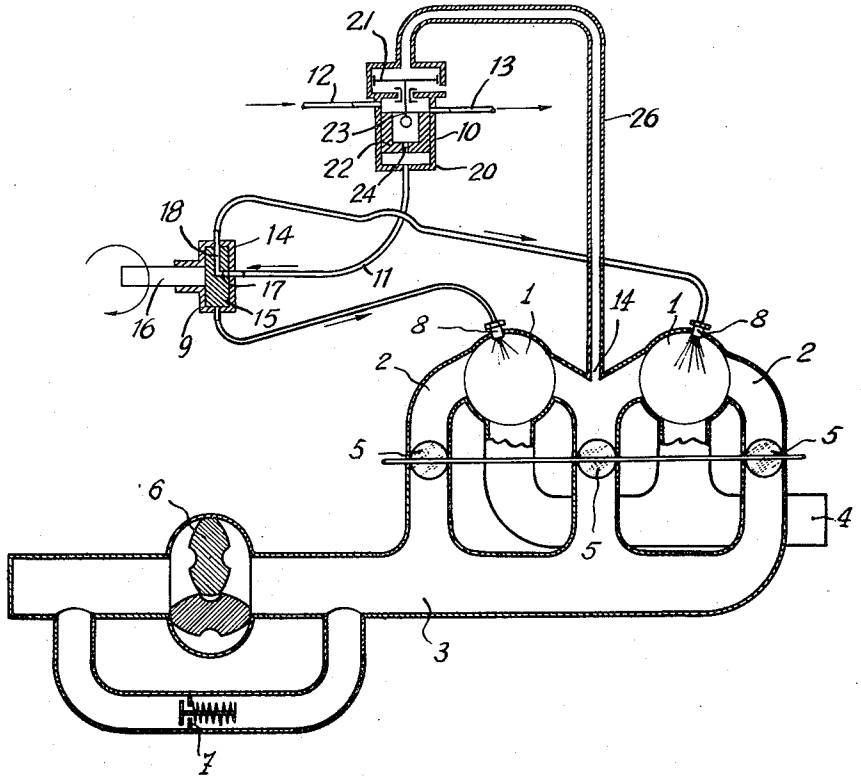
May 3, 1960 A. BRUEDER 2,935,053

TWO STROKE ENGINES

Filed Nov. 27, 1956 2 Sheets-Sheet 1

Fig. 1



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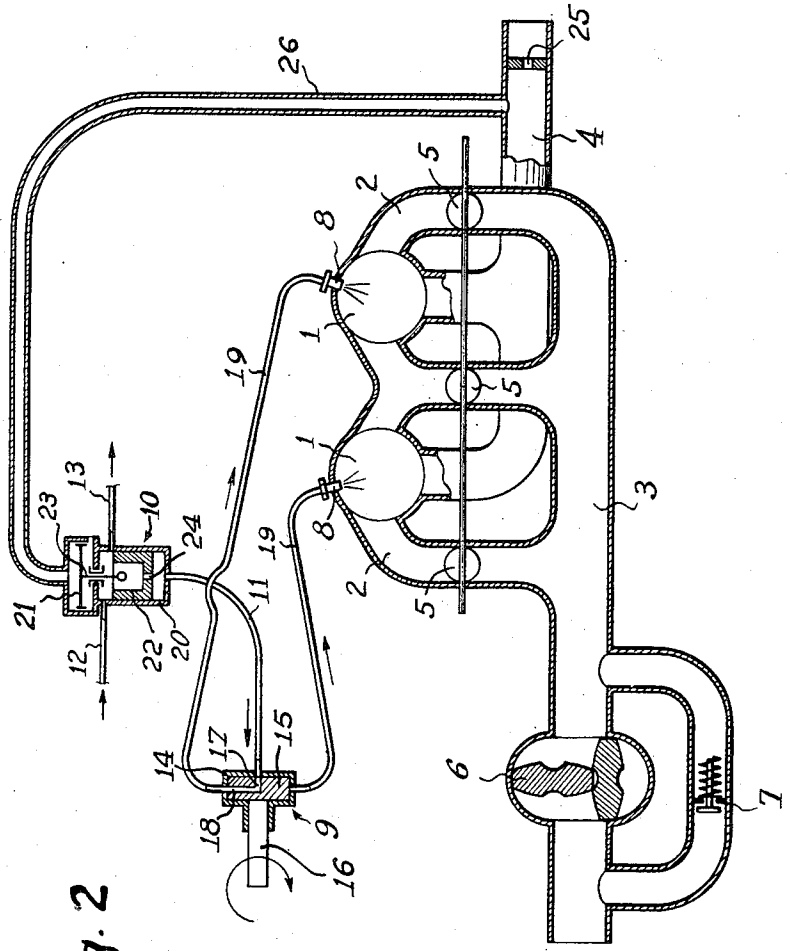


Fig. 2

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United States Patent Office 2,935,053 Patented May 3, 1960

2,935,053

TWO STROKE ENGINES

Antoine Brueder, Paris, France, assignor to Societe Anonyme Andre Citroen, Paris, France, a French company

Application November 27, 1956, Serial No. 624,663

Claims priority, application France February 7, 1956

1 Claim. (Cl. 123—32)

In a four-stroke engine all of the air entering the engine is usable for combustion. As a result the rate of fuel delivery will automatically have the correct value provided the rate of fuel delivery is made proportional to the rate of air delivery. In particular the fuel may be metered in response to the rate of air delivery as measured by the degree of suction generated at the neck of a venturi nozzle; this is the procedure used in carburettors and in some types of mechanical metering devices.

In a two-stroke engine on the other hand part of the air flows through the engine during the scavenging period and is lost insofar as combustion is concerned. This fraction will be large in proportion as the power output of the engine is large; for it is well-known that the power output of a two-stroke engine may be varied by correspondingly varying the scavenging air ratio, i.e. the ratio of the rate of volume flow of air delivered, to the volume generated per unit time by the pistons of the engine. Where the fuel supply means are operated independently from the air supply means, as by injection, then the fuel supply rate must be made proportional to the rate of supply of the air actually used for combustion rather than to the rate of supply of scavenging air.

In some types of two stroke fuel injection engines, the fuel rate is regulated in response to the suction obtaining at the neck of a venturi interposed in the air supply circuit, the suction acting on the diaphragm or piston of a flow regulating device. Such apparatus are open to the above indicated drawback. For, assuming that the supply rate has the proper value for operation at the maximum scavenging air ratio, the ratio of the air supply rate usable for combustion to the scavenging air supply rate will increase as the scavenging air ratio decreases; the flow regulator will then not deliver sufficient amounts of fuel.

It is an object of the present invention so to improve two-stroke injection engines that a correct fuel delivery rate will be maintained regardless of the scavenging air ratio, and hence of the power output of the engine.

According to this invention the engine comprises means for regulating the rate of fuel delivery as a function of the pressure drop across an orifice through which the combustion gases are made to flow.

The orifice may be inserted in the exhaust pipe. Alternatively the exhaust port may be used as the orifice of the invention, the fuel delivery being controlled as a function of the scavenging air pressure; this is because the scavenging air pressure depends primarily on the pressure drop across the exhaust port.

According to the invention therefore the engine is utilized as a means of flow measurement rather than using a venturi as in the type of engine above indicated. Since the two-stroke engine behaves as an orifice of predetermined flow section, it might appear at first glance that the result is identical in both cases. Actually, as the scavenging air ratio increases, the mean temperature of the gases flowing through the engine decreases since the relative amount of air which passes into the exhaust during

the scavenging period increases; as a result the scavenging air pressure rises, but it does so less rapidly than it would if the temperature were to remain constant. Consequently, if the rate of fuel delivery is made to be a function of the scavenging air pressure, such fuel-feed rate will increase with the scavenging air ratio, but it will increase less swiftly than does the total air delivery rate; in fact it remains substantially proportional to the combustion air delivery rate so that it automatically assumes the correct value.

Since it is the temperature of the gas flow through the engine which acts to alter the scavenging air ratio, it will alternatively be possible in order to measure the delivery rate, to utilize the pressure drop through a venturi or a diaphragm inserted in the exhaust pipe as already indicated above. It is simpler however to use the scavenging air pressure.

In the drawings:

Fig. 1 is a diagrammatic view of one embodiment of the invention.

Fig. 2 is a diagrammatic view of another embodiment.

As shown in the drawing the engine includes two cylinders 1 each formed with two intake ports connected with intake conduits 2 connected with a common manifold 3, and an exhaust port connected with the exhaust pipe 4.

Fitted in each of the conduits 2 is a butterfly valve 5, which valves provide for regulation of the scavenging air ratio.

The intake manifold 3 is connected with a compressor 6 which supplies the scavenging air and is bypassed by a check valve 7 serving to prevent the compressor discharge pressure from rising excessively when the valves 5 are moved to closed condition.

The injection nozzles 8 are supplied through a distributor valve 9 the operation of which is synchronized with that of the engine and a metering regulator 10 connected with the distributor by a pipe 11. The fuel passes from the supply pump to the regulator over a conduit 12 and the excess thereof is returned to the pump by way of conduit 13. The regulator 10 is controlled through a pipe 26 in response to the scavenging air pressure which is related and responsive to the pressure drop in the combustion gases from the engine and is picked off at 14 beyond the valves 5 and ahead of the cylinder 1.

The distributor valve 9 may comprise a housing in which revolves a rotary valve disc 15 which has an axial passage communicating through the housing with the fuel pipe 11. The axial passage 17 which passes only half way through the valve disc 15 communicates with a radial passage 18 which communicates with one or the other of the fuel pipes for delivering the fuel to the cylinders 1. The valve disc 15 is mounted fixedly upon a shaft 16 which rotates with the motor.

The fuel regulator 10 may comprise a housing having pistons 21 and 22 in opposite ends sliding in cylindrical chambers. The pistons 21 and 22 are joined together by a piston rod 23. In the face of the piston 22 is an atomizing orifice 24. Fuel entering through pipe 12 into the upper part of the chamber in which the piston 22 works and above the piston passes through the atomizer 24 and into the pipe 11 leading from the opposite or lower end of said chamber to the distributor.

The piston 22 is responsive to a reduction in the amount of fuel delivered. In the wall of the chamber about 180° around that wall from the inlet 12 is an orifice communicating with the fuel return pipe 13. As the piston 22 is displayed, it varies the section of this orifice which is uncovered, in consequence of which the quantity of fuel returning to the pump by the pipe 13 is varied. The pressure exerted on the piston 22 is maintained in equilibrium with the pressure change or drop in the piston 21. Hence, any change in pressure applied to the

piston 21 will change the position of the piston 22 in accordance with movement of the piston 21 and will cover or uncover more or less of the orifice leading to the fuel return pipe 13. As a result, the amount of fuel fed through the atomizer 24 will vary.

In the form illustrated in Figure 2, which is claimed in my copending divisional application Serial No. 850,653, filed November 3, 1959, and entitled "Two Stroke Engines," a calibrated orifice 25 is placed in the exhaust pipe. The change in pressure created by the size of this orifice is reflected upon the piston 21 by a pipe connecting the exhaust pipe 4 with the chamber in which the piston 21 works.

It will be understood that the invention is not limited to the embodiment described and illustrated but may cover modifications.

What I claim is:

In a two-cycle internal combustion engine, a cylinder with intake and exhaust ports therein, air supply means connected with said intake port and an exhaust conduit connected with said exhaust port, fuel injection means for delivering fuel into said cylinder and means for igniting said fuel, valve means in said air supply means for regulating the air supply, pressure responsive means connected to a point in the air supply means between said intake port and said valve means and responsive to variations in the pressure thereat, and regulating means connected with said pressure responsive means and with said injection means for varying the fuel delivery rate of said injection means in proportion to said pressure and independent of the engine speed.

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