May 4, 1943. T. A. MORRIS 2,318,008

CARBURETOR FOR MULTICYLINDER INTERNAL COMBUSTION ENGINES

Filed Dec. 23, 1940

FIG.1.

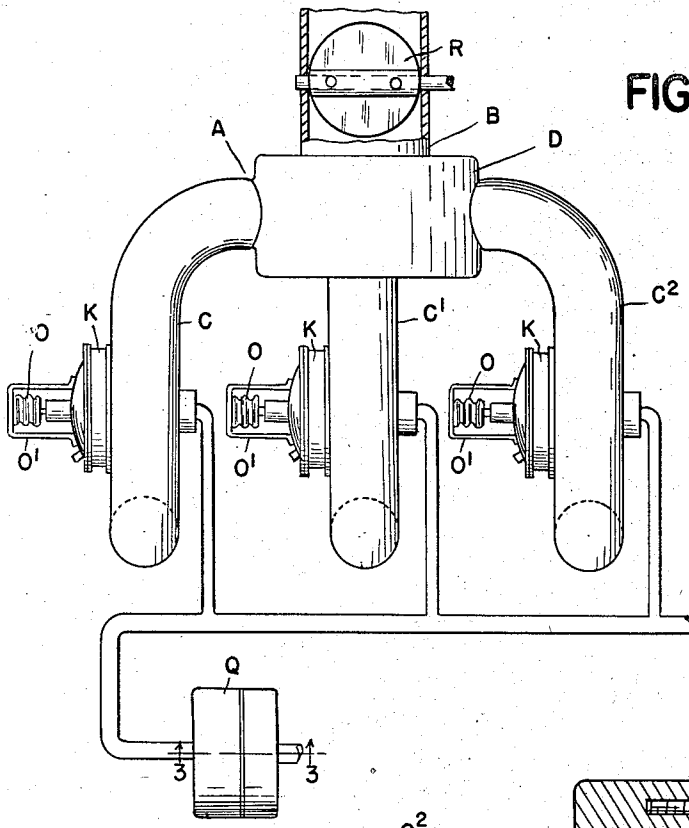
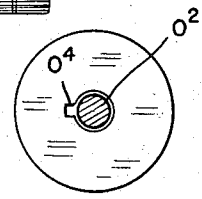


FIG.4.



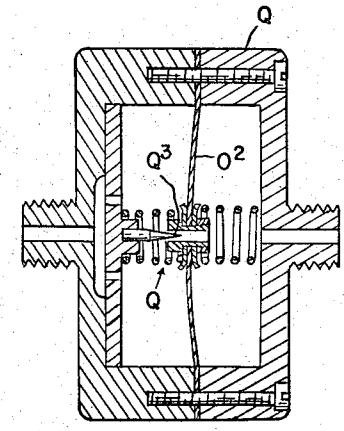
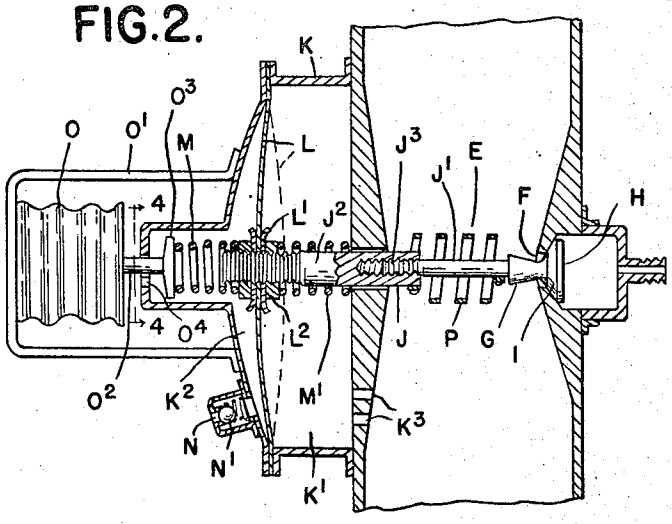


FIG.3.

FIG.2.



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CARBURETOR FOR MULTICYLINDER INTERNAL COMBUSTION ENGINES

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10 Claims. (Cl. 123—119)

The invention relates to carburetors more particularly designed for multicylinder internal combustion engines and has for its object the obtaining of a more uniform combustible mixture in each of the cylinders and under varying conditions. Some of the conditions which interfere with successful operation of multicylinder engines are:

1. Uneven distribution of the combustible mixture to the different cylinders;
2. Inequality in the fuel to air ratio of the mixture arriving in the different cylinders;
3. Variations due to temperature differences;
4. Variations due to atmospheric conditions;
5. Variations due to the falling out of the liquid fuel from the mixture during its passage from the carburetor to the cylinder;
6. Variations due to surging of the mixture in the manifold.

It is the object of the invention to overcome the difficulties due to the conditions above referred to and to this end the invention consists in the construction as hereinafter set forth.

In the drawing:

Figure 1 is a side elevation of a manifold and carburetor as applied to a multicylinder internal combustion engine;

Figure 2 is a vertical central section through one of the branches of the manifold showing the fuel injection and controlling means therefor;

Figure 3 is a central section on line 3—3 of Figure 1 through the regulator for the liquid fuel supply;

Figure 4 is a cross section on line 4—4, Figure 2.

As illustrated, A is a manifold having a common inlet portion; B a plurality of branch portions, C, C', C^2 leading to the several cylinders or pairs of cylinders and an enlarged surge chamber D between the inlet portion B and the branches. The branches C, C', C^2 preferably extend vertically downward to the inlet ports in the cylinder block (not shown) and each branch is provided with an independent fuel injection means. As shown in Figure 2, each branch conduit has a Venturi shaped portion E with a fuel injection port F in the constricted portion of the venturi. The discharge of fuel through the port F is controlled by a metering device which, as shown in Figure 2, comprises a tapering pin G longitudinally movable in the port F to variably restrict the same. There is also a head H at the small end of the pin which forms a closure for the port when the carburetor is not in action thereby preventing leakage of the liquid fuel into the Venturi conduit. A gasket I of suitable material, such as "neoprene," which is not detrimentally affected by the liquid fuel is placed on the head to form the seal. The metering pin G has a shank portion J which extends diametrically across the venturi and out through a port in the opposite wall thereof into an auxiliary casing K. L is a flexible diaphragm extending across this casing and centrally secured to the shank of the metering pin G by suitable means, such as washers L' and nuts L^2 engaging a threaded portion of the shank on opposite sides of the diaphragm. Springs M and M' on opposite sides of the diaphragm are properly tensioned to yieldably hold the same in a normal position. The diaphragm L divides the casing K into two chambers K' and K^2, the chamber K' being connected by one or more ports K^3 with the Venturi conduit on the engine side of the constriction. The outer chamber K^2 communicates with the external atmosphere through a port N which is provided with a check valve N' closing the same against outward movement of the air while permitting free inward movement thereof. Thus on the suction stroke of the piston in the engine cylinder, the partial vacuum formed on the engine side of the constriction will be communicated to the chamber K' so that the external atmospheric pressure will move said diaphragm inward opening the port F but variably restricting the same according to the position assumed by the metering pin G. This position will be determined by the differential pressure on the diaphragm so that the higher the vacuum, the greater the restriction of the port F. When the pressure within the venturi and the chamber K' rises, this will cause an outward movement of the diaphragm but by reason of the fact that air is trapped in the chamber K^2 due to the closing of the check valve N', this outward movement is retarded. Consequently, when the pulsations in the manifold are very rapid as where the engine is running at high speed, the lag in the movement of the diaphragm will be sufficient to hold it in a substantially constant position determined by the average depression in the venturi.

Changes in barometric pressure of the atmosphere will tend to modify the action of the diaphragm. This I have avoided by the use of an evacuated metallic bellows member O which is anchored to a bracket member O' secured to the casing K and has its opposite end connected to a stem O^2 passing through an aperture in the casing and provided at its inner end with an abutment O^3 for the spring M. This will compensate for changes in atmospheric pressure by

movement of the abutment O^3 inward when the barometric pressure falls so as to increase tension on the spring M while, on the other hand, an increase in barometric pressure will move the abutment O^3 outward and decrease the tension of the spring M.

Changes in temperature causing expansion and contraction of the parts will tend to alter the metering function. Also increase in heat will expand the air and render the liquid fuel less viscous. To compensate for these changes, I employ a thermostat which alters the length of the shank J between the diaphragm and the metering pin. As shown, the shank J is formed in two sections J' and J^2 which have a threaded engagement J^3 with each other. Surrounding the shank centrally of the constricted portion of the venturi is a helical thermostatic bar P, one end of which is attached to the section J' and the other to the section J^2. Changes of temperature in this bar will coil or uncoil the same relatively rotating the sections J' and J^2 and through the screw threaded engagement J^3 altering the length.

To obtain accurate metering of the fuel, the pressure under which it is forced through the metering device must remain as nearly as possible constant. I, therefore, employ a regulator Q which is shown in Figure 3 as a metering device Q' controlled by a flexible resilient diaphragm Q^2. The metering device consists of a tapering pin extending into a port Q^3 through the diaphragm and the arrangement is such that when the fluid pressure is increased on the inlet side of the regulator, the diaphragm will be deflected so that the port Q^3 is further restricted thereby reducing the pressure on the opposite side of the diaphragm and on the fuel in the conduit leading to the fuel injection ports F. In like manner, a decrease in the pressure on the fuel entering the regulator will cause the resilient diaphragm to move so as to increase the port area and thereby increase the pressure on the liquid which is delivered to the ports F. The total effect is to maintain a substantially constant pressure on the liquid fuel in the conduits adjacent to the ports F.

In the complete operation, the air entering the common conduit B is controlled by a single throttle valve R which may be adjusted to variably restrict said conduit. From the common portion B of the conduit, the air passes to the several branches C, C', C^2 passing therethrough and through the venturi portions E into the engine cylinders (not shown). As the suction in these cylinders is successive, there will be a corresponding successive flow of air through the several branch conduits but the enlarged surge chamber D will prevent the movement of air in one branch conduit from materially affecting the movement in another branch conduit. The air in passing through the venturi will be commingled with the fuel injected through the port F and, as above described, the area of this port is variably restricted by the metering means; also the metering means is conjointly controlled by the pressure within the venturi on the engine side of the constriction, the barometric pressure of the atmosphere and the temperature of the parts. This will insure a substantially constant ratio between the air and the fuel of the carbureted mixture. As the branch conduits extend vertically downward to the engine cylinders, the carbureted mixture will be drawn into said cylinders without any tendency for liquid fuel particles to drop out. When the engine is not in operation, the restoration of atmospheric pressure on the inner side of the diaphragm L will move the metering pin G outward seating the head H and its gasket I so as to close the port F. However, when the engine is in operation, the outward movement of the diaphragm is retarded as previously described due to the closing of the check valve M' and the trapping of air in the chamber K^2. There is, however, a slow leak for air out of this chamber preferably through a small port O^4 at one side of the stem O^2 as shown in Figure 4.

My improved carburetor is one which is adapted for operation under various conditions, such for instance, as with engines for aircraft which operate under varying atmospheric pressures according to altitude. It is customary to provide superchargers for such use and under certain conditions the air supplied to the carburetor is supercharged and under other conditions it is not. My improved construction will adapt itself to this by a proper fashioning of the metering pin G which will automatically adjust the amount of fuel discharged in proportion to the quantity of air.

What I claim as my invention is:

1. In a carburetor, the combination with a Venturi conduit having a fuel injection port in the constricted portion thereof, of metering means for the fuel passing through said port completely closing the port in one position, and a flexible diaphragm operatively connected with said metering means responsive to variations in pressure within said Venturi conduit to progressively restrict said port by decrease in pressure in the venturi and to completely close the port when the pressure within the venturi is equal to atmosphere.

2. In a carburetor, the combination with a Venturi conduit having a fuel injection port in the constricted portion thereof, of metering means for the fuel passing through said port completely closing the port in one position, a flexible diaphragm operatively connected with said metering means responsive to variations in pressure within said Venturi conduit to progressively restrict said port by decrease in pressure in the venturi and to completely close the port when the pressure within the venturi is equal to atmosphere, and means for retarding rapid oscillations of said diaphragm to maintain the same substantially in a position corresponding to the average pressure.

3. In a carburetor, the combination with a casing provided with a Venturi conduit extending therethrough and a fuel injection port entering the constricted portion of the venturi, of a metering member engaging said port and adapted to completely close the same in one position, a chamber in said casing having air connection with said Venturi conduit, a flexible diaphrgam extending across said chamber and centrally connected to said metering member, said diaphragm being responsive to variations in pressure in said chamber and venturi to progressively increase the restriction of said port proportional to decrease in air pressure in said chamber and to close the port when the air pressure is equal to atmosphere, and means for retarding the movement of said diaphragm towards its normal position.

4. In a carburetor, the combination of a casing having a Venturi conduit therethrough and a fuel injection port in the constricted portion of

said venturi, said casing being also provided with a portion forming a chamber having air connection with said Venturi conduit, a flexible diaphragm extending across said chamber, a metering member for variably restricting said port engaging the same from the inner side thereof and provided with a head at its outer end for completely closing said port, a shank for said metering member extending across said Venturi conduit and through a port in the opposite wall thereof into said chamber and connecting with said diaphragm whereby variations in pressure in said chamber corresponding to pressure variations in the Venturi conduit will progressively increase the restriction of said port in proportion to decrease in air pressure and will close said port at atmospheric pressure, and means forming a chamber on the opposite side of said diaphragm having a restricted vent port and a free entrance port for air from the external atmosphere whereby rapid oscillations of said diaphragm are checked and said metering means is substantially held in a position corresponding to the average decrease in pressure in said first mentioned chamber.

5. In a carburetor, the combination with an air conduit having a fuel injection port therein, of metering means for the fuel passing through said port, and means for operating said metering means conjointly controlled by the pressure within the conduit, the temperature of the parts and barometric pressure of the atmosphere.

6. In a carburetor, the combination with a casing having a Venturi conduit extending therethrough and a fuel injection port in the constricted portion of the venturi, said casing being also provided with a portion forming a chamber having air communication with the venturi, a diaphragm extending across said casing, a metering member for engaging said port to variably restrict the same, a shank for said metering member formed in two portions having a threaded engagement with each other, said shank extending across said venturi through a port in the opposite wall thereof into said chamber and being connected to said diaphragm, and a thermostatic member surrounding said shank within said venturi and connected to the separate portions of said shank whereby temperature variations will relatively rotate said shank portions and correspondingly vary the combined length thereof.

7. In a carburetor, the combination with an air conduit having a fuel injection port therein, of means for supplying liquid fuel to said port, means for maintaining a substantially constant pressure on the liquid fuel delivered to said port, metering means for the fuel passing through said port completely closing the port in its normal position, a flexible diaphragm operatively connected with said metering means responsive to variations in the pressure within said air conduit to progressively restrict said port by decrease in air pressure in the conduit and to completely close the port when the air pressure is equal to atmosphere, and means for retarding rapid oscillations of said diaphragm to maintain the same substantially in a position corresponding to the average pressure in the conduit.

8. In a carburetor for multicylinder internal combustion engines, an inlet conduit having a common portion and a plurality of branch portions extending therefrom with an enlarged surge chamber intermediate said common portion and said branch portions, each of said branch portions having a vertically downwardly extending suction portion, a single throttle for controlling said common conduit portion, individual liquid fuel injection means for each branch conduit having a discharge port therein, metering means for each discharge port, and means responsive to pressure in the branch conduit for operating said metering means to restrict the area of discharge in proportion to decrease in pressure in said conduit.

9. In a carburetor, the combination with an air conduit having a fuel injection port therein, of metering means for the fuel passing through said port completely closing the port in one position, and a flexible diaphragm operatively connected with said metering means responsive to variations in pressure within said conduit to progressively restrict said port by decrease in pressure in the conduit and to completely close the port when the pressure within the conduit is equal to atmosphere.

10. In a carburetor, the combination with an air conduit having a fuel injection port in the constricted portion thereof, of metering means for the fuel passing through said port completely closing the port in one position, a flexible diaphragm operatively connected with said metering means responsive to variations in pressure within said conduit to progressively restrict said port by decrease in pressure in the conduit and to completely close the port when the pressure within the conduit is equal to atmosphere, and means for retarding rapid oscillations of said diaphragm to maintain the same substantially in a position corresponding to the average pressure.

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