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DRY SUMP LUBRICATING SYSTEM FOR INTERNAL COMBUSTION ENGINES

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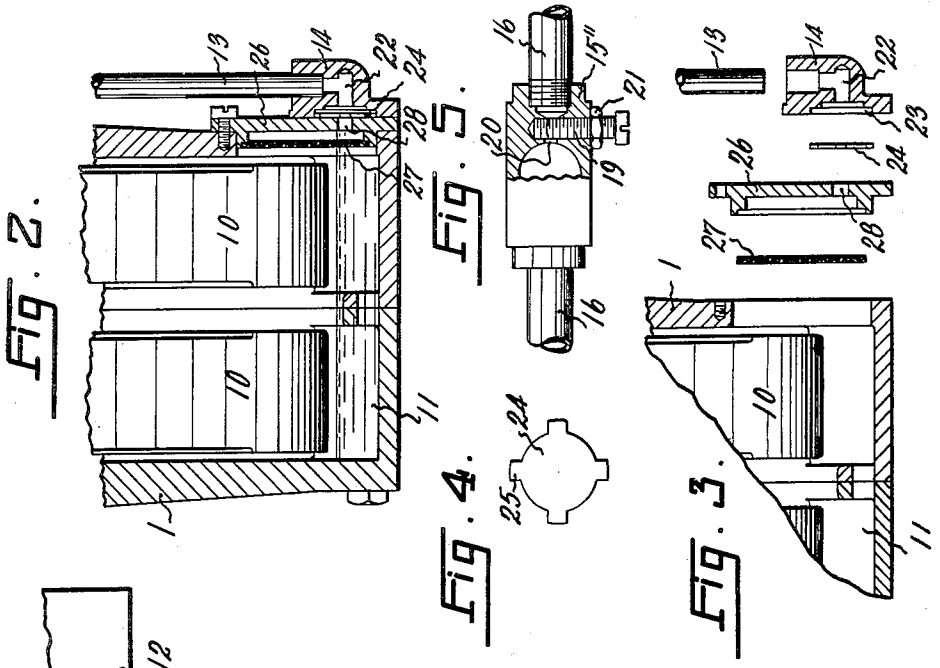

Fig. 2.

Fig. 5.

Fig. 4.

Fig. 3.

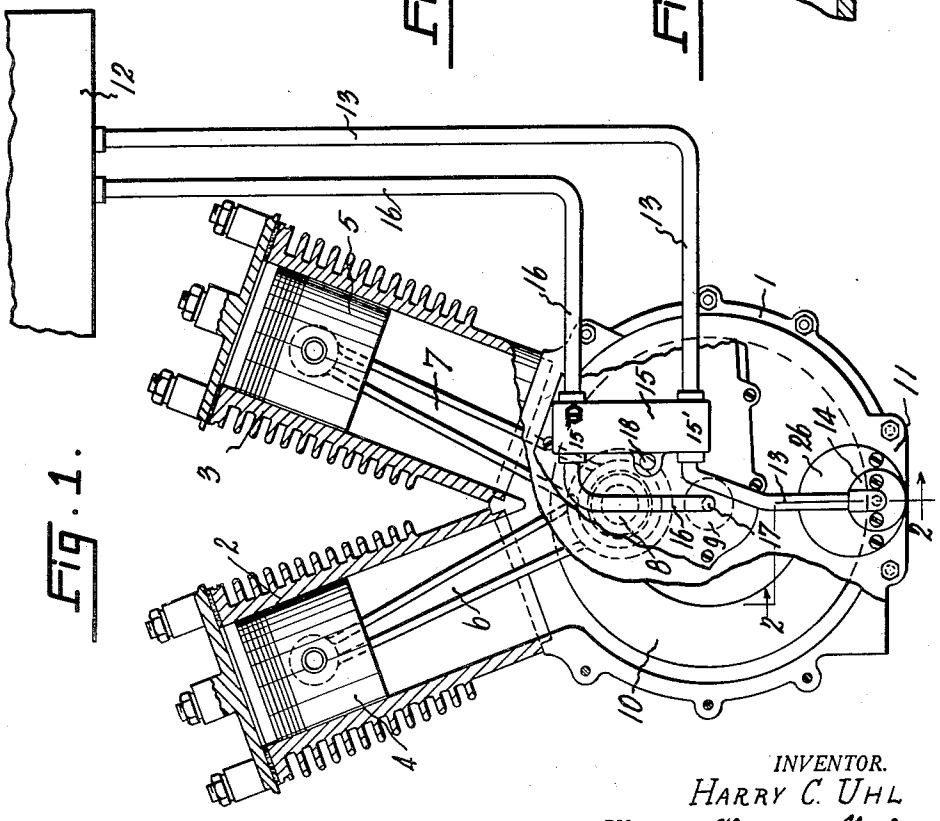

Fig. 1.

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DRY SUMP LUBRICATING SYSTEM FOR INTERNAL COMBUSTION ENGINES

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8 Claims. (Cl. 184—6)

This invention relates to an improvement in a lubricating system for internal combustion engines and more particularly to such a lubricating system of the dry sump type.

In the dry sump type of lubricating system the main supply of oil is maintained in a reservoir separate from the sump portion of the crank case of the engine. The oil for lubricating purposes is fed from said reservoir directly to the parts of the engine to be lubricated and in such quantity as will be substantially consumed in the lubrication of said parts. In some instances the control of the lubricating oil feed may contemplate a slight surplus of oil over that consumed in the lubrication of the parts which surplus oil will drain to the bottom of the crank case and collect in the sump portion thereof. There is however, but a relatively small quantity of oil allowed to collect in the sump since in the dry sump system this oil is being constantly withdrawn from the sump and delivered into the main oil reservoir. The sump need not be actually dry or free from oil but the desideratum is that the small amount of oil collected in the sump shall not be sufficient to encounter moving parts of the engine within the crank case and thereby be splashed around with a consequent fouling of the spark plugs which would cause the engine to stop.

It is an object of the present invention to provide means for insuring the proper drainage of the sump portion of the crank case under all conditions of operation of the engine and particularly throughout wide changes of speed of said engine during which difficulties have heretofore been encountered in the use of the dry sump system.

In the present embodiment of the invention I have preferably shown the same as applied to a typical motorcycle engine having a substantially closed crank case within which the fly wheel along with the usual crank shaft and connecting rod or rods are contained. By substantially closed I mean that whereas the crank case may have the usual breather valve or vent common to such cases, it is otherwise closed. Motorcycle engines are commonly built with single or multiple cylinders and in the illustrated embodiment of my invention I have shown a two cylinder engine. It will be noted that in the typical form shown, the pistons of each cylinder are connected to the crank shaft to move up and down in unison. In such an engine the substantially closed crank case is obviously subject to widely fluctuating and rapidly alternating pressures within the same due to the relatively small unoccupied space therein and to the sameness in the reciprocation of the two pistons. Under such conditions of widely and rapidly fluctuating pressures within the crank case it has heretofore been difficult to obtain a proper drainage of the sump collected oil from said crank case by the usual means or methods employed for this purpose. When the sump is not properly drained the engine will stop due to fouling of the spark plugs. It has been found moreover that the usual methods fail particularly in keeping the sump properly drained after a wide change from high to low speed in the operation of the engine.

The full advantages of the present invention and objects thereof in overcoming the previously mentioned difficulties will become apparent in the following description taken in connection with the accompanying drawing in which,

Fig. 1 is an end elevation of the apparatus showing a portion of the engine in section;

Fig. 2 is an enlarged detail section taken longitudinally of the lower part of said crank case along line 2—2 of Fig. 1;

Fig. 3 is a fragmentary view of the same parts as shown in Fig. 2 in detached relation for clearer illustration thereof;

Fig. 4 is a separate view of the valve disk; and

Fig. 5 is an enlarged view partly in section of the feed oil line connection to the pump to show the adjustable throttling device therefor.

Referring more specifically to the drawing 1 indicates the usual closed crank case of a two cylinder motorcycle engine, said cylinders being preferably of the air cooled type and indicated at 2 and 3. The crank case is provided with the usual breather valve or vent not shown. The respective pistons of said cylinders are indicated at 4 and 5 with connecting rods 6 and 7 connected to the single crank 8 of the crank shaft 9. The fly wheel for said engine mounted on the crank shaft in the usual manner is indicated at 10 and as shown nearly fills the free space within said crank case in the usual manner for such engines.

The lower portion of the crank case 1 is formed to provide a sump or oil collecting basin 11 and as shown in Fig. 2 the level of oil collected in this sump is to be maintained no higher than slightly below the bottom periphery of the fly wheel 10 within the crank case. The main reservoir for lubricating oil is indicated at 12 and as shown is mounted in an elevated position with respect to the sump 11 so as to require means for lifting the oil from said sump 11 into the reservoir 12.

A scavenging oil line for draining the sump is indicated at 13, the lower end of which enters

the sump through a valve and valve casing hereinafter described and indicated generally at 14. The oil line 13 passes through the lower section 15' of a duplex pump 15 and continues as shown up to the reservoir 12. The lubricating oil feed line 16 leads downwardly from the reservoir 12 through the upper section 15'' of the duplex pump 15 as shown and continues therefrom for connection to a suitably drilled oil passage 17 in the crank shaft. It will be understood that the lubricating oil is distributed therefrom to other moving parts in the engine in the usual manner.

The duplex pump 15 is of the well known commercial type known as the Pilgrim pump wherein the upper section 15'' acts as a forcing pump for the feed line 16 and the lower section 15' acts as a lifting pump for the scavenging line 13. The duplex pump 15 is mounted adjacent the usual cam shaft 18 of the engine so as to receive its operating power directly therefrom in the usual manner. It will be understood that in the duplex pump 15 the lower pump section 15' for the scavenging line 13 has a slightly greater pumping capacity than the upper pump section 15'' for the feed line 16, the object thereof being to avoid more oil being fed into the crank case than will be removed from the same. It will also be understood that two separate pumps might be used in place of said duplex pump, one pump for the scavenging line 13 and one pump for the feed line 16.

In order to adjustably regulate the relative flow of oil through the scavenging line 13 and feed line 16 I preferably employ a throttling device in said feed line 16 between the pump and said reservoir 12. This device is more particularly shown in Fig. 5 and consists of an adjustably fixed valve comprising a screw stud 19 which is screw threaded into the upper section 15'' of the pump casing 15 and intersects the passage 20 of the oil line 16. By screwing of the stud 19 the passage 20 can be closed, partly opened, or fully opened as desired. A lock nut 21 is provided to keep said stud 19 in a fixed adjustment.

Referring now to the lower end connection of the scavenging line 13 with the sump as shown in Figs. 2 and 3; a screen holder plate 26 is secured as a closure to an opening in the lower portion of the crank case 1 and holds in place an oil screen 27 as shown. The plate 26 has an oil port 28 through the lower portion thereof and mounted at the outside of said oil port is the valve casing 14 having a right angle oil passage 22 therethrough which is in line with the oil port 28. The valve casing 14 has a shouldered recess 23 into which said passage 22 opens and mounted in said recess is a very thin light weight valve disk 24 which has peripheral projections 25 for resting on the shoulders of said recess 23. The disk portion of said valve 24 is sufficient to completely close the port 28 when lying against the same but due to the shouldered recess 23 said disk may freely move a slight distance toward and away from said port 28 in the closing and opening of the same. The disk 24 is preferably of very light thin metal but may be of any suitable material and quickly responds to any difference of pressure upon its opposite sides; a greater pressure on its sump side causing the valve to open, and a greater pressure on its reservoir or pump side causing the valve to close. The valve 24 is preferably located as shown, viz. closely adjacent the sump and at the lower end of the oil scavenging line 13.

From the above it will be clear that whenever in the operation of the engine conditions are such that the pressure in the crank case is low enough to tend to suck oil down through the scavenging line 13 and out of the pump 15, the disk valve 24 closes. On the other hand, whenever the pressure within the crank case is relatively high the disk valve 24 opens and allows said excess pressure to be communicated to the scavenging line 13 below the pump 15 which of course tends to carry oil from the sump to the pump. The disk 24 thus acts as a check valve to trap all high pressure pulsations of the crank case within the scavenging line 13 and to prevent any low pressure pulsations of the crank case from being communicated to said scavenging line 13. It is found that this action of the valve 24 insures a constant priming of the pump 15 under all conditions of speed operation of the engine and successfully prevents failure of operation of said pump due to nonpriming or slow priming thereof. Under certain conditions of engine operation it will be found that the use of the quick acting valve 24 will be sufficient to lift the oil from the sump 11 up into the reservoir 12 without the necessity of employing any pump such as 15, due to the efficient action of said valve in trapping only the high pressure pulsations from the crank case in said oil line 13. Such a result will occur for instance when the engine is operated in a fairly constant manner at high speed. For operation at widely varying speeds, first high and then low, it is found that the pump 15 in the scavenging line 13 is of material assistance in the proper withdrawal of oil from the sump. However, the changed conditions occurring in the closed crank case as the result of a sudden change of motor speed, viz. from high to low, make essential the use of the quick acting check valve between the pump and the sump, in order to keep the pump in effective operation. The probable reason for this is that the mean effective pressure in the crank case varies abruptly with any sudden change of motor speed and drops from high to low with a similar drop in motor speed, thereby having a tendency to suck the pump dry and unprime it. The use of the check valve prevents this and keeps the pump operating effectively under all conditions of change in motor speed.

A further advantage found in the use of the valve 24 located as shown and operating as described, is that it permits mounting of the scavenging pump when employed, at a higher elevation than said sump 11 and so that the pump may be conveniently mounted directly on the cam shaft of the engine for direct operating connection thereto.

What I claim is:

1. In a lubricating system for internal combustion engines of the dry sump type in combination with a crank case having a sump for collection of oil, a separate oil reservoir, a scavenging oil line connected between said sump and reservoir, a check valve in said scavenging oil line acting to permit pressure within said crank case to discharge oil from said sump into said reservoir, a feed oil line from said reservoir to operating parts of the engine to lubricate the same, a feed pump in said feed oil line, and a throttling device in said feed oil line between the feed pump and reservoir to adjust the relative amount of oil flowing through said scavenging oil line and feed oil line.

2. In a lubricating system for internal combustion engines of the dry sump type in combination a crank case having a sump for collection of oil, an oil reservoir separate from said sump, a scav-

enging oil line from said sump to said reservoir and a feed oil line from said reservoir to operating parts of the engine to lubricate the same, a scavenging pump in said first named oil line and a feed pump in said second named oil line, said scavenging pump having a greater pumping capacity than said feed pump and a throttling device in said feed oil line between said feed pump and reservoir to adjust the difference of effective pumping capacity of said pumps.

3. In a lubricating system for internal combustion engines of the dry sump type in combination a crank case having a sump for collection of oil, an oil reservoir separate from said sump, a scavenging oil line from said sump to said reservoir and a feed oil line from said reservoir to operating parts of the engine to lubricate the same, a scavenging pump in said first named oil line and a feed pump in said second named oil line, said scavenging pump having a greater pumping capacity than said feed pump and a throttling device in said feed oil line between said feed pump and reservoir to adjust the difference of effective pumping capacity of said pumps, and a check valve between said scavenging pump and sump adapted to open when the pressure on the sump side of the valve is higher and to close when it is lower than on the pump side of the valve.

4. In a dry sump lubricating system for internal combustion engines of the type wherein a substantially closed crank case is subject to widely varying pressures within the same and in which the lower part of the crank case serves as an oil collecting sump, the cam shaft of the engine being located substantially above the sump, the combination therewith of a separate reservoir for oil in elevated position with respect to the sump, a scavenging oil line from said sump to said reservoir, an oil feed line from said reservoir to working parts of the engine to lubricate the same, a pump for each of said oil lines mounted adjacent the cam shaft for operation thereby, and a quick acting check valve in said scavenging oil line in close proximity to said sump adapted to open when the pressure on the sump side of the valve is higher, and to close when it is lower than on the pump side of said valve, and a throttling device in said oil feed line between its pump and reservoir to adjust the relative amount of oil flowing through said scavenging line and feed line.

5. In a dry sump system for internal combustion engines of the enclosed type in combination, the closed crank case with a lower part thereof serving as an oil sump, a separate oil reservoir, an oil scavenging line from said sump to said reservoir, an oil feed line from said reservoir to moving parts of the engine to lubricate the same, a cam shaft adjacent the crank shaft of said engine, a duplex oil pump located in elevated spaced position with respect to said sump and operated directly by said cam shaft, one part of said pump operating in said scavenging line to deliver oil from said sump to said reservoir and the other part of said pump operating in said feed line, a sump outlet valve in said scavenging line operating to keep said scavenging pump primed throughout the fluctuations of pressure which prevail in said closed crank case during the operation of the engine, and a throttling device in said feed line to adjust the effective capacity of said feed line pump relative to the capacity of said scavenging line pump.

6. In a dry sump lubricating system for internal combustion engines of the motorcycle type wherein an enclosed crank case closely surrounds the fly-wheel of the motor and the lower part of said crank case serves as an oil sump and wherein the reciprocation of the engine pistons causes within the crank case rapid fluctuations, the mean pressure of which varies with changing speeds of the engine, the combination therewith of an oil pump mounted above the sump to elevate the oil therefrom, an inlet passage for the pump leading upwardly from the sump to the pump, said inlet passage communicating with the sump at a point to keep the oil level therein below the moving parts of the engine, and a quick acting check valve located in said inlet passage between the pump and sump to keep said pump primed at all times during varying running speeds of said engine.

7. In a dry sump lubricating system for internal combustion engines of the motorcycle type wherein an enclosed crank-case closely surrounds the fly-wheel of the motor and the lower part of said crank case serves as an oil sump and wherein the reciprocation of the engine pistons causes within the crank case rapid fluctuations, the mean pressure of which varies with changing speeds of the engine, the combination therewith of an oil pump mounted adjacent the cam shaft of the engine and directly operated thereby, an inlet passage for the pump leading upwardly from the sump to the pump, said inlet passage communicating with the sump at a point to keep the oil level therein below the moving parts of the engine, and a quick acting check valve located in said inlet passage closely adjacent the sump to keep said pump primed at all times during varying running speeds of said engine.

8. In a dry sump lubricating system for internal combustion engines of the motorcycle type wherein an enclosed crank case closely surrounds the fly-wheel of the motor and the lower part of said crank case serves as an oil sump and wherein the reciprocation of the engine pistons causes within the crank case rapid fluctuations, the mean pressure of which varies with changing speeds of the engine, the combination therewith of an oil reservoir separate from the sump, an oil scavenging line from said sump to said reservoir, an oil feed line from said reservoir to moving parts of the engine to lubricate the same, a duplex oil pump mounted adjacent the cam shaft of the engine for direct operation thereby, one part of said pump operating in said oil scavenging line to lift oil from said sump to said reservor and the other part of said pump operating in said oil feed line to deliver oil for lubrication, the pump inlet passage of said scavenging line communicating with said sump at a point to keep the oil level therein below the moving parts of the engine, and a quick acting check valve located in said pump inlet passage closely adjacent the sump to keep said pump primed at all times during varying running speeds of said engine.

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