Aug. 21, 1934. C. L. REED 1,970,866

FUEL SUPPLY MEANS FOR OIL ENGINES

Filed July 22, 1930 2 Sheets-Sheet 1

FIG. 2

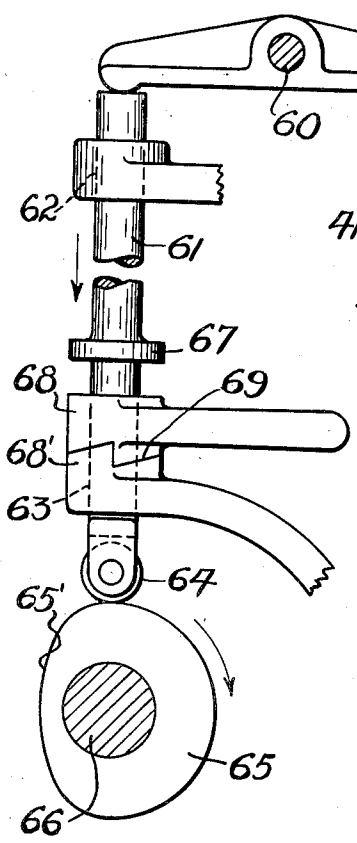


FIG. 1

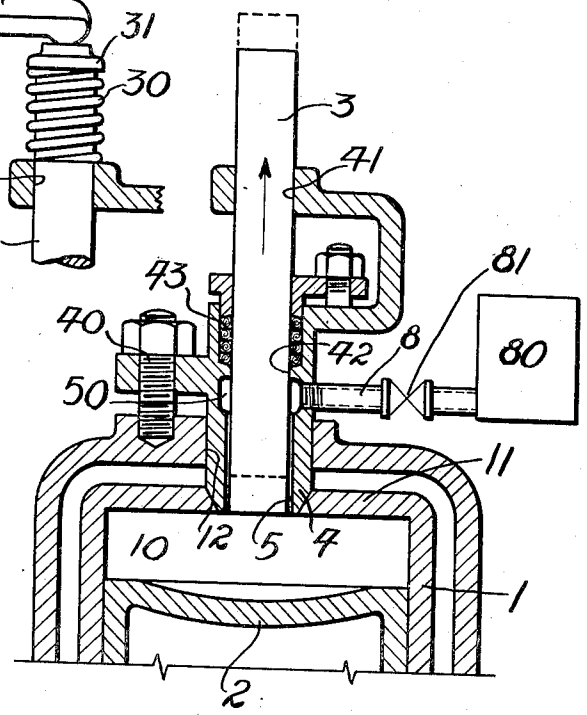


FIG. 4

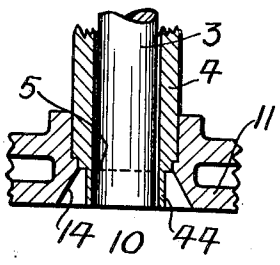


FIG. 5

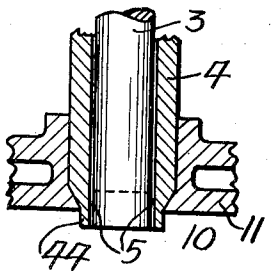
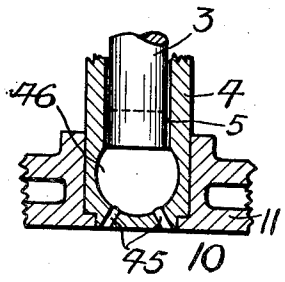


FIG. 3



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Filed July 22, 1930 2 Sheets-Sheet 2

FIG. 6

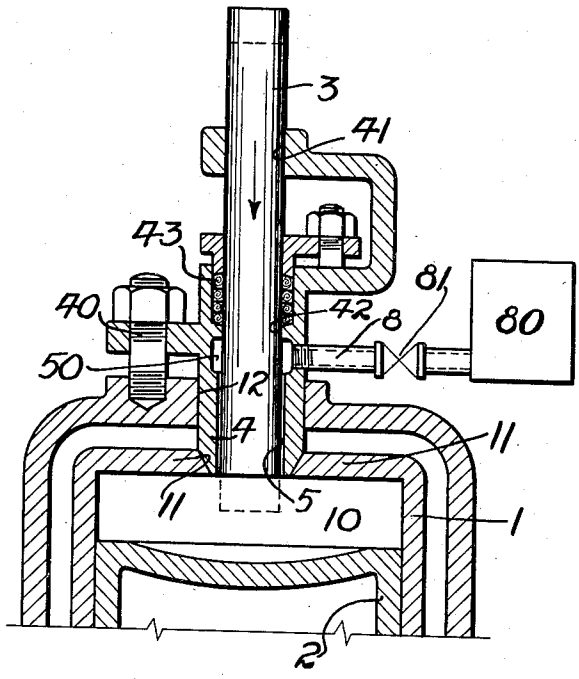


FIG. 7

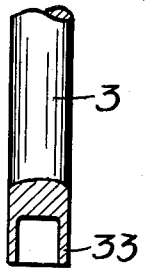


FIG. 8

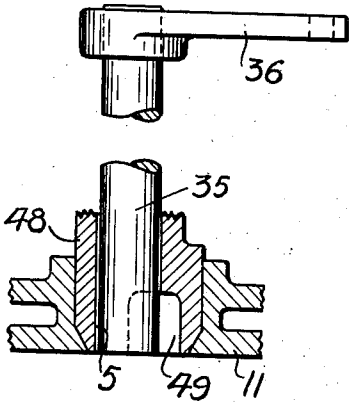
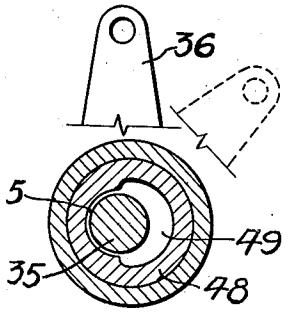


FIG. 9



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UNITED STATES PATENT OFFICE

1,970,866

FUEL SUPPLY MEANS FOR OIL ENGINES

Clifford L. Reed, Seattle, Wash.

Application July 22, 1930, Serial No. 469,734

9 Claims. (Cl. 123—137)

In its general aspect, my invention is concerned with the feeding of fuel oil into combustion chambers. More specifically, a special application of the invention relates to internal combustion engines, and more especially to the heavy oil burning engines, of which the Diesel and semi-Diesel engines are types.

The principal object of the present invention is to provide for the supply of fuel in such form and in such amount to the combustion chamber of such an engine as may be best assimilated without the necessity of employing fuel oil injection nozzles, with small openings subject to erosion and being stopped up by dirt, without the usual high-pressure fuel oil pump, and without the usual high-pressure air compressor, and their piping.

In other words, it is the object of my invention, as relates to internal combustion engines generally, to provide a low-pressure, simple, and thoroughly reliable method and means for supplying the fuel oil to the interior of the combustion chamber.

It is also an object of my invention to provide means for introducing fuel oil into combustion chambers, more particularly of the smaller sizes of engines, in minute quantities, and in all sizes of engines to provide a means for regulating at will the quantity of oil supplied with an exactness not heretofore possible.

Other objects, and particularly such as relate to the purely mechanical details of my invention, will be understood from a study of the attached drawings (wherein my invention is shown, largely diagrammatically, in forms now preferred by me), of this specification, and of the claims which terminate the same.

My invention comprises the novel method and the novel parts and the combination and arrangement thereof, all as shown in the drawings, described in the specification, and as will be hereafter defined in the claims.

Figure 1 is an axial section through the upper part of a cylinder and piston of a typical internal combustion engine, showing my invention in a simple form, associated therewith.

Figure 2 is an elevation of a typical control and actuating means for such fuel feed means.

Figures 3, 4 and 5 are detail axial sections through the fuel supplying means, illustrating various modifications.

Figure 6 is a section similar to Figure 1, showing a slightly modified method of operation.

Figure 7 is a detail view, partly in section, of a modified type of plunger.

Figure 8 is an axial section, and Figure 9 a partial plan view and transverse section of a further modification.

My invention is concerned with the supplying of fuel oil to the combustion chamber of any suitable type of oil-consuming engine, and the details of the engine, therefore, are unimportant. Those shown are purely typical and illustrative, and for that reason, the usual intake valves and exhaust valves, if any be employed, have been omitted from the drawings, as have also been omitted the various timing, driving, starting, and other auxiliary and necessary devices, it being understood that these will be provided as necessary to the proper functioning of the engine.

As illustrated, therefore, the engine is diagrammatically represented by the cylinder 1 and the piston 2, movable within the combustion chamber 10 of the cylinder. As will be understood, the movement of the piston toward the head 11 of the cylinder, highly compresses air previously admitted into the chamber 10, raising its temperature to the point where it will spontaneously ignite and cause to burn any oil which is exposed to such highly heated air in the chamber.

Communicating directly with the combustion chamber are two relatively movable elements, which are so spaced as to receive a thin film of oil between them and to retain it by capillary action. The capillary action not only serves to distribute the oil in this space, but also to retain it there in opposition to reasonably high pressures tending to dislodge it. These members, upon relative movement, expose oil-coated surfaces to the highly compressed air within the combustion chamber, the compression and attendant heat having been caused, as has been explained, by compression due to movement of the piston 2. The mechanical form of such relatively movable members is unimportant, as is the precise means for securing their relative movement. They may take various forms, and the relative movement may be attained in various ways.

As an illustration of a simple means of achieving this result, I have illustrated a plunger 3 which is received within the bore of a sleeve 4, which sleeve admits to the compression space within the cylinder. This sleeve is shown as received within an aperture 12 in the head 11 of the cylinder. Obviously, the sleeve 4 might be dispensed with and the plunger received within a bore of the cylinder, or its head, but

for convenience of manufacture, assembly, inspection and repair, I prefer that the sleeve be formed separately and inserted; a bolt and nut, illustrated at 40, typifies a holding means. The plunger is guided at 41 and 42 in the sleeve 4, or in parts associated therewith, and suitable packing, if needed, serves to prevent leakage past the plunger, and is indicated at 43.

Above the chamber 10, the plunger and its sleeve 4 are slightly spaced from each other to leave a very thin, annular chamber 5, communicating with the combustion chamber. This has been exaggerated in the drawings, the better to illustrate it, but this chamber or annular space would be very thin and would serve to hold the oil therein and to cause it to penetrate all parts of this space by capillary attraction, yet it will not drop from the lower end thereof, nor burn, because of the confined space and lack of access of air in effective quantities. If desired, a local reservoir 50 may be provided at the upper end of this space 5, formed either in the sleeve or in the plunger itself. Discharging either into the local reservoir 50, if one be used, or directly into the annular space 5, is an oil supply pipe 8.

This oil supply pipe 8 leads from a fuel supply source, such as the tank 80 or a low-pressure oil pump, past a check-valve, diagrammatically represented at 81. The pressure in the tank 80 or other supply source need be very small, since the capillary action of the space 5 induces flow of the oil, aided by gravity or other slight pressure, throughout the annular space 5. The check-valve prevents blowing out through the oil supply conduit 8, but the capillary action is in most cases sufficient to prevent blowing back through the narrow space 5, and in such cases no check-valve would be required. The valve 81 will prevent blowing back whenever the resistance of the capillary film is not quite sufficient and it supplies the final resistance (though a small portion of the whole) in such cases.

Any means may be provided to cause relative movement between the plunger 3 and its sleeve 4. Normally, they are in the position shown in full line in Figures 1, 3, 4, 5 and 6, but the plunger may be moved, as indicated in dotted lines in these figures. Referring more particularly to Figure 1, movement of the plunger from the full line towards the dotted line position begins at about or just preceding the instant of maximum compression in the combustion chamber 10, and as this retractive movement of the plunger continues, there are left exposed progressively portions of the surface of the bore within the sleeve 4, which surface is coated with a thin film of fuel oil. The exposure of the thin film of oil to the high temperature and the highly compressed air in the combustion chamber causes it to burn, thereby expanding and giving a power impulse to the piston. The rate of exposure, and consequently the rate of burning, can be regulated by designing the relative shapes of the plunger and sleeve, or by control of the retractive movement of the plunger.

Referring now to Figure 6, it will be noted that the plunger 3 is projected out of the sleeve 4, instead of being retracted thereinto as in Figure 1, and this exposes the oil-coated surface at the lower end of the plunger rather than at the end of the sleeve. The result is the same.

The means for accomplishing movement of the plunger may be varied widely, as has been noted, but as a typical means of inducing retraction of the plunger, I have illustrated the mechanism shown in Figure 2. A spring 30 bears upon a collar or flange 31 at the upper end of the plunger 3, tending to draw it outward, that is, to retract it from its normal full-line position of Figure 1. This tendency is normally resisted by a rocker arm 6, pivoted at 60, and acted upon by a rod 61, guided at 62 and at 63, which rod carries a cam follower 64 bearing upon a rotary cam 65, the shaft 66 of which is driven from some suitable portion of the engine and synchronized with the crankshaft thereof. The cam 65 is circular, except for the portion 65', which, when the cam follower rides thereupon, permits the rod 61 to drop, releasing the plunger 3 to the action of its spring 30, and returning the plunger to its normal position as the follower again rides up to the circular portion of the cam. Downward movement of the rod 61 is limited by a collar or flange 67, engaging a stop member 68. A complementary stop member 68' supports the member 68, and complemental inclined surfaces 69 permit the height of the stop member to the flange 67 to be varied, upon rotation of the member 68, by minute amounts. The greater the distance to which the plunger is retracted, the more oil is exposed and the greater the power impulse, and vice versa. Such an arrangement as described permits minute variations in the amount of oil exposed, and consequently, minute variations in the power impulses.

In the form illustrated in Figures 8 and 9 the movable member 35 is held closely adjacent the surface of a sleeve 48, but instead of moving longitudinally, this member 35 is given a rotary movement, by some such means as the external handle 36. Since the sleeve 48 is recessed at one side, at 49, such rotary movement of the member 35 accomplishes the same result as before, namely, it brings an oil-coated surface, previously protected by the closely fitting portion of the sleeve 48, into this recess, where it is exposed to the combustion chamber. The amount of such movement can be varied at will by means which can be devised by any engineer. It will operate most satisfactorily if the member 35 is moved in one rotary direction and stopped, for each individual power impulse, and then is reversed, or is again advanced, and stopped, for the next impulse, instead of causing it to oscillate during any one impulse.

It is a well-known fact that some fuel oils require more heat to completely burn in a small space of time than others. In view of that fact, the inner end of the sleeve 4, in Figures 4 and 5, has been made thin, in order that this portion of the sleeve may be hotter than if it were thick, and it produces more favorable results with fuel oils requiring more heat to burn them completely. In Figure 4, the inner end 44 of the sleeve 4 projects into a recess 14 in the cylinder head 11, and this end 44 is made thin. Therefore, both because it is thin and because it is at all times directly exposed on the outside to the temperatures within the combustion chamber, it is quickly heated. Similarly, in Figure 5, the thin end 44 of the sleeve 4 projects directly into the combustion chamber 10. The same result is obtained, for a plunger which is projected as in Figure 6, by recessing the lower end of the plunger to leave a thin wall 33 at its lower end, as is illustrated in Figure 7.

In Figure 3, the arrangement is somewhat

different, the inner end of the sleeve 4 being closed to the combustion chamber direct, and communicating therewith through small ports 45, leading from a chamber 46 within the end of the sleeve 4, to the main combustion chamber 10. In operation, at the end of the compression stroke the pressure in the small gasifying chamber 46 is practically the same as the pressure in the combustion chamber 10, as is also the temperature. As the plunger 3 recedes, the fuel oil is completely gasified, but is only partially burned in the chamber 46, due to the limited amount of air in this small chamber, but, due to the partial burning, the pressure in the gasifying chamber 46 considerably exceeds the pressure in the main combustion chamber 10. Consequently, the partly burned gas issues from the chamber 46 through the ports 45 into the combustion chamber 10 with considerable force, which promotes turbulence in the combustion chamber 10 and thereby accelerates combustion in this main chamber. This permits lower pressures to be used in the combustion chamber, yet produces the maximum of turbulence, and complete combustion.

What I claim as my invention is:

1. Fuel feeding means for oil engines comprising in combination, a plunger and a sleeve closely surrounding but slightly spaced from the plunger, and communicating with a combustion chamber, means for supplying fuel to the space between plunger and sleeve, and means for producing relative movement between the plunger and sleeve to expose a fuel-covered surface to highly compressed air within the combustion chamber.

2. Fuel feeding means as in claim 1, and a local reservoir formed between the plunger and sleeve above the surface to be exposed, and feeding thereto by capillary action prior to exposure of such surface.

3. Fuel feed means as in claim 1, the material behind the surface to be exposed being of such thinness, relative to the temperature of compression, and this portion being so exposed to such temperature, as to raise its temperature during compression higher than the surrounding metal.

4. Fuel feeding means as in claim 1, the plunger being retractible within the sleeve, to expose the surface of the latter.

5. Fuel feeding means as in claim 1, and means to regulate the area of surface exposed.

6. The combination of claim 1, and means acting to retract the plunger within the sleeve, a constant throw actuating means normally maintaining the plunger projected within the sleeve, and means interposed between the actuating means and the plunger to vary the retraction of the plunger.

7. Fuel feeding means as in claim 1, the plunger being projectable from the sleeve, to expose the surface of the plunger.

8. Fuel feed means for oil engines comprising, in combination with a cylinder, a piston reciprocable therein, a sleeve communicating with the compression space between the piston and the cylinder head, means for delivering fuel to the interior of said sleeve, a plunger reciprocable within the sleeve, and spaced therefrom to form a thin film of fuel therebetween, said film of fuel being of sufficient length to resist being blown back under high pressures obtaining in the compression space, and means for producing movement of the plunger relative to the sleeve, to expose a film-covered surface to the highly compressed air within the compression space of the cylinder.

9. Fuel feed means as in claim 1, the cylinder head being recessed, about the end of the sleeve, and the end of the sleeve projecting into such recess, and being of such thinness relative to the temperature of compression, as to be raised in temperature, during compression, higher than the surrounding metal.

CLIFFORD L. REED.