

[54] EGR SYSTEM BUILT INTO CARBURETOR

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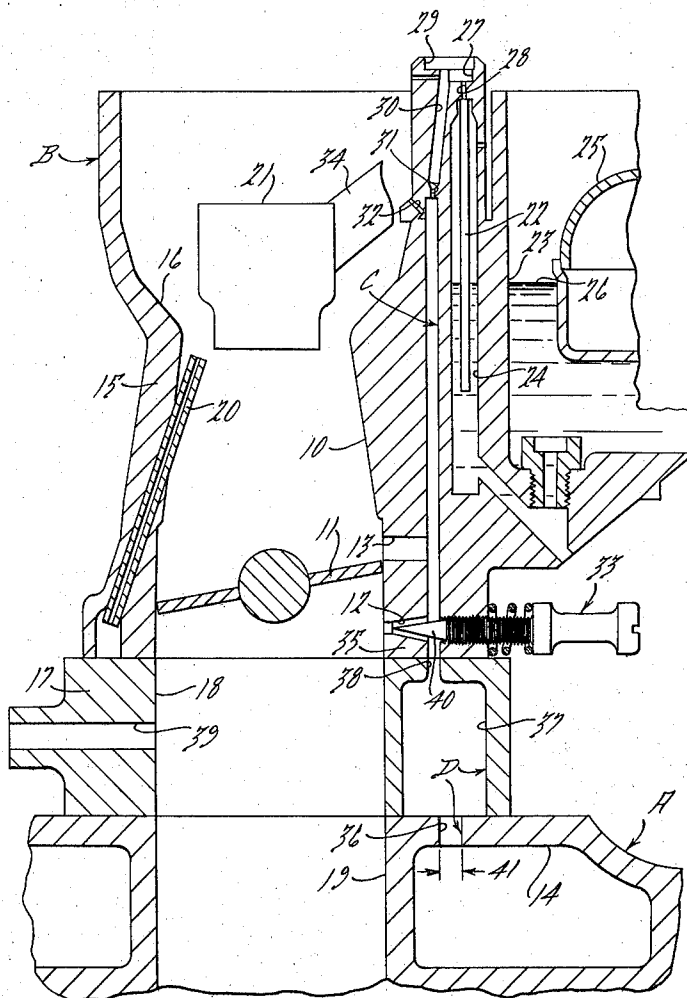
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[57]

ABSTRACT

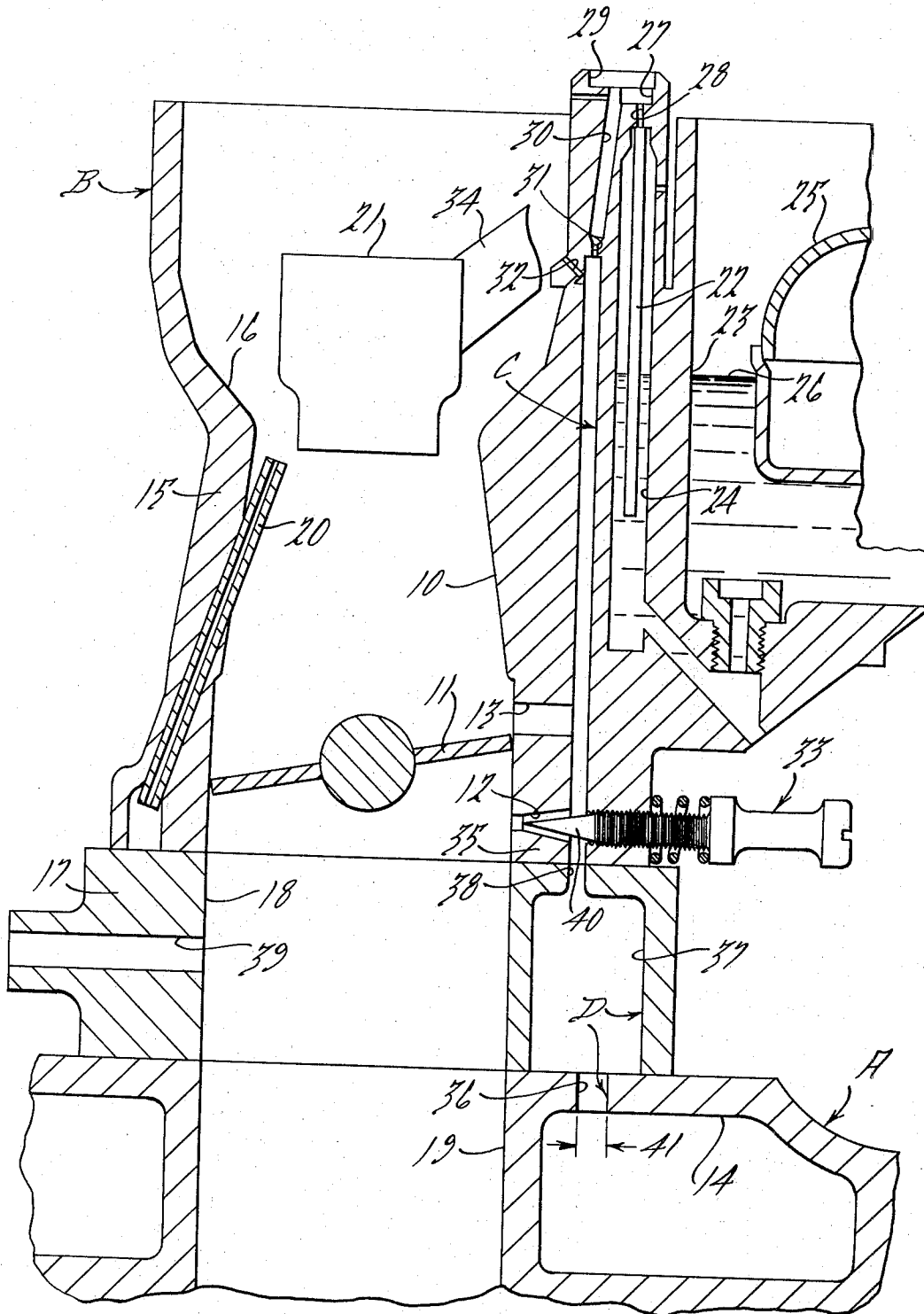
At least one channel is employed to directly communicate the exhaust manifold cross-over passages with the idle and low-speed fuel circuit for the carburetor of an internal combustion engine. Typical pressure conditions in the air horn of the carburetor draw in a combination of air/fuel and exhaust gases. The carburetor throttle and other carburetor controls function to regulate the degree of exhaust gas recirculation.

7 Claims, 1 Drawing Figure



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EGR SYSTEM BUILT INTO CARBURETOR

BACKGROUND OF THE INVENTION

Numerous systems have been devised to recycle exhaust gases into the air-fuel induction system of an automotive engine for a variety of purposes, among which include:

- a. use of the exhaust gases to prewarm and thereby vaporize the incoming air/fuel mixture to facilitate its complete combustion in the combustion zone,
- b. recirculation of the exhaust gases to reuse the unignited or partially burned portions of the fuel which would otherwise pass out of the exhaust pipe and into the atmosphere, and
- c. recirculate exhaust gases for the purpose of reducing oxides of nitrogen emitted from the exhaust system and into the atmosphere.

One of the most important of the above is the reduction of NO_x brought about by reducing the maximum combustion temperature in consequence of the dilution of the air/fuel mixture by the recycling of exhaust gases. Commercially used EGR systems typically return approximately 12% of the exhaust gas for recirculation, and in some cases the range is wide as 6 to 13% depending upon the manner of controls. It is known that the recycling of at least 5% and not more than 25% of the total exhaust gases through the engines, depending upon the load or power demand, will reduce the combustion temperature to less than 2,200°F.

However, the temperature reduction is presently accomplished by means which sacrifice minimum cost and preferred operating efficiency. Structures have been complicated by the desire to reduce cycling during conditions of both engine idling (when it is thought that nitrogen oxide emission is a minor problem) and wide-open throttle (when maximum power is required). This follows from the fact that the nitrogen oxide emission is a direct function of combustion temperature and for that reason is less critical during engine idling when the rate of fuel consumption and the consequent combustion temperature is minimum. At wide-open throttle conditions, the emission is not considered serious as such throttle conditions are ordinarily of very short duration.

In other ways, the prior art has resorted to rather sophisticated and complicated control systems which vary in the following principal categories:

- a. where the exhaust gas is tapped,
- b. where the exhaust gas is introduced to the induction chamber,
- c. how the flow of the EGR is modified or admitted in response to various thermal automatic conditions, and
- d. the percentage of flow as related to engine performance.

Particularly in the control area, most systems have utilized no less than three control devices, namely a pressure sensitive admitting valve, a thermally activated control valve and various means for sensing various vacuum pressures within the induction passage of the carburetor.

SUMMARY OF THE INVENTION

This invention has a primary object to obviate the need for extraneous controls and to allow a more direct recirculation of gas under the influence of the carburetor and throttle mechanism.

As another object, this invention contemplates introducing the exhaust gas into the idle and low-speed fuel systems of a typical carburetor for premixing prior to entrance into the induction passage of the carburetor.

- 5 A specific object of this invention is to provide an ultra simple mode for exhaust gas recirculation by taking exhaust gas from the central portion of the exhaust manifold cross-over (as closely adjacent the carburetor throttle), introducing the exhaust gas through conventional idle or low-speed carburetor ports and controlling exhaust gas recirculation by conventional mechanisms already in said carburetor.

SUMMARY OF THE DRAWING

- 15 FIG. 1 is a central sectional view, somewhat schematic of a typical carburetor, and illustrating the idle and low-speed fuel circuits in conjunction with an exhaust gas recirculation system.

DETAILED DESCRIPTION

- 20 As shown in FIG. 1, the preferred embodiment broadly comprises an apparatus useful in an internal combustion engine having an exhaust system A for discharging combustion products from the engine and the carburetor B having an air horn 10 and a throttle 11 for inducting air and fuel for conveyance to said engine for combustion. The apparatus has an idle and low speed carburetor fuel system C which is useful in inducting an air/fuel mixture through two ports 12 and 13 adjacent to throttle 11. A communicating means D is employed to connect a cross-over passage 14 (of a manifold forming part of the exhaust system) with the idle and low speed fuel system C of the carburetor, whereby exhaust gases may be recirculated back into the air horn for re-introduction to the engine combustion cycle as controlled by the carburetor and other elements therein.

- 35 The carburetor B comprises a cast housing 15 within which is defined the air horn 10 having a venturi 16 shaped on the interior of one portion thereof. Throttle 11 is disposed at a lower portion of the air horn and is adapted for conventional movement. The air horn is continued through (a) a spacer plate 17 having a central opening 18 which is commensurate with the diameter of the air horn 10 at the bottom of the housing 15, (b) a manifold A via opening 19 completing the inlet of the system for the engine. A balance tube 20 is employed to equalize pressure between a fuel reservoir 23 and the upper portion of the air horn. A booster venturi 21 is disposed centrally within an upper portion of the air horn to cooperate in the manner of introducing primary fuel to the air horn.

- 50 The idle and low speed fuel system C comprises an idle tube 22 adapted to receive fuel from the reservoir 23 which normally maintains a level of fuel 26 in a primary fuel tube 24 and into which the idle tube extends. A float 25 is employed to maintain the fuel level 26 in both the primary fuel tube 24 and the reservoir 23 at a predetermined level. During idle and low speeds, fuel normally travels from the idle tube 22 through a cross-over passage 27 which has a calibrated restriction 28 at the mouth thereof to meter the flow of fuel during the idle and low speed circuit operation. Air enters the idle system through a primary bleed 29 exposed to atmosphere, the mixture of air and fuel proceeding down a passage 30 in which is provided another restrictor 31 which is primarily adapted to limit the mixture flow; another air bleed 32 is adapted to introduce additional air

into the idle and low speed system. The fuel and air mixture finally reaches the air horn of the carburetor by passing through port 12 (disposed below but adjacent the edge of the throttle 11) and a slotted port 13 (disposed adjacent but upstream from the throttle blade edge). Ports 12 and 13 are in series communication with passage 30; a needle valve assembly 33 is employed to control the flow of gases and/or fuel through port 12 during idle conditions. The nose 40 of the needle valve can be adjusted to provide the proper flow area through port 12.

The idle and low speed fuel system or circuit C is only operative when the throttle is in the closed or partly open condition thereby creating a significant vacuum sufficient to induce fuel and gases to be drawn in through ports 12 and 13. When the throttle is in the substantially open position, fuel is drawn into the air horn through a main fuel system (not shown) carrying fuel from the reservoir 23 into the interior of the booster venturi 21 through an integrally cast arm 34 supporting said booster venturi.

The communicating means D comprising the passage 30 which extends beyond ports 12 and 13 to the spacer plate 17, the latter having a passage portion 37 communicating with the lower portion of passage 30 by way of an opening 38 in alignment therewith. The passage portion 37 is much greater than passage 30 to conveniently allow for proper alignment during assembly with an orifice 36 disposed in the upper-most wall of the exhaust manifold A. Orifice 36 has a diameter 41 adapted to limit the maximum flow of exhaust gases even though shown slightly larger than passage 38 for other illustrative purposes. Manifold A has the cross-over passage 14 placed directly in communication with the carburetor ports 12 and 13 in a most direct and immediate route.

In operation, and during idle conditions, the throttle 11 will be in a position as shown in FIG. 1 (substantially closing the air horn and thereby port 13). A substantial vacuum is built up downstream of the throttle to draw fuel from the reservoir 23 up into the idle tube 22 to mix with air introduced at locations 27 and 32; the mixture is carried through passage 30 into port 12 and into the air horn. The high vacuum preferentially draws in the higher density air/fuel mixture to the partial exclusion of exhaust gas. Thus, in this condition, the means D is not capable of providing a maximum amount of exhaust gas for recirculation. As throttle 11 is opened to a low speed condition uncovering port 13, a greater percentage of uncovering the slotted port 13 will cause a higher degree of exhaust gas to be drawn into the air horn along with the air/fuel mixture in proportion to the lowering of vacuum at port 13. As the throttle is opened beyond the slotted port 13 into a mid-range condition, the vacuum will normally not be sufficient to draw the higher density air/fuel mixture thereinto, but will be sufficient to siphon in a specific flow of exhaust gas when exhaust gas circulation is most desirable. Thus, through both ports 12 and 13, exhaust gas will be introduced substantially into the air horn devoid of the air/fuel mixture. At a wide-open throttle condition, the vacuum at ports 12 and 13 will be extremely low so that even exhaust gas recirculation will substantially cease. A passage 39 is shown in an opposite wall of the spacer for the use by a PCV valve in crankcase flow-by.

I claim:

1. In an internal combustion engine having an inlet system for conducting an air/fuel mixture into said engine for combustion and having a throttle, an exhaust system for discharging the combustion products from said engine, and a fuel circuit means for adding fuel to said inlet system and having a fuel reservoir, the combination comprising:

- a. at least one port in said inlet system effective to function as part of said fuel circuit means, said port being located substantially adjacent said throttle so that said throttle controllably effects a suction at said port during flow through said inlet system.
- b. at least one opening in said exhaust system,
- c. means commonly communicating said opening, port and fuel reservoir at a location immediately adjacent said port whereby exhaust gases may be drawn into said inlet system premixed with fuel under the influence of vacuum operating at said port, for the purpose of continuous engine operation, said location being arranged so that at high suction levels fuel will be inducted therein through said port to the exclusion of exhaust gases and at low suction levels exhaust gases will be siphoned into the port to the exclusion of fuel.

2. The combination as in claim 1, in which said common communicating means includes a restrictor effective to limit the maximum flow of exhaust gases to said inlet system to a predetermined level.

3. The combination as in claim 1, in which said communicating means has a limiting orifice for controlling the maximum flow of exhaust gases.

4. In an internal combustion engine having an exhaust system for discharging combustion products from said engine, a carburetor with an air horn defined by a wall and a throttle for inducting air and fuel into said engine for combustion, the combination comprising:

- a. at least one port in said wall adjacent the closed position of said throttle so that said throttle controllably effects a suction at said port during flow through said air horn,
- b. means defining an idle and low-speed fuel circuit for delivery of fuel to said port, and
- c. a passage disposed partly in the wall of said air horn communicating said exhaust system with said port for providing exhaust gas recirculation, said port and passage being located so that at high suction levels fuel will be inducted into said port to the exclusion of exhaust gases and at low levels exhaust gases will be siphoned into the port to the exclusion of fuel.

5. The combination as in claim 4, in which two ports are disposed in the wall of said air horn each adjacent said throttle, one below and one above.

6. The combination as in claim 5, in which said port above said throttle is formed as a slot aligned with the length of said air horn.

7. In an internal combustion engine having an exhaust system for discharging combustion products from said engine, a carburetor with an air horn defined by a wall and a throttle for inducting air and fuel into said engine for combustion, said exhaust system having an exhaust manifold beneath said carburetor, the combination comprising:

- a. at least one port in said wall adjacent the closed position of said throttle
- b. means defining an idle and low-speed fuel circuit for delivery of fuel to said port,

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- c. a spacer disposed between said carburetor and manifold having an opening for extending said air horn, and
- d. a passage disposed partly in the wall of said air horn communicating said exhaust system with said port for providing exhaust gas recirculation and a

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passage portion in each of said spacer and manifold forming the remainder of said communicating passage, one of said passage portions having an orifice for limiting the maximum exhaust gas recirculation.

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