Oct. 28, 1958 L. D. WATKINS 2,857,903

DEVICE ACTUATED BY CYCLIC PRESSURE VARIATION
FOR COLLECTING AND EJECTING LIQUIDS

Filed Jan. 10, 1955

Fig. 1

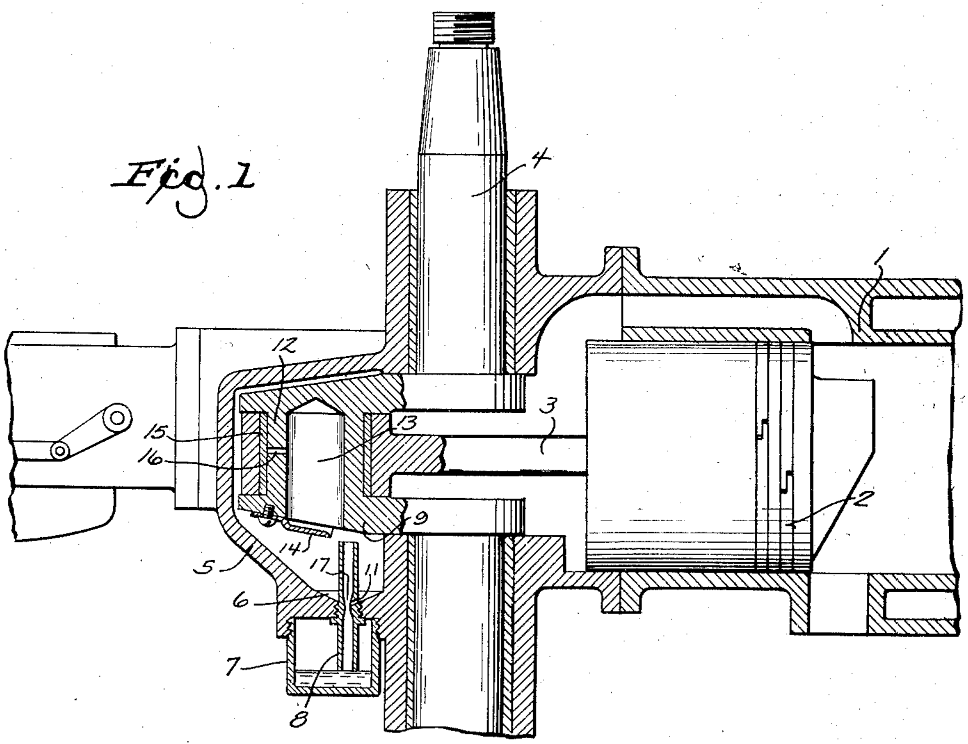
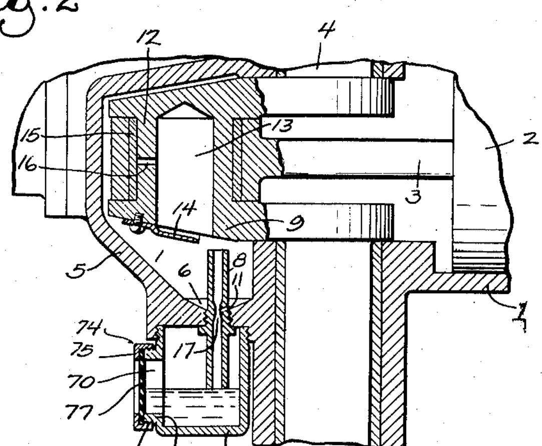


Fig. 2



INVENTOR.
LUCIUS D. WATKINS
BY
Wheeler, Wheeler & Wheeler
ATTORNEYS

2,857,903

DEVICE ACTUATED BY CYCLIC PRESSURE VARIATION FOR COLLECTING AND EJECTING LIQUIDS

Lucius D. Watkins, Hartland, Wis., assignor to Outboard Marine Corporation, a corporation of Delaware

Application January 10, 1955, Serial No. 480,752

14 Claims. (Cl. 123—196)

This invention relates to a device actuated by cyclic pressure variation for collecting and ejecting liquids and other substances which behave like liquids or can be carried with liquids or gases.

The invention has particular application to the oiling system of a two-cycle engine. The crank case of such an engine is subject alternately to compression and to sub-atmospheric pressure as the piston reciprocates in the cylinder. The lubricating oil is mixed with the gasoline. The mixture is atomized and entrained in the air drawn into the crank case during decompression therein. The droplets of oil tend to cling to the surfaces of the interior of the crank case and to the moving parts of the crank shaft and connecting rod and piston, but much of the oil passes from the crank case into the combustion chamber through the transfer port during the period of crank case compression. The present invention seeks to make the best possible use of such oil as is trapped within the crank case by accumulating this in a sump, passing it into a receiver having restricted communication with the crank case, subjecting the oil to gaseous pressure in the receiver during the period of crank case compression, and using the stored pressure to discharge the collected oil from the receiver during periods of crank case decompression. The orifice through which the oil is discharged from the receiver is so located in the path of crank rotation that the crank and the connecting rod bearing will be passing over the orifice at the time of discharge to receive the oil for guidance into the connecting rod bearing.

By reason of the construction disclosed, it is possible to store substantial quantities of oil in the crank case sump or the receiving chamber for delivery to the bearing, whereby to reduce to a minimum the amount of lubricating oil which must be introduced into the engine by admixture with the fuel. Regardless of how the oil is introduced into the crank case, it will be evident that the construction inherently provides for use and re-use of the lubricant in liquid form, as distinguished from conventional use of atomized oil only in such instances.

More generally, the invention contemplates a transfer of pressure and liquid between two chambers which have cyclic pressure variation, as do the crank case and receiving chamber above referred to.

In the drawings:

Fig. 1 is a view in fragmentary axial cross section through the crank case and cylinder of a two-cycle engine with portions of the crank shaft and piston shown in elevation.

Fig. 2 is a view in cross section of a modified form of receiver.

The engine selected to exemplify the invention is conventional, having the usual cylinder **1**, piston **2**, connecting rod **3**, crankshaft **4**, crankcase **5**, etc. At the lowest part of the crankcase **5**, an oil sump **6** is provided. Below the sump is a trap chamber **7** which I call a receiver which may communicate with the crankcase solely through a tube **8** which extends from a level near the center of the receiver upwardly through the top of the receiver to a point in close proximity to the plane of rotation of the cheek **9** of the crank.

At the point where the tube **8** passes through the bottom of the sump **6**, I desirably provide a hole **11** in the wall of the tube. The tube is desirably constricted at the point **17** at which the hole **11** opens. The tube, the top of the receiver, and the receiver, may be assembled to each other and to the crankcase by any convenient means which permits gas to be compressed in the receiver by rising crankcase pressure. I show the parts assembled by means of screw threads to the crankcase.

The crank pin **12** is shown to be provided with a large cavity **13** conventional for the purpose of weight reduction. I provide a shield **14** serving as a collector and guide for lubricant and projecting part way across the cavity and attached to the crank pin at the edge farthest from the axis of rotation. The body of the shield is spaced slightly from the plane of the cheek of the crank. A hole **16** is provided in the crank pin **12** running from the outer side of the cavity **13** to the bearing surface **15** of connecting rod **3**.

From the lowermost point of the sump **6**, the oil caught in the crankcase passes through hole **11** into tube **8** and collects to a substantial depth in the chamber. Gases compressed in the crank case also pass through the tube and are trapped in the chamber **7** above the lower end of the tube.

The gases passing through the tube to equalize the pressures in the receiver **7** and in the crankcase **5** create an aspirating effect at the constriction **17**, which assists in drawing oil into the tube and thence into the receiver. The level of oil in the receiver ordinarily will reach a level above the lower end of the tube **8** and be subject to the pressure of the gas trapped in the top of the chamber **7**.

Ultimate ejection of oil is made possible by the compression of the entrapped gases. This mode of storing energy may be augmented or supplanted in other types of receivers having resiliently yieldable walls, such, for example, as a receiver having an elastic membrane **77** in one wall, as illustrated in Fig. 2. In the receiver shown in Fig. 2, one side of the receiver has a circular opening **70** encircled by an annular flange **71** having screw threads **73**. A ring **74** having an annular flange **75** has screw threads complementary to screw threads **73**. A diaphragm **77** is clamped between ring **74** and flange **71** by screwing the parts together. In operation diaphragm **77** yields as the pressure in receiver **7** increases, permitting an influx of air and oil to the receiver.

During outward movement of piston **2**, as the pressure in the crankcase decreases relative to that in the receiver, any oil in either type of receiver above the level of the lower end of the tube **8** is forced up the tube by pressure of trapped gases in the receiver **7**, and/or by pressure of the resiliently yieldable member, if any. When the level of the oil in the receiver falls to the bottom of the tube, trapped gas, if any, rushes up the tube. As the gas and oil pass the constriction **17** and the hole **11** in the tube **8**, an aspirating effect is again created, drawing from the sump **6** any additional oil collected about the hole **11**. However, the constriction in the vertical tube is not essential. The ejection of oil is ordinarily sufficient without the venturi throat.

The tube is so positioned angularly about the axis of crankshaft rotation that the oil is ejected at a time when the cheek of the crank is in line with the tube, in order that much of the oil will enter cavity **13**. While the tube may be located elsewhere, if that is found desirable, in the instant exemplification, I seek to deposit the largest possible amount of oil in the hollow crank pin. This position will be determined by the timing of pressure variations in the crankcase and the rotational position of the crank, as indicated above.

The oil ejected from the tube either enters the cavity **13** in the crank directly, or is deposited on the cheek **9** of the crank and is then moved outwardly by centrifugal force into the cavity, guided by the shield **14** over the end of the cavity. The oil inside of the cavity is thrown by centrifugal force to the side farthest from the crankshaft axis, and enters the hole **16** in the outer side of the cavity, leading to the bearing surface of the crank pin and the connecting rod. Oil passing through the connecting rod bearing and thrown out onto the inner surface of the crank case runs down into the sump and is recirculated.

It has been found that oil will move along the cheek of the crank to the cavity in the crank pin without being thrown radially away from the surface even in cases when the angle of the cheek to the axis of the crank is quite acute and even without the collector or guide plate **14**. Thus it will be seen that this invention provides a positive system of lubrication, far superior to those presently common in two-cycle engines. Moreover, a greater portion of the oil supplied to the engine is used, and oil is re-circulated, all of which leads to economy in oil use. Since these results are achieved without adding moving parts, the system is virtually failure-proof.

In some other applications of this device the hole **11** in the tube would be unnecessary. For instance, the entire supply of lubricant may be placed in the receiver instead of being collected therein from an oil-fuel mixture (permitting application of a pre-measured quantity); or the supply of lubricant in a sump such as **6** may be such as to reach a level equal to the height of the tube **8**.

The proportions of the tube may also be modified to preclude the trapping of gas or to draw the ejected substance from the bottom of the receiver if the receiver has a resilient wall portion or if the substance to be ejected is sufficiently compressible.

I claim:

1. In a device having a liquid-containing chamber also containing gas subject to cyclic pressure variation, the combination therewith of a receiver having restricted communication with the chamber, a duct extending from a point below the top of the receiver and opening into the chamber, and a bypass duct opening into the duct first mentioned from the bottom of said chamber for draining liquid into said receiver, said first mentioned duct constituting the sole direct communication between said receiver and said chamber constituting means for admitting gas from the chamber to the receiver during periods of high pressure in the chamber and constituting means for ejecting liquid under receiver pressure into the chamber during periods of low chamber pressure.

2. The device of claim 1 in which the chamber comprises a two-cycle engine crankcase having carbureting means for admitting air and combustible fuel with oil admixed therewith, whereby the said oil condensed in said crankcase will accumulate about said communicating means by gravity and be drawn into said duct upon passage of gas therethrough.

3. The device of claim 1, said duct being constricted in the region of said communicating means to form a venturi throat.

4. The device of claim 1 in which the chamber has a pressure responsive movable wall which decreases and increases the volume of the receiver in response to decreases and increases, respectively, in pressure therein.

5. A device of claim 1 in which said chamber constitutes the crankcase of an engine, a body of oil surrounds said communicating means in the crank case, and there is a part to be lubricated comprising a crank pin bearing portion of the crankshaft of said engine, said crank pin being provided with a cavity having an aperture at the crank cheek proximate to and in line with said tube, said crank pin being further provided with a passage leading from the side of said cavity farthest from the axis of rotation to the bearing surface of said crank pin, said crank having a crank cheek provided with a shield over that portion of said opening to said cavity which is farthest from the axis of rotation, said shield having edge portions contacting the face of the crank cheek and a center portion offset outwardly from the face of the crank cheek over said opening to said hollow, whereby oil deposited on said crank cheek face by said tube and moving outwardly under the influence of centrifugal force will be guided by said shield into said hollow.

6. In an engine of the type in which a mixture of air, fuel and oil is pumped through a crank case by means of cyclic pressure variations due to reciprocation of a piston in a cylinder, an oil sump portion at the bottom of the crankcase, a substantially upright open ended tube extending from a point above said sump portion through the bottom of said sump, said tube being provided with an orifice intermediate its ends, said orifice being in communication with said sump, a receiver surrounding the lower end of the tube, a substantial portion of said receiver being above the lower end of the tube, and a part to be lubricated in the crankcase in the path of oil ejected from said tube.

7. The device of claim 6 in which said part to be lubricated constitutes bearing means on a crankshaft which revolves in said crankcase.

8. The device of claim 6 in which said tube is constricted into a venturi throat at said orifice.

9. The device of claim 7 in which said part to be lubricated constitutes a crank pin of said crankshaft, said crank pin being provided with a cavity, said cavity having an aperture to the outer surface of said crank pin, and said cavity being further provided with an aperture to a cheek of said crankshaft, the upper end of the tube being so positioned within the crank case that said aperture in said cheek will be in proximity to the tube during a portion of the cycle when pressure in the crank case is relatively low, whereby oil is ejected toward said aperture in the crank cheek.

10. The device of claim 9 in further combination with means to guide oil which lands on the said crank cheek through said aperture therein and into said cavity, said means further comprising means for retaining said oil in said cavity against the urging of centrifugal force, whereby said oil is urged by centrifugal force through the aperture to the outer surface of the crank pin.

11. In a device having a crankcase with a sump portion, a crankshaft including a crank, and a connecting rod and piston and subject to cyclic pressure variation due to the reciprocation of the piston, a receiver below said crank case, a tube extending from a point spaced from the top of said receiver through said top and through the bottom of said sump to a point within said crank case proximate to the path of a cheek of said crankshaft, said crankshaft having a hollow opening from said cheek and extending through said cheek and through the crank, a flange over the radially outward portion of the opening to said hollow, and a hole from the radially outward portion of the hollow to the surface of said crank, whereby to introduce oil between said surface and an adjacent bearing surface of a connecting rod of said engine.

12. A device having a crank case, a crankshaft having crank cheeks and a crank pin mounted for revolution within said crankcase, a connecting rod having a bearing surface enclosing a bearing surface on the crank pin, said pin having an interior cavity extending through one of said crank cheecks to a first aperture in the outer surface thereof, and said pin having a second aperture opening radially outwardly from said cavity to said bearing surface of the crank pin, a shield over the outer portion of said first aperture, and means for jetting oil toward said

aperture in said cheek in intermittently timed synchronous relationship with the rotation of the crankshaft.

13. A device having a crankcase, a crankshaft having crank cheeks and a crank pin mounted for revolution within said crankcase, a connecting rod having a bearing surface enclosing a bearing surface on the crank pin, said pin having an interior cavity extending through one of said crank cheeks to a first aperture in the outer surface thereof, and said pin having a second aperture opening radially outwardly from said cavity to said bearing surface of the crank pin, a shield over the outer portion of the said first aperture, and means for jetting oil toward said aperture in said cheek in intermittently timed synchronous relationship with the rotation of the crankshaft, means for producing cyclic pressure variations in said crankcase, said oil jetting means comprising a receiver below the crankcase, and a tube through the top of the receiver and opening from the bottom of the crankcase, the said tube being positioned so that the axis of said tube points toward said aperture in the crank cheek during a portion of the low pressure period of the cyclic variation.

14. In a two cycle internal combustion engine having a cylinder and a crankcase to which oil is admitted, the combination with said crankcase and cylinder, of a piston having a connecting rod provided with a bearing, a crankshaft having a crankpin with which said connecting rod bearing is engaged, the crankpin having an oil-receiving cavity from which a duct leads to said bearing, and means for lubricating the bearing comprising a reservoir having means for delivering oil thereto from the bottom of the crankcase and having a delivery duct opening from a lower portion of the reservoir and extending toward the path of rotation of said crankpin, said delivery duct having its discharge end so positioned that the crankpin cavity passes said duct at the time when crankcase pressure passes its peak, said duct having a terminal portion with a substantial component of direction parallel to the crankshaft and toward said crankpin cavity, whereby oil ejected from said duct consequent upon pressure differential resulting from maximum pressure in the reservoir and initiation of pressure reduction in the crankcase will be delivered from the reservoir to the cavity for the lubrication of said bearing.

References Cited in the file of this patent

UNITED STATES PATENTS

1,598,456	Sohosky	Aug. 31, 1926
1,791,045	Stevens	Feb. 3, 1931
2,003,281	Bijur	June 4, 1935
2,728,412	Bolsius	Dec. 27, 1955

FOREIGN PATENTS

58,018	Sweden	Dec. 23, 1924
1,023,500	France	Dec. 30, 1952
688,083	Great Britain	Feb. 25, 1953
1,085,991	France	Aug. 4, 1954
717,788	Great Britain	Nov. 3, 1954

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 2,857,903 October 28, 1958

Lucius D. Watkins

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

Column 3, line 52, after "chamber" insert -- and --; line 71, for "A device" read -- The device --; column 4, line 71, for "cheecks" read -- cheeks --.

Signed and sealed this 10th day of March 1959.

(SEAL)
Attest:

KARL H. AXLINE
Attesting Officer

ROBERT C. WATSON
Commissioner of Patents