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INTERNAL COMBUSTION ENGINE

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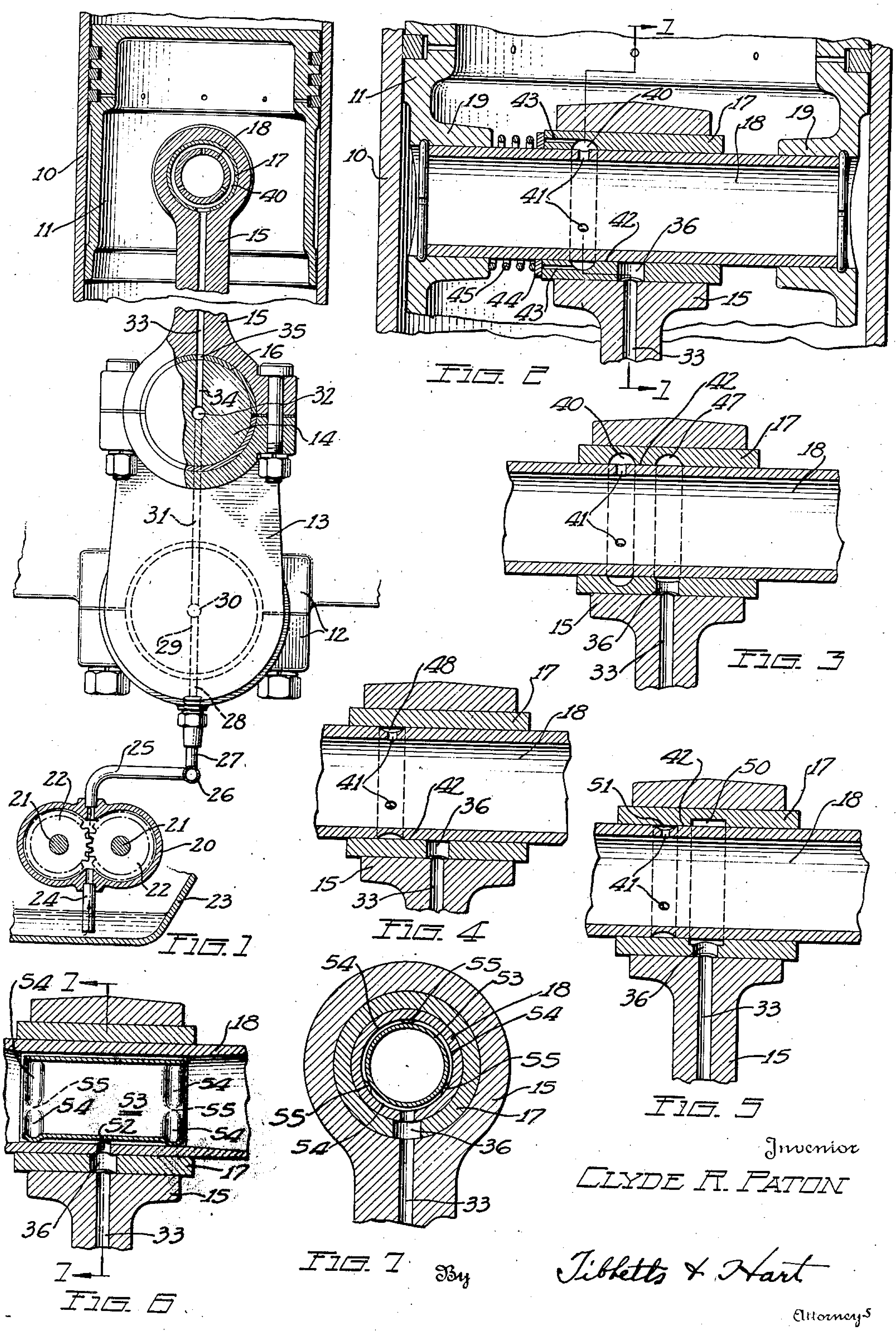

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INTERNAL COMBUSTION ENGINE

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10 Claims. (Cl. 184—6)

This invention relates to internal combustion engines and more particularly to lubricating systems for engines.

Lubricating systems for internal combustion engines usually include a pump for feeding oil to the bearings of the crank shaft and the connecting rods, the cylinder walls being lubricated by the spray of some of the oil flowing from such bearings. Due to friction, the heat developed by the piston movement in the cylinders increases with crank shaft speed and, consequently, a larger quantity of oil is required for high speed engine operation than for low speed engine operation. In a lubricating system arranged to feed an economical quantity of oil to adequately lubricate the cylinders during high speed engine operation there is too little oil delivered to the cylinders during low speed engine operation which results in wear. If the system is arranged to feed an economical quantity of oil to the cylinders during low speed operation then the oil supplied to the cylinder walls during high speed engine operation is too great with the result that some of it passes into the internal combustion chamber and is wasted. Lubricating systems are therefore usually designed to deliver an economical quantity of oil for adequate cylinder lubrication at an intermediate engine speed with the result that oil is wasted at the higher engine speeds and undesired cylinder wear occurs at the lower engine speeds.

An object of this invention is to provide an economical lubricating system for internal combustion engines wherein the supply for the cylinder walls approximates the desired requirement for all engine speeds.

Another object of this invention is to provide an auxiliary lubricating system for an engine cylinder wall which includes a direct oil supply during the slow speed engine operation and a more restricted oil supply during high speed engine operation.

A further object of the invention is to utilize the piston pin lubricating portion of an engine lubricating system as the source of an auxiliary system for supplying oil directly to a cylinder when the engine is operating in its lower speed range.

Other objects of the invention will appear from the following description taken in connection with the drawing, which forms a part of this specification, and in which:

Fig. 1 is a fragmentary sectional view of an engine taken on line 1—1 of Fig. 2 illustrating, partly diagrammatically, a lubricating system incorporating my invention.

Fig. 2 is an enlarged fragmentary sectional view through the piston illustrating one form which my invention can take in feeding oil to the cylinder wall.

Fig. 3 is a fragmentary sectional view through the connecting rod and piston pin showing a modified form of oil feeding means.

Fig. 4 is a view similar to Fig. 3 showing another modified form of oil feeding means.

Fig. 5 is another sectional view similar to Figs. 3 and 4 showing still another modified form the oil feeding means can take.

Fig. 6 is a sectional view similar to Figs. 3, 4 and 5 showing another modified form of the oil feeding means.

Fig. 7 is a sectional view taken on line 7—7 of Fig. 6.

The invention is shown associated with a conventional type of internal combustion engine having a cylinder 10 in which a hollow piston 11 is mounted to reciprocate. Within the crank case (not shown) is arranged the usual sectional bearing members, as indicated at 12, in which the crank shaft 13 is rotatably mounted, and connecting the engine crank pin 14 with the piston is a connecting rod 15. The end of the connecting rod associated with the crank pin is provided with the usual fixed bushing 16 and the end of the connecting rod associated with the piston is provided with a fixed bushing 17 which is rotatably mounted on a hollow pin 18 carried by the piston pin bosses 19 and open at its ends to the cylinder.

Leading to the crank shaft bearings and connecting rod bearings is a conventional type of force feed lubricating system. A pump casing 20 is fixed in the crank case and a pair of shafts 21 extend into and are carried by said casing. Mounted on such shafts, within the casing, is a pair of meshing pump gears 22 which are rotated through conventional driving means (not shown) connected to one of the shafts and driven by a rotating part of the engine. Within the crank case is a sump 23 into which oil returning from the bearings collects and this sump is connected with the pump casing by a conduit 24. An outlet conduit 25 leads from the pump casing to a main oil distributing manifold 26, and leading to the crank shaft bearings from this manifold are a plurality of conduits, one of which is indicated at 27. Each conduit 27 connects with a passage 28 in the bearing to lubricate the adjacent surfaces of the crank shaft and the bearing and connected with the passage 28 is another passage 29 leading to an axial passage 30 in the crank shaft. This passage 30 connects with a passage 31 in a cheek of the crank which communicates with an axial passage 32 in the crank pin 14 of the crank shaft. The connecting rod 15 has a longitudinally extending passage 33 which communicates with a radial passage 34 in the crank pin through an aperture 35 in the bearing 16. The bushing 17 is formed with a passage 36 registering with the passage 33 in the connecting rod in order that oil passing therethrough will be fed to lubricate the surface between such bushing and the piston pin.

The pressure oil feeding system operates to draw oil from the sump and move it through the passages just described to lubricate the surface between the crank shaft and its bearing, between bushing 16 and the crank pin, and between bushing 17 and the piston pin 18. As the lubricant is fed to such locations under pressure, it will be forced through the ends of such bearings and a portion thereof will drop into the crank case and reenter the sump and another portion will be thrown by centrifugal force to the inner surface of the cylinder to lubricate the portion thereof with which the piston engages in its reciprocation.

With the conventional engine so far described, the pump is usually geared to circulate oil in a quantity such that the oil consumption is most economical for average operating conditions. As the pump is driven by the engine, its speed increases in accordance with the speed of crank shaft rotation and, consequently, oil pressure in the lubricating system will vary with the speed of engine operation. With such system, an economical oil circulation for high speeds will deliver insufficient oil during low speed operation to adequately lubricate the cylinder. When the pump is geared to supply an economical quantity of oil for slow speed engine operation then too much oil is moved through the bearings at the high engine operating speeds with the result that some of the oil is wasted through being drawn into the combustion chamber. Because of these two undesirable extreme pressure conditions just mentioned, the pump is usually geared to provide an economical oil consumption somewhere between high and low engine speeds. With this compromise driving speed of the pump, there is an insufficient quantity of oil moved through the bearings to properly lubricate the cylinder during slow speed engine operation and it is the purpose of this invention to provide an auxiliary supply of oil to the cylinder during the lower speed range of engine operation.

As one means of providing an auxiliary oil supply for the interior of the cylinder during slow speed engine operation, I utilize the conventional force feed lubricating system, above described, and more particularly I utilize the oil moved to the connecting rod bearing associated with the piston pin.

The connecting rod bushing is associated with the piston pin so that the fit is relatively close, that is, the clearance is relatively small. As shown in Figs. 1 and 2, the inner face of the bushing 17 is formed with a groove 40 extending therearound and located in spaced relation axially from the oil inlet opening 36. As previously explained, oil moves through the opening 36 under pressure and then travels toward the ends of the bushing to lubricate the surface between the bushing and the pin so that some of such oil will collect in the groove 40. The pin 18 is formed with passage means leading from the groove 40 to the ends thereof and, in the present instance, such passage means consists of the interior of the hollow pin and a plurality of radially extending holes 41 through the pin wall which register with the groove 40. The annular space between the bearing 17 and the pin 18 located axially between the groove 40 and the inlet passage 36 in the bushing forms an oil metering means indicated generally by the numeral 42.

Oil flows from the supply passage 34 into the passage 33 in the connecting rod only during the time in each crank shaft rotation when the passages are in communication. The oil pressure in the lubricating system varies with the crank shaft speed and the time that passages 33 and 34 communicate in each crank shaft rotation is inversely to crank shaft speed. Under such circumstances, the resultant oil quantity passing through the passage 33 increases with the speed of engine operation but not to the same extent. The effect of the restriction formed by the fit of the bushing and the pin between the opening 36 and the groove 40 is to provide a metering passage which in connection with the effect of engine speed on flow of oil to the bushing will tend to supply oil to the interior of the piston pin at low speed. As the engine speed increases, the quantity of oil supplied to the cylinder wall through the piston pin will decrease until at high speeds it is negligible. Thus there will be an extra supply of oil to the cylinder wall at low engine speed and substantially no additional supply beyond that delivered by the conventional system at high engine speeds.

Referring particularly to Fig. 2, means is associated with the auxiliary cylinder lubricating system, just described, for relieving the same of oil when the pressure gets above a predetermined amount so that by means of such regulation the feeding function of the auxiliary system will substantially cease when the engine is operating above some predetermined rate of speed. To this end I provide axially extending passages 43 in one end of the bearing 17 from the groove 40 to the end of the bearing. Valve means 44 in the form of a brass disc is associated with the end of the bearing 17 to close these passages 43 and a coil spring 45 normally presses this valve element into passage closing position. The coil spring encircles the pin 18 and bears against the valve ring at one end and against the adjacent piston boss 19 at the other end. The pressure of the spring 45 is selected so that the valve 44 will be unseated at a predetermined oil pressure and allow by-passing of oil otherwise moving from the groove 40 through the holes 41.

In Fig. 3 I have illustrated a modified form of the auxiliary cylinder lubricating system wherein the structure differs from that in Fig. 1 only by the addition of a groove 47 around the interior of the bushing 17 in registration with the inlet opening 36. This groove 47 provides a reservoir entirely around the space between the pin and the bushing. Oil is moved by a pressure axially of the pin from both ends of the reservoir so that a sleeve of oil will be moving through the metering space 42 from the groove 47 to the groove 40 when the engine is in operation. A greater quantity of oil will travel to the groove 40 in the structure shown in Fig. 3 than in the structure shown in Fig. 2, assuming that pressure in the system and the space between the pin and the bushing are the same in both cases. So with the structure shown in Fig. 3, a greater quantity of oil is moved to the interior of the pin and thence to the cylinder wall than with the structure shown in Fig. 2 where the oil moves to the groove **40** from the opening **36**.

In Fig. 4 there is shown another modified form of auxiliary oil feeding means for the cylinder which differs slightly from the structure shown in Figs. 1 and 2. In the present instance, the pin is formed with a groove **48** around the periphery thereof which registers with the openings **41** leading to the interior of the pin. This form of metering device operates in substantially the same manner as that shown in Figs. 1 and 2.

In Fig. 5 I have shown another form of auxiliary oil feeding means for the cylinder wall. In this instance the bushing **17** is formed with a recess **50** around the inner face thereof which registers with the inlet opening **36**. Spaced axially from this groove **50** is a peripheral groove **51** around the hollow pin which registers with the openings **41** extending through the pin. This form of metering device functions in substantially the same manner as that shown in Fig. 3.

In Figs. 6 and 7 I have shown another form which the auxiliary oil feeding means for the cylinder wall can take. In this instance the bushing **17** fixed in the small end of the connecting rod **15** is provided with the same oil inlet opening **36** as has been described in the previously described forms of the invention. Registering with this bushing inlet oil opening is an opening **52** extending radially through the hollow pin. Some of the oil from the pressure feeding system moves endwise from the inlet opening **36** between the bushing and the pin to lubricate their engaging surfaces while the remainder of the oil passing through the inlet opening **36** is moved through the opening **52** in the pin. Metering means is provided interiorly of the pin so that oil passing through the opening **52** must flow thereby to reach the cylinder wall at the ends of the pin. In the present instance, this metering means is formed by the inner wall of the pin and a metal sleeve **53**. The ends of this sleeve are formed with a plurality of outwardly pressed bosses **54** which engage the inner surface of the hollow pin. Between the ends of these bosses and the adjacent inner wall of the hollow pin will be formed restricted passage means **55** through which oil entering the opening **52** must pass before moving to the ends of the hollow pin.

In all forms of the invention herein described, the oil passes from the main force feed lubricating system through metering means to passage means associated with the piston pin and leading to the cylinder wall. In each instance there is a groove beyond the orifice restriction which provides a reservoir immediately adjacent the openings through the hollow pin. In some forms of the invention there is less resistance to flow of oil to the interior of the hollow pin than in other forms of the invention, but, in either event, at low engine speeds oil flows through this auxiliary system to assist in lubricating the interior wall of the cylinder. The invention herein described permits the oil pump to be driven at a speed to secure the most economical consumption of oil without wasting oil due to an over supply to the cylinders at high speeds and without an under supply of oil to the cylinders at low speeds.

Although the invention has been described in connection with a specific embodiment, the principles involved are susceptible of numerous other applications which will readily occur to persons skilled in the art. The invention is therefore to be limited only as indicated by the scope of the appended claims.

What I claim is:

1. A lubricating system for an engine cylinder and piston comprising a piston pin having passage means therein open to the cylinder, a connecting rod bushing rotatably mounted on said pin with small clearance having an oil passage therethrough open to said pin, an engine driven pump connected to feed oil through said bushing passage, oil restricting means between said bushing passage and said pin passage means, and means for relieving said restricting means above a predetermined oil pressure therein.

2. A lubricating system for an engine cylinder and piston comprising a piston pin having passage means therein open to the cylinder, a connecting rod bushing rotatably mounted on said pin having an oil passage therethrough open to said pin and a circular groove in the inner face spaced axially from said passage, said piston pin passage means being in communication with said circular groove, and an engine driven pump connected to feed oil through said bushing passage.

3. A lubricating system for an engine cylinder and piston comprising a hollow piston pin having a radial opening therethrough, a connecting rod bushing rotatably mounted on said pin with relatively small clearance and having a pair of axially spaced interior grooves open to said pin and one of said grooves registering with the opening in said pin, an engine driven means, and an engine driven pump connected to feed oil to the groove spaced from the opening in said pin.

4. A lubricating system for an engine cylinder and piston comprising a hollow piston pin open at its ends to the cylinder and having a radial opening therethrough, a connecting rod bushing rotatably mounted on said pin and having passage means communicating with the radial opening in the pin during its rotative movements, an engine driven pump connected to feed oil through the passages in said bushing and said pin, and a sleeve member within said hollow pin for restricting oil flowing to the ends of said hollow pin through the passage therein.

5. A lubricating system for an engine cylinder and piston comprising a piston pin having passage means therethrough open to the cylinder, a connecting rod bushing rotatably mounted on said pin with relatively small clearance, said bushing having an oil inlet passage therethrough and an interior circular groove open to the passage means in said pin and spaced axially from said inlet opening, by-pass openings connected with by-pass openings in said bushing between the interior groove and an end thereof, a valve element mounted on said pin and closing the end of said by-pass means in said bushing, spring means associated with said pin and valve to exert a predetermined pressure for holding said valve in closed relation with said by-pass means, and an engine driven pump connected to feed oil through the inlet opening in said bushing.

6. A lubricating system for an engine cylinder and piston comprising a piston pin having passage means therein open to the interior cylinder wall, a connecting rod bushing mounted on said pin, said bushing having an oil passage therethrough open to the pin, a circular groove between the pin and the bushing spaced axially from said bushing passage, said piston pin pas-

sage means being in open communication with said groove, and engine driven pump means connected to feed oil through said bushing passage.

7. A lubricating system for an engine cylinder and piston comprising a piston pin with a passage terminating at its ends, a connecting rod bushing mounted on said pin, a pair of axially spaced circular recesses between said pin and said bushing, an oil inlet in the bushing open to one of said recesses, an oil outlet between the other circular recess and the passage in the pin, and engine driven pump means connected to feed oil through said oil inlet.

8. A lubricating system for an engine cylinder and piston comprising a hollow piston pin open at the ends to the cylinder, a bushing on the pin, passage means extending through and between the bushing and the pin for feeding oil from the bushing exterior to the interior of the pin, oil restricting means in the portion of the passage means between the pin and the bushing, and an engine driven pump connected to feed oil through the passage means.

9. A lubricating system for the adjacent surfaces of an engine piston and cylinder comprising a hollow piston pin open at its ends to the cylinder, a sleeve member coaxial with the pin, said pin and sleeve member forming an axially extending passage open to the interior of the hollow pin, restricting means in the axially extending portion of the passage means, and an engine driven pump for moving oil through the passage means into the hollow pin.

10. A lubricating system for the cylinder and piston of an engine comprising a hollow pin open at its ends to the cylinder wall, said pin having an oil passage through its wall, a connecting rod, a bushing in one end of the rod pivotally mounted on the portion of the pin having the passage in its wall, said rod and said bushing having connecting oil passages therethrough, the oil passage in said pin being spaced from the oil passage in said bushing, restricting passage means connecting said bushing passage and said pin passage, and engine driven pressure means for feeding oil from the exterior of said bushing to the interior of said pin through said passages and said passage means.

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