MACHINE LUBRICATING MEANS AND PARTS THEREFOR

Original Filed Sept. 6, 1963

FIG. 2

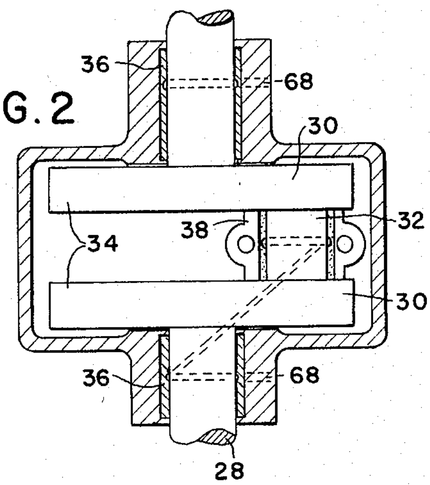


FIG. 1

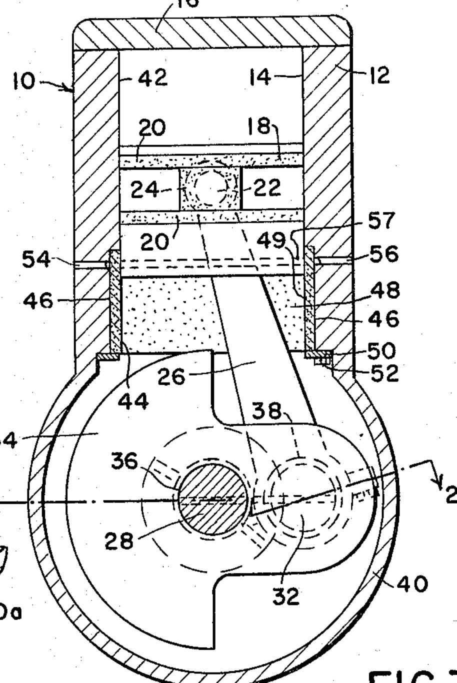


FIG. 3

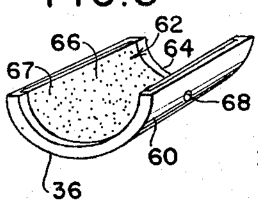


FIG. 4

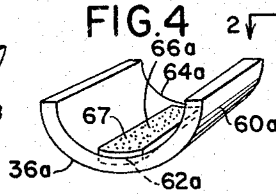


FIG. 5

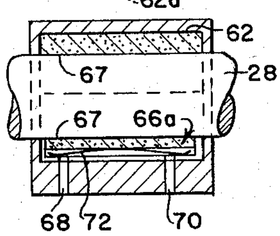


FIG. 7

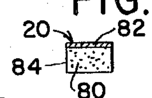


FIG. 6

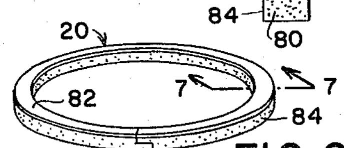


FIG. 11

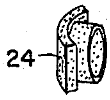


FIG. 9

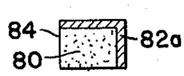


FIG. 10

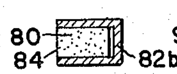


FIG. 8

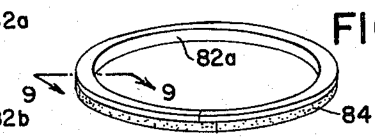
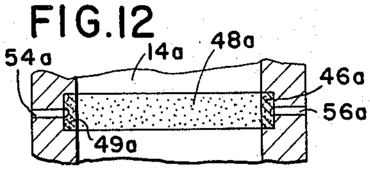


FIG. 12



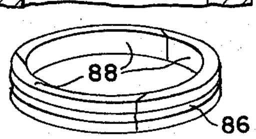


FIG. 13

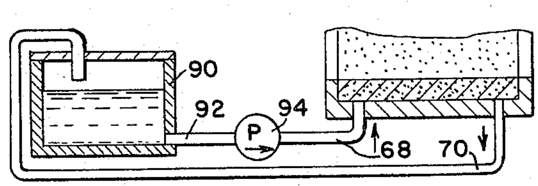


FIG. 14

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3,286,792

Patented Nov. 22, 1966

3,286,792

MACHINE LUBRICATING MEANS AND PARTS THEREFOR

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Continuation of application Ser. No. 307,059, Sept. 6, 1963. This application Nov. 26, 1965, Ser. No. 514,753

19 Claims. (Cl. 184—6)

This application is a continuation of my application Serial No. 307,059, filed September 6, 1963, now abandoned.

The present invention relates to means for lubricating a machine comprising relatively movable parts having surfaces in contact with each other in which at least one of said surfaces is a bearing which includes a porous insert having a pervious surface for passage of liquid lubricant to the contacting surface of the other part but all other surfaces completely sealed against outflow of said lubricant, and to parts for use in such machines. More particularly the invention is applicable without outstanding advantage in internal combustion engines of the two cycle type.

In general practice today most of the many two cycle motors are lubricated by the addition of oil to the gasoline supply. This has many undesirable results. Among other things it is wasteful of lubricating oil and requires constant attention to keep a sufficient proportion of oil in the gasoline supply to provide the lubrication. Moreover the excess oil not actually used in lubricating contacting relatively moving surfaces is exhausted to the atmosphere, or in the case of outboard motors to the water, with the products of combustion where it contaminates or pollutes the environment since it is never wholly combusted itself. Reasons for the widespread use of this system of lubricating motors despite these disadvantages are the relative simplicity of the motor as compared with the forced lubricating systems common in four cycle motors, the absence of over oiling in loose motors and the presence of oil even during heavy influx of raw gasoline on starting cold.

The present invention overcomes the disadvantages of the conventional lubricating systems for many purposes including both two and four cycle motors through the use of porous inserts in a new relation or combustion as described in detail hereinafter in conjunction with the drawings in which:

FIG. 1 is a vertical section through a cylinder and crankcase of an internal combustion engine or motor constructed in accordance with the invention;

FIG. 2 is a fragmentary sectional view along the line 2—2 of FIG. 1;

FIG. 3 is an isometric view of one embodiment of a bearing part of the invention;

FIG. 4 is an isometric view of another embodiment of a bearing part of the invention;

FIG. 5 is a vertical sectional view of an assembled shaft (fragmentary) and bearing of the invention;

FIG. 6 is an isometric view of a piston ring of the invention;

FIG. 7 is a sectional view on the line 7—7 of FIG. 6;

FIG. 8 is an isometric view of a different embodiment of a piston ring of the invention;

FIG. 9 is a sectional view of the line 9—9 of FIG. 8;

FIG. 10 is a sectional view similar to FIG. 9 of a different embodiment of piston ring of the invention;

FIG. 11 is an isometric view of one of the two wrist pin bearings which in the invention are located at the ends of the wrist pin on opposite sides of the connecting rod;

FIG. 12 is a fragmentary vertical section of a cylinder wall insert and adjacent cylinder wall of a different embodiment from that of FIG. 1;

FIG. 13 is an isometric view of the insert of FIG. 12 showing how it is sectionalized for insertion into the groove in the cylinder wall; and

FIG. 14 is a schematic diagram of a lubricating system of the invention.

Referring now more particularly to FIGS. 1 and 2, a machine **10** is illustrated which has a number of structures comprising two relatively moving parts. Thus there is shown a cylinder block **12** having a cylinder **14** therein closed at the top by a cylinder head **16** and with a piston **18** reciprocable therein, the piston and cylinder being the two relatively movable parts with the cylinder wall constituting a bearing which supports and guides the piston as it reciprocates. The piston is shown with two piston rings **20** whose outer cylinder surfaces constitute a bearing against the cylinder wall, a wrist pin **22**, wrist pin bearings **24**, a connecting rod **26** between the wrist pin **22** and a crankshaft **28** for reciprocating the piston. The wrist pin and wrist pin bearings, and the connecting rod and crank arms **30** and crank pin **32** are other instances of two relatively movable parts of which at least one serves as a bearing for the other. The crankshaft is shown with counterweights **34** to reduce vibration during operation of the machine. A main bearing **36** is provided at each side of the crank arms and a crank pin bearing **38** is provided for the connecting rod. Crankcase **40** closes the lower part of the motor or compressor schematically represented by FIGS. 1 and 2.

The cylinder has a bi-surfaced cylinder wall comprising an upper section or portion **42** which may be called the combustion or compression portion and a pervious portion **44**. The dividing line between these portion **42** and **44** is approximately in the zone from the top of the piston at the bottom of its stroke and the top of the lowermost piston ring when the piston is at the bottom of the stroke. Thus the pervious portion of the cylinder wall preferably does not come into full or even partial contact with the gases in the cylinder but is below the cylinder cavity yet in face to face contact with at least one of the piston rings at least at the end of the stroke of the piston. The advantages of this relationship is that the lubricant that comes to the surface of the pervious portion, in the manner described later, is not exposed to the hot combustion gases in an internal combustion motor nor to the air in the cylinder in a compressor. This preserves the lubricating oil from breakdown from contact with hot or flaming gases and preserves the air into which the combustion gases discharge free from contamination by the oil.

In FIG. 1 the cylinder is shown as extending downwardly below the combustion or compression portion and is provided with a rabbet **46** to receive a porous insert **48** having a pervious surface **49** facing the piston which provides the pervious portion of the cylinder wall. The insert is held in the rabbet **46** by a retainer ring **50** fastened to the end of the cylinder by bolts **52**. A feed passage **54** is provided at one side and a return passage **56** at the other side. If desired these passages may be joined by an oil groove **57** either in the rabbet or the outer wall of the insert, or the communication may be through the porous insert itself. In any event the only surface of the insert from which lubricant can flow is the pervious surface because other surfaces are completely sealed against movement of liquids therethrough. Where the insert is tightly held in a groove the walls of the groove may provide the seal but it is preferred actually to seal completely all the surfaces other than the pervious contacting surface, e.g., by burnishing them against a dull tool in a lathe, by spraying a sealant on them or by laminating a thin impervious metal sheet to them.

Referring now to FIGS. 3, 4 and 5 the main bearing comprises a shell **60** or **60**_a_ having a recess **62** or **62**_a_ with a surrounding wall **64** or **64**_a_. An insert **66** or **66**_a_ is placed in the respective recess **62** or **62**_a_. The difference in the bearing parts shown in FIGS. 3 and 4 is that the insert **66** in FIG. 3 is a complete semicircle in cross section whereas insert **66a** in FIG. 4 is only a segment. The bearing shown in FIG. 5 includes as the upper half a part like FIG. 3 and as the lower half a part like FIG. 4 in which a feed passage **68** and a return passage **70** are provided. In this embodiment there is shown also a leaf spring **72** to bias the insert **66a** yieldingly against the shaft **28** to assure proper application of oil to the shaft.

These porous inserts, like insert **48** already described, have a pervious surface **67** facing the shaft and all other surfaces completely sealed against passage of liquids therethrough, either by the surrounding wall **64** or preferably by a sealed surface directly on the insert.

The structure of the piston rings, as shown in FIGS. 6 to 10, comprises a compression ring made of porous metal **80** which has a seal **82** at the upper sectoral surface to prevent passage of liquids therethrough. Thus the liquid lubricant in the porous metal cannot flow out through the seal and gasoline that flows down in the space between the cylinder wall and the piston cannot flow into the porous metal through the seal and leach out the oil or waste it. In two cycle motors where both ends of the piston are subjected to compression and combustion the upper piston ring can be as shown in FIGS. 6 and 7 while the lower ring can have the same structure but have the sealed sectoral surface down. Similarly the rings may have both the top and back surfaces sealed as shown at **82a** in FIGS. 8 and 9, or the top, bottom and back surfaces may be sealed as shown at **82b** in FIG. 10. In all cases the outer cylindrical surface **84** is a pervious surface.

At least one of the piston rings **20** comes in contact with the insert **48** during part of the stroke to pick up oil from the insert which has been supplied by oil feed through inlet passage **54** and transfer it to the cylinder wall to lubricate the movement of the piston. Another way of supplying the piston rings is to provide oil passages, as illustrated in part by the dotted lines of FIG. 2, from the main bearing feed line **68** through the crankshaft to the connecting rod, through it to the wrist pin and the piston ring grooves.

The wrist pin bearings **24**, as shown in FIG. 11, are made of porous metal and the surfaces that contact relatively moving parts are pervious to lubricant while other surfaces are sealed completely as described for the inserts **48** and **66**.

The structure of the cylinder shown in FIG. 12 is different from that of FIG. 1 in that the insert **48a** is placed in a groove **46a** instead of a rabbet. One satisfactory expedient for placing the insert ring in the groove is to make the ring in segments of about 120 degrees each, tapering the ends as shown so that each segment may be placed in the groove from within the cylinder and make, when assembled, a complete ring of proper inner diameter to make contact with the piston rings as they come into surface contact with its pervious surface **49a**. An oil channel **86** is shown in the outer cylindrical wall of the ring insert **48a** which has the three segments marked **88** as seen in FIG. 13.

A schematic illustration of one type of system for feeding the lubricating oil is shown in FIG. 14 in which **90** represents a reservoir for lubricating oil and which may be the crankcase or other source. A suction line **92** connects the supply or reservoir to a pump **94** which causes the oil to flow through feed passage **68** into the porous body. Excess oil may be returned to the reservoir **90** through return passage **70**. In cases where price and weight must be kept to a minimum a simple gravity feed from a reservoir at some elevation above the machine is satisfactory.

For motors that operate for a short time, e.g., model airplane motors, it is sufficient to charge the porous inserts with lubricating oil before a run from a gravity or pressure source. Similarly internal combustion motors and compressors can work with dry crankcases by providing

constant or intermittent feed of oil to the porous inserts from another reservoir.

In any case the oil pressure used in the machines of the present invention is much lower than the pressure in oil feed lines used conventionally in four cycle motors. The pressure is not critical as long as it suffices to maintain the pervious surfaces wet with lubricant and does not force the oil laterally between the contacting surfaces in an appreciable amount. The return lines, if used, easily control pressure. Where feed and return lines are provided the surfaces of the porous insert is left unsealed adjacent thereto to permit the flow and the word "completely" as used herein is to be construed to include all surfaces of the inserts except that adjacent to a feed or return line.

The structure of the invention lends itself also to utilization of the best combinations of metals to minimize friction and seizing. Thus the inserts can be made by powder metallurgy by well known methods of various metals and alloys which do not tend to bind the metal moving over them and where pervious surfaces of one insert contacts the pervious surface of another insert, they can be made of different metals or alloys to minimize friction and seizing. Although these porous metal parts may have a low ratio or metal to volume, i.e., a large proportion of the volume is space for lubricant, they are essentially rigid bodies that have compressive strength to withstand stresses to which they are subjected in use.

While the invention has been described and illustrated with reference to certain preferred embodiments and applications of the principle of the invention, those skilled in this art will readily understand the almost limitless applicability of the principal of the invention to machines wherever there are two relatively movable parts which require lubrication. It is intended that the following claims be given broad interpretation to cover the generic and specific aspects of the invention defined.

Having thus described and illustrated the invention, what is claimed is:

1. A machine comprising at least two relatively movable parts, one of said parts being a bearing including a porous metal element having a liquid lubricant pervious surface contacting and supporting the other of said relatively movable parts, liquid lubricant filling said porous metal element, said porous metal element having all its surfaces other than the one contacting said other relatively movable part completely sealed against outflow of liquid lubricant through said other surfaces from said element and thereby supplying lubricant between the relatively movable parts.

2. A machine as set forth in claim **1** which includes means to supply liquid lubricant to said porous metal element under sufficient pressure to keep lubricant at said pervious surface and thereby supply lubricant between the relatively movable parts.

3. A machine as set forth in claim **1** which is an internal combustion motor in which said two relatively movable parts comprise a cylinder and a piston, said cylinder having a combustion portion and a pervious portion provided by said porous metal element.

4. A machine as set forth in claim **3** in which said piston includes a porous metal element that contacts said pervious portion during each stroke to pick up oil therefrom.

5. A machine as set forth in claim **1** which is an internal combustion motor in which said other relatively movable part is a crankshaft.

6. A machine as set forth in claim **1** which is an internal combustion motor and said two relatively movable parts comprise a crankshaft and a connecting rod and said bearing is a crank pin bearing.

7. A machine comprising a plurality of two relatively movable parts including (1) a cylinder having a cylinder head and a piston, (2) a crankshaft and bearings therefor and (3) a connecting rod for the piston and crankshaft, said connecting rod being adapted to move the piston on rotation of the crankshaft from an inner position near the cylinder head to an outer position nearer the crankshaft, said cylinder having a portion extending outwardly toward said crankshaft beyond the top of the piston in said out position, a porous metal insert in the extending portion of the cylinder surrounding the piston having a cylindrical surface pervious to lubricating oil facing said piston and all other surfaces completely sealed against outflow of lubricating oil.

8. A machine as set forth in claim 7 having means to supply lubricating oil to said porous bearing under sufficient pressure to lubricate said piston.

9. A machine as set forth in claim 7 in which the piston has piston ring grooves, piston rings in said grooves, said piston rings including a porous metal ring having an outer surface pervious to lubricating oil and other surfaces impervious to lubricating oil.

10. A machine as set forth in claim 7 in which the extending portion of said cylinder includes a rabbet receiving said bearing and a ring removably secured to said cylinder to retain said bearing in said rabbet.

11. A machine as set forth in claim 7 in which the extending portion of said cylinder includes a groove and said bearing is segmented to permit insertion thereof into the groove from within the cylinder.

12. A machine as set forth in claim 7 in which said piston includes wrist pin gearing made of porous metal having surfaces pervious to lubricating oil facing parts slidable thereover and other surfaces impervious thereto.

13. A machine as set forth in claim 7 which is an internal combustion motor.

14. A machine as set forth in claim 8 which is a two cycle internal combustion motor.

15. In an internal combustion engine having a cylinder with a closed head and an open bottom, a rotatable crankshaft, a connecting rod and a piston having a piston ring movable in said cylinder, a bi-surfaced cylinder wall comprising a porous but essentially rigid section extending from the bottom of the cylinder to the top of the piston ring at the lowest position of its stroke, said ring including porous material having a pervious surface slidable against said cylinder wall and receiving lubricant from said porous section, further porous inserts at other bearing surfaces for said crankshaft and connecting rod to provide lubrication to parts sliding thereagainst and properly fitted and sealed to exclude contaminants.

16. In a motor of the two stroke or two cycle type having a cylinder, piston, wrist pin, connecting rod, crankshaft and main bearing, the improvement which comprises oiling means for lubricating relatively moving parts without fuel gas mixture lubrication comprising a cylinder wall with a porous insert having a pervious inner cylindrical surface extending downwardly from just below the explosion and compression portion of the cylinder, a ring of porous material having a pervious outer cylindrical surface carried by the piston, said ring being in position to face said porous metal insert during part of

each stroke to pick up lubricant therefrom, porous bearing inserts having pervious surfaces facing relatively moving parts at least partially surrounding said wrist pin and crankshaft and forming at least part of the connecting rod and main bearings, conduits for supplying said porous inserts with lubricant to pass through said pervious surfaces to contacting surfaces and for draining lubricant from said inserts, other surfaces of said porous inserts and rings being sealed against passage of contaminants and lubricant.

17. In an internal combustion engine having a cylinder, a crankshaft, a connecting rod, a piston with a plurality of rings reciprocally mounted in said cylinder by means of said crankshaft and connecting rod, said cylinder having a bisurfaced cylinder wall comprising an impervious upper section extending approximately to the position of the top of the uppermost piston ring at the bottom of the stroke of the piston and of a pervious portion extending downwardly below this position, said pervious portion comprising a porous insert ring in the downwardly extending portion of the cylinder wall, said porous insert ring having a sufficient width to distribute oil on the surface of the piston as it passes in contact therewith, porous inserts in at least some of the bearing surfaces, said inserts having their surfaces which contact moving ports pervious to flow of oil and having other surfaces sealed to reduce escape of oil and to prevent contaminants from entering, and means to feed oil to and drain oil from said porous inserts.

18. In combination a rotary shaft and a bearing having an arcuate surface engaging and supporting said shaft, said bearing comprising an impervious metal part having a recess surrounded by walls, including arcuate end walls forming part of said arcuate surface, a porous metal insert in said recess having an arcuate pervious surface alignable at its ends with the adjacent arcuate end walls and forming part of said arcuate surface, the end walls of said porous metal insert being completely sealed against flow of lubricant therethrough, and a passageway to supply lubricant to said insert.

19. In an internal combustion engine having a piston with a piston ring groove, a lubricant containing porous metal piston ring in said groove, said ring having its peripheral cylindrical surface pervious to said lubricant and at least the sectoral surface which is exposed to fuel sealed to be impervious to fluids to inhibit the washing out of lubricant by fuel.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,286,792 November 22, 1966

Byron T. Wall

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 43, for "combustion" read -- combination --; column 5, line 28, for "gearing" read -- bearings --.

Signed and sealed this 12th day of September 1967.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents