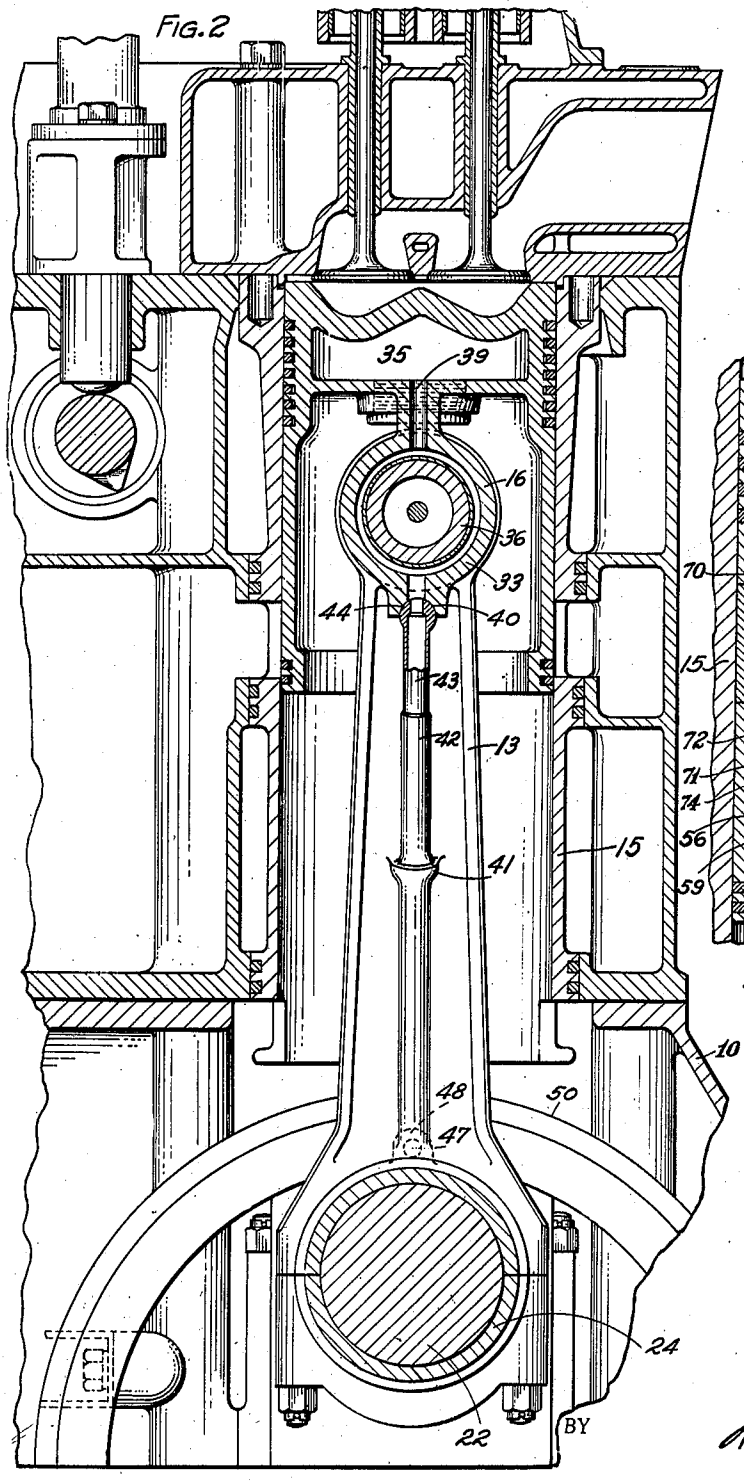
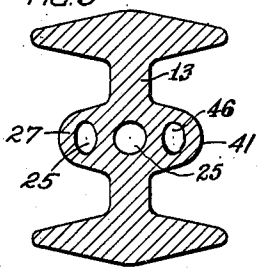


FIG. 5



16 FIG. 4

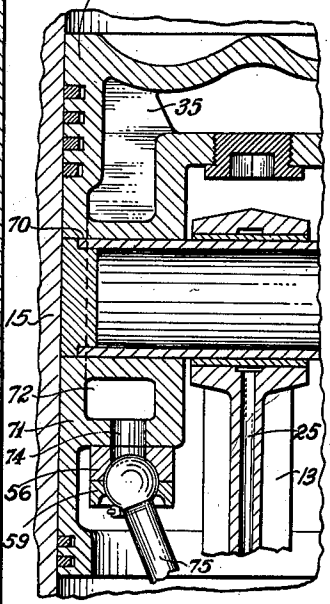
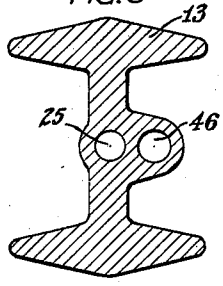


FIG. 6



INVENTOR.
HAROLD D. CHURCH.
Richey & Watts.
ATTORNEYS.

Patented Jan. 17, 1939 2,144,449

UNITED STATES PATENT OFFICE

2,144,449

INTERNAL COMBUSTION ENGINE

Harold D. Church, Cleveland Heights, Ohio

Application December 15, 1937, Serial No. 179,903

11 Claims. (Cl. 123—176)

This invention relates broadly to internal combustion engines and more specifically to media for cooling the head of the pistons therein.

In my co-pending application, Serial No. 58,370, filed January 9, 1936 and entitled "Internal combustion engine", a piston cooling system is disclosed which embodies generally a rocker arm assembly having fluid passages therein connected to the chambered head of the piston through conduits organized for automatic adjustment compensative the relative movement of the rocker arm and piston during the operation of the engine.

My present invention contemplates a piston cooling system for engines of the type having high unit pressure loads throughout the length of the piston pin and/or engines where the rate of travel of the piston precludes the practical application of a fluid connection of the link type or one having a member subjected to sliding engagement with the full travel of the reciprocative part with which it is associated.

In addition to the foregoing, the invention further contemplates a connecting rod provided with fluid passages for the circulation of a cooling medium to the chambered head of the piston and to an improved and more comprehensive construction of the conduits forming the connections between the reciprocating member and connecting rod.

Another object of the invention resides in the provision of a telescopic coupling which is positive of operation and organized for minimized reciprocative movement between the tubes embodying the assembly.

Other objects and advantages more or less ancillary of the foregoing and the manner in which all the various objects are realized will appear in the following description which, considered in connection with the accompanying drawings, sets forth the preferred embodiment of the invention.

In the drawings wherein the preferred embodiment of the invention is illustrated:

Fig. 1 is a vertical section through a fragmentary portion of an internal combustion engine illustrating the improved fluid circulatory system and the connections therefor;

Fig. 2 is a vertical section of the portion of the engine illustrated in Fig. 1, and taken on the plane normal thereto;

Fig. 3 is a vertical section through a fragmentary portion of the cylinder block and piston illustrating a modified form of the coupling members and fluid passages in the piston;

Fig. 4 is a vertical sectional view of an alternate arrangement of fluid passages leading to the chambered head of the piston;

Fig. 5 is a transverse section through the connecting rod, the section being taken on a plane indicated by the line 5—5 in Fig. 1; and

Fig. 6 is a transverse section through the connecting rod, the section being taken on a plane indicated by the line 6—6 in Fig. 1.

As illustrated in Figs. 1 and 2, the engine chosen for purposes of illustration herein comprises a crankcase 10 having the customary crankshaft journal bearings 11, the crankshaft 12 and connecting rod 13, the cylinder block 14 is formed with a sleeve 15 having a piston 16 mounted for reciprocative movement therein. The crankshaft bearings 11 are formed with an annular groove 8 ported for continuous communication with a duct 19 connected through a conduit 20 for circulating a cooled lubricant from an oil cooler 20*a* and oil pump 20*b* through said conduit. The crankshaft 12 is drilled to form a passage 21 between the crankshaft journals and the connecting rod pin 22, the passage 21 being arranged to facilitate the continuous circulation of fluid from the duct 19 to an annular groove 23 formed in the connecting rod bearing 24. The connecting rod 13 is machined with a longitudinal bore 25 extending throughout the length thereof for conducting lubricant to the wrist pin bearing 26. The connecting rod is formed with a boss 27 intermediate the ends of the rod, which is drilled for fluid communication with the bore or passage 25. The face of the boss 27 is formed with a spherical seat for the reception of the ball end 28 of a tube 29 engageable with the spherical seat in the boss 27. Within the tube 28 there is a second tube 30 formed with a ball end 31 engaged within a spherical seat formed in a boss 32 in the lower face of the piston wrist pin boss 33. The wrist pin boss is drilled to provide a fluid passage 34 extending from the ball seat 32 to the chambered head portion 35 of the piston 16. The wrist pin boss is also formed with an annular groove 36 circumambient the wrist pin and disposed to register with the fluid passage 34. The opposed wrist pin boss 38 is drilled to form a passage 39 leading from the chambered head of the piston to a ball seat 40 in the lower face of the boss. Adjacent the shoulder or boss 27 and upon the opposite side of the web of the connecting rod 13 there is a boss 41 formed with a spherical seat to receive the ball of a tube 42 of similar configuration to that of the tube 29. Within the tube 42 there is a second tube 43

having a ball end 44 thereon engageable in the seat 40. The telescopic tubes 29 and 42 are assembled with springs 45 disposed between the shouldered bores thereof and the ends of the tubes 30 and 43, respectively, the springs being adapted to maintain the ball ends of the rods in their seated engagement with the seats in the connecting rod and piston bosses at the maximum operative speed of the engine. The boss 41 is drilled to communicate with a bore 46 in the connecting rod, the latter passage-way being connected with a port 47 formed in a boss 48 in the connecting rod crank pin end.

Within the crankcase 10 adjacent the crankshaft arms 49 there is a semi-circular guard or shield 50 adapted to prevent excessive lubrication of the cylinder walls of the engine by the oil discharged from the canal 47. The shield 50 is preferably of a channular form, the outer depending flange thereof being disposed relatively close to the connecting rod, thus affording a cover plate over a generous portion of the open end of the cylinder. (See Fig. 1.)

In certain types of internal combustion engines it has been found desirable to employ anti-friction bearings of the so-called needle type in order to sustain the dynamic loading imposed upon the wrist pin journal bearings. In Figs. 1, 2 and 3 where such bearings are employed in conjunction with the wrist pin assemblies it will be noted that the design provides for the delivery of fluid about the bearing without sacrifice of static or dynamic bearing area throughout the length of the wrist pin. It will also be noted that the construction provides for the lubrication of the wrist pin bearing through the channel formed by the extension of the bore 25 in the connecting rod.

The circulatory system for the oil constituting the cooling medium contemplated herein comprises a source of cooled lubricant under pressure and suitable fluid connections to the conduit 20 and passages leading to the chamber 35 in the head of the piston. As the cool oil flows through the chamber and across the top of the piston it absorbs sufficient heat to maintain the upper zone of the piston at temperatures permitting power outputs per unit of piston displacement which would otherwise be impossible. The heated oil in the chamber is discharged therefrom through the passage 39, tube connections 43 and 42, connecting rod bore 46 and outlet 47. The oil thus discharged is arrested from entry into the open end of the cylinder 15 by the guard or shield 50.

As illustrated in Fig. 3 the wrist pin 37 is formed with longitudinal bores extending partially through the pin and defining a transverse dividing wall 51. The cylindrical wall of the pin is drilled adjacent its ends to form ports 52 and 53 constituting respectively the intake and discharge openings for the cooling lubricant delivered through the telescopic tube assemblies 54 and 55. In this embodiment the spherical heads of the tube assemblies are supported in bearing blocks 56 which are formed with tubular extensions 57 projected through the wrist pin bosses and apertures in the wrist pin 37, to form fluid communication to and from the piston head chamber and also to prevent the rotation of the pin within the piston bosses. The bearing blocks 56 are secured to the faces of the wrist pin bosses 33 by machine screws 58. Upon the face of the blocks there are caps 59 formed with sufficient bearing surface to support the lower portion of the spherical heads of the tube assemblies 54 and 55 and prevent separation of the ball ends of the tubes from their seats, thus effecting the reciprocative movement of the telescopic tube members during the oscillatory movement of the connecting rod. It is obvious that in such design the springs 45 may be eliminated without hazard to the operative function of the device.

In Fig. 4 a connecting rod is illustrated which embodies a wear bushing 70 of the tubular type. In this embodiment the piston wrist pin bosses 71 are formed with cored annular canals 72 circumambient the wrist pin bearing and in fluid communication with the chamber 35 in the head of the piston. The canals 72 are in fluid communication with the inlet and discharge passages in the connecting rod 73 through ducts 74 in the lower face of the wrist pin bosses 71 and telescopic tube assemblies 75 of the form illustrated in Fig. 3.

An inherent advantage of the present design resides in the minimized reciprocative movement of the telescopic tube assemblies. To this end the ball seats in the piston bosses are disposed in the vertical plane passing through the medial axis of the wrist pin as near to the wrist pin axis as possible and as near to the vertical axis of the piston as is possible. Likewise, as will be seen in Fig. 2, the lower ends of the telescopic tubes are disposed upon the center line of the connecting rod so as to effect equi-angular movement of the tubes and consequent minimized reciprocative movement thereof during the full cycle of connecting rod operation.

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 the specific terminology is not intended to be restrictive or confining, and that various rearrangements of parts and modifications of detail may be resorted to without departing from the scope or spirit of the invention as herein claimed.

I claim:

1. In an internal combustion engine embodying a crankshaft connecting rod and piston means for cooling the head of the piston which comprises a transverse wall adjacent the head of the piston defining a chamber, wrist pin bosses in said piston having passages therein in fluid communication with said chamber, bearing seats in said piston bosses, bearing seats in said connecting rod intermediate its ends, telescopic tubes intermediate said piston and connecting rod bearing seats, said connecting rod having passage-ways therein in fluid communication with said telescopic tubes, one of said passage-ways being in fluid communication with a channel in said crankshaft containing a cooled lubricant under pressure.

2. In an internal combustion engine embodying a crankshaft, connecting rod and chambered piston, means for cooling said piston comprising mechanism for circulating a cooled lubricant under pressure through communicating passages defined by the walls of the crankshaft and connecting rod, yieldable tubes intermediate said connecting rod and piston, the walls of said piston defining passages communicating with the chambered head thereof and said yieldable tubes.

3. In an internal combustion engine embodying a piston, connecting rod and crankshaft, a piston cooling system comprising, a wall adjacent the head of the piston defining a chamber, wrist pin bosses in said piston having passages therein circumambient the wrist pin and in communica-

tion with said chamber, telescopic tubes having one end thereof mounted in said wrist pin bosses in fluid communication with said passages and having the opposed end thereof mounted in said connecting rod, the walls of said connecting rod defining passages in communication with said telescopic tubes, one of the passages in said connecting rod being in fluid communication with a canal defined by the walls of said crankshaft and containing a cooled lubricant under pressure, another of the passages in said connecting rod opening in a side wall thereof and constituting the discharge passage for the lubricant circulated through said chamber in said piston.

4. In an internal combustion engine embodying a piston connecting rod and crankshaft, means for cooling the head of the piston comprising, a wall within said piston defining a chamber adjacent the head thereof, wrist pin bosses having passages therein extending from the lower faces of the bosses around the wrist pin bearing and in communication with said chamber, spherical seats in the lower faces of said bosses concentric said passages, ball ended telescopic tubes having one end thereof engaged in said seats, bosses in said connecting rod intermediate its ends, spherical seats in said bosses, said connecting rod having fluid passages therein communicating with said seats, the opposed ends of said tubes being engaged in the seats in said connecting rod bosses, means for the retention of said tubes within their seats, said crankshaft having a passage therein communicating with a source of cooled lubricant under pressure, one of the passages in said connecting rod being in fluid communication with the passage in said crankshaft and constituting in combination with the telescopic tube associated therewith an inlet canal for the lubricant circulated through the chamber in said piston, another of said passages in said connecting rod terminating in an opening upon an external face of the rod and constituting in combination with the telescopic tube associated therewith a discharge canal for the lubricant circulated through the chamber in said piston.

5. In an internal combustion engine embodying a chambered piston, a connecting rod and a crankshaft, mechanism for conducting a coolant to and from the chambered head of said piston comprising, yieldable tubular connections intermediate said piston and said connecting rod, said connecting rod having fluid passages therein communicating with said tubular connections, said piston having passages therein connecting said chamber with said tubular connections, and said crankshaft having a passage therein connected with one of the passages in said connecting rod and with a source of cooled lubricant under pressure.

6. In an internal combustion engine embodying a chambered piston, a connecting rod and a crankshaft, mechanism for conducting a coolant to and from the chambered head of said piston, comprising, yieldable tubular connections intermediate said piston and said connecting rod, said connecting rod having an inlet passage therein communicating with one of said tubular connections and with the wrist pin bearing, and having a second passage therein constituting a discharge passage connected with another of said tubular connections, said piston having an inlet and discharge passage therein connecting said chamber with said tubular connections, said crankshaft having a passage therein connected with said inlet passage in said connecting rod and with a source of cooled lubricant under pressure.

7. In an internal combustion engine embodying a chambered piston, a connecting rod and a crankshaft, mechanism for conducting a coolant to and from the chambered head of said piston, comprising, a pair of longitudinally yieldable tube assemblies mounted for swiveled movement intermediate said connecting rod and said piston, said connecting rod having an inlet passage therein communicating with one of said tube assemblies and with the wrist pin bearing for the lubrication thereof and having a second passage therein constituting a discharge passage having an opening adjacent the crank pin bearing, said last named passage being connected with the second tube assembly, said piston having inlet and discharge passages therein connecting said chamber with the respective tube assemblies, said crankshaft having a passage therein connected with said inlet passage in said connecting rod and with a source of cooled oil under pressure, and a baffle plate adjacent the discharge opening in said connecting rod for restricting the admission of oil into the engine cylinder.

8. In an internal combustion engine embodying a crankshaft, connecting rod and a reciprocating member, means for cooling said reciprocating member comprising, yieldable tubes intermediate said connecting rod and said reciprocating member, said connecting rod and reciprocating member having passages therein in communication with said tubes, said crankshaft having a passage therein in communication with one of the passages in said connecting rod and with a source of cooled lubricant under pressure.

9. In an internal combustion engine embodying a piston, connecting rod and crankshaft, means for cooling said piston comprising, a wall adjacent the head of the piston defining a chamber, wrist pin bosses in said piston having passages therein in communication with said chamber, a wrist pin in said bosses having passages in communication with the passages in the wrist pin bosses, telescopic tubes having one end thereof mounted in the wrist pin bosses in communication with the passages therein and having the opposed ends thereof mounted in said connecting rod, the walls of said connecting rod defining passages in communication with said telescopic tubes, one of the passages in said connecting rod being in fluid communication with a canal defined by the walls of said crankshaft and containing a cooled lubricant under pressure, another of the passages in said connecting rod opening in a side wall thereof and constituting the discharge passage for the lubricant circulated through said chamber in said piston.

10. In an internal combustion engine embodying a piston, connecting rod and crankshaft, means for cooling said piston comprising, a wall in said piston disposed to define a chamber in the head thereof, wrist pin bosses in said piston having passages therein communicating with said chamber, bushings in said bosses having annular grooves in the periphery thereof in registration with said passages, a wrist pin in said bushing constituting the bearing for the connecting rod, said connecting rod having a plurality of passages therein, one of which is in communication with said wrist pin bearing, telescopic tubes intermediate said piston bosses and said connecting rod and in communication with the passages in said wrist pin bosses and the passages in said connecting rod, said crankshaft having a passage

therein in communication with the passage in the connecting rod leading to said wrist pin bearing and in communication with mechanism for the delivery of a cooled lubricant under pressure.

11. In an internal combustion engine embodying a crankshaft and connecting rod having intercommunicating fluid passages therein and a chambered piston, means for cooling said piston, comprising mechanism for circulating a cooled lubricant through said fluid passages and yieldable connections between said connecting rod and piston for circulating the lubricant in said crankshaft and connecting rod passages to and from said chambered piston.

HAROLD D. CHURCH.