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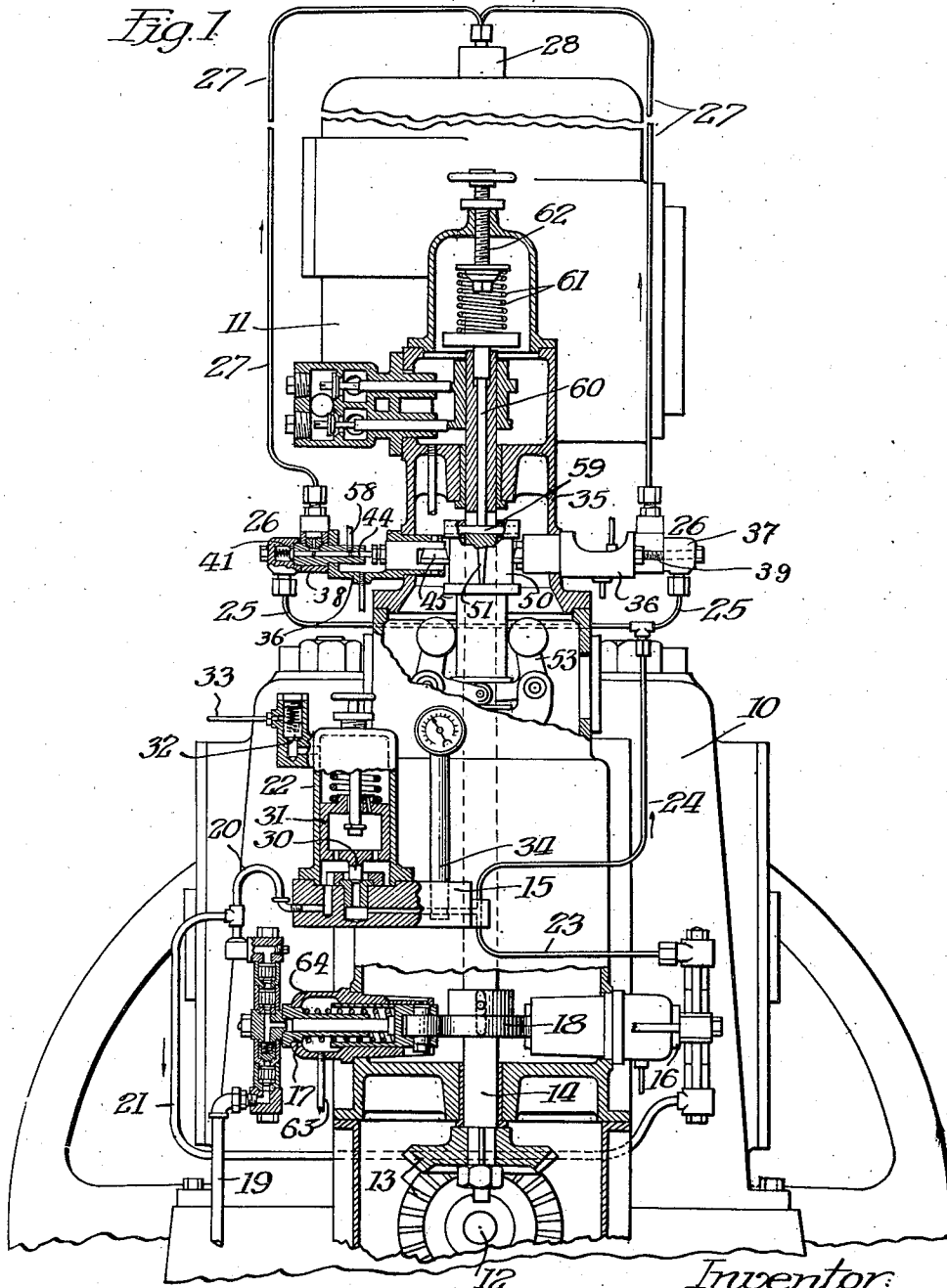
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1,617,567

OIL ENGINE

Filed Feb. 6, 1925

3 Sheets-Sheet 1



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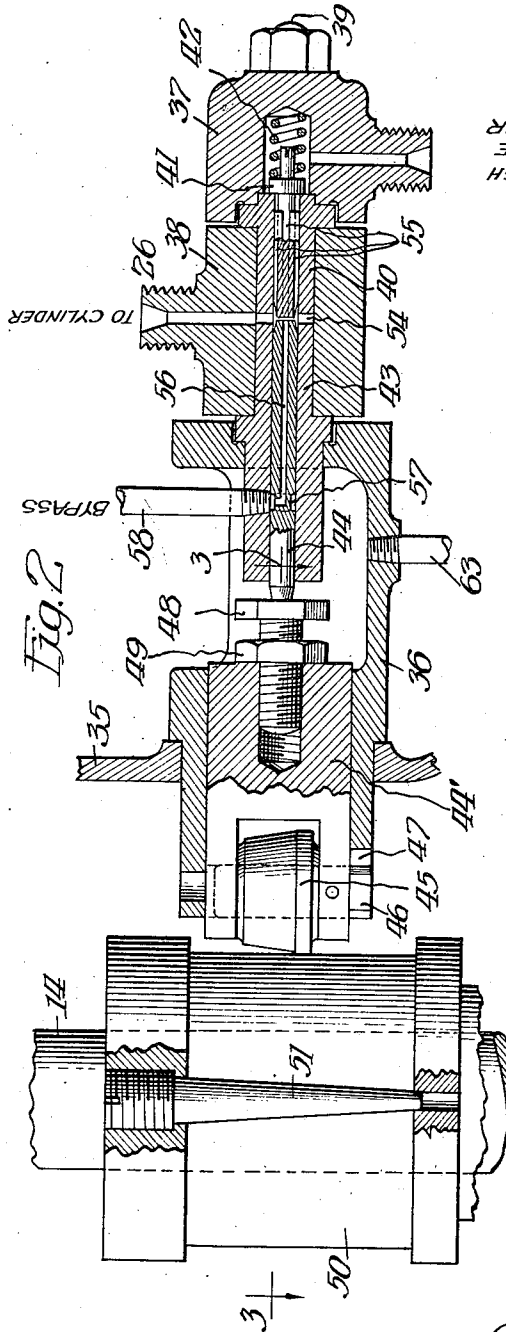
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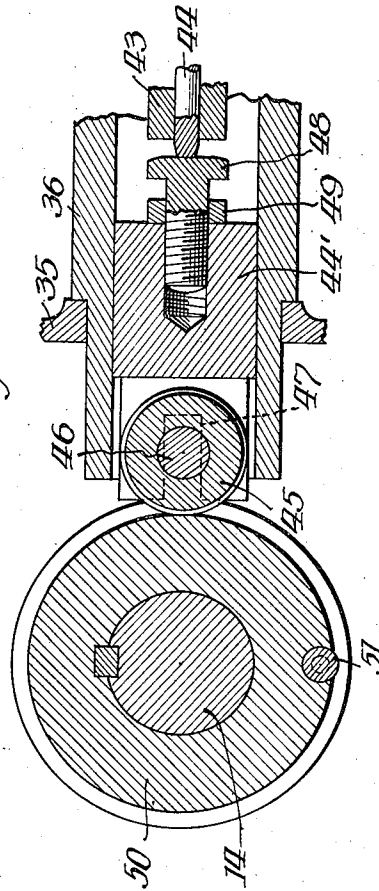
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FROM HIGH  
PRESSURE  
RESERVOIR

Fig. 3



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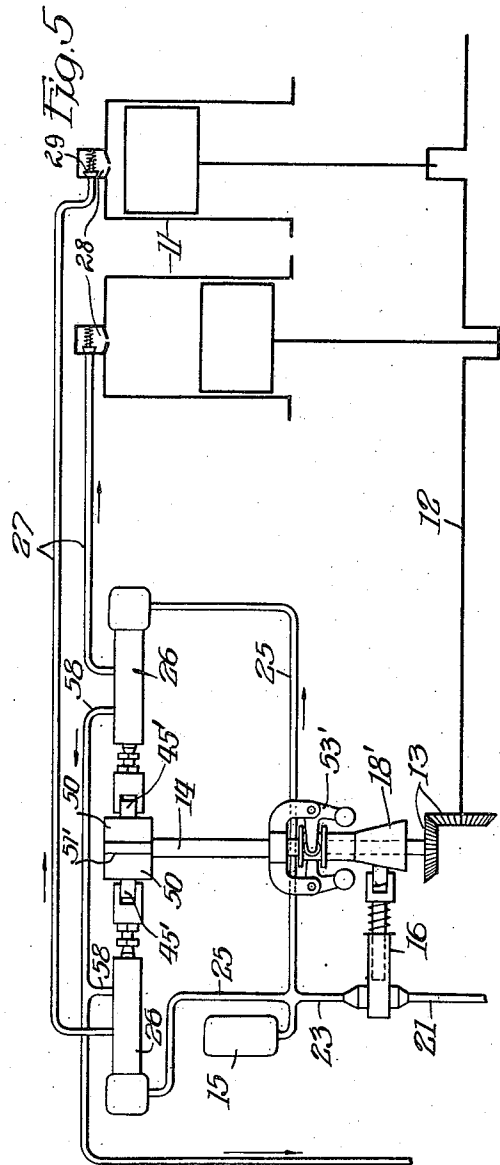
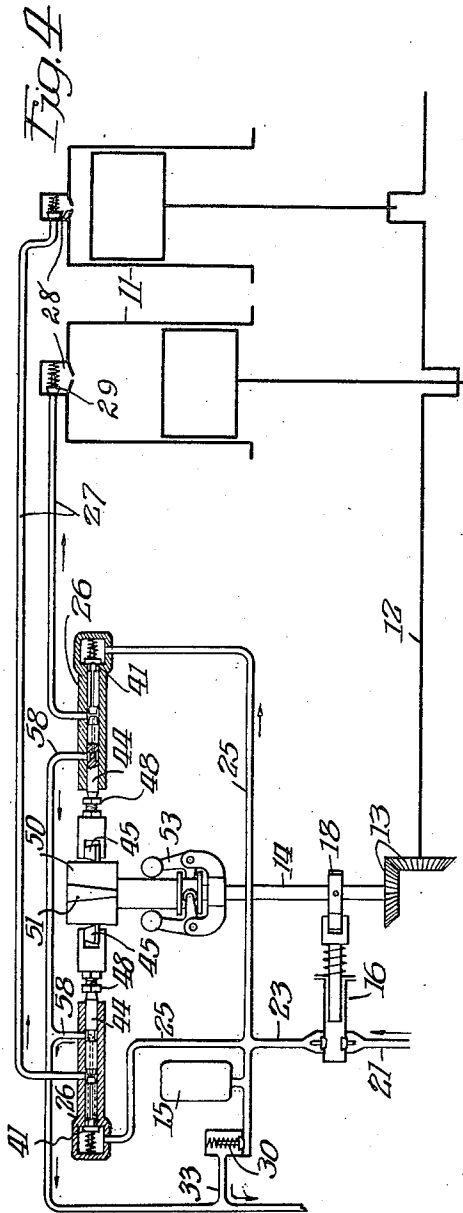
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**1,617,567**

OIL ENGINE

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3 Sheets-Sheet 3



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Patented Feb. 15, 1927.

1,617,567

# UNITED STATES PATENT OFFICE.

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## OIL ENGINE.

Application filed February 6, 1925. Serial No. 7,201.

The present invention relates to injection type oil engines and seeks to provide improved means for effecting the injection of the liquid fuel, and more particularly provide improved means for effectively injecting and uniformly distributing the liquid fuel to the several working cylinders of a multiple cylinder engine.

Heretofore in multiple cylinder, injection type oil engines, it has been found difficult to secure equal distribution of the fuel to the different cylinders and, unless this is attained, there is not only loss of efficiency but one or more of the cylinders may be seriously overloaded and so damaged. In such engines in which each cylinder is provided with a pump for measuring and injecting the fuel charges, it is difficult to obtain a sharp cut-off and good atomization of the fuel in the cylinder unless a by-pass valve is provided between the pump and the spray nozzle at the cylinder. In such cases however, the slightest leak in the check valve at the spray nozzle will allow the pressure within the cylinder to partially empty the fuel passage leading to the spray nozzle, with the result that the cylinder having a leaky check valve will not do its full share of the work. Furthermore, it is difficult to properly adjust the by-pass valves, since very minute differences in the adjustment of these valves will cause unequal distribution of fuel to the cylinders and unequal distribution of work.

In other multiple cylinder oil engines, the distribution of oil to the different cylinders is determined by the size of the opening of the spray nozzles and the duration of opening of mechanically controlled valves arranged in proximity to the spray openings, the oil at desired pressure being supplied to the different valves from a common manifold in which the fuel is maintained under pressure by a feed pump. In such cases a single pump can be employed in place of one for each cylinder, but complicated mechanically controlled valve mechanism replaces the simple automatic check valves at the cylinder spray nozzles. Also it is difficult to properly adjust and keep such valves tight and the slightest leak will admit fuel to the working cylinder during its entire cycle of operation, resulting not only in loss of efficiency but also dangerously high pressure therein.

The present invention seeks to retain the

advantages of the old systems above referred to and avoid the noted objections, and provides a liquid fuel supply maintained under pressure, spray nozzles having automatic check valves at the working cylinders and intermediate distributing and by-pass valve means all arranged to provide for effective injection and uniform distribution of the fuel to the several cylinders. Preferred embodiments of the invention are illustrated in the accompanying drawings and the invention itself more particularly pointed out in the appended claims.

In the drawings:

Fig. 1 is an end elevation of a multiple cylinder, injection type oil engine, with the present improved fuel feeding and distributing means applied thereto, and with parts of the feeding means shown in section.

Fig. 2 is a detail vertical section on an enlarged scale of the distributing and by-pass valves for one of the engine cylinders.

Fig. 3 is a detail section on the line 3-3 of Fig. 2.

Fig. 4 is a diagrammatic view of the improved fuel feeding means.

Fig. 5 is a similar view illustrating a modification.

The improvement is shown applied to an upright oil engine having a suitable frame, two or more cylinders 11 and a main crank shaft 12. In the form shown, the main shaft 12 is connected by intermeshing beveled gears 13 to a vertical valve shaft 14. The fuel oil is forced into a manifold 15 mounted on the engine frame, preferably by means of high and low pressure pumps 16 and 17. These pumps which are of similar construction, are arranged on opposite sides of the shaft 14 and the pump plungers are operated by a cam 18 thereon. The fuel supply pipe 19 leads to the intake of the low pressure pump 17 and the latter delivers the oil through branch pipes 20 and 21 to a low pressure chamber 22 mounted on the manifold 15 and to the intake of the high pressure pump. The latter delivers the oil through a pipe 23 to the high pressure manifold 15, and this manifold is connected by pipe 24 and branches 25 with the distributing valve casings 26. These casings are connected by pipes 27 with the spray nozzles 28 at the engine cylinders and the latter are provided with suitable automatic check valves 29 for preventing return flow through the pipes or passages 27.

The high and low pressure fuel supply pumps can be of any suitable construction and, if desired, a pump having a single plunger can be employed. Preferably, the feed pump is arranged to supply liquid fuel in excess of that required by the engine and the pressure in the supply manifold 15 is maintained uniform by means of a relief valve. In the preferred form shown, the high pressure relief valve 30 discharges into the low pressure chamber 22 and is carried by a spring-held plunger 31 arranged within this chamber. Suitable means are preferably provided for adjusting the plunger spring to determine the desired pressure within the fuel supply manifold 15. As shown, the plunger 31 is hollow and perforated to permit the passage of oil therethrough, and the low pressure relief valve 32 communicates with the upper end of the chamber 22, oil passing therethrough being returned to the main supply by a pipe 33. To increase the capacity of the supply manifold 15 and aid in maintaining the pressure uniform therein, the latter is provided with a cushioning chamber 34 within the upper portion of which air is trapped when the engine is in operation.

In the construction shown, the vertical valve shaft 14 is arranged within a casing 35 and the distributing valves, one for each of the cylinders, are radially disposed about the shaft and suitable supports 36 therefor are mounted on the casing 35. In the particular two-cylinder engine shown, the distributing valves are on opposite sides of this casing.

Each distributing valve casing, in the form shown, comprises inlet and discharge sections 37 and 38 mounted upon the outer end of a support 36 and secured thereto by bolts 39. An intermediate sleeve-like section 40 is held in place between the casing sections 37 and 38 and extends into the bore of the discharge section 38. The distributing valve 41 is of the poppet type and is arranged within the chamber of the valve section 37 with its stem extending into the bore of the sleeve section 40. A coiled spring 42 in the chamber of the section 37 tends to hold the valve 41 in engagement with its seat formed upon the outer end of the sleeve section.

A second sleeve section 43 held in place between the support 36 and the casing section 38 forms a guide for a valve actuating tappet 44. The latter is cylindrical and fits within the bore of the sleeve. A cylindrical tappet actuator 44' is guided in a correspondingly shaped opening in the outer end of the support 36 and has a forked inner end within which is mounted a roller 45. One end of the pintle 46, upon which the roller 45 is mounted, is flattened and projects within a guiding slot 47 in the support 36 to hold the tappet actuator 44 against rotation.

The tappet actuator is provided with an adjustable abutment for engaging the tappet or plunger 44, in the form of a screw 48, adjustably threaded on the outer end of the actuating member 44' and held in adjusted position by a lock nut 49.

The distributing valves are actuated by a cam 50 mounted on the shaft 14. The greater portion of the periphery of this cam is cylindrical and a small section thereof is provided with a raised actuating portion, preferably formed of a conical or tapered pin 51 arranged within the correspondingly shaped seat therein. Similarly, each of the rollers 45 is provided with cylindrical and tapered portions for engaging the cylindrical and tapered portions of the cam.

Obviously, by adjusting the position of the cam, the period of opening of the distributing valves can be varied to correspondingly vary the fuel charges that are injected into the cylinders and so control the engine speed. This adjustment of the cam may be effected, if desired, manually. In the construction shown, a fly-ball governor 53 mounted on the shaft 14 is connected to the cam to adjust its position.

The sleeve sections 40 and 43 of each distributing valve casing are spaced apart as shown in Fig. 2, and this space 54 communicates with the passage extending through the discharge section 38, and communicating by means of the pipe 27 with the spray nozzle of the corresponding cylinder. The stem of the distributing valve 41 is provided with an enlarged cylindrical portion having a guiding fit in the sleeve 40, and this enlarged portion is provided with longitudinal grooves 55 communicating with the discharge side of the valve and with the space 54. The valve actuating tappet or plunger 44 is provided with an axial bore 56 communicating with the space 54 and with an annular groove 57 formed in the inner end of the plunger, and which in turn communicates with a by-pass pipe 58. With this arrangement, the adjacent abutting ends of the valve stem and the valve actuating plunger or tappet form, in effect, a by-pass valve which is closed when the plunger or tappet is shifted to open the distributing valve 41, but which is opened immediately when the distributing valve is seated.

In operation the abutment 48 is so adjusted that, with the plunger or tappet 44 engaging it and the roller 45 engaging the cylindrical portion of the cam, the outer end of the plunger is spaced to a slight extent from the inner end of the distributor valve stem. When the plunger is shifted by the cam to open the distributor valve, its outer end engages the valve stem and closes the by-pass or relief port 56, but, as soon as the valve seats, the by-pass is opened to relieve the pressure on the discharge side of

the distributor valve and in the passage or pipe between the valve and the corresponding spray nozzle.

The improved construction avoids the necessity of employing complicated mechanically operated valves at the spray nozzles and also avoids the use of a complicated arrangement of pumps, one for injecting fuel charges into each of the cylinders. Instead, the spray nozzles are provided with simple, automatic check valves and only a single pump of simple construction is needed to feed the oil. The improved combined distributing and by-pass valve for each cylinder effects a sharp cut-off, as in the pump injection type of oil engine having a by-pass beyond the discharge check of the pump, but without the disastrous results occurring in that type of engine in case of a leak at the spray nozzle check valve. With the present construction, while a leaky check valve might partially empty the pipe or passage leading to the spray nozzle, the loss would be made up the instant the distributor valve opened and no inequality of distribution of oil to the different cylinders would result. This is because the opening of the distributor valve immediately connects the spray nozzle to the supply manifold in which the fuel is maintained under pressure, and because the opening through the poppet type distributing valve is relatively large as compared with the opening at the spray nozzle. Nor would a leak through a distributor valve cause unequal distribution of fuel to the different cylinders, since this leakage would simply go to the associated by-pass pipe 58 and would not pass to the corresponding cylinder. Indeed, leaks at the distributing and check valves will only lessen the amount of oil passing through the relief valve 30, and, until leakage became so great as to exceed the excess capacity of the fuel feed pump, no effect would be produced in the performance of the engine.

It is also noted that because of the relief of pressure in the passages leading to the spray nozzles, there is no opportunity for fuel to find its way into a working cylinder except during the injection period. Also, the only accurate adjustment required for effecting uniform distribution of fuel to the several cylinders, is to see that the same clearance exists between the tappet of each distributor valve and the base circle of the cam 50. Preferably, as stated, this cam is provided with a tapered portion 51 so that, by adjusting its position on the shaft 14, the injection periods determined by opening the distributing valves, can be varied to regulate the speed of the engine.

In the preferred construction shown, the cam is mounted on a sleeve having an annular groove at its lower end which is engaged by the arms of the fly-ball governor 53 (see

Fig. 1). A pin 59 extending through the upper end of the cam sleeve, also extends through a slot in the shaft 14 and is engaged by a rod 60 extending through a bore in the upper end of the shaft. A disk on the upper end of this rod is engaged by a spring 61, the tension of which can be adjusted by a screw 62.

If desired, the distributing valves may be uniformly operated and the fuel charges varied to control the engine speed by varying the pressure in the supply manifold. In this case, as indicated in Fig. 5, the rollers 45' on the tappet actuators are cylindrical, and the operating portion 51' of the cam is not tapered. Instead, the fuel feed pump is operated by a tapered cam which can be adjusted either by hand or by a governor to vary the stroke of the pump and consequently vary the pressure in the supply manifold. In this case the supply manifold will not be provided with a relief valve. With either arrangement, the oil supplied to a spray nozzle is maintained under steady pressure throughout each injection period to effect good atomization.

Oil passing through the by-pass pipes 58 is conducted back to the main fuel supply. Any leakage occurring around the operating tappets or the distributing valves is collected in chambers formed in the supports 36 (see Figs. 1 and 2), and drip pipes 63 conduct it back to the main fuel supply. Similar drip pipes lead from chambers 64 enclosing the high and low pressure pumps 16 and 17. Changes may be made in the details set forth without departure from the scope of the appended claims.

I claim as my invention:

1. In combination in a multiple cylinder, injection type oil engine, a supply manifold, means for constantly maintaining liquid fuel under injection pressure in said manifold, a spray nozzle at each working cylinder having an automatic check valve adapted to be opened by the injection pressure, and mechanically actuated distributing and by-pass valve means interposed between the supply manifold and each spray nozzle for timing and measuring the injected charges and for relieving the pressure in the passage leading to each spray nozzle during non-injection periods.

2. In combination in a multiple cylinder, injection type oil engine, a supply manifold, means for maintaining liquid fuel under pressure therein, a spray nozzle having an automatic check valve at each working cylinder, and intermittently-operating distributing and by-pass valve means for alternately placing each spray nozzle in communication with the supply manifold and relieving the pressure in the passage leading thereto.

3. In combination in an injection type oil

- engine, a supply manifold, means for maintaining liquid fuel therein under pressure, a spray nozzle for the working cylinder, and intermittently acting valve means for alternately placing the passage leading to the spray nozzle in communication with the supply manifold and with a relief port.
4. In combination in a multiple cylinder, injection type oil engine, a supply manifold, means for maintaining liquid fuel therein under pressure, a spray nozzle for each working cylinder, valve means for alternately placing the passage leading to each spray nozzle in communication with the supply manifold and with a relief port, and devices for intermittently actuating said valve means, said devices being adjustable to control the engine speed.
5. In combination in a multiple cylinder, injection type, oil engine, a liquid fuel supply maintained under pressure, a spray nozzle having a check valve at each working cylinder, a distributing valve and a by-pass valve for each cylinder, said by-pass valve being arranged to relieve the pressure on the discharge side of the associated distributing valve when the latter is closed, and means for intermittently actuating said distributing and by-pass valves.
6. In combination in a multiple cylinder, injection type oil engine, a supply manifold, means for maintaining liquid fuel under pressure therein, a spray nozzle at each working cylinder, a distributing valve and a by-pass valve for each cylinder interposed in the order named between the supply manifold and the corresponding spray nozzle, and means for alternately opening and closing said distributing and by-pass valves.
7. In combination in a multiple cylinder, injection type oil engine, a supply manifold, means for maintaining liquid fuel therein under uniform pressure, a spray nozzle at each working cylinder, a distributing valve and a by-pass valve for each working cylinder interposed in the order named between the supply manifold and the corresponding spray nozzle, actuating devices for alternately opening and closing said distributing and by-pass valves, and means for adjusting said valve actuating devices to control the engine speed.
8. In combination in a multiple cylinder, injection type oil engine, a supply manifold, means for maintaining liquid fuel under pressure therein, a spray nozzle having a check valve at each working cylinder, a combined distributing and by-pass valve, one for each cylinder, arranged to alternately place the passage leading to the corresponding spray nozzle in communication with the supply manifold and with a relief port and means for intermittently operating said valves.
9. In combination in a multiple cylinder, injection type oil engine, a supply manifold, means for maintaining liquid fuel under pressure therein, a spray nozzle having a check valve at each working cylinder, distributing valves, one for each cylinder, interposed between the supply manifold and the spray nozzle, means including tappets for intermittently operating said valves, and a by-pass controlled by the engagement and disengagement of each tappet and valve for relieving the pressure on the discharge side of the valve when the latter is closed.
10. In a multiple cylinder, injection type oil engine, the combination with means for maintaining liquid fuel under pressure and a spray nozzle at each cylinder of distributing valves, one for each cylinder, yieldingly held in closed position, and intermittently operated tappets for lifting said valves, each of said tappets having a by-pass controlled by the engagement and disengagement of the tappet with the corresponding valve for relieving the pressure between the latter and the corresponding spray nozzle when the valve is closed.
11. In a multiple cylinder, injection type oil engine, the combination with means for maintaining liquid fuel under pressure and a spray nozzle at each cylinder, of a poppet distributing valve for each cylinder held to its seat by the pressure of the fuel supply, a casing for said valve, and a valve actuating tappet extending into the casing and having a by-pass extending therethrough for relieving the pressure in the discharge side of the valve, the contacting faces of the valve stem and tappet forming a supplemental valve for controlling the by-pass.
12. In combination in a multiple cylinder, injection type oil engine, a supply manifold, means for maintaining liquid fuel under pressure therein, a spray nozzle having a check valve at each working cylinder, a distributing valve for each cylinder, a casing therefor, a valve tappet extending into said casing, the contacting faces of the tappet and valve forming a by-pass valve for relieving the pressure in the discharge side of the distributing valve, and means for actuating the tappet to alternately open and close the distributing and by-pass valves.
13. In combination in a multiple cylinder, injection type oil engine, a supply manifold, means for constantly maintaining liquid fuel under injection pressure in the said supply manifold, a spray nozzle at each working cylinder having an automatic check valve adapted to be opened by the injection pressure, poppet distributing valves, one for each cylinder, directly controlling communication between the supply manifold and the spray nozzles and normally held to their seats by the constantly maintained, injection pressure in said supply manifold, mechanism for successively operating said distrib-

uting valves to determine the injection periods and amount of the injected charges and by-pass means controlled by said mechanism for relieving the pressure on the discharge side of each of said poppet valves when the latter is closed.

14. In a multiple cylinder, injection type oil engine, a supply manifold, means for constantly maintaining liquid fuel under substantially uniform pressure therein, a spray nozzle having an automatic check valve at each working cylinder, a poppet distributing valve for each cylinder held to its seat by the pressure of the fuel supply, a valve shaft about which said distributing valves are radially disposed, a tapered cam on said shaft for intermittently actuating the distributing valves, and means for adjusting said cam to control the engine speed.

15. In a multiple cylinder, injection type oil engine, the combination of a supply manifold, means for maintaining liquid fuel under pressure therein, a spray nozzle having check valve at each working cylinder, a poppet distributing valve for each cylinder, an actuating tappet therefor, and a by-pass controlled by the actuating tappet of each distributing valve for relieving the pressure in the discharge side thereof when the same is closed.

16. In a multiple cylinder, injection type oil engine, a supply manifold, a feed pump and a pressure relief valve for constantly

maintaining liquid fuel under uniform injection pressure in the supply manifold, a spray nozzle at each working cylinder having an automatic check valve, distributing valves interposed between the supply manifold and said spray nozzles and mechanism for successively operating said distributing valves to determine the injection periods and the amount of the injected charges, means actuated by said mechanism for relieving the pressure on the discharge side of each of said valves during the non-injection periods, said mechanism being adjustable to vary the injection and non-injection periods and thereby control the engine speed.

17. In a multiple cylinder, injection type oil engine, a supply manifold, means for constantly maintaining liquid fuel under injection pressure in the supply manifold, a spray nozzle at each working cylinder having an automatic check valve adapted to be opened by the injection pressure, poppet distributing valves, one for each cylinder, held to their seats by the pressure of the fuel supply in said manifold, and means for operating said distributing valves to time and determine the amount of injected charges comprising a valve shaft about which said valves are radially disposed, a common operating cam on said shaft and adjustable actuating members interposed between said cam and each of said valves.

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