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LUBRICATION SYSTEM FOR INTERNAL COMBUSTION ENGINES

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FIG. 1.

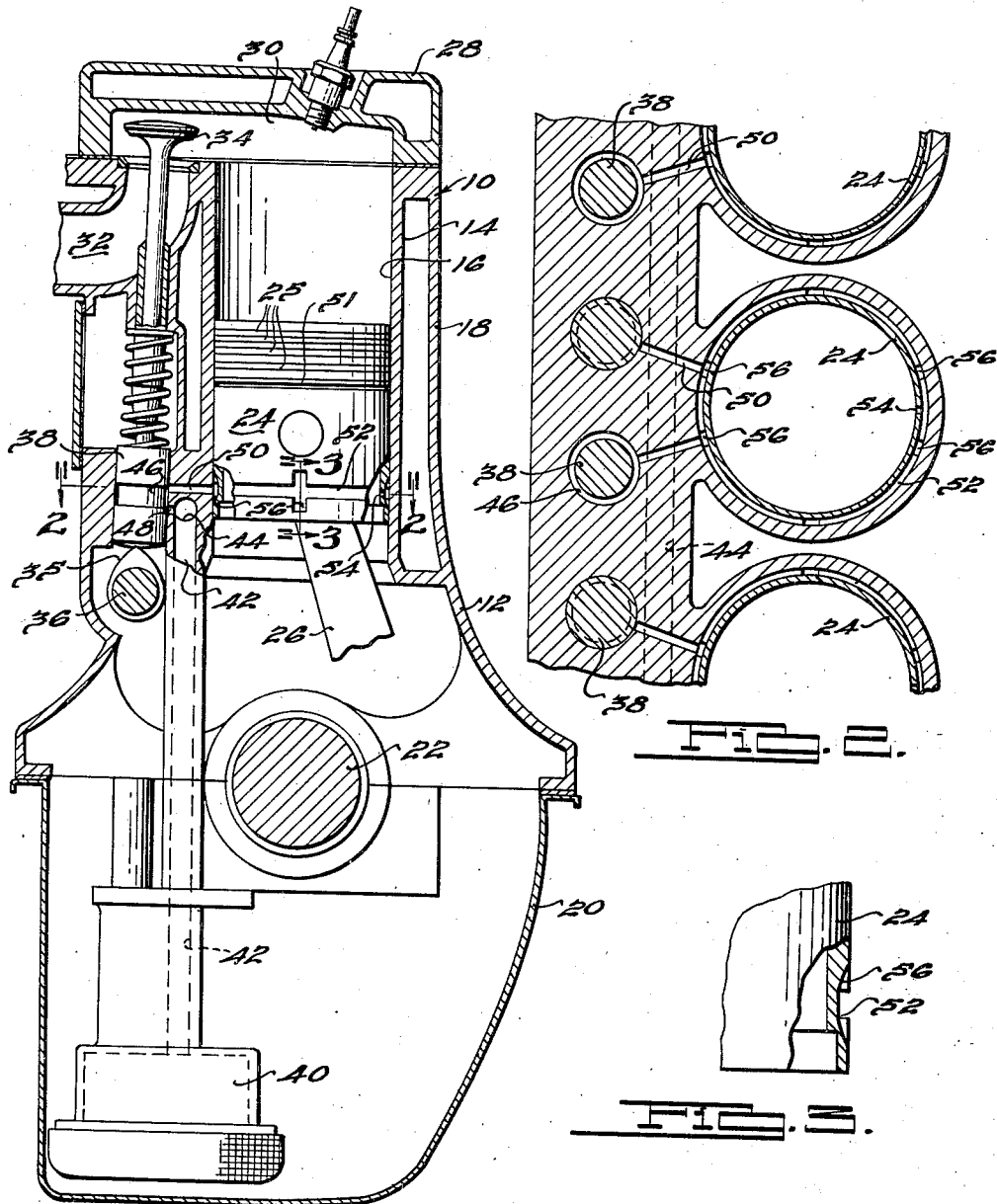


FIG. 2.

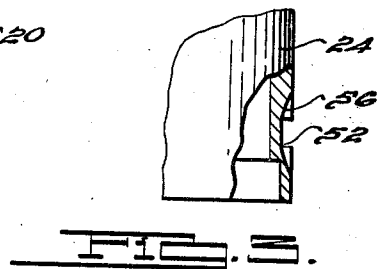


FIG. 3.

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LUBRICATION SYSTEM FOR INTERNAL COMBUSTION ENGINES

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4 Claims. (Cl. 184—18)

This invention relates to internal combustion engines and particularly to the lubrication of the pistons and cylinders thereof, the principal object being the provision of a new and novel arrangement of parts insuring efficient lubrication between each piston and its cooperating cylinder wall.

Objects of the invention include the provision of means in an internal combustion engine for delivering lubricant to and distributing it around the walls of a cylinder and its cooperating piston; the provision of means whereby a lubricant delivered to one point in the circumference of a cylinder of an internal combustion engine will be distributed completely around the circumference of such cylinder and cooperating piston; and the provision of a construction in which lubrication of the cooperating walls of a piston and cylinder of an internal combustion engine will be insured even though the piston may be traveling at a relatively high rate of speed within the cylinder.

The above being among the objects of the present invention the same consists in certain novel features of construction and combinations of parts to be hereinafter described with reference to the accompanying drawing, and then claimed, having the above and other objects in view.

In the accompanying drawing which illustrates a suitable embodiment of the present invention and in which like numerals refer to like parts throughout the several different views,

Figure 1 is a partially broken, vertical sectional view taken transversely through an internal combustion engine of the multi-cylinder type;

Fig. 2 is an enlarged fragmentary, horizontal sectional view taken on the line 2—2 of Fig. 1; and

Fig. 3 is an enlarged fragmentary, vertical sectional view taken radially through the piston of the engine shown in Fig. 1 as on the line 3—3 thereof.

It is well understood by those skilled in the art that it is a common occurrence for the internal combustion engine of an automobile, for instance, to be damaged because the operator starts the engine up from a cold or relatively cold condition and operates the engine at relatively high speed before the engine and its lubricant contained therein has had an opportunity to become warmed up. When an internal combustion engine has been operating for a sufficient length of time to permit it and the lubricant contained therein to reach normal operative temperatures,

the viscosity of the lubricant attains its lowest value for normal operating conditions. If such engine at normal operating temperatures is stopped and allowed to remain stopped for a considerable length of time such lubricant or lubricating oil as has collected on the walls of the cylinders and between the walls of the cylinders and the walls of the cooperating pistons has a tendency to and actually does drain to a greater or lesser degree from the walls of the cylinders and pistons back into the crankcase. Should the weather be cold or relatively cold and the engine be allowed to stand a sufficiently long time to permit the oil to drain away from the walls of the cylinders and pistons as above described and, further, to attain a temperature corresponding with the outside air the lubricant, because of its character and/or condition, may under such circumstances become relatively heavy and viscous and resistive to the desired speed of flow through the various lubricating passages in the engine and particularly to transfer to the walls of the cylinders under the urge of the usual means provided for such purpose. In such event if the engine is run at a speed above a relatively low speed, because of the lack of lubrication between the cylinders and their pistons these parts may and often do come into actual metallic contact with each other with the result that the walls of the cylinders or the walls of the pistons or both become scored or scuffed to a greater or lesser degree. Such scoring or scuffing not only endangers further sticking between the cylinders and the pistons but also has the tendency to foster excessive oil pumping of the engine, that is, excessive passage or flow of oil from the crankcase upwardly in the cylinders past the pistons therein and into the combustion chamber where it fosters the formation of carbon deposits, and in many cases fosters locking of the piston rings in their respective grooves thereby preventing the piston rings from satisfactorily performing their intended function.

It has heretofore been suggested that means be provided for delivering to the cooperating surfaces of a piston and cylinder a direct flow of oil or other lubricant to obviate the above described difficulty. It has even been suggested heretofore that such means be provided that will function only during the initial starting period of the engine at which time such damage usually occurs. However, as far as I am aware these prior suggestions extended only so far as to provide an opening through the wall of a cylinder and suitably connected to a source of lubricant under

pressure but without any attempt to distribute such oil about the circumference of the piston and cylinder once it has been lead thereto. I have found where such lubricant or oil is simply delivered through a hole in a cylinder wall to the surface of a piston operating within the cylinder, particularly when the engine and oil are cold, that the oil will not be distributed for more than a few degrees to either side of the hole in the cylinder wall and consequently leaves the remaining circumference of the piston and cylinder open to all the dangers of scoring or scuffing that they would otherwise be subjected to. I have found that in order to obviate the danger of scoring or scuffing of the piston or cylinder walls by this method some means must be provided for the ready flow of lubricant completely around the circumference of the piston and cylinder, and particularly in engines capable of a relatively high speed, means for prolonging such circumferential flow of oil.

The circumferential flow of oil around a piston and cylinder under the above described conditions may be accomplished by either grooving the surface of the cylinder or the surface of the piston circumferentially so as to provide a duct for the ready flow of oil therearound, but in view of the fact that it would be a relatively difficult operation to form such groove in the walls of the cylinder itself and because the presence of such grooves might interfere with the proper movement of the piston in the cylinder due to contact of the compression or piston rings with the grooves, it is more expedient to form such grooves in the walls of the piston. Additionally if such groove is to be operable for the described purpose under all conditions I have found that drainage means should be provided from the groove to the crankcase at a point approximately diametrically opposite the point of admission of the lubricating oil, this particularly for the purpose of permitting the escape of air which may have displaced the oil in the grooves during the preceding inoperative periods of the engine, thereby to permit the ready and unobstructed flow of the oil circumferentially of the cylinder and piston.

Additionally because of the fact that such groove formed in the wall of a piston may be only momentarily in register with the opening in the wall of the cylinder through which the lubricating oil is introduced, it is preferable, particularly in the higher speed types of engine, to provide grooves in the wall of the piston extending longitudinally thereof or in axially parallel relation with respect to the piston so as to provide an appreciable time element during which the opening in the wall of the cylinder is not sealed by a piston surface but lies in open communication with the circumferential groove. I have found that where a piston and cylinder are so constructed and arranged and means are provided for supplying a quick and ready supply of lubricating oil under pressure through the opening in the wall of the cylinder, the danger of scuffing as above described is eliminated for all practical purposes.

Referring now to the accompanying drawing, an internal combustion engine is shown as including a cylinder block indicated generally at 10 and comprising a crankcase portion 12, cylinders 14 each having a bore 16 and a conventional water jacket 18; an oil pan 20, a crankshaft 22, a piston 24 for each cylinder provided with conventional rings 25 and connected in a conventional manner by means of connecting rods 26 to the crankshaft 22, and a cylinder head 28 inte-

riorly formed to provide the usual combustion chamber 30. The flow of combustible mixture to the combustion chambers 30 and/or the discharge of exhaust gases therefrom is accomplished by means of the usual ports or passages 32 each controlled by a valve 34 in a conventional manner. The valves 34 are illustrated as being actuated in suitably timed relation with respect to the rotational position of the crankshaft 22 by means of the usual cams 35 arranged in a conventional manner upon a cam shaft 36 and cooperating through tappets 38 with the stems of the valves 34. A conventional type of oil pump 40 is illustrated as being positioned in the bottom of the oil pan 20 and as discharging the oil pumped thereby through the vertical discharge passage 42 to a horizontal gallery or duct 44 extending longitudinally of the cylinder block 10 along one side of the cylinders 14 and adjacent the lower ends thereof.

Although in accordance with the present invention the particular means provided for introducing oil under pressure from the duct 42 to the bores 16 of the various cylinders 14 is more or less immaterial, and may be such as to provide either a continuous or an intermittent flow of oil to the bore of the cylinders, in the particular instance shown each tappet 38 is provided with a circumferential groove or recess 46, and an opening 48 connects the gallery 44 with the bore in which each tappet is slidably guided and consequently with the groove 46 of each tappet 38 as indicated. Although only one of the two tappets provided for each cylinder may be employed to control the flow of oil to the cylinder bores, in the particular instance shown both tappets for each cylinder are employed for this purpose, and accordingly, the bore in which each of the tappets 38 is slidable is connected with the corresponding cylinder bore 16 by a passage 50 extending inwardly therefrom to the bore 16 of such corresponding cylinder 14. Particularly where it is desired to limit the flow of oil through the passages 50 to the bore of the corresponding cylinder walls the relation of the passages 48 and 50 to the grooves 46 in the corresponding tappets 38 may be such that a flow of oil from the gallery 44 through each opening 48, groove 46 and passage 50 occurs only once during each reciprocation of each tappet 38. The construction shown accomplishes this result by positioning the passages 50 in such relation to the tappets 38 that each passage 50 is open to the groove 46 in its corresponding tappet 38 only when the corresponding tappet 38 is in its uppermost position as controlled by its corresponding cam 35.

In accordance with the present invention the piston 24 for each cylinder is provided on its exterior surface with a circumferential groove 52 which extends completely therearound. This groove 52 is so positioned on the wall of the piston 24 that it will align itself or come into registry with the point of discharge of the corresponding passage 50 onto the bore 16 of the corresponding cylinder 14 at least once during each reciprocation of the piston 24 and this at a time when the corresponding passage 50 is in open communication with the gallery 44 containing lubricating oil under pressure. In order to prevent possible registry of the usual oil drain groove 51 in the piston 24 shown immediately below the ring assembly and which oil drain groove communicates with the interior of the piston in a conventional manner, from registering with the corresponding passage 50, the passage 50 is so located in the

length of the cylinder bore as to be beyond the limit of travel of the oil drain groove 51 in the cylinder during reciprocation of the piston therein. Accordingly, it will be understood that at least once during each reciprocation of a piston 24 the groove 52 therein will become aligned with the corresponding passages 50 through which oil under pressure will be delivered into the groove 52 and will be carried thereby around the circumference of the piston. As previously described, in order to insure such oil flowing completely around the piston 24, the piston 24 at a point thereon approximately diametrically opposite from the passages 50 is provided with an opening 54 communicating the groove 52 with the interior of the piston and consequently the interior of the crankcase 12. This opening 54 permits any air that may have become entrapped in the groove 52 to readily be displaced therefrom so as to permit a complete and free flow of oil circumferentially of the piston in the groove 52. The size of the opening 54 is more or less immaterial but it is preferably such as to prevent a too rapid draining of the oil in the groove 52 therethrough, thereby insuring a proper supply of oil in the groove 52 to accomplish the desired purpose.

It will be apparent that with the construction thus far described if the piston is travelling at an appreciable rate, the time element during which each groove 52 is in registry with the corresponding opening 50 will be extremely small and consequently an insufficient supply of oil may be discharged into the groove 52 to properly overcome the condition for which the structure is designed. Accordingly, in order to increase this time element and to insure a proper supply of oil being delivered from the passages 50 to the grooves 52, the surfaces of the pistons 24 particularly along those lines thereof in angular alignment with the passages 50 are grooved as at 56 in parallel relation with respect to the axis of the piston and in intersecting relation with respect to the corresponding grooves 52. The length of these grooves 56 may, of course, be varied to obtain any desired length of time of flow between each passage 50 and its corresponding groove 52 during each reciprocation of the piston. I have also found it preferable to provide such grooves 56 circumferentially of the piston in intersecting relation with respect to the groove 52 at points other than in angular alignment with the passages 50, thereby to more efficiently distribute the oil from the grooves 52 over the face of the piston and bore of the corresponding cylinder.

With the above described structure, and where the size of the grooves 52 and 56, the openings 54, passages 50 and the like are properly proportioned with respect to the pressure of the oil to which they are subjected, and ordinary precautions are taken to insure a flow of oil immediately to these parts upon initiation of engine operation, the danger of scuffing of the walls of the piston and cylinder because of lack of lubrication under starting conditions is entirely eliminated from a practical standpoint.

Formal changes may be made in the specific embodiment of the invention described without departing from the spirit or substance of the broad invention, the scope of which is commensurate with the appended claims.

What I claim is:

1. In combination with an internal combustion engine, a cylinder and a piston reciprocable

therein, said cylinder having a passage extending into the bore thereof at a point normally traversed by the piston during its reciprocation, means for feeding a lubricant under pressure to said passage, said piston having a continuous groove therein extending circumferentially around the outer surface thereof in a position to align itself with said passage during each reciprocation of the piston, and said piston having a passage therethrough at a point circumferentially remote from the first mentioned passage connecting said groove with the interior of said piston for venting entrapped air and permitting free circulation of lubricant.

2. In combination with an internal combustion engine, a cylinder, a piston reciprocable therein, a plurality of piston rings carried by said piston adjacent the closed end thereof, said piston having a circumferential oil drainage groove in its outer surface adjacent said rings communicating with the interior of said piston, said cylinder having a passage therethrough opening onto the bore thereof at a point in the length of said cylinder beyond the normal limits of travel of said drain groove therein and in that area of said cylinder bore swept by said piston during normal reciprocation, means for supplying lubricant under pressure to said passage, said piston having a continuous groove in the outer surface thereof extending circumferentially thereabout and so located in the length of said piston as to be open to the reception of oil from said passage during each reciprocation of said piston, and said piston having an opening therethrough communicating with said groove therein to permit escape of air entrapped in said groove and permitting free circulation of lubricant.

3. In combination with an internal combustion engine, a cylinder and a piston reciprocable therein, said cylinder having a passage extending into the bore thereof at a point normally traversed by the piston during its reciprocation, means for feeding a lubricant under pressure to said passage, said piston having a continuous groove therein extending circumferentially around the outer surface thereof in a position to align itself with said passage during each reciprocation of the piston, and said piston having an additional groove in the outer surface thereof extending transversely of and in intersecting relation with respect to the first mentioned groove, the second mentioned groove being angularly aligned with said passage relative to the axis of said cylinder whereby to lengthen the effective time period of communication between said passage and the first mentioned groove during each reciprocation of said piston, and said piston at a point circumferentially remote from said passage having an opening therethrough connecting one of said grooves with the interior of said piston for venting entrapped air and permitting free circulation of lubricant.

4. In combination with an internal combustion engine, a cylinder and a piston reciprocable therein, said cylinder having a passage extending into the bore thereof at a point normally traversed by the piston during its reciprocation, means for feeding a lubricant under pressure to said passage, said piston having a continuous groove therein extending circumferentially around the outer surface thereof in a position to align itself with said passage during each reciprocation of the piston, and said piston having an additional groove in the outer surface thereof extending transversely of and in intersecting

relation with respect to the first mentioned groove, the second mentioned groove being angularly aligned with said passage relative to the axis of said cylinder whereby to lengthen the effective time period of communication between said passage and the first mentioned groove during each reciprocation of said piston, and said piston at points circumferentially spaced from said passage having additional transversely extending passages in the exterior surface thereof intersecting the first mentioned groove.

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