

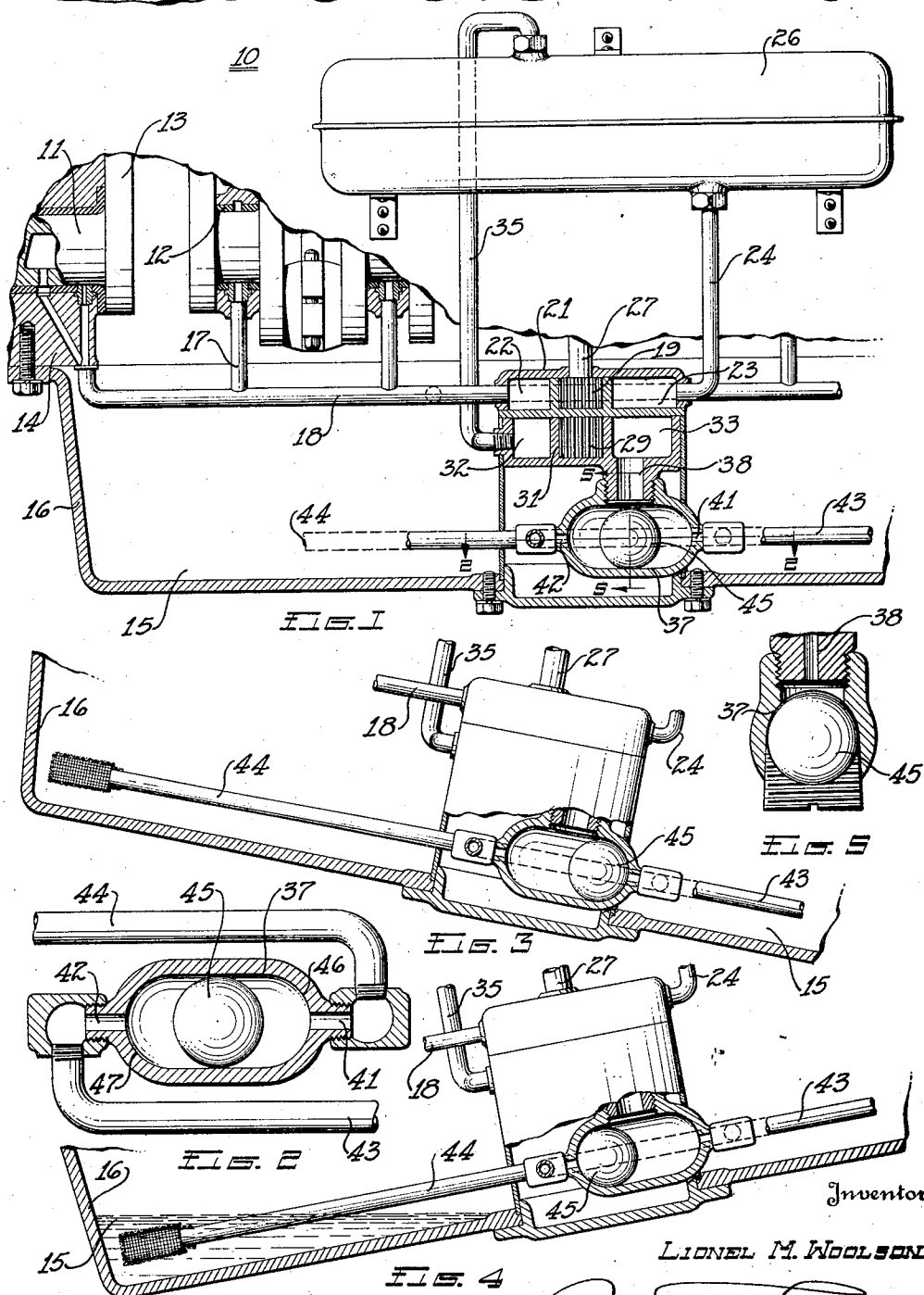
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INTERNAL COMBUSTION ENGINE

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INTERNAL COMBUSTION ENGINE

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This application is a continuation of or a substitute for application Serial No. 683,586, filed December 31, 1923.

This invention relates to internal combustion engines, more particularly to the lubrication apparatus thereof, and it has for one object to provide such lubrication apparatus having a pressure feed system and a return system in which the circulation shall be continuously maintained.

Another object of the invention is to provide an internal combustion engine with an oil return system in which the return of the oil to the pressure system or to storage, is accomplished by a single pump, regardless of the inclination of the engine to the horizontal.

A further object of the invention is to provide a simple and improved lubrication system in which the oil return pump shall be automatically connected, upon inclination of the engine, to that end of the oil pan in which the oil collects because of such inclination.

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 longitudinal section through part of an internal combustion engine equipped with the invention;

Fig. 2 is a horizontal section to a larger scale, on the line 2—2 of Fig. 1;

Fig. 3 is a view, partially in section and partially in elevation, of a portion of the apparatus shown in Fig. 1, the left end of the engine being raised above the horizontal.

Fig. 4 is a view similar to Fig. 3 but showing the right end of the engine raised above the horizontal, and

Fig. 5 is a section to a larger scale, on the line 5—5 of Fig. 1.

It is essential in the operation of internal combustion engines to maintain a continuous circulation of the lubricant. Particularly is this true of engines used in the propulsion of aircraft, and certain difficulties have been experienced in the lubrication of such engines by interruption of the flow of oil caused by inclination of the engine to the horizontal, which cuts off the supply of oil to the pump

intake. To meet this situation the so-called dry sump system has been evolved, in which a pressure unit provides the engine with oil under pressure, this oil being collected and returned to the pressure system by an independent return system. Apparatus of this character heretofore devised has required a number of pumping elements, thus materially increasing the complication and the liability to breakdown. The present invention provides lubrication apparatus of the greatest reliability and simplicity, in which only two pumps are necessitated, one for the pressure system and one for the return system thereof.

Referring to the drawing, at 10 is illustrated an internal combustion engine having a crank shaft 11, journaled in bearings 12, and provided with the usual cranks 13. The bearings 12 are mounted in suitable webs in a crank case 14, which surrounds the upper portion of the crank shaft and partially encloses the cranks 13. The remainder of the crank shaft enclosure is effected by an oil pan 16, secured to and co-operating with the crank case 14, and forming a sump 15 into which oil discharged from the bearings and other parts of the engine, is drained.

The lubricating oil is supplied to the bearings 12 and certain other parts of the engine under pressure through conduits 17, which communicate with a delivery pipe 18 of an oil pressure pump 19. The pump 19 may be of any suitable type. As illustrated, it is of the well known gear type, comprising a pair of mating gears mounted within a suitable pump housing 21, which housing defines a pressure chamber 22 and a suction chamber 23. The pressure chamber 22 communicates with the delivery pipe 18 so that oil under pressure delivered by the pump into the chamber 22 flows through the pipe 18 and the conduits 17 to the bearings. The suction chamber 23 is adapted to receive oil from an intake pipe 24, which communicates with and is fed from a suitable storage receptacle, illustrated as an elevated tank 26. The pump 19 may be driven by any appropriate mechanism but is shown as connected to a vertical shaft 27, driven from the engine through suitable gearing (not shown).

Mounted immediately below the pump 19 is a return pump 29, also preferably of the gear type, and driven from a continuation of the driving shaft 27. The pump 29 is enclosed in a suitable housing 31, which may be integral with the housing 21, and which defines a pressure chamber 32 and a suction chamber 33. The pressure chamber 32 communicates with a conduit 35 leading to the upper part of the tank 26. The suction chamber 33 is adapted to receive oil which has collected in the sump 15. For this purpose it is formed with a communicating housing, which may readily be integral therewith, and which forms a cylindrical valve chamber 37. The chamber 37 communicates with the suction chamber 33 by a narrow slot 38, disposed longitudinally in a wall separating the chambers, as clearly shown in Fig. 5. The cylindrical valve housing, best illustrated in Fig. 2, is provided at its opposite ends with ports 41 and 42. These ports are connected with suction pipes 44 and 43 respectively, preferably mounted in the sump 15 just above the bottom of the oil pan 16 and extending to the opposite ends of the sump. Each of the suction pipes is connected to the port disposed toward the other end of the sump from the end to which it extends. The suction ends of the pipes 43 and 44 may be provided with suitable strainers as shown in Figs. 3 and 4.

The chamber 37 is provided with a ball 45, preferably a loose fit therein, which constitutes a valve member adapted to co-operate with seats 46 and 47 formed at the entrances to the ports 41 and 42 respectively, which seats are preferably spherical in contour corresponding to the radius of the ball. It will be apparent that as the inclination of the engine, and consequently of the chamber 37 is varied from the horizontal in either direction, the ball 45 will move under the influence of gravity toward one or the other of the seats 46 or 47. It will also be seen that this ball can close either of the ports 41 or 42, by co-operation with the corresponding seat, but that it cannot close both of these ports at the same time, and that it cannot close the passage to the chamber 33 formed by the slot 38.

The operation of this device will be readily understood. When the engine is in a horizontal position, as illustrated in Fig. 1, the ball 45 assumes a position midway between the seats 46 and 47, and the pump 29 draws oil through both of the pipes 43 and 44, their respective ports 41 and 42 into the valve chamber 37, thence through the slot 38 into the suction chamber 33, and delivers it through the pressure chamber 32 and the pipe 35 into the tank 26.

If the engine assumes an inclined position such as that illustrated in Fig. 3, with the left hand end elevated, the oil which collects

in the sump 15 will flow, under the influence of gravity, toward the right hand end of the sump, leaving the suction end of the pipe 44 exposed. If it were not for the valve mechanism of this invention, the pump 29 would draw air through the path of lesser resistance provided by the intake pipe 44, substantially stopping the circulation of the oil. However, as the engine tilts the ball 45 moves by gravity toward the lower or right hand end of the valve chamber 37, and engages the seat 46, the shutting off communication with the passage 41 and the pipe 44. The pump 29 then draws oil through pipe 43, the end of which is submerged, through port 42 and chamber 37 into its suction chamber 33.

Similarly, if the left hand end of the engine is depressed, as illustrated in Fig. 4, the ball moves to the left and engages the seat 47, thus shutting off communication with the passage 42 and the pipe 43. The pump 29 then draws oil through the pipe 44 from the lower end of the sump 15.

It will be evident that the ball must be of sufficient size and have sufficient weight so that it will be held against the seat with enough force to overcome the total suction head of the pump 29, to which it is exposed. This total suction head includes both the lift head and the head caused by resistance to flow or friction in the various passages, the friction head being very small relatively to the lift head. Any material of sufficient density may be employed for this purpose, but it is preferred to use a metal such as bronze or steel, or the ball 45 may be made hollow and filled with a heavy material such as lead.

Of course, as the inclination of the engine to the horizontal increases, the lift component of the suction head also increases, reaching a maximum when the engine is nosed up or down in a vertical position. As the suction head increases, however, that component of the weight of the ball which tends to hold it against the seat also increases, so that when the engine is in a vertical position practically the entire weight of the ball is exerted to keep the valve closed.

It will also be appreciated that the pumps and the valve mechanism may be located anywhere on the engine, as long as the housing 37 is mounted so as to tilt with the engine, and the suction pipe 43 and 44 terminating near the ends of the oil pan and close to the bottom thereof.

It will now be seen that this apparatus provides means by which the single return pump is automatically connected to the oil in the sump, notwithstanding variations in the direction and degree of inclination of the engine to the horizontal, thus insuring a continuous and uninterrupted circulation of oil in the return system. It will be understood that the capacity of the pump 29 is adequate under all circumstances to keep the

sump 15 pumped out and substantially empty of oil. Oil from the tank 26 is fed to the pump 19 and circulated thereby through the pressure system in the usual way.

5 It will be understood that various forms of the invention other than those described above may be used without departing from the spirit or scope of the invention.

Having thus described the invention, what is claimed and desired to be secured by Letters Patent is:

1. The combination in an internal combustion engine having a crank case of an oil pan secured beneath the crank case, and a pump 15 mounted in said pan and having a conduit at either end thereof extending to the opposite end of the pan, a port at the pump end of each said conduits forming a valve seat, and a ball valve operated by gravity on inclination of the pan to close the port corresponding to the conduit having least resistance.

2. In an internal combustion engine, an oil return system including a sump, a single return pump, suction pipes extending to the 25 ends of said sump, a housing connected to the intake of the pump and having ports communicating with the suction pipes, and a ball valve adapted to cooperate with either of the ports to automatically close the suction pipe 30 having the upper terminus.

3. In an internal combustion engine having an oil pan, a pump, a valve chamber associated with the pump having ports disposed toward the ends of the pan respectively, a suction pipe connected to each port and extending in an opposite direction to the 35 other end of the pan, and a ball valve in said chamber operable in response to the inclination of the engine from the horizontal to close the lower of said ports.

4. In an internal combustion engine having pressure oil feeding means, the combination with an oil pan adapted to collect the oil discharged from said feeding means 45 of a single oil return pump having intake pipes to the ends of the pan, a cylindrical valve housing connected at each end to the intake pipe for the opposite end of the pan and communicating with the pump through a narrow slot, and a ball valve operable by 50 gravity within said housing to close the higher intake pipe when the engine is inclined to the horizontal.

5. In an internal combustion engine having pressure oil feeding means, the combination with an oil pan adapted to collect the oil discharged from said feeding means of a return pump, a valve housing connected to the pump having spaced alined ports, connections from said ports extending to opposite 60 ends of the oil pan, and a ball valve in said housing movable by gravity therein as the engine is inclined to close that port corresponding to the higher end of the oil pan.

6. In an internal combustion engine hav-

ing an oil feeding means, an oil pan and an oil return pump, a valve housing connected to the pump having spaced suction ports, connections from said ports to the opposite 70 ends of the pan and a ball valve in the housing to co-operate by gravity with the port having the higher connection.

7. In an internal combustion engine having an oil feeding means, an oil pan and an oil return pump, a valve housing having 75 spaced alined ports, the valve housing connected to the pump and communicating therewith intermediate the ports, a suction pipe connected to each of the ports and reversed to extend to the opposite end of the oil pan, and a ball valve in the housing movable 80 by gravity to co-operate with the ports.

8. In an internal combustion engine having a sump, a pump having a suction chamber, a valve housing communicating with 85 said chamber having longitudinally spaced ports, a gravity operated ball valve in said housing adapted to close the lower port as the engine is inclined, and a suction connection from each port to the oppositely disposed end of said sump.

9. In a lubricating system, a reservoir adapted to contain oil, a pump for removing oil from the reservoir and having two spaced inlets near the bottom of the reservoir and 95 normally below the level of the oil therein, a normally horizontal track fixed to said reservoir substantially parallel to a line through the said inlets, a rollable weight adapted to roll on said track by gravity when it is tilted 100 substantially out of the horizontal, and means operable upon the movement of the weight to one end of the track to close communication between the pump and the opposite inlet, whereby when one of the inlets 105 is projected above the oil level by tilting of the reservoir, the pump will be supplied with oil entirely from the lower inlet, and air will be precluded from entering the system at the upper inlet.

In testimony whereof I affix my signature.
LIONEL M. WOOLSON.

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