

UNITED STATES PATENT OFFICE.

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FUEL-FEED APPARATUS FOR INTERNAL-COMBUSTION ENGINES.

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My invention is an improved fuel feed apparatus for internal combustion engines, the primary object being to provide a novel and efficient means whereby fuel gas may be mixed with the usual charge introduced into an internal combustion engine cylinder or introduced alone after the engine has become sufficiently heated.

A further object is to provide an apparatus of this character which may be readily adapted to an ordinary internal combustion engine with only minor changes in its structure.

It is likewise an object to provide an automatic fuel flow control or regulator comprising a minimum number of parts which may be quickly assembled and adjusted by comparatively inexperienced persons and are readily separable for repair.

In the accompanying drawings forming a part of this application:—

Figure 1 is a vertical sectional view showing the invention in detail;

Figure 2 is an elevation of the outer regulator sleeve;

Figure 3 is a side elevation of the regulator valve or inner sleeve.

Figure 4 is a side elevation of the body portion of the regulator; and

Figure 5 is an end elevation of the body shown in Fig. 4.

In illustrating this invention, I have shown it in connection with a cylinder 1 of an internal combustion engine having the usual valved inlet port 2 in its upper end, said inlet port being alined with an intake manifold 3 whose lower end is flanged and connected in any preferred manner to a carbureter C. While any preferred form of carbureter may be employed, for the purpose of this application, I have illustrated one comprising an annular chamber which contains gasoline or like high-grade fuel adapted to be fed into the manifold 3 through an ejector nozzle 4, the rate of flow through said nozzle being controlled by a needle valve 5 or the like. A butterfly choker valve 6 is arranged outwardly of the carbureter to control the inlet of air as in the usual construction. Between the carbureter and the cylinder in the manifold is a throttle valve 7 which is designed and so arranged as to control the inlet of fuel from the carbureter C as is well known in devices of this character.

In order that a fuel gas may be fed into the manifold 3, I provide as shown in Fig. 1, an opening 8 in which one end of a supply pipe 9 is fixed the other end of this pipe being connected to an automatic fuel feed regulator. This regulator is also connected to a supply pipe 10 which conveys fuel gas from the reservoir or tank 11 as shown in Fig. 1.

This regulator comprises a body 12 having a central longitudinal bore 13 opening through one end and having connection to the supply pipes 9 and 10 through adjacent walls. Communication between the bore 13 and the supply pipes 9 and 10 is effected through forming longitudinal and radial openings 14 and 15 through externally threaded bosses 16 and 17 which are connected to the aforementioned pipes by means of packing nuts or glands 18. The inner end of the radial inlet opening 15 communicates with an annular way or chamber 19 which is formed in the wall of the bore 13 adjacent the open end of the body 12, this annular way or chamber serving to uniformly distribute the incoming fuel for a purpose which will be hereinafter apparent. A relatively long sleeve or cylinder 20 has one open end externally threaded for engagement with threads formed in the inner end of the bore 13 of the head portion 12 and substantially midway its length is provided with a radial annular flange or nut portion 21 which may be readily engaged by a wrench or like tool when assembling the structure. This flange or nut portion 21 is adapted to snugly engage the open end portion of the body 13 as shown. This sleeve or cylinder 20 is provided with a series of radial openings 22 which provide communication between the annular chamber 19 and the interior of said sleeve or cylinder, thereby permitting flow of fuel gas from the reservoir 11 through the pipe 10 and the inlet and outlet openings 13 and 14 respectively, through the intake manifold 3. Through forming the annular chamber 19 about the inner portion of the cylinder or sleeve 20, the fuel gas entering from the pipe 10 will be uniformly distributed for entrance into the sleeve or cylinder through the radial openings 22. The outer end of the sleeve or cylinder 20 is closed by means of a head plate 23 provided with a central opening 24, said head being spaced inwardly from the extreme end of the cylinder so as to form a

recess 25 whose purpose will be hereinafter apparent.

For the purpose of controlling the flow of fuel through the cylinder 20 and into the intake manifold 3, I provide a sleeve valve 26 having a closed end normally abutting the head 23 and carrying at said closed end a rod or stem 27 whose outer end is externally threaded for reception in an adjusting nut 28 by means of which the tension of an expansion coil spring 29 may be varied. The inner end of this expansion spring 29 is seated in the recess 25 previously mentioned, while its outer end bears against a washer 30 which is disposed in contact with the inner face of the adjusting nut 28 as shown in Fig. 1. The other end of this sleeve valve 26 is open to permit passage of incoming fuel gas which enters through a set of radial openings 31 spaced inwardly from said open end as shown. These radial openings 31 communicate with an annular groove or channel 32 which is formed in the outer face of this sleeve valve 26, this arrangement being provided so as to assure entry of fuel gas regardless of whether the radial openings 22 and 31 are alined or otherwise positioned.

The operation of the apparatus may be stated as follows. Assuming the parts to be positioned as shown in Fig. 1, the crank shaft is turned with the result that the piston within the cylinder 1 creates a vacuum in the manifold 3 and in the supply pipe 9, the result being that fuel is drawn through the injector 4 from the carbureter C and the sleeve valve 26 in the regulator is snapped across to the extreme opposite position to that shown in Fig. 1. It is understood that the adjusting nut 28 has been so moved as to permit a compression of the spring 29 to a degree allowing movement of the sleeve valve to the other end of the cylinder 20. With the parts in this position, the engine is operated upon fuel drawn from the carbureter C, the richness of the mixture being varied through actuating the butterfly choker valve 6. After the engine has been running for a period of time and has become sufficiently heated, the butterfly valve 6 may be opened, with the result that the vacuum created in the pipe 9 and manifold is slightly decreased. Through reduction of the vacuum in the pipe 9, the coil expansion spring 29 is allowed to act and move the sleeve

valve 26 outwardly until the radial openings 22 and the channel 32 or the way 31 are alined. In this position, fuel gas will be drawn from the reservoir 11 and mixed with the fuel being fed from the carbureter C. Further, heating of the engine will permit its being operated upon a low-grade fuel gas which is contained in the reservoir 11, in consequence of which I entirely close the needle valve 5 in the carbureter and cut off the supply of gasoline or other high grade fuel, as will be clearly understood from Fig. 1. Valves 6 and 7 are opened to permit air to be drawn in and mixed with the fuel from tank 11. Through varying the tension of the expansion spring 29 by adjusting the nut 28, the extent to which the inlets are opened may be readily controlled and thereby vary the amount of fuel gas entering the manifold as may be desired by the operator.

Excellent results have been obtained from the details disclosed, and they are preferably followed, but it is understood that minor changes which fall within the scope of the appended claim are considered within the spirit of my invention.

I claim:

In combination with an internal combustion engine, an intake manifold therefor, a carbureter connected with said manifold, and a choke for the carbureter air inlet; a fuel gas reservoir, a valve body formed with inlet and outlet ports, a passage connecting the inlet port with said reservoir, a second passage from the outlet port to the manifold, a normally closed valve controlling communication between said inlet and outlet ports, and variable spring means for yieldably holding said valve in its normally closed position, said spring means permitting shifting of the valve beyond its open position to a second closed position under the influence of the vacuum created when starting the engine with the choke closed, said valve being movable to its open position under the action of said spring means upon opening of the choke and consequent reduction of the vacuum, thereby effecting feeding of fuel gas to the engine from the reservoir and permitting the cutting off of fuel to the carbureter.

In testimony whereof I have hereunto affixed my signature.

ROLLIE CRAIN.