H. LEMP & H. W. STOCK.

LUBRICATING SYSTEM FOR ENGINES.

APPLICATION FILED JULY 31, 1915.

1,257,258.

Patented Feb. 19, 1918.

2 SHEETS—SHEET 1.

Fig. 1.

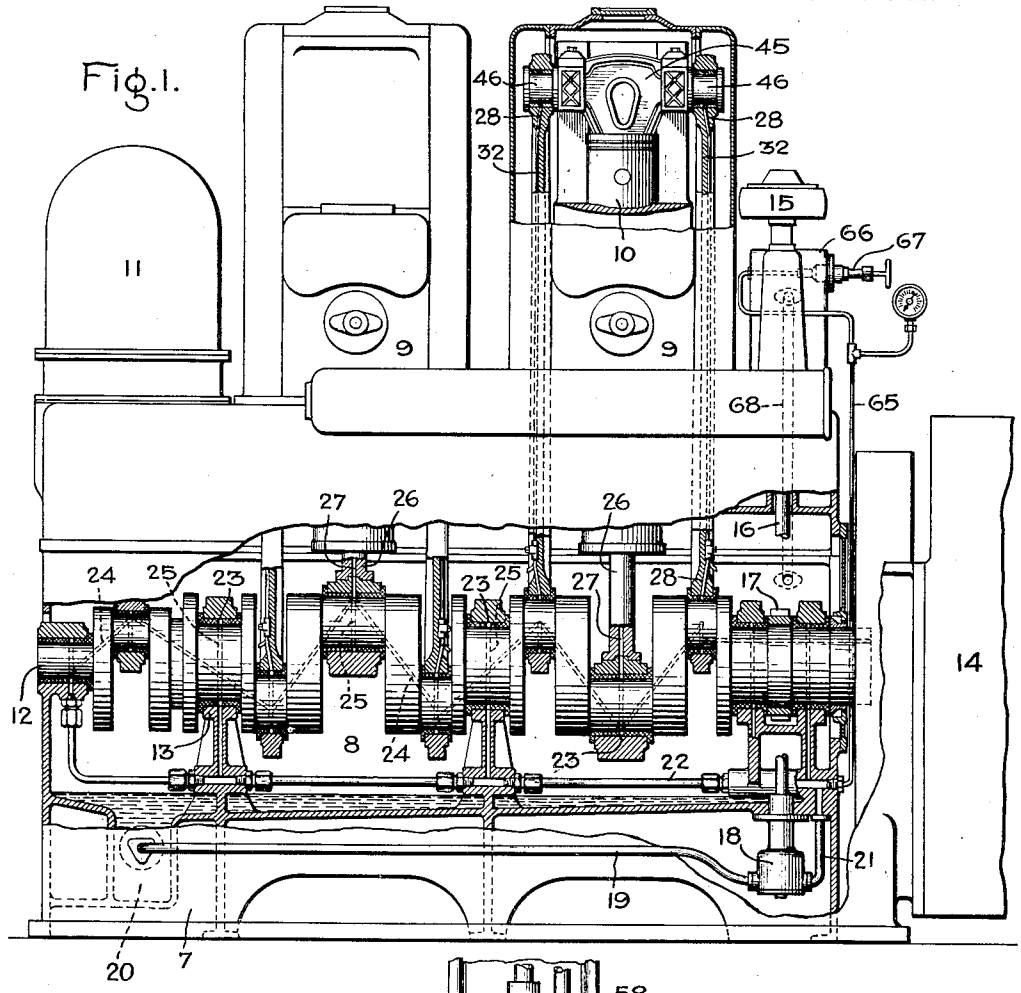
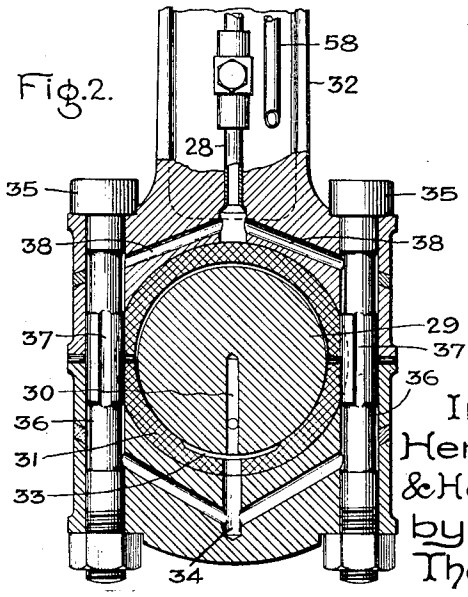


Fig. 2.



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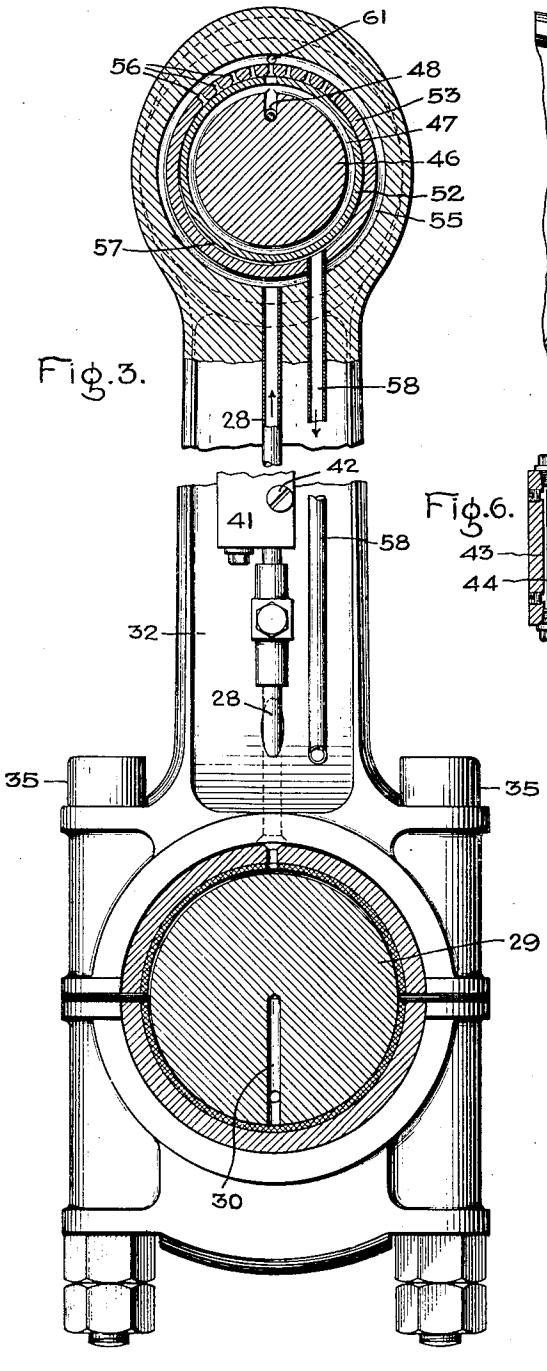


Fig. 3.

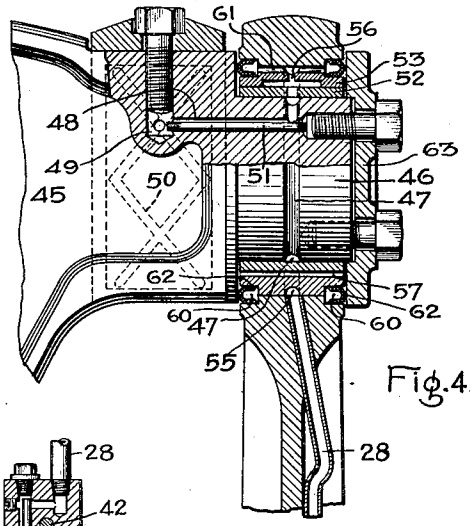


Fig. 4.

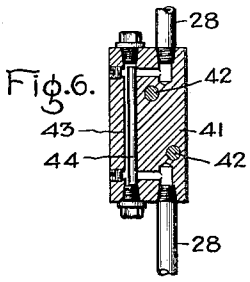
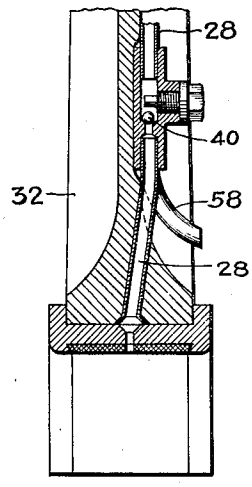


Fig. 6.



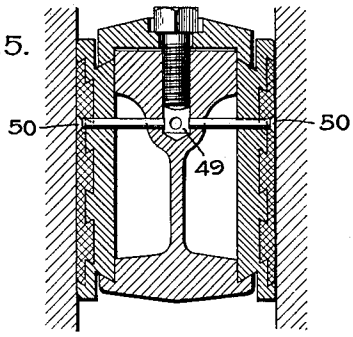


Fig. 5.

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UNITED STATES PATENT OFFICE.

HERMANN LEMP AND HENRY W. STOCK, OF ERIE, PENNSYLVANIA, ASSIGNORS TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

LUBRICATING SYSTEM FOR ENGINES.

1,257,258 Specification of Letters Patent. **Patented Feb. 19, 1918.**

Application filed July 31, 1915. Serial No. 42,955.

To all whom it may concern:

Be it known that we, HERMANN LEMP and HENRY W. STOCK, citizens of the United States, both residing at Erie, county of Erie, State of Pennsylvania, have invented certain new and useful Improvements in Lubricating Systems for Engines, of which the following is a specification.

The present invention relates to lubricating systems for engines, and in particular to vertical engines of that type wherein each cylinder has oppositely moving pistons, the inner piston, the one nearer the crank shaft, being connected to said shaft by a single connecting rod, and the outer piston by a pair of side connecting rods. Such an engine presents certain difficulties in the way of lubrication not found in the more usual type of engine having only a single piston in each cylinder.

The object of the invention is to improve the lubrication of such an engine, and in particular to lubricate the bearings of the outer or side connecting rods and also of the cross-head that is secured to each of the outer pistons.

For a consideration of what we believe to be novel and our invention, attention is directed to the accompanying description and claims appended thereto.

In the drawings, Figure 1 is a view in side elevation of a vertical engine having oppositely moving pistons in each working cylinder; Fig. 2 is a section through the lower or big end of one of the side connecting rods; Fig. 3 is a view in side elevation of one of the side rods with the upper end in section; Fig. 4 is a longitudinal section of said rod; Fig. 5 is a cross-section of one end of a cross-head, and Fig. 6 is a detail sectional view of a means for regulating the flow of lubricant to the upper or small end of the connecting rod and cross-head.

7 indicates the base of the engine which has a closed crank chamber 8 containing lubricant. Mounted on the base are two cylinders 9 each containing an inner piston and an outer piston 10. At the left hand end of the engine is an air compressor 11 for furnishing high pressure air to inject the fuel (in this case fuel oil) into the working cylinders and also for furnishing air to scavenge said cylinders. 12 indicates the main crank shaft which is carried in suitable bearings 13 of which four are provided in the present case. To the right hand end of the shaft is connected the armature of an electric generator 14. 15 indicates a speed governor that is driven by a vertical shaft 16 through a gear 17 mounted on the main shaft. The lower end of the shaft 16 is arranged to drive a gear pump 18. This pump is located below the level of the oil chamber in the base so that oil will be supplied thereto by gravity through the pipe 19, the latter being connected to the sump 20. It is important to have the pump fed by gravity head so as to avoid any danger of the pump failing to work. Oil under pressure is delivered by the pump to the pipe 21 and by it to the manifold 22 which feeds all of the main bearings in multiple. Each of the main bearing liners or brasses is provided with an annular groove 23 from which oil flows axially to lubricate the journals. The main shaft is also provided with diagonal oil carrying passages 24 as is indicated by the dotted lines. These passages are connected by radial passages 25 in the shaft with the annular grooves 23 in the brasses so that oil which is received thereby under pressure is transmitted to said diagonal passages for lubricating other bearing surfaces as will appear later.

Each of the connecting rods 26 of the lower pistons is provided with a passage or duct 27 for conveying oil under pressure to its associated wrist pin. Each of the side connecting rods is provided with a conduit 28 made in the form of a small pipe securely fastened to said rod. The lower end of each conduit receives its source of supply from the annular groove in the bearing liner or brass as shown more particularly in Fig. 2. Referring to this figure, 29 indicates a crank pin containing a duct 30 to which oil is supplied under pressure by the pump 18. 31 indicates the liner for the side connecting rod 32 which is always under tension. Oil escaping from the duct 30 enters a small arc-shaped recess 33 in the liner to lubricate it. As the crank pin always rests on the surface of the liner during the working stroke, it follows that oil under pressure will always be maintained in the recess 33. For the purpose of illustration, the clearance above the crank pin and between it and the liner has been exaggerated.

Leading from the recess is a short duct or passage 34 that communicates with two

ducts leading left and right. These terminate in holes through which pass the bolts 35 for securing the cap to the main body of the rod. These bolts are reduced in section at 36 to provide a space for the oil and are also provided with vertical passages 37 so that the oil can flow upward into the ducts 38 leading to the pipe 28 previously referred to. This pipe leads to the bearing at the upper end of the connecting rod to lubricate the upper bearing and the cross-head.

Experience has demonstrated that oil will readily flow upward through this pipe to the bearings so long as the speed of the main shaft is low, say up to 150 R. P. M., but when this speed is substantially exceeded the flow becomes erratic and finally stops altogether. This is true even though the substantial pressure of 25 lbs. per square inch be maintained by the lubricating pump 18. Experiment and test have demonstrated that this is due to the inertia of the column of oil in the pipe between the upper and lower bearings, and that increasing the pump pressure does not improve the matter except to slightly raise the point at which the supply fails. Apparently the tendency of the oil to flow upward by pump pressure is counterbalanced by that of the oil to flow downward due to its inertia as the connecting rod descends. A mechanical analogy is found in the action of a ratchet and pawl. So long as the pawl is advanced and retracted and properly acts on the teeth, the ratchet moves forward; but when the pawl fails to properly engage the teeth, the forward movement ceases. After much effort had been expended to overcome the above mentioned objection, a very simple remedy was found, *i. e.*, inserting a non return check valve 40, Fig. 4, in the pipe between the lower and upper bearings. To obtain the best results, the valve should be placed near the lower end of the pipe. With the valve arranged to close when the oil column tends to flow back toward the pump all trouble from lack of lubrication ceases. The pump delivers oil to the pipe past the valve when the rod is moving upward, and whatever oil passes the valve is prevented from returning.

To provide a simple means for regulating the flow of oil to the upper bearings, a controlling device such as is illustrated in Fig. 6 is provided. It comprises a small block 41 that is connected to the connecting rod by bolts 42. The pipe conveying the oil is interrupted and the adjacent ends are screw-threaded to the block. Communication between the ends of the pipe is established by the passage 43 and located therein is a removable plug 44 that forms a restriction. By removing the plug and substituting another of different size, a greater or less amount of oil is permitted to flow. Such an arrangement enables the flow to be regulated with great exactness, and any foreign matter which is trapped thereby can be easily removed.

The means for lubricating the bearing at the upper end of the connecting rod and for lubricating the cross-head will now be described. 45 indicates the cross-head which is attached to the upper piston 10. It is provided with trunnions or pins 46 on opposite sides with which the connecting rods 32 engage. Each pin is provided with an annular oil groove 47 which is in communication with a horizontal passage 48 that feeds oil to the recess 49 in the cross-head, the latter communicating with diagonal grooves 50 as indicated in dotted lines Fig. 4, which supply oil to the faces of the cross-heads, as indicated in Fig. 5. The passage 48 contains a removable plug 51 which acts as a restriction therein, and which can be removed and another one substituted when it is desired to change the cross-sectional area thereof, and which may be removed for the purpose of cleaning.

Surrounding the pin 46 is a hardened and ground sleeve 52 which is tightly seated thereon. Surrounding the sleeve is a liner 53 which coöperates with hardened sleeve 52. As before stated, the side rod is under tension during the working stroke and hence the bearing surfaces are above the center line of the pin. To properly lubricate these parts, the bearing liner is provided with an annular chamber 55 to which oil under pressure is admitted by the pipe 28. In the liner are numerous radially extending slots 56 through which oil passes to lubricate the contacting surfaces of the bearing liners and sleeve. These slots are so spaced apart and are so related to the angular movement of the connecting rod about the pin 46 that the entire bearing surface of the sleeve 52 will be lubricated for each revolution of the main shaft. In other words, the passages 56 are so close together that during the one revolution of the shaft that portion of the sleeve which is under one hole at the beginning of the stroke moves under an adjacent hole before the stroke has completed. The oil, after lubricating the sleeve, collects in the clearance 57 at the bottom of the bearing. For the purpose of illustration, we have shown this clearance as exaggerated. The oil which collects in this clearance is conveyed by the pipe 58 to the lower end of the connecting rod, after which it is permitted to escape to the crank chamber case.

As before stated, it is necessary to supply oil to these upper bearings under pressure. From experience we have ascertained that when the pressure is great enough to properly lubricate the parts it will be forced out between the bearing surfaces and run down again on the connecting rod. A part of this

oil is thrown off by the rapid movement of the connecting rod and the remainder runs down the rod to the crank case. This leakage is objectionable for the reason that it requires an excess amount of oil; because it renders the lubrication less certain, and because it impairs the appearance of the machine. By experiment we have discovered that this leakage can be prevented by a very simple means, to wit: On each side of the connecting rod is turned a groove 60, part of the groove being formed in the connecting rod and the remainder in the bearing liner. In the outer surface of the bearing liner is an annular chamber 55 previously referred to. Communicating with this chamber are passages 61 leading left and right, Fig. 4, which discharge into the grooves 60. In each of the grooves is located a suitable elastic packing as a leather packing 62 that is U-shaped in cross-section. The pressure of the oil in chamber 55 and in the groove 60 tends to spread the edges of the packing and also to force it out of the groove. The packing is prevented from getting out of place on the inside by the adjacent shoulder upon the cross-head. The outer packing is held in place by a disk 63 that is secured to the pin 46 by suitable bolts, as shows.

In order to regulate the supply of oil delivered by the pump 18 a by-pass connection 65, Fig. 1, is provided. This enters a chamber casing 66 in which is located a throttle valve 67. By opening this valve a greater or less amount more or less fluid from the pump will be by-passed to the chamber in the casing. 68 indicates an overflow pipe which conveys excess oil back to the crank chamber.

In accordance with the provisions of the patent statutes, we have described the principle of operation of our invention, together with the apparatus which we now consider to represent the best embodiment thereof; but we desire to have it understood that the apparatus shown is only illustrative, and that the invention can be carried out by other means.

What we claim as new and desire to secure by Letters Patent of the United States, is:—

1. An engine having a cylinder, a piston therein, a main crank shaft, and a connecting rod and pin uniting the piston to a crank on the shaft, in combination with a conduit carried by the rod for conveying lubricant from the crank to the pin, means in the conduit which permit lubricant to flow therethrough to the pin, but prevent it from returning due to the inertia of the fluid column, and a controlling device in the conduit for regulating the amount of lubricant that flows through the conduit.

2. An engine having a cylinder, a pair of oppositely moving pistons therein, a main crank shaft, bearings therefor, a rod connecting the inner piston and the shaft, a cross-head and guides for the outer piston, a pair of side rods connecting the cross-head and the shaft, in combination with conduits carried by the side rods for conveying lubricant to the cross-head bearings, and means which permit the lubricant to flow freely from the lower ends of the side rods to the cross-head and which prevent it from flowing in the reverse direction due to inertia.

3. An engine having a cylinder, a pair of oppositely moving pistons therein, a main shaft, bearings therefor, a rod connecting the inner piston and the shaft, a cross-head and guides for the outer piston, pins on the cross-head, and a pair of side rods connecting the cross-head pins and shaft, in combination with conduits carried by the side rods which deliver lubricant to said pins, means conveying lubricant from the pins to the cross-heads, and non-return valves which permit lubricant to freely flow through the conduits to the pins and cross-head but which prevent it from flowing in the opposite direction due to inertia.

4. In an engine, the combination of a piston, a pin, a main shaft, a rod connecting the pin and shaft, a conduit for supplying lubricant under pressure to the contacting surfaces of the rod and pin, packings for preventing lubricant from escaping from said surfaces that are subjected to said pressure, and means coöperating with the packings to hold them in place.

5. In an engine, the combination of a piston, a pin, a main shaft, a rod connecting the pin and shaft, a conduit supplying lubricant under pressure to the bearing surfaces of the pin and rod, said pin and rod being formed with grooves, cup-shaped packings mounted in the grooves which are pressed outwardly by the pressure of said lubricant, and means that restrict the outward movement of said packings.

6. In an engine, the combination of a piston, a cross-head having pins, a main shaft, rods for connecting the pins and shaft, a liner which surrounds each of the pins and is provided with slots, an annular chamber that surrounds the liner and supplies lubricant to the slots under pressure, means at opposite ends of the liner which prevent the escape of lubricant, conduits carried by the rods which supply lubricant under pressure to the chamber, and means in the conduits for preventing the flow of the lubricant therein from the chamber toward the shaft due to its inertia.

7. The combination with an internal combustion engine having a cylinder with oppositely moving pistons, a main crank shaft, a connecting rod connecting the inner piston to a crank on the shaft, and side rods, pins, and a cross head connecting the outer piston to cranks on the crank shaft, of means for lubricating the pins and cross head compris-

ing a pump which supplies lubricant to cranks on the crank shaft, conduits associated with the side rods for conveying lubricant from the cranks to the pins and cross head, and non-return check valves in said conduits.

8. The combination with an internal combustion engine having a cylinder with oppositely moving pistons, a main crank shaft, a connecting rod connecting the inner piston to a crank on the shaft, and side rods, pins, and a cross head connecting the outer piston to cranks on the crank shaft, of means for lubricating the pins and cross head comprising a pump which supplies lubricant to cranks on the crank shaft, conduits associated with the side rods for conveying lubricant from the cranks to the pins and cross head, non-return check valves in said conduits, and removable means in said conduits for restricting the flow therethrough.

In witness whereof, we have hereunto set our hands this twenty-ninth day of July, 1915.

HERMANN LEMP.
HENRY W. STOCK.