Oct. 16, 1934. G. S. OSTERBERG 1,977,200

INTERNAL COMBUSTION ENGINE

Filed April 19, 1930

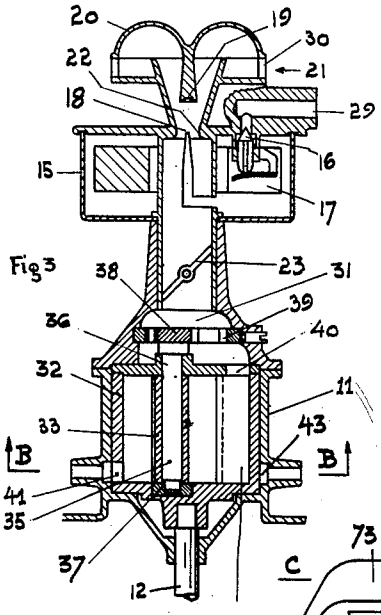


Fig 3

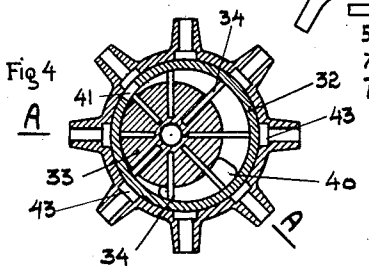


Fig 4

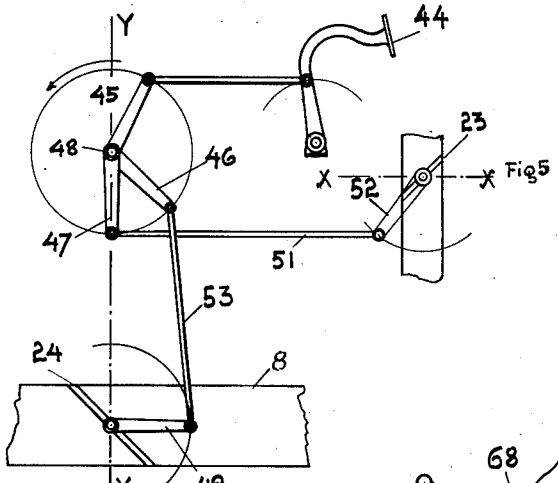


Fig 5

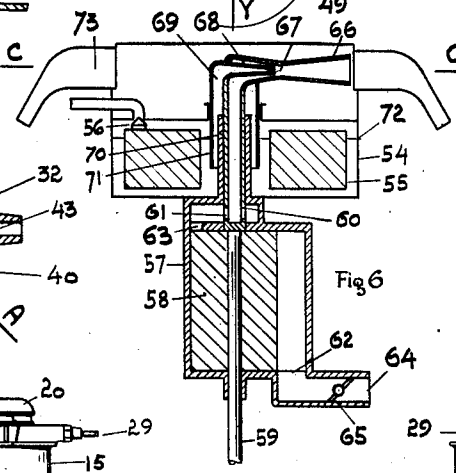


Fig 6

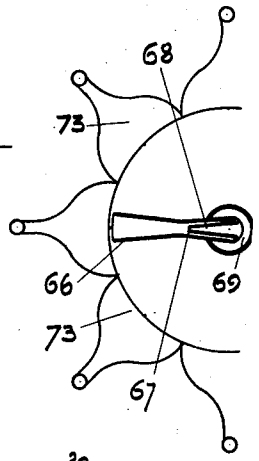
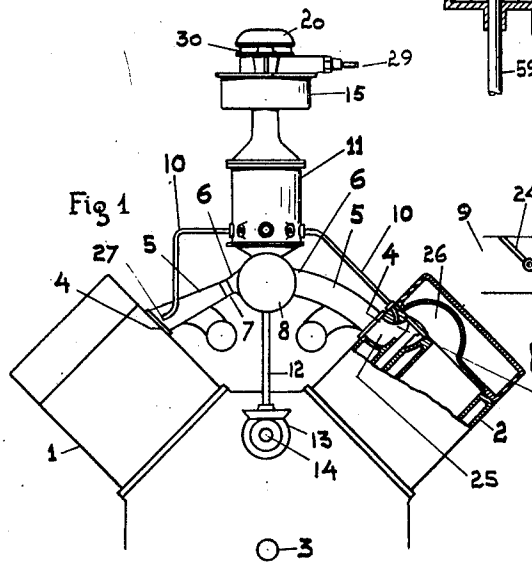
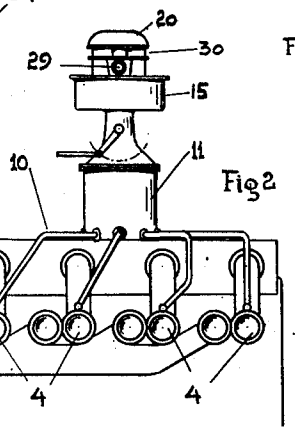


Fig 7





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INTERNAL COMBUSTION ENGINE

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8 Claims. (Cl. 123—119)

My present invention relates to internal combustion engines in general and is adapted for use in connection with gasoline or petrol engines, heavy fuel engines like Diesel engines or any other kind of engines using liquid fuel for power producing.

It may be used on engines for stationary purposes and for automotive purposes in automobiles and aero-planes.

The purpose of my present invention is:

(1) To increase the power output per unit of displaced volume of an engine without a special compressor of large dimensions.

(2) To insure smooth operation by equal distribution of fuel to the different cylinders of a multicylinder engine.

(3) To reduce the fuel consumption per horse power produced by the engine.

(4) To produce an easy ignitable and economic mixture of air and fuel without reducing the power output of the engine and to make starting in cold weather easy and dependable.

(5) To increase the volumetric efficiency of the engine.

(6) To use higher compression ratios without knock.

My invention resides in utilizing the inertia of the incoming air to produce a supercharging effect on the cylinder during the suction stroke of the piston.

My invention further resides in the substantially equal distribution of the fuel into the individual cylinders of a multi-cylinder engine and in the method of and apparatus for producing the combustible mixture consisting of air and fuel and in controlling or automatically varying the ratio of air and fuel of the mixture.

For an illustration of some of the forms my invention may take, and for an illustration of some of the forms of apparatus for carrying out my invention and method, reference is to be had to the accompanying drawing, in which:

Fig. 1 is a diagrammatic sketch of the arrangement embodying my invention.

Fig. 2 is a diagrammatic side elevation of Fig. 1.

Fig. 3 a vertical sectional view of the carbureter and fuel pump representing section AA of Fig. 4.

Fig. 4 a horizontal sectional view of the fuel pump along line BB in Fig. 3.

Fig. 5 is a possible diagrammatic arrangement of the levers operating the throttles controlling the fuel inlet and the air inlet.

Fig. 6 is another modification of my invention embodying the carburation and distribution according to my new method but with different means.

Fig. 7 is a horizontal section through Fig. 6 along line CC.

Figs. 1 and 2 indicate my invention in connection with a multicylinder internal combustion engine having for instance two blocks of cylinders forming a V. The cylinders within the blocks 1 and 2 work with their pistons on a common shaft 3. Each cylinder of the engine has preferably an individual inlet port 4 to which is connected a tubular intake conduit which I shall call in the following the raming tube.

These raming tubes may either be cylindrical as shown on the right side cylinder block 2 in Fig. 1 or they may be convergent divergent as shown on block 1. The inlets 6 of these raming tubes 5 communicate with the common header 8, which is open at least at one side 9. Through this open end air may enter into the header 8 and from there into the individual raming tubes 5 as the pistons corresponding to the individual raming tubes are on the suction stroke. This common header 8 is only used when the air inlet is supposed to be controlled by a throttle valve. The header may be omitted if no throttling of the air is required; in such case the inlets 6 are open to atmosphere.

The fuel is injected into the air intake passage through pipes 10 by a pump 11. This pump is driven by a shaft 12 by means of gear 13 from the shaft 14 (which may be the camshaft) which in turn is driven by any suitable or desirable means from the main shaft 3 of the engine. On top of pump 11 (Fig. 3) is a carbureting device comprising a float chamber 15, inlet valve 16 controlled by float 17 and a nozzle 18 projecting the liquid jet of fuel upwardly against a deflecting plate 19 carried by a mushroom-like cover 20. The air enters in the direction of the arrow 21 under the cover 20 into the Venturi tube whose throat is at 22 and flows around plate 19 towards valve 23, mixing on its way with the fuel, which is deflected downwardly by the plate 19.

After the mixture has passed valve 23 it enters the pump 11 which will be described later.

The air entering through opening 9 into the header 8 is controlled by a valve 24 (Fig. 2).

The action of a ram tube is best explained by the fact, that once an inlet valve of the engine is opened and the piston corresponding to such valve starts on its way on the suction stroke a certain portion of the air within header 8, all the air within the particular ram tube 5 and in the intake passage 25, also the gases in the explosion cham-

ber 26 have to be set into motion and accelerated to follow the motion of the piston. Of this inertia of the gases in the induction conduit advantage is taken to raise the pressure within the cylinder at the end of the suction stroke to a value close to atmospheric or above.

The motion of all these gases and vapors will be still there when the piston has come to a standstill in the outer dead end center and the kinetic energy of the gases will be converted into pressure, thus raising the pressure of the charge within the cylinder. Experiments have shown that this raming effect is so great as to cause the compression pressure (when the piston is in its inner dead center) to be 10 to 25% greater than the compression pressure without raming effect. Obviously the mean effective pressure will be correspondingly higher and thus the power output of the engine will be accordingly increased in a similar way as it is accomplished mechanically by means of an air pump or supercharger or compressor.

The degree of the supercharging effect by the raming tube, that is the increase in compression pressure depends upon the length, diameter and shape of the raming tube 5. Experiments show that with a well designed raming induction pipe a supercharging effect may be obtained at all loads and speeds and that the peak of the effect may be placed at any desirable load and speed by varying the length and the diameter of the ram tube.

In order to obtain an equal fuel distribution into all cylinders of the engine I employ injection nozzles 27 and inject the metered fuel either into each ram tube 5 or into the air passage closely adjacent to the inlet valve as indicated in the right hand cylinder block of Fig. 1. In order to be able to control the amount of fuel according to load and speed of the motor I mix the fuel with some air before it is delivered to nozzle 27. This air together with the fuel vapor will have an entraining effect on the intake air and will also increase the supercharging effect. To mix the fuel with a certain amount of air before it enters the nozzle 27 I employ a carbureter of any known type (15, 16, 17, 18, 19) Fig. 3 and deliver this primary mixture into a wet air pump or compressor through valve 23. The ratio of fuel delivered through nozzle 18 to the amount of primary air sucked into the throat 22 is approximately constant and the amount of fuel and air sucked into the wet pump depends, as with any known carbureter, upon the position of the throttle valve 23. Pump 11 delivers this primary mixture of air, liquid fuel and evaporated fuel through pipes 10 into each ram tube 5. The metering of the primary mixture is accomplished by the new design of the pump 11 as shown in Figs. 3 and 4 which forms an important part of my present invention.

The upper part of Fig. 3 indicates a suitable carbureter device consisting of well known elements as float 17 in housing 15. 16 being the fuel inlet valve controlled in any desirable way by the float 17. 18 is the fuel injection nozzle, 19 the deflector against which the fuel jet projects. 22 is the throat of the venturi as found in most carbureters used today and 20 is the cover. The air enters through the ports 30 in the direction of the arrows 21. The liquid fuel is delivered at 29, flows through valve 16 into the float housing 15 and from there into nozzle 18. The amount of air and fuel and the pressure within the throat 22 is controlled by the throttle valve 23.

After the mixture has passed the valve 23 it enters the inlet port 31 of the pump 11. This pump consists of two rotating elements. A hollow cylinder 32 and the piston 33. This piston 33 is rotating with the cylinder and is carrying a suitable number of vanes 34 Figs. 3 and 4. The pump cylinder 32 is rotatably fitted into pump housing 11 and is driven by shaft 12. Within the bore of the cylinder 32 is eccentrically located the rotor or piston 33. It is keyed to the shaft 35 which is journaled in bearings 36 and 37 carried by the cylinder.

The upper end of shaft 35 is carrying a pinion 38 whose teeth operatively engage with the teeth of an internal gear 39. By rotating the cylinder 32 around shaft 12 the rotor or piston 33 with gear 38 perform the same motion around axis 12. This rotation causes gear 38 to perform a second motion around its own shaft and axis 35, forcing the rotor 34 to assume a relative eccentric motion within the cylinder 33. This relative rotating motion in turn causes together with the vanes 34 the pumping action of the pump by coacting relation of the suction port 40 and the discharge port 41 of Figs. 3 and 4 in a well known manner.

The mixture flows into the suction port 40 through and between the gears 38 and 39 and its pressure is increased by the action of the vanes of the rotor, leaving the cylinder by the port 41. Due to the rotation of the calender this port is brought into successive registration with ports 43 in pump housing 11. These ports communicate by conduits 10 with nozzles 27 through which the primary mixture is delivered into the raming tubes and into the cylinders. By spacing the ports 43 equally on the periphery of the housing 11 an equal amount of mixture or fuel will be distributed into each conduit 10 and consequently to the engine cylinders.

To further ensure equality of the fuel charges delivered into the engine cylinders it is of advantage to make the number of vanes of the rotor 33 equal to the number of engine cylinders.

The common header 8 forms a continuation of the ram tubes 5 due to the fact that the air column within is accelerated and retarded with the air in tubes 5, but since the accelerated volume within the header 8 is different for different cylinders I prefer not to utilize the raming effect of the header to any appreciable extent in order not to obtain different raming pressures in the different cylinders of the engine. I therefore keep the velocity within the header 8 low by giving it a greater diameter than the diameter of the ram tube proper.

At the open end 9 of the header I place a throttle valve 24 (Fig. 2) to control the amount of air entering the cylinders of the engine, in case quantitative regulation is desirable. Then valve 23 controls the fuel inlet and valve 24 the air inlet.

By opening and closing these valves at certain rates in relation to load and speed of the engine a purely qualitative or a combination of qualitative and quantitative regulation may be obtained. No valve 24 is required however for a purely qualitative regulation of the explosive mixture.

By operating these two valves so that the rate of opening of both of them would be alike would give a constant mixture ratio at the cylinder of the engine or a purely quantitative regulation. This is the general fault of the carbureters marketed at present. It is preferable to change the mixture ratio with different loads. A rich mixture at low load (idling) and an increasingly

leaner mixture with increasing load, is most preferable if smooth running and economy of the engine are expected; I therefore connect the operating levers of the 2 valves 24 and 23 with the foot pedal (Fig. 5) or accelerator in such a way that the opening ratio of the valve opening rate varies during the stroke of the accelerator pedal.

In Fig. 5 44 is the accelerator pedal, 23 is the fuel inlet valve and 24 the air inlet valve. Lever 45 is connected to the accelerator 44 and swings around axis 48 driving levers 46 and 47. Lever 46 is connected by rod 53 to lever 49 which operates valve 24, lever 47 is connected by rod 51 to lever 52 operating valve 23.

The dead center line of the air valve leverage is YY—that of the fuel valve leverage is XX. Driving lever 47 is in vertical position to XX at the beginning of the opening of valve 23. The angular travels of lever 52 will be decreasing per unit of angular travel of lever 47. While the driving lever 46 is under an angle less than 90 degrees towards the dead center line YY at the beginning of the opening period of valve 24. The angular travel of the driven lever 49 and valve 24 will be increasing per unit of angular travel of lever 46 as the valve opens. Thus if the position of levers and valves in Fig. 5 corresponds to idling the fuel valve will open at the beginning faster than the air valve and with increased load the air valve opens faster than the fuel valve. If valve 24 is omitted, then the header 8 may be omitted too, and the raming tubes are open at the end to the atmosphere.

A modified structure of my invention is shown in Fig. 6. There 54 is the gasoline tank with float 55 and valve 56. 57 is the compressor housing with eccentric rotor 58, driven and rotated by shaft 59. The shaft of the rotor extends upwardly to form a tubular extension 60 with holes 61. 62 is the suction opening, 63 the discharge opening of the compressor. The air is sucked in through pipe 64 in which is placed a butterfly valve 65. The hollow shaft 60 carries a rotating diffuser 66 which is of convergent divergent shape. At the throat of this diffuser is placed the orifice 67 of nozzle 68. Through this the gasoline is sprayed into the air flow. Nozzle 68 communicates with the space 69 formed by the two cylindrical tubes 70 and 71. 71 being rotatable with shaft 60 and diffuser 66 while 70 is a stationary part of the gasoline tank.

The level of the fuel in the tank is kept approximately constant at 72 and the fuel is sucked and rises into the space 69 and into nozzle 67 and is thrown with the air flow through the diffuser into the receiving chambers or channels 73, which chambers are equally spaced around the periphery surrounding the diffuser. See Fig. 7.

The receiving channels 73 are connected to the intake of the engine in a similar manner as shown in Fig. 1.

The operation is as follows:

The air delivered by the compressor into the diffuser 66 attains a high velocity at the throat of the diffuser and acts sucking on the fuel orifice 67. The fuel is raised and flows through the orifice towards the receiving channels 73 from where it flows into the engine cylinders. The flow towards and through the orifice 67 is supported by the centrifugal force due to the radial arrangement of nozzle 68. The shaft 59 is synchronized with the engine and driven at half the speed of the engine. At high speed when a greater quantity of fuel is required per unit time a greater suction will be applied at 67 due to the greater air quantity delivered by the compressor, and at low speed a smaller quantity of air will be delivered by the compressor and less fuel will be sucked into and thrown out of nozzle 67. The quantity of air entering the compressor can be regulated at any speed by the throttle 65.

The air entering into the compressor through pipe 64 is only a small portion of the air quantity required by the motor for combustion, the larger remaining part being sucked by the engine through the ram or intake tubes (intake manifold).

The receiving chambers 73 are connected in firing order to the cylinders or the intake ports of the engine.

The arrangement of the fuel orifice within the diffuser makes the fuel delivery independent of the sucking action of the engine and the fuel can be delivered to the engine at the correct rate even if the vacuum in the intake manifold should be inadequate. In its performance the apparatus shown in Figs. 1 and 6 are similar.

The greatest advantage in both these fuel distributing arangements is that the air can be drawn into the engine with a very small pressure drop below atmospheric, that it can be cold, that the volumetric efficiency is high and the distribution of the fuel perfect.

What I claim is:

1. A multicylinder internal combustion engine having an intake ram tube for each cylinder and a common intake header for a group of ram tubes, means to allow air for combustion to enter the ram tubes by sucking action of the engine through the header, a compressor for compressing air outside of the engine and means to use the air passing through the compressor for lifting and for metering of the fuel and for delivering the fuel to the cylinders of the engine.

2. A multi-cylinder internal combustion engine having a carbureter, a rotating compressor driven by the engine causing a part of the air, required by the engine for combustion, to be carbureted, means within the rotating part of the compressor to meter and to distribute the carbureted air to the cylinders of the engine and means to mix such metered quantities with additional air before its final compression within the engine cylinders.

3. The method of distributing fuel into the cylinders of a multi-cylinder internal combustion engine which consists in precompressing a part of the air required by the engine for combustion outside of the engine after the fuel has been added to it, dividing the mixture while being compressed into charges and causing said charges to be distributed to the engine cylinders in the firing order and to be mixed with additional air required by each cylinder for combustion.

4. Fuel distributing and metering system for multi-cylinder internal combustion engines comprising a compressor compressing primary air and fuel, means to deliver secondary air required for combustion to the cylinders and means integral with the compressor for dividing the primary air and fuel into equal parts and distributing and delivering such parts to the cylinders of the engine in the firing order.

5. A multi-cylinder internal combustion engine with an air intake manifold having an inlet, means to pass uncarbureted air through said manifold towards the engine cylinders, means to inject metered quantities of a mixture of air and

fuel into the uncarbureted air somewhere between the said inlet and a piston of the engine before the air has been compressed to its final compression pressure within the engine cylinder, and means separate from the engine piston to compress the carbureted air before injecting it into the uncarbureted air, the said compressing means causing the fuel to be divided in metered charges and the charges to be distributed in firing order to the engine cylinders.

6. In a multi-cylinder internal combustion engine the combination of an air intake manifold for drawing air into the cylinders by sucking action of the engine, a compressor outside of the engine operating in synchronism with the engine for compressing primary air and means to draw fuel by this primary air and to distribute it into the cylinders in substantially equal charges by means working independently from the engine suction.

7. In a multi-cylinder internal combustion engine having a free or atmospheric air inlet controlled by a valve, a fuel metering and fuel distributing compressor with an air and fuel inlet, means to deliver mixture of air and fuel from the compressor in metered quantities to the cylinders, and means to allow sufficient air to enter the compressor to make the engine idle while the said air inlet controlling valve is closed, the air entering means and the inlet valve being simultaneously and coordinately operable.

8. Fuel controlling means for a multi-cylinder internal combustion engine comprising a carbureter and an intake manifold, each having an independent air inlet, each air inlet controlled by a separate valve, a compressor drawing air through the carbureter and through one of said valves for metering and distributing the fuel to the cylinders, and lever interconnecting means to operate the valves manually in unison, so as to cause the delivery of a rich mixture of fuel and air to the engine at light load and a lean mixture at higher load of the engine.

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