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[54] **EVAPORATIVE EMISSION SYSTEM**

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[52] **U.S. Cl.** **123/136;** 123/121

[51] **Int. Cl.²** **F02M 25/08**

[58] **Field of Search** 123/136, 121; 60/285, 301

[56] **References Cited**

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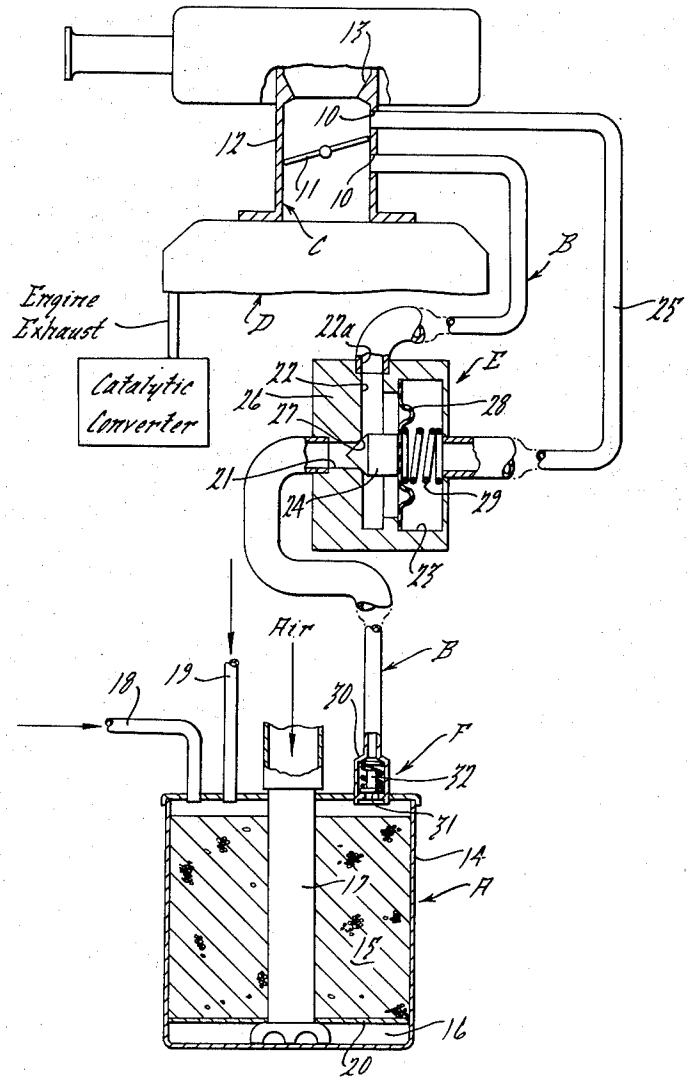
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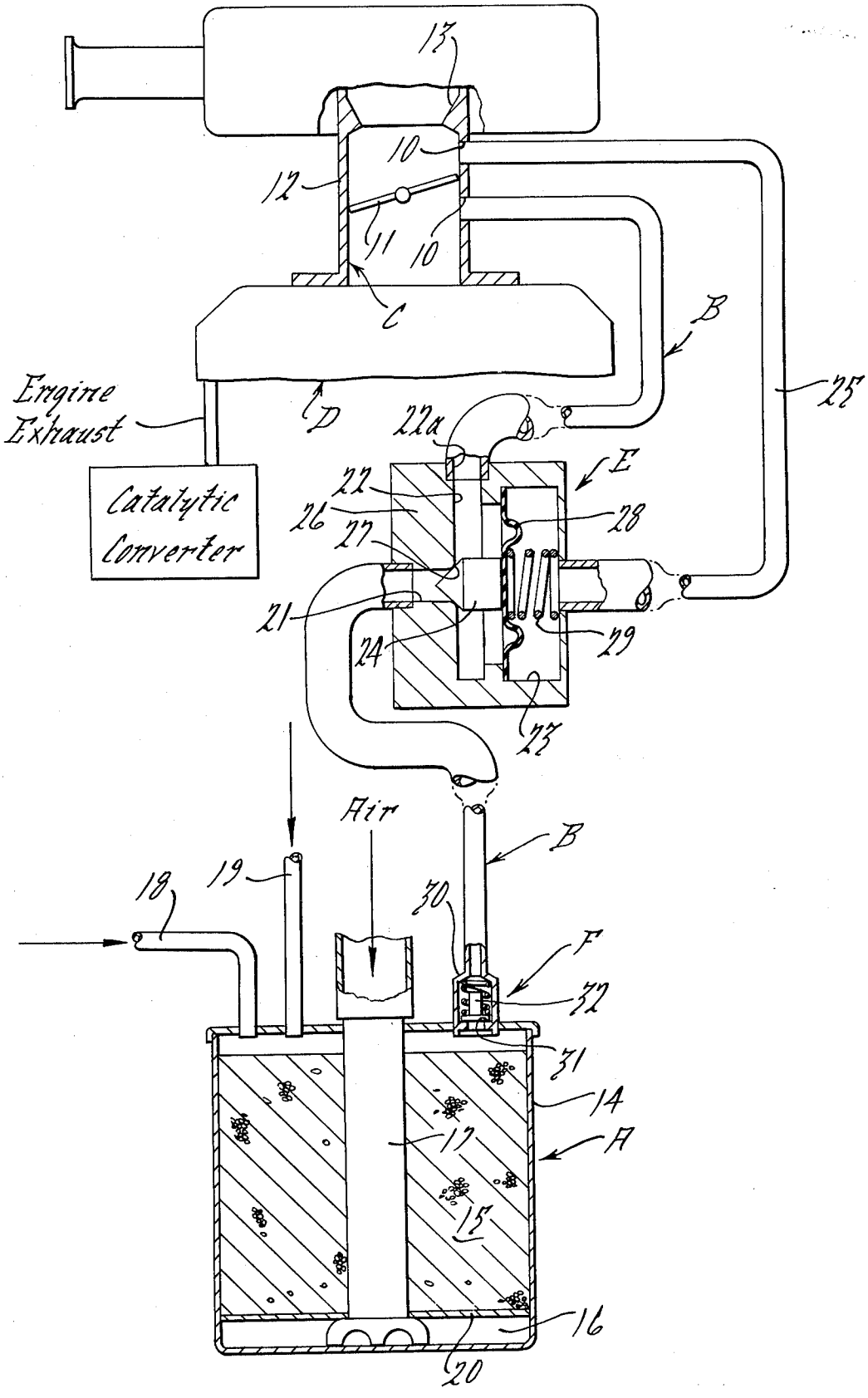
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[57] **ABSTRACT**

A fuel vapor recovery system for the adsorption, storage and eventual recycling of vapors to an engine. The system has a vapor-storage canister containing activated carbon for adsorbing fuel vapors from various parts of the engine fuel system. The system selectively purges the fuel vapors for introduction to the engine intake manifold. The purging is controlled in response to engine loading and engine speed for improved engine operation.

4 Claims, 1 Drawing Figure




13
10
12
11
10
C
B
25
Engine Exhaust
D
22a
E
Catalytic Converter
22
26
27
28
21
24
29
23
Air
B
18
19
30
F
32
31
14
17
A
15
16
20

EVAPORATIVE EMISSION SYSTEM

BACKGROUND OF THE INVENTION

In an effort to reduce hydrocarbon emissions from the fuel system, various evaporative loss control devices have been proposed, which typically comprise a canister filled with suitable adsorbent material, such as activated charcoal. The carbon adsorbs the hydrocarbon vapors when the engine is not in operation; when the engine is operative, means are provided to effect desorption or purging of the vapors from the adsorbent material so that these vapors can be fed to combustion chambers of the engine for consumption therein. During engine operation, the running vapor losses from both the fuel tank and carburetor bowl are being consumed as they are generated. This approach has worked successfully to reduce hydrocarbon emissions to the atmosphere, but under certain engine operating conditions, the introduction of both the stored and currently generated hydrocarbon vapors for consumption in the engine affects engine operation or causes an increase in the exhaust emission of unburned hydrocarbons. On other occasions, only the stored vapors may cause an over rich air/fuel mixture during the initial portion of the purged cycle. The latter can result in such a rich mixture that engine performance becomes irregular and poor (i.e., hesitation and stumble affecting drivability) and most importantly the carbon monoxide content of the exhaust is increased.

Although the prior vapor emission systems have been concerned with the need for a controlled purge of hydrocarbon vapors to avoid some of the above problems, the attempts have not been entirely successful. For example, there has been proposed a system which would have two adsorption beds connected in series to each other. Upon purging, the series connected adsorbent beds are unloaded sequentially thereby resulting in some degree of modulated release.

Another approach is the use of a canister bypass for providing a variable purge rate. The canister bypass attempts to smooth out the air/fuel ratio since the amount of air going ultimately through the throat of the carburetor will be constant, while the amount of air going through the adsorbent material increases or decreases in the response to the amount of air bypassing the adsorbent. In this manner, a controlled amount of purged fuel vapors may be obtained to some degree.

SUMMARY OF THE INVENTION

It is a primary object of this invention to provide an improved apparatus and method for a fuel vapor recovery system; purging of the system is controlled so that overrichness is avoided in the mixture receiving the recovered vapors and thereby avoid momentary sag or poor engine performance.

Still another object of this invention is to provide a means of controlling the return of excess fuel vapors to the combustion cycle of the engine in such a manner that the carburetor air-fuel ratio is maintained at least above 14/1, thus avoiding a significant change in the combustion products of the engine, such as carbon monoxide. This becomes significant particularly with respect to total auto emission controls which may employ a catalytic converter to reduce unwanted gaseous constituents of the exhaust; in many cases the catalytic converter requires a controlled feed (within a limited range) of carbon monoxide as part of the exhaust being introduced to the catalytic converter.

SUMMARY OF THE DRAWING

The FIGURE is a schematic illustration of various components comprising an evaporative emission control system. There is shown in cross-section a storage canister for fuel vapors as well as first and second purge control means and a typical carburetor used with a conventional internal combustion engine.

DETAILED DESCRIPTION

Referring now to the drawing, there is illustrated a fuel vapor recovery system adapted for recovering fuel vapors which may collect in the carburetor fuel bowl or the vehicle fuel tank. In general, the recovery system comprises a canister A containing a bed of adsorption material in the form of activated carbon, a passage B communicating the interior of said canister with the intake manifold C of an internal combustion engine D at a location downstream of throttle **11.** The recovery system further comprises a first control means E employed to completely shut off or completely open the passage B in response to a vacuum signal received from a location **9** upstream from the throttle **11** of carburetor **12,** but downstream from the venturi restriction **13** of the carburetor; this location is commonly referred to as the spark port. A second control means F is employed to operate in series with said first control means and is effective to modulate the flow of fuel vapors through said passage in response to the magnitude of the vacuum received from location **10,** thereby controlling the aperture through a portion of passage B.

The canister may typically comprise a container **14** having the bed of adsorption material **15** substantially filling said container, except for an air space **16** defined by a screen **20** at the bottom thereof; a fresh air intake **17** is arranged to admit air to said space **16** during a purging phase of the system. Fuel vapors are conveyed to the canister at the top thereof by way of a conduit **18** leading from a vehicle fuel storage tank and a conduit **19** leading from the carburetor fuel bowl. Thus, during inoperative conditions of the engine or hot soak cycles, fuel vapors are released and adsorbed by the adsorption bed **15,** the passage B being closed thereby maintaining atmospheric pressure therein suitable to prevent an induced air flow through **17** but receptive to admit vapors from conduits **18** and **19.**

To purge the canister of collected vapors, passage B is placed in communication with a vacuum obtained at location **10** in the intake manifold immediately below the throttle of the carburetor (this location is commonly referred to as the PCV port). The passage B is maintained closed when purging is not desired by the first control means E. Means E comprises a valve housing **26** having a boring or channel **22,** one end **22***a* of the channel serving as the inlet for vacuum; a cross bore **21** intersects with boring **22.** Passage B is interrupted by means E so that one break in passage B becomes the inlet at **22***a* and the other break in passage B becomes the outlet for the vacuum through crossbore **21.** A valve **24** (urged by spring **29**) is adapted to normally close off the connection between bore **21** and boring **22** by seating against surface **27.** Valve **24** is attached to a diaphragm **28** residing in chamber **23;** the diaphragm is actuated by a vacuum signal in conduit **25.** The vacuum signal is taken at location **9** (com-

monly referred to as the spark port) and the vacuum here is relatively non-existent at idle or wide-open-throttle conditions. Thus, passage B will be prepared to purge only during intermediate engine loading conditions.

To further modulate the flow of vapors during purging, control means F is employed to vary the aperture of passage B. Means F comprises a valve housing **30** defining an interior valve seat **31** which is progressively closed, but never completely, by a spring biased valve element **32** acting in response to intake manifold vacuum in passage B thereby to vary the spacing between element **32** and the seat **31.** Means F functions to allow more flow through, the lower the vacuum pressure; the latter vacuum force purges the vapors and acts proportionate to engine loading. There is a slight bleed through means F even in its most restricted position when vacuum pressure is the highest. Thus, the flow is not preprogrammed independent of engine operation.

We claim:

1. In an internal combustion engine having a fuel system, an intake manifold and a carburetor with a throttle to provide a gaseous mixture engine flow, an apparatus for controlling the recovery of fuel vapors in said system, comprising:

a. means for adsorbing and storing said fuel vapors,

b. a passage for purging said stored fuel vapors and for conveying said vapors to said intake manifold,

c. a first control means responsive to vacuum upstream from said throttle for maintaining said passage in either a fully opened or a fully closed condition, said passage having internal walls defining an aperture between said first control means and said means for absorbing vapors and through which flow must pass in said passage, and

d. a second control means responsive to vacuum in said intake manifold for regulating the aperture of said passage whereby said storing means is desorbed at a rate inversely proportional to engine flow.

2. An apparatus as in claim **1,** in which said second control means comprises a valve biased to a minimum aperture condition and progressively opened in opposition to said bias by an increase in intake manifold vacuum.

3. An apparatus as in claim **2,** in which said second means is actuated in response to PCV port vacuum.

4. The apparatus as in claim **1,** which further comprises, in combination with said apparatus, an engine exhaust system having a catalytic converter and means calibrated to vary in response to predetermined air/fuel mixtures, said second control means being effective to regulate desorption of fuel vapors from said storing means in such amounts as to maintain said calibrated means in a condition to provide an air/fuel mixture at least above 14/1 whereby the amount of carbon monoxide in said exhaust gas system is maintained in a predetermined range compatible for operation of said catalytic converter.

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