Nov. 14, 1944. G. M. BICKNELL 2,362,879

CARBURETOR

Filed Feb. 3, 1943

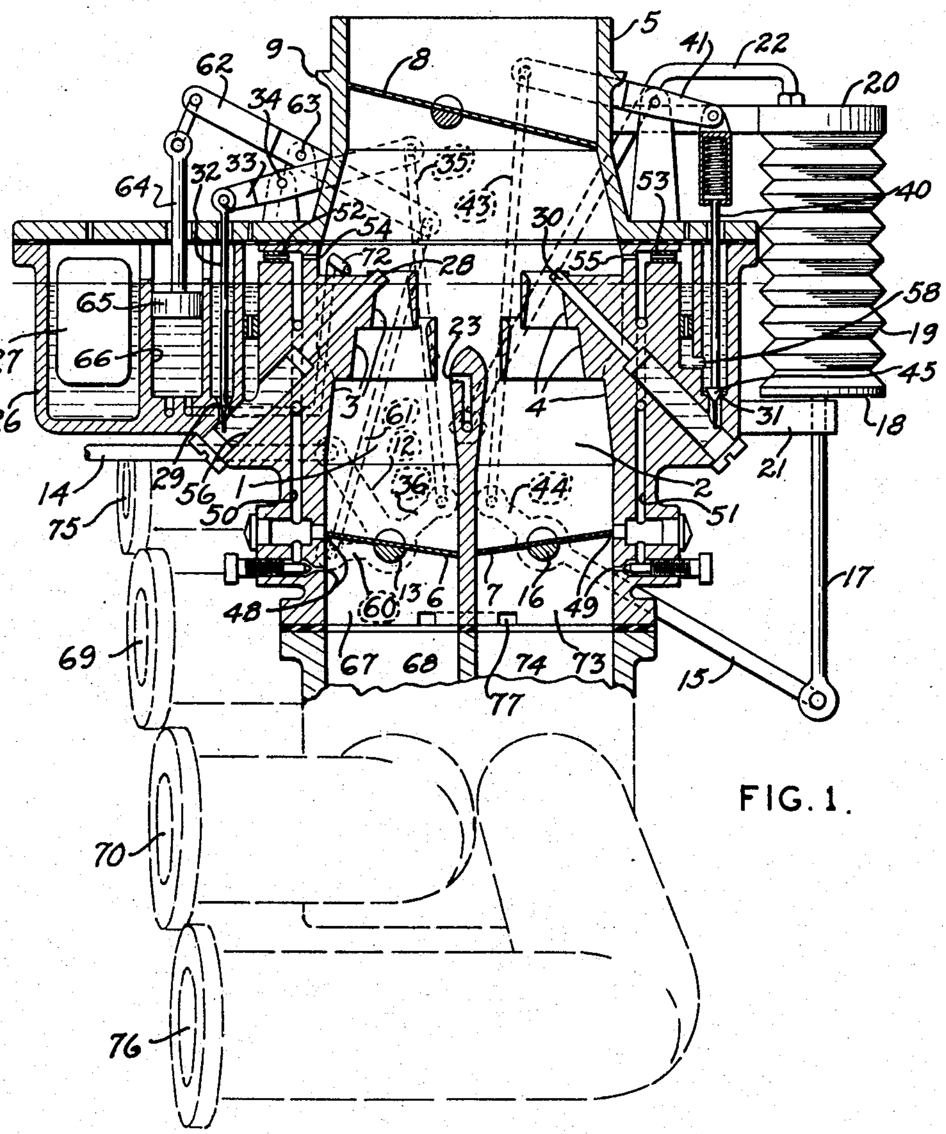

FIG. 1.

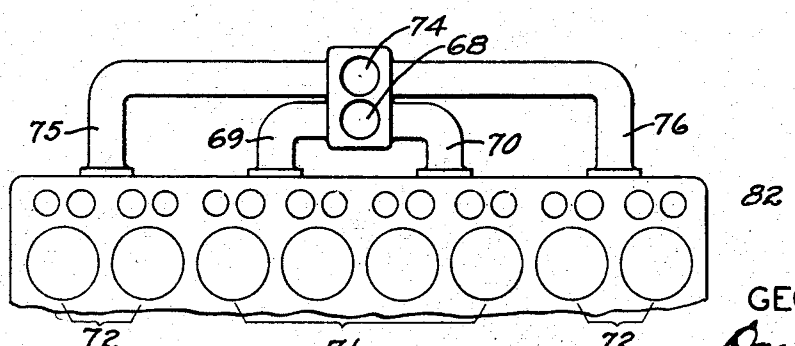

FIG. 2.

INVENTOR.
GEORGE M. BICKNELL

Donald U. Rich

ATTORNEY.

Patented Nov. 14, 1944 2,362,879

UNITED STATES PATENT OFFICE

2,362,879

CARBURETOR

George M. Bicknell, St. Louis, Mo., assignor to Carter Carburetor Corporation, St. Louis, Mo., a corporation of Delaware

Application February 3, 1943, Serial No. 474,583

12 Claims. (Cl. 123—127)

This invention relates to improvements in internal combustion engines and more particularly to improvements in carburetors and methods of controlling the supply of fuel to obtain the greatest operating efficiency from the engine. The invention is particularly designed for multicylinder engines of the type in which two or more cylinders or groups of cylinders are supplied by separate intake conduits and the most important advantages of the invention are obtainable with engines designed to be used under varying conditions of speed and load, such as automotive engines.

Most automotive engines in use at the present time are operated at speeds and loads substantially below the maximum capacity and this results in loss of efficiency because, the best point on the specific fuel curve of an automotive engine is usually found at speeds and loads above the normal operating speed and load of the engine. Even in truck engines which are normally operated at high speeds and loads, driving conditions make it necessary to frequently operate the engine at speeds and loads far below those at which the best efficiency is obtainable.

Another cause of loss of efficiency at low speeds is the poor distribution and vaporization of fuel which results from the use of a Venturi size in the carburetor which has a capacity sufficient to deliver the amount of fuel mixture required for operation at full power.

In the usual form of automotive carburetors now in use, liquid fuel is discharged into a venturi located anterior to the throttle valve where the suction available for drawing fuel from the nozzle is substantially directly proportional to the degree of opening of the throttle valve and to the engine speed. It is desirable that the main fuel nozzle discharge into a restricted zone, preferably of Venturi shape, so that under the least favorable suction conditions, that is, when the throttle is fully opened, but the engine is operating slowly, quantities of fuel are discharged from the main nozzle. Accordingly, the size of the mixture conduit is necessarily a compromise between the relatively small size which is advantageous at low speeds, and the larger size which has maximum capacity for high speed operation.

In order to overcome the disadvantages of this compromise, I have provided two separate main venturis supplied by separate fuel nozzles together with a manual throttle valve to control the mixture discharged from one of the venturis and an automatically operated throttle valve to control the supply of additional fuel when required. The automatically operated throttle valve is controlled by a piston or diaphragm, one side of which is exposed to the suction in the venturi of the mixing conduit which is controlled by the manual throttle.

The above described arrangement would result in the operation of only one-half of the cylinders of the engine when the engine is operating at low speeds, except for the provision of a by-pass which allows fuel from the manually controlled throttle barrel to flow to the mixing conduit operated by the automatically controlled throttle. I thus obtain two main advantages; first, the fuel supply for all of the cylinders may be taken at low speeds through a venturi which is only large enough to supply one-half of the cylinders at high speeds. This results in better vaporization and distribution. The second advantage is that four cylinders operated directly through the manually controlled throttle barrel received mixture much more freely than the other four cylinders which results in operating the first four cylinders much nearer their efficiency peak than would be possible if the power was taken equally from all eight cylinders.

Restriction in the by-pass or barrel passage is sufficient to cause the most of the mixture to be supplied directly to the manually controlled manifold while just sufficient mixture will be supplied to the other passage during low power operation to carry the load of this part of the motor and prevent it being a drag on the cylinders which are in full operation. At the same time, the by-pass is not so small as to prevent effective operation of all the cylinders of the motor when the manual throttle is wide open and the automatic throttle is closed as it would be when climbing or accelerating with wide open throttle at a low rate of speed.

Due to the fact that the by-pass or cross passage is not in the direct line of fuel flow, the mixture supplied to the cross passage and to the automatically controlled cylinder group is leaner than that which is supplied to the manually controlled cylinder group. This results in better economy, and also in maintaining better heating of the automatically controlled cylinders because of the slow combustion of the leaner mixture.

In order to realize the advantages of my invention more completely, I provide a fuel cut-off for the main nozzle on the automatic side of the carburetor and this fuel cut-off is controlled by the automatic throttle in such a manner as to prevent the supply cf fuel through this main nozzle when the automatic throttle is closed. I also provide an independent idling system for the automatically controlled side of the carburetor although this feature is not necessarily required.

The invention will be better understood upon reference to the accompanying drawing in which:

Fig. 1 is a diagrammatic perspective of an intake manifold with a sectionalized carburetor mounted thereon.

Fig. 2 is a diagram of the dual manifold arrangement for application of my invention to a typical eight cylinder engine.

The carburetor shown is of the downdraft type having a divided mixture conduit, the lower portion thereof forming a pair of mixing conduits 1 and 2 including venturis 3 and 4 and having a common air inlet horn 5. Butterfly throttle valves 6 and 7 are mounted, respectively, in the lower or discharge portions of the mixture conduits and a choke valve 8 is similarly mounted in air horn 5. The choke valve may be operated by any suitable manual or automatic control device (not shown and conveniently of the type shown in Coffey Patent No. 2,085,351). The air horn is provided with an annular rib 9 to facilitate the mounting of the usual air cleaner and silencer device (not shown).

Throttle valve 6 has an arm 12 rigidly secured to its shaft 13 and to this arm there is connected a link 14 extending to the usual throttle pedal for manual control of the valve. Throttle 7 has a lever 15 rigid with its shaft 16 and to the outer end of this lever there is pinned a rod 17 which is secured to the lower, movable end 18 of a bellows 19. The bellows is supported at its upper end by a bracket 20, secured to the body of the carburetor, and an apertured lug 21 slidably receives and guides throttle operating rod 17. A tube 22 extends to a port 23 opening into mixture conduit 1 controlled by manual throttle 6 so that the suction conditions in this conduit are transmitted to bellows 19.

It will be understood that the bellows may be a cylinder and piston or flexible diaphragm, and spring means may be provided if desired to assist the inherent resiliency of the bellows to hold the throttle valve 7 in closed position until the desirable amount of suction has been built up as hereinafter described.

A constant level fuel reservoir 26 is formed on the carburetor in which fuel is maintained at a substantially uniform level by the usual float and needle valve mechanism, the float being shown at 27. A main fuel passage or nozzle 28 communicates with the fuel reservoir through a calibrated metering orifice 29 and discharges into the smallest or primary venturi 3 in mixture conduit 1. A second main nozzle 30 communicates with the fuel reservoir through a calibrated metering restriction 31 and communicates with the smallest or primary venturi 4 in second mixture conduit 2. Metering orifice or restriction 29 is controlled by a metering rod 32 pinned at its upper end to a lever 33 which is pivotally mounted at 34 and connected at its opposite end by means of a link 35 to an arm 36 rigid with manual throttle shaft 13. Metering pin 32 and its control linkage are arranged so that as manual throttle 6 is opened, the metering pin will be raised so as to progressively move smaller portions thereof into metering orifice 29 and thus enrich the mixture being discharged through mixture conduit 1.

The second metering orifice 31 is controlled by a metering pin 40 yieldingly connected at its upper end to a pivoted lever 41, this lever being connected at its end opposite pin 40, by means of a link 43, to an arm 44 rigid with suction controlled throttle shaft 16. Metering pin 40 has an enlargement 45 positioned to seat against the upper edge of orifice 31 and cut off the communication between secondary nozzle 30 and the constant level fuel reservoir whenever throttle 7 is substantially closed.

When both throttle valves 6 and 7 are substantially closed, fuel is supplied to mixture conduits 1 and 2 through the usual idling ports 48 and 49 communicating with the constant level reservoir through passages 50 and 51 having restrictions 52 and 53 and air bleeds 54 and 55. Idling passage 50 supplying mixture conduit 1 communicates with the enlarged lower portion 56 of main fuel passage 28 posterior to metering restriction 29 so as to form an interconnected idle in which all fuel for supplying both the main and idling passages flows through a single metering restriction. Idling passage 51 supplying secondary mixture conduit 2, communicates with the fuel reservoir by means of a port 58 which is independent of secondary main nozzle 30 so that fuel will be discharged from idling ports 49 whenever throttle 7 is substantially closed, regardless of the position of metering pin 40.

A third arm 60 is formed rigidly on manual throttle shaft 13 and connected by a link 61 to a lever 62 pivotally mounted at 63, the lever being connected at its other end to a piston rod 64 and piston 65 forming an accelerating pump. Piston 65 operates in cylinder 66 so as to discharge a shot of fuel in the mixture conduit 1 when throttle 6 is open. Any suitable type of accelerating pump and valving may be provided, but I prefer to use the type shown in my Patent No. 2,252,958 having a discharge outlet as diagrammatically indicated at 72. The mixture outlet 67 on the normally controlled side discharges into manifold portion 68 which has one or more outlet branches 69 and 70. These outlets supply fuel to the inner group of cylinders 71 of the associated internal combustion engine 82. The outer groups of cylinders 72 are supplied from the mixing conduit 73 controlled by the automatically operated throttle 7 which discharges into the manifold 74 having discharge outlets 75 and 76. Since different engines have different distribution, it may be expedient to mount the carburetor on the manifold structure in such a manner as to have the manually controlled mixture conduit supply outer cylinder groups 72 instead of the inner cylinders, as shown.

In order to provide for the supply of fuel to the outer cylinder groups 72 under part throttle conditions and to assist in damping undesirable pressure pulsations in the manifold, I provide a restricted balance passage 77 which permits the flow of a limited amount of mixture to the manifold portion 74 when the valve 7 is closed. One of the reasons for supplying some fuel to the cylinder groups 72 even when sufficient power could be obtained by operation of the cylinder group 71, is to maintain the temperature of these cylinders so that full operation can be instantly resumed and other reasons which will be apparent to those skilled in the art. This requirement, is well satisfied by the delivery of a leaner mixture than might be desirable otherwise, particularly because maximum economy and also greater heating effect are obtainable from a leaner mixture. The position of the passage 77 with respect to the fuel discharge is such that only fuel which has been substantially gasified enters this passage from the discharge outlet 67, the unvaporized fuel being discharged downwardly through the manifold 68 thereby causing the mixture delivered to the cylinder group 71 to be richer than that delivered to the groups 72.

In the operation of the carburetor, the carbureting elements shown at the left side of Fig. 1, including mixture conduit 1, main nozzle 28, idling system 48, 50, metering pin 32, and the accelerating pump function to provide properly metered fuel for all low speed operating conditions. The elements shown at the right side of the figure, including mixture conduit 2, idling system 49, 51, metering pin 40, and main nozzle 30, provide a secondary carburetor in which the idling system discharges substantially continuously whenever port 49 is exposed to suction, but in which no fuel can be drawn from main nozzle 30 until the suction in mixture conduit 1 is sufficient to indicate a predetermined speed, say 35 miles an hour, at which the added fuel is desired, whereupon bellows 19 will be contracted, opening throttle 7 and lifting valve enlargement 45 controlling metering orifice 31.

When the engine is operated under part throttle conditions at comparatively low speeds, for instance 15 to 40 miles per hour in a car which is capable of a maximum speed of approximately 85 miles per hour, most of the power will be delivered by the inner cylinder group 71 so that these cylinders will be operating more efficiently than that would be the case if a balanced amount of power were taken from all 8 cylinders. Cylinder groups 72 will deliver a comparatively small amount of power and operate on a rather lean mixture so as to consume very little fuel. During acceleration substantially all of the fuel will be supplied through the mixing conduit 67 but enough mixture will flow through the by-pass and manifold 75 and 76 to cause cylinder groups 72 to carry substantially their full load. At higher speeds, when throttle 7 is open, the fuel supply from mixing conduit 67 will be delivered entirely to cylinder group 71 and cylinder groups 72 will be supplied from mixing conduit 73.

Various modifications may be made as will occur to those skilled in the art and the exclusive use of all modifications as come within the scope of the appended claims is contemplated.

I claim:

1. In an internal combustion engine having a plurality of cylinder groups, separate intake conduits for supplying fuel mixture to said groups, a manually operated throttle valve for controlling one of said conduits, a throttle valve for another of said conduits, means responsive to the velocity of flow through the manually controlled conduit for controlling the throttle in the other conduit, and a cross passage connecting said conduits posterior to said throttle valves.

2. In an internal combustion engine having a plurality of cylinder groups, separate intake conduits for supplying fuel mixture to said groups, a manually operated throttle valve for controlling a first one of said conduits, a second throttle valve for a second of said conduits, means for controlling said throttles, and means for supplying a limited amount of fuel mixture from said first conduit to said second conduit when said second throttle is closed.

3. In an internal combustion engine having a plurality of cylinder groups, separate intake conduits for supplying fuel mixture to said groups, a manually operated throttle valve for controlling the supply of fuel mixture to a first one of said groups, a second throttle valve controlling the supply of fuel to another of said groups, idling systems discharging adjacent said throttle when closed, means normally closing said second throttle when the power required from the engine is comparatively small, means responsive to increased power demand for opening said second throttle, and means to by-pass a reduced supply of fuel to said second group from the conduit supplying said first group when said second throttle is closed.

4. In an internal combustion engine having a plurality of cylinder groups, separate intake conduits for supplying fuel mixture to said groups, a manually operated throttle valve for normally controlling the supply of fuel mixture to one of said groups, a second throttle valve controlling the supply of fuel to another of said groups, means normally closing said second throttle when the power required from the engine is comparatively small, means responsive to increased power demand for opening said second throttle, and means for partially relieving the suction in said second intake conduit when said manual throttle is moved towards open position.

5. The method of operating an internal combustion engine of the type having a plurality of cylinder groups which comprises supplying idling fuel to all of said groups, increasing the fuel supply to different groups at different rates in response to increased power demands until one of said groups is receiving all the fuel it requires for full power operation at a predetermined intermediate speed, while restricting the fuel supply to another group, and increasing the fuel supply to the other of said groups in response to a further increase in power demand.

6. The method of operating an internal combustion engine of the type having a plurality of cylinder groups which comprises supplying idling fuel to all of said groups, increasing the fuel supply to different groups at different rates in response to increased power demand until one of said groups is receiving all the fuel it requires for full power operation at a predetermined intermediate speed, while restricting the fuel supply to another group, and increasing the fuel supply to the other of said groups in response to an increase in engine speed.

7. The method of operating an internal combustion engine which comprises operating all cylinders of the engine during idling, increasing the supply of fuel to a part of said cylinders in response to increased power demand until said cylinders are operating at a capacity corresponding to a point of high efficiency on the specific fuel curve, and finally increasing the fuel supplied to other cylinders in response to further increases in power demand until all cylinders are operating at a point of high specific fuel efficiency.

8. The method of operating an internal combustion engine of the type having a plurality of cylinder groups which comprises supplying sufficient fuel to a part of the cylinders to develop the necessary power for operation at normal loads, supplying only sufficient fuel to the remaining cylinders to keep them in operation at normal loads and supplying maximum fuel to all cylinders when the engine is operating under full load.

9. The method of operating an internal combustion engine of the type having a plurality of cylinder groups which comprises supplying suf-

ficient fuel to one group of said cylinders for developing the power required to operate under normal loads, supplying a smaller amount of fuel of leaner quality to another group of cylinders to keep them in operation while the power is being developed by the first group of cylinders, supplying maximum quantities of fuel of substantially equal quality to all cylinders during full load operation.

10. The method of operating an internal combustion engine of the type having a plurality of cylinder groups which comprises supplying sufficient fuel to one group of said cylinders for developing the power required to operate under normal loads, supplying a smaller amount of fuel of leaner quality to another group of cylinders to keep them in operation while the power is being developed by the first group of cylinders, supplying maximum quantities of fuel of substantially equal quality to all cylinders during full load operation, and supplying minimum quantities of fuel of substantially equal quality to all cylinders for idling.

11. In an internal combustion engine having a plurality of cylinder groups, separate intake conduits and carburetors for supplying fuel mixture to said groups, a manually operated throttle for controlling a first one of said carburetors, a second throttle and a liquid fuel valve controlling the supply of fuel by said second carburetor, means normally closing said second throttle and said fuel valve to cut off the supply of fuel by said second carburetor when the power required from the engine is comparatively small, means responsive to increased power demands for opening said second throttle and fuel valve, and means for supplying a limited amount of fuel to said conduit when said second throttle and said fuel valve are closed.

12. In an internal combustion engine having a plurality of cylinder groups, separate intake conduits and carburetors for supplying fuel mixture to said groups, throttle valves for said conduits, idling systems discharging adjacent said throttle valves when closed, a fuel valve controlling the supply of liquid fuel to said second conduit, and a by-pass between said conduits for supplying fuel from said first conduit to said second conduit when said liquid fuel valve is closed.

GEORGE M. BICKNELL.