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T. H. PICKRON ETAL
DEVICE FOR SUPPLYING A FUEL AND AIR MIXTURE
TO INTERNAL COMBUSTION ENGINES

3,220,709

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2 Sheets-Sheet 1

Fig. 1

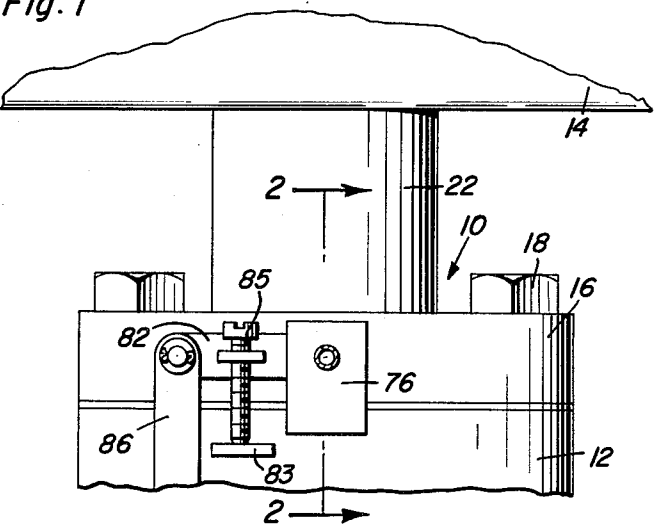


Fig. 5

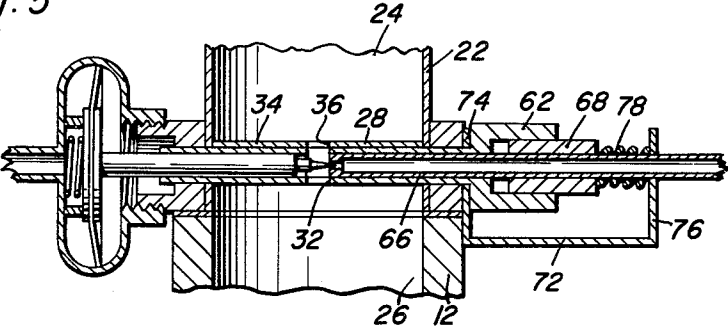
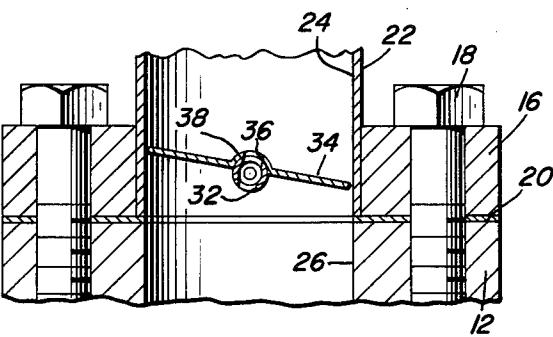


Fig. 4



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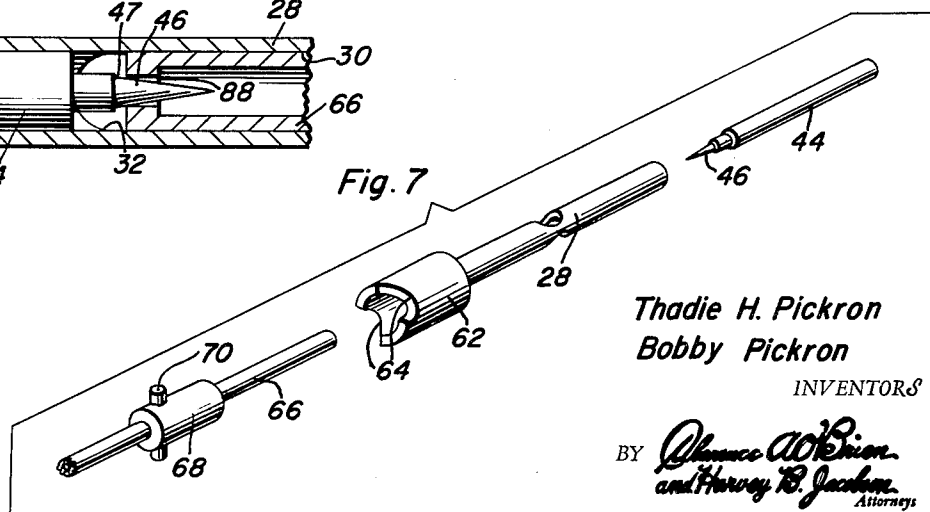
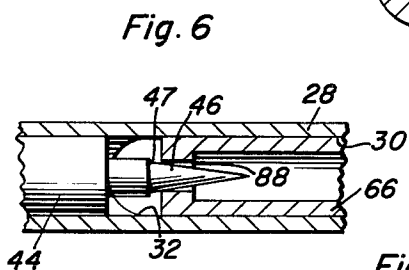
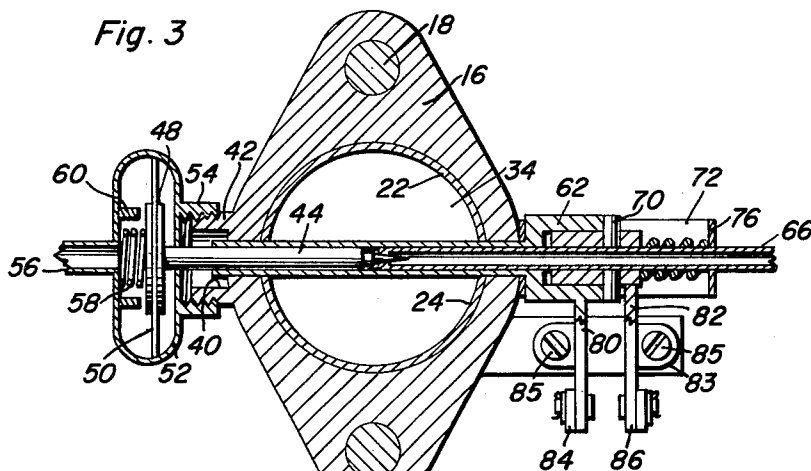
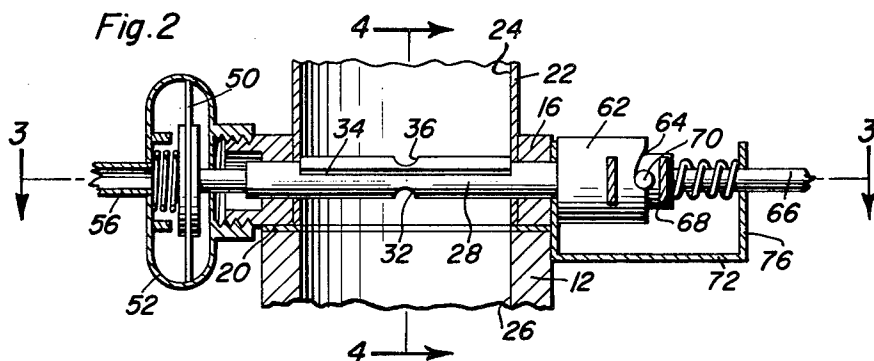
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DEVICE FOR SUPPLYING A FUEL AND AIR MIXTURE TO INTERNAL COMBUSTION ENGINES

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1 Claim. (Cl. 261-44)

The present invention generally relates to novel and improved structural arrangements in a device for supplying a liquid fuel and air mixture to an internal combustion engine and more particularly to a device for injecting a metered quantity of liquid fuel in the airstream. More particularly, the present invention relates specifically to a fuel injection device having a structural arrangement for mechanically controlling the quantity of liquid fuel discharged directly at the point of intermingling of the liquid fuel and air.

In present day internal combustion engines such as are employed in various types of vehicles such as automobiles, trucks, buses, airplanes, boats and the like, devices known as carburetors are employed for supplying a fuel and air mixture to the intake manifold. Such devices normally employ a venturi and various metering jets for controlling the quantity of fuel entrained in the airstream. Such devices are quite complex, require frequent adjustment and while successful to a certain extent have certain shortcomings most of which stem from the principle of operation of the venturi.

The primary object of the present invention is to provide a fuel injecting device in the form of a tubular body attached to the intake manifold of an engine in the same nature as a carburetor is attached but which includes only a single butterfly valve pivotally supported therein for controlling airflow into the engine. The butterfly valve is carried by a hollow shaft having openings communicated with both surfaces of the butterfly valve for discharging liquid fuel into the airstream with the airstream having a portion thereof actually passing through the apertures in the shaft and in the butterfly valve. The hollow shaft is connected by a suitable tubing, hose or the like to a fuel pump so that a supply of fuel under pressure will be available and a metering valve assembly is incorporated into the hollow shaft with the metering operation being mechanically controlled directly in alignment with the apertures or at the point of discharge of the liquid fuel thereby assuring accurate control of the fuel while at the same time providing a highly simplified structure which will produce engine performance equal to if not better than a conventional carburetor.

Another object of the present invention is to provide a fuel injecting device in accordance with the preceding object in which the metering of the fuel is accomplished by a mechanical means operable in response to an actuating mechanism for mechanically controlling the metering of the liquid fuel.

Briefly, the present invention incorporates a structure in which gasoline is supplied under pressure to a suitable pipe, tube or hose to a point in the intake air stream where the flow of the gasoline is mechanically controlled with a leverage mechanism. The point of mechanical control is that point at which an air opening is located which allows the vacuum produced by the engine to pull through most or part of the air for idling of the engine and some of the air for engine speeds above the idle speed. This air passing through the openings will more effectively atomize the gasoline at all engine speeds. The concept of mechanically controlling the gasoline or liquid fuel flow at the point of discharge eliminates the need of various components of the conventional gasoline carburetors presently employed on automobiles, various vehicles and other internal combustion engines.

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These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is a side elevational view of the fuel injecting device of the present invention illustrating the manner in which it is associated with the internal combustion engine;

FIGURE 2 is a vertical sectional view taken substantially upon a plane passing along section line 2-2 of FIGURE 1 illustrating the structural details of the invention;

FIGURE 3 is a longitudinal, plan sectional view taken substantially upon a plane passing along section line 3-3 of FIGURE 2 illustrating further structural details of the fuel injecting device and illustrating the relationship of the components thereof;

FIGURE 4 is a transverse, vertical sectional view taken substantially upon a plane passing along section line 4-4 of FIGURE 2 illustrating the construction of the butterfly valve and its relationship to the hollow shaft;

FIGURE 5 is a sectional view similar to FIGURE 2 but illustrating the meter valve in a retracted position and also the tubular member having the orifice in the inner end thereof retracted;

FIGURE 6 is an enlarged fragmental sectional view illustrating the construction of the needle valve and the valve seat receiving the needle valve;

FIGURE 7 is an exploded group perspective view illustrating the three components of the control mechanism.

Referring now specifically to the drawings, the numeral 10 generally designates the fuel injecting device of the present invention which is illustrated as being mounted on the adapter flange 12 of an intake manifold of a conventional internal combustion engine. The upper end of the fuel injecting device 10 is provided with a suitable detachable air cleaner or air filter 14 of conventional construction which is attached to the fuel injecting device 10 in any suitable manner and this arrangement does not form any particular part of the invention.

As illustrated in FIGURE 1, the fuel injecting device 10 includes a mounting flange 16 corresponding in shape and size to the adapter flange 12 with the mounting flange 16 being retained in position by suitable retaining bolts or cap screws 18. As illustrated in FIGURE 4, a gasket 20 of conventional construction is disposed between the adapter flange 12 and the mounting flange 16 to seal the connection therebetween. If desired, the gasket 20 may be of insulating material or an insulator may be disposed between the adapter flange 12 and the flange 16 to prevent transfer of heat to the fuel injecting device from the engine.

The fuel injecting device 10 includes a cylindrical pipe or body 22 having a flow path 24 in the form of a passageway of constant cross-sectional area. The flow passage 24 provides for inlet of air into the intake manifold and the fuel injecting device of the present invention is for the purpose of intermingling liquid fuel with the air in a novel and efficient manner so that a combustible mixture is supplied into the inlet passageway 26 in the intake manifold for distribution to the various cylinders of the internal combustion engine. One of the important factors of this invention is the fact that the airflow passageway 24 is of constant cross-sectional dimension and is of substantially the same cross-sectional dimension as the inlet passageway 26 in the intake manifold.

At the lower end of the tubular body 22, there is disposed a tubular shaft 28 which extends transversely across the center of the tubular body 22 and which is journaled in and extends through the attaching flange. The tubular

shaft 28 has an internal bore 30 of constant cross-sectional dimension and a transverse passage is formed centrally of the tubular shaft 28 thus defining openings at diametrically opposed points on the tubular shaft 28. The openings are designated by numeral 32 and are curved downwardly on the side portions thereof. The passage in shaft 28 may vary as to its position in the air flow path. Further, the shaft 28 may be two pieces spaced apart at the inner ends and rigidly fixed to a butterfly valve plate 34 which is mounted on the shaft 28 for rotation therewith and is generally circular in shape. The butterfly valve or plate 34 will substantially close the air flow path 24. The butterfly valve 34 is provided with an opening 36 therein in alignment with the openings 32 and the center of the butterfly valve 34 is provided with a partial cylindrical portion 38 which fits around a portion of the shaft 28 on the upstream side of the shaft 28 and the butterfly valve 34 is secured to the shaft 28 in any suitable manner either permanently or detachably such as by small screws or the like. The butterfly valve 34 does not form a complete closure for the air flow path 24 in view of the opening therethrough and never reaches a horizontal position since the size thereof is such that it will always be orientated in an angular orientation as illustrated in FIGURE 4 when the fuel supply mechanism is in a position with the fuel control mechanism in its closed position.

One end of the tubular shaft 28 terminates in a recess 40 defined by an externally threaded projection 42 at one side of the flange 16. Rotatably and slidably received in this end portion of the tubular shaft 28 is a needle valve body 44 having a tapered and pointed needle valve member 46 at the inner end thereof and having the outer end thereof provided with plates 48 mounting the needle valve body 44 to a flexible diaphragm 50 secured medially within a casing 52. The casing 52 has an internally threaded hollow projection 54 in threaded adjustable engagement with the projection 42 thus enabling initial longitudinal adjustment of the needle valve 46. The portion of the casing 52 exteriorly of the diaphragm 50 is communicated with a source of vacuum through a suitable tube, pipe or hose 56 which is communicated with the intake manifold or the like so that immediately upon rotation of the engine crankshaft, the vacuum induced in the intake manifold will operate the diaphragm 50 so that it will move to the position illustrated in FIGURE 5 thus retracting the needle valve 46 slightly to provide sufficient liquid fuel discharge so that the engine will idle. A spring 58 is provided for the diaphragm and stop elements 60 are also provided for limiting the movement thereof. The stop elements may be adjustable and may be in the form of adjustment screws and also the spring 58 may be adjustable by virtue of any suitable screw threaded mechanism to enable variation in the characteristic of the diaphragm 50 depending upon the particular characteristics of the engine involved. The portion of the casing 52 on the inner side of the diaphragm 50 may be vented in any suitable manner and if desired, adjustable stops may be provided for limiting the inward movement of the diaphragm 50. This construction provides for initial retraction of the needle valve 46 immediately upon the cranking of the engine so that the engine will be supplied with sufficient fuel for starting and idling thus rendering it unnecessary to depress the accelerator pedal although it may also be employed to vary the fuel supplied to the air entering the intake manifold.

The other end of the tubular shaft 28 is provided with an enlarged cylindrical portion 62 having cam recesses 64 at diametrically opposed points on the end edge thereof thereby forming axial cams which have a specific inclination as illustrated in FIGURE 2.

Slidable in and rotatable with respect to the tubular shaft 28 is a liquid fuel inlet tube 66 having an enlargement 68 thereon in close fitting relationship to the interior of the cylindrical enlargement 62. Diametrically

opposed projecting pins 70 are provided on the enlargement 68 for engagement in the cam recesses 64 in a manner described hereinafter. The outer end of the tube 66 is connected by virtue of a suitable flexible hose or the like to a suitable fuel pump of any conventional type which will supply fuel at a suitable pressure.

For retaining the tubular shaft 28 and the inlet tube or sleeve 66 in assembled relation, there is provided a generally U-shaped bracket 72 having one leg 74 thereof received between the enlargement 62 and the side of the attaching flange 16. The other leg 76 journals and slidably receives the outer end portion of the inlet tube 66 and a compression coil spring 78 encircles the tube 66 with one end abutting the inner surface of the leg 76 and the other end abutting the enlargement 68 on the tubular member 66 thereby urging the tubular member 66 inwardly so that the pins 70 will be retained against the cam surfaces 64 but a spring 78 will permit axial movement of the tube 66 when the cam surfaces 64 and the pins 70 are moved in relation to each other.

The enlargement 62 is provided with an arm 80 extending laterally thereof and the enlargement 68 is also provided with an arm 82 extending laterally thereof and connected to the respective arms 80 and 82 are actuating linkage structures 84 and 86 respectively which are connected thereto in any suitable manner and which move in any suitable direction depending upon the particular construction of the existing vehicle. For example, some accelerator linkages have a vertically moving terminal component while some have a horizontally moving terminal component. Thus, the arm 80 which is attached to the tubular shaft 28 may be oriented in any desired angular relation to the longitudinal axis of the tubular shaft 28 thus enabling the accelerator linkage to pivot the tubular shaft 28 about its longitudinal axis for opening and closing the butterfly valve and opening and closing the needle valve assembly at the center of the shaft 28. Also, the arm 82 is connected to either a manual choke device or an automatic choke device so that the mixture of gas and air may be enriched when the linkage mechanism 86 is actuated either manually or by an automatic choke device responsive to engine temperature. The end of the tube 66 is connected with a flexible coupling or hose such that it can rotate and also move axially while still supplying fuel under pressure to the inner end of the tube 66 which is provided with an orifice 88 which telescopically receives the tapered needle valve 46 in the manner illustrated in various figures of the drawings.

The elimination of the venturi in the air passage provides free breathing of the engine especially at higher speeds. Also, the elimination of various components such as the choke butterfly valve, the float bowl, the accelerator pump, the idling jets, the main jets all serve to reduce the cost of the carburetor and produces a simplified structure which enables the device to be more economically manufactured and more easily installed, adjusted and maintained. The device may be constructed of any suitable material such as metals presently employed in carburetor constructions. The various rotational and reciprocating components may be sealed in any suitable manner either by a close fitting relationship or suitable sealing devices such as O-ring seals and the like wherever desired and also lubrication may be provided for the various components as desired and required.

While one particular embodiment of the invention has been illustrated, it is clearly within the purview of the invention to reverse the orientation of the needle valve and tube 66 so that the needle valve 44 is reciprocated in response to movement of the accelerator linkage. Further, any suitable fuel cut-off mechanism may be employed to cut off the fuel when the engine is not operating thereby eliminating any possibility of flooding of the engine in the event the engine does not start immediately upon cranking. The tube 66 may be provided with an adapter on the inner end thereof having a particular size

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orifice therein whereby the replacement of the adapter enables variation in the size of the orifice. Thus, by using needle valves having different taper characteristics and different diameter dimensions together with different orifice sizes, the quantity of liquid fuel discharged by the present invention may be accurately determined so that the device may be used for various types and sizes of engines. The needle valve member 46 has a peripheral shoulder 47 which serves to initially break up the liquid fuel. Also, the needle body 44 may be screw threaded into the hollow shaft 28. A stop 83 is provided for engagement by adjusting screws 85 on the arms 80 and 82. The screw 85 on arm 82 is normally slightly spaced from the stop 83 to provide for enrichment of the combustible mixture. However, the particular stop mechanism and the control mechanism may vary in accordance with the particular installation. The mechanical control feature is the most significant feature whereby the liquid fuel is controlled at the fuel inlet within the tubular member.

Another factor in this invention is the provision of the butterfly valve 34 which substantially closes the air passage to prevent vaporization of gaseous fumes upwardly through the carburetor when the vehicle is not operating thereby eliminating this source of contamination and pollution of the surrounding air.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

A device for supplying fuel and air to an internal combustion engine having an intake manifold comprising a tubular member adapted to be communicated with the intake manifold and defining an air and fuel passage for supplying fuel and air to the intake manifold when vacuum is induced therein, a butterfly valve disposed in said tubular member for pivotal movement about a centrally disposed transverse axis for controlling the air flow therethrough by forming a hollow column of air, means forming a fuel inlet in the center of the butterfly valve for discharging fuel into substantially the center of the tubular member and in the center of the column of air flowing therethrough, said means forming a fuel inlet also forming an air passageway through the center of the butterfly valve for mixing the fuel with the minor portion of combustion supporting air when the fuel and minor portion of combustion supporting air is introduced into the column of air flowing through the tubular member, said means forming the fuel inlet and air passageway including a tubular shaft orientated transversely of the tubular member and having the butterfly valve mounted thereon, a

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needle valve reciprocally mounted in one end portion of said tubular shaft and having a tapered point adjacent the center of the butterfly valve, a hollow sleeve reciprocally mounted in the other end portion of the shaft in opposed axial alignment with the needle valve and having an orifice at the inner end thereof engaging the tapered end of the needle valve at the center of the butterfly valve, said hollow sleeve being communicated with a source of fuel for introducing fuel into the center of the hollow shaft, said hollow shaft and butterfly valve having an opening extending therethrough defining the air passageway with the orifice at the inner end of the sleeve communicating with the air passageway, means connected to said needle valve and adapted to be communicated with the intake manifold for reciprocating the needle valve in response to vacuum induced in the intake manifold for positioning the needle valve in response to intake vacuum of the engine, accelerator linkage means connected with the tubular shaft for oscillating the same thereby oscillating the butterfly valve for controlling the position thereof, choke linkage means connected with the sleeve for oscillating the sleeve, means interconnecting the sleeve and the rotatable shaft for varying the initial axial position of the sleeve in relation to the shaft and the tapered end of the needle valve for enabling variation in the rate of discharge of liquid fuel through the orifice when the sleeve and shaft are in initial position and axially moving the sleeve away from the needle valve when the shaft and butterfly valve are pivoted to a second position, said last named means also moving the sleeve axially in relation to the needle valve when the sleeve is rotated, and spring means biasing the sleeve toward the needle valve for normally urging the orifice into engagement with the needle valve.

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