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CATALYTIC EXHAUST PURIFIER HAVING AIR CONTROL MEANS THEREFOR

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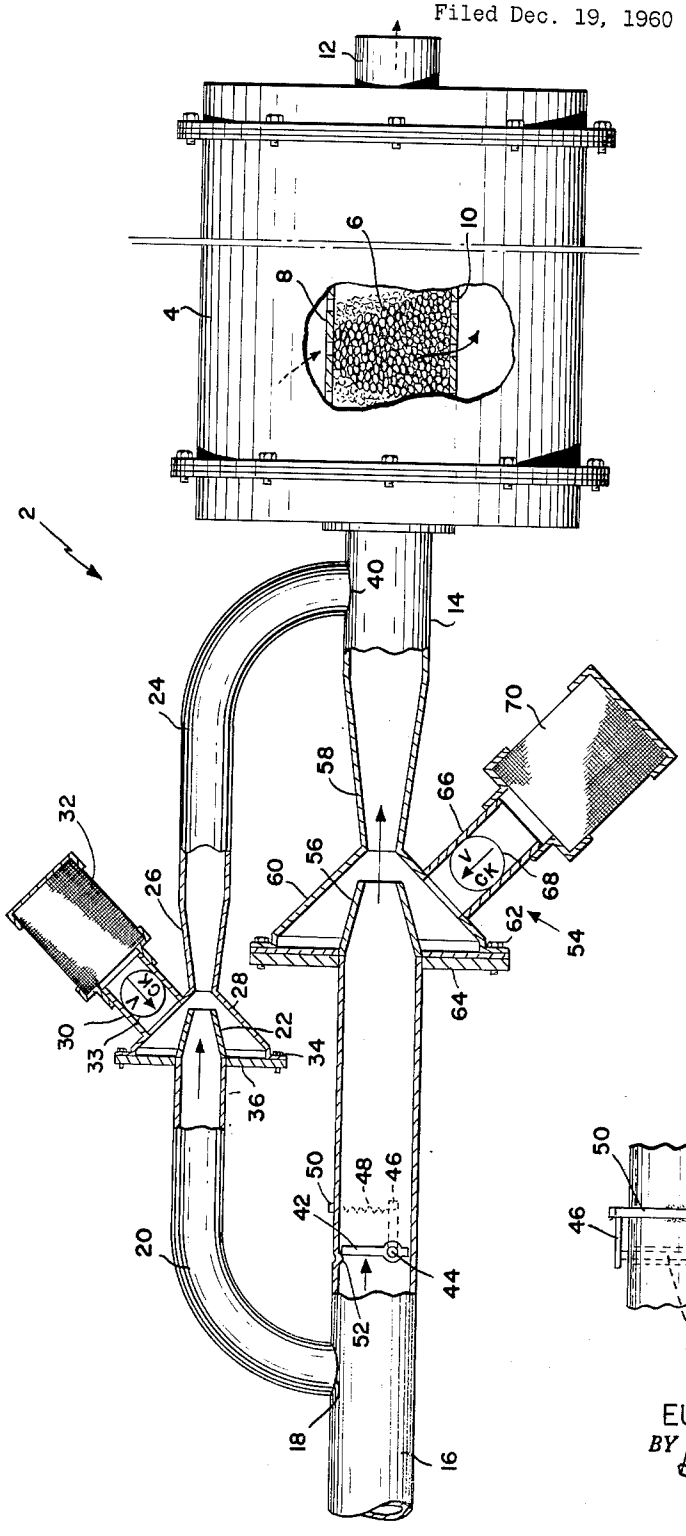

FIG. 1.

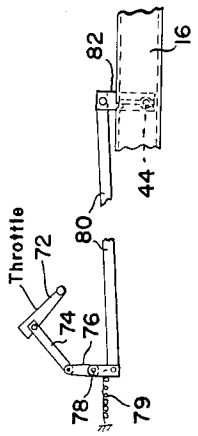

FIG. 3.

FIG. 2.

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CATALYTIC EXHAUST PURIFIER HAVING AIR CONTROL MEANS THEREFOR

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This invention relates to an improvement in a catalytic exhaust purifier, and more particularly relates to means for supplying the correct amount of air for complete oxidation of the oxidizable constituents of exhaust gases during varying conditions of operation of an internal combustion engine.

While catalytic exhaust purifiers for use with gasoline powered internal combustion engines are well-known in principle, numerous problems have been encountered in their practical application. One of the major problems has been to provide a high percentage of oxygen to oxidize the high percentage content of oxidizable constituents at idling and low speeds close to idling when the flow rate of the exhaust gas is relatively low, and at the same time providing for a large flow rate of oxygen at higher engine speeds when the flow rate of exhaust gas is relatively high but the oxygen percentage requirement is lower than at the idling condition. The standard use of an air inspirator of the ejector type has failed to solve this problem. A novel solution to the problem is provided by this invention.

The invention will be understood from a reading of the following description in conjunction with the drawings in which:

FIGURE 1 is a side elevation of an improved exhaust purifier in accordance with this invention partially broken away;

FIGURE 2 is a plan view of the linkage controlling the exhaust flow control valve in FIGURE 1; and

FIGURE 3 is a schematic view of an alternate control means for the exhaust flow control valve of FIGURE 1.

As shown in the drawing, a catalytic purifier 2 for exhaust gases in accordance with this invention has a catalytic purifier unit 4 containing a bed of catalyst 6 between perforate supports 8 and 10. Unit 4 has a discharge line 12 and is supplied with exhaust gases from conduit 14. Such catalytic units are well-known to the art and reference may be had, for example, to Houdry Patent No. 2,776,875, and Houdry Patent No. 2,828,189, for typical such units.

The novel means of supplying oxygen to the exhaust gases in the proper amounts by the introduction of air will now be described. Conduit 16 which is connected to the exhaust manifold of an automobile gasoline engine (not shown) has connected thereto at 18 a conduit 20 of a substantially smaller diameter than the diameter of conduit 16. Conduit 20 is provided with a reduced nozzle end 22 which discharges into a conduit 24 having a reduced inlet portion 26. A bell-shaped portion 28 is secured to the inlet end of conduit 26 and is supplied with air by a pipe 30 which has secured to its inlet end an air cleaner indicated at 32 and contains a check valve 33 to prevent backflow of exhaust gases when driving above idling speed. Bell-shaped portion 28 is flanged at 34 to a flange 36 secured to conduit 20. The parts 22 through 36 form a venturi air inspirator. Conduit 24 discharges into conduit 14 at 40.

Downstream of the point where conduit 20 takes off from conduit 16 there is provided in conduit 16 a valve 42 which is adapted to restrict conduit 16. Valve 42 is fixedly secured to a shaft 44 which is rotatably mounted in the walls of conduit 16. A lever 46 secured to shaft 44 is connected to an extension spring 48 which is secured to member 50 welded to conduit 16. Spring 48 through

lever 46 acts to bias valve 42 to the closed position against dimple 52 formed in conduit 16. Downstream of valve 42 is a venturi air inspirator 54 formed by a reduced nozzle portion 56 of conduit 16, reduced entrance portion 58 of conduit 14, bell-shaped portion 60 attached to conduit 14 and flanged at 62, to flange 64 secured to conduit 16, air supply pipe containing a check valve 68 and having at its inlet end an air purifier 70.

As will be apparent to one skilled in the art, the air inspirator formed by the parts 22 through 36 which handles the inspiration of air during the idling condition of the engine will be constructed to operate at a maximum efficiency at the idling condition, i.e. with a low c.f.m. (cubic feet per minute) flow of exhaust gases. Air inspirator 54 advantageously will be designed to operate at a maximum efficiency when the automobile is traveling at from about 65 to 75 miles per hour, which is the speed range at which the high speed carburetor jets normally come into action resulting in the requirement for a higher ratio of air to exhaust gases than is required at lower speeds above idling. Generally the smaller air inspirator for use primarily at idling will have an inside diameter at the discharge end of the nozzle in the range of from about .16" to .40" and an inner diameter for the throat (the entrance to inlet portion 26) of from about .17" to .41" with a distance between the discharge end of the nozzle and the throat of from ⅛" to ⅝". The larger venturi for employment during driving conditions will generally have an inside diameter at the discharge end of the nozzle from about .50" to about 1.25" and a throat (entrance to portion 58) of from about .60" to about 1.35" with the discharge end of the nozzle and the throat being about ⅛" to about ⅝" apart. For example, in a 1960 Corvair it was found to be satisfactory to employ an inner diameter of .315" for the nozzle and .335" for the throat with a nozzle-throat separation of ¼" in the smaller inspirator while employing .80" for the inner diameter of the nozzle and .90" for the throat with a separation of ⅜" for the larger inspirator.

Operation

Spring 48 is designed to bias valve 42 towards its closed position to restrict the passage of exhaust gases through conduit 16 when the gasoline engine is idling or operating at low speed to cause a sufficient flow of exhaust gases into conduit 20 and its associated venturi to provide the oxygen necessary for oxidation of the oxidizable constituents of the exhaust gases. Check valve 68 prevents the flow of exhaust gases out through pipe 66. The design of the air inspirator between conduits 20 and 24 is selected to provide a relatively high rate of flow of the exhaust gases delivered at the idling or low speed condition of the engine in order that the air inspirator between conduits 20 and 24 can function efficiently to supply the desired volume of air for mixture with the exhaust gases at the idling or low speed condition. It will be evident that the air inspirator 54 which is designed for efficient handling of the large volume of exhaust gases supplied by the engine at higher speeds would function very inefficiently if it alone were handling the exhaust gases at idling speed.

As the volume of exhaust gases increases, the pressure in conduit 16 increases and valve 42 is moved in the direction of opening to provide for an increase in flow of gases through conduit 16, air inspirator 54, conduit 14 and through the catalytic unit 4. Air inspirator 54 is designed to provide the larger volumes of air required when the engine is operating at a speed above low speed.

At speeds above low speed until relatively high speeds of, for example over 65 miles per hour, are reached, the ratio of contaminants per unit volume of exhaust gases is sufficiently constant so that the increase

in rate of flow of the exhaust gases as the engine speed is increased will produce a satisfactory increase in the amount of air inspirated by inspirator 54. The increased ratio of air to exhaust gases desired due to the increase of the percentage of contaminants at relatively high speeds is achieved by designing the air inspirator to provide maximum efficiency at those speeds at which the percentage of contaminants increases.

As shown in FIGURE 3, the opening and closing of valve 42 can be controlled by the actuation of the conventional automobile throttle pedal 72, which is pivotally connected to a lever 74. Lever 74 is pivotally connected to lever 76 which is pivotally mounted at 78 and in turn is pivotally connected to lever 80. An extension spring 79 connected to lever 76 urges lever 76 in a direction to restore the throttle pedal 72 to the idling position. Lever 80 is pivotally connected to a lever 82 which is fixedly secured to shaft 44 on which valve 42 is mounted. In this modification, spring 48 and lever 46 are eliminated. As the throttle pedal 72 is moved downwardly to advance the engine speed from idling speed, it will be apparent that valve 42 will be opened to permit the flow of exhaust gases through air inspirator 54. It will be appreciated that a wide variety of structurues can be employed to control valve 42 to achieve the desired effect of opening valve 42 relatively promptly on advancing the engine speed above idling speed.

It is not desired to be limited except as set forth in the following claims.

What is claimed is:

1. In the combination of a catalytic exhaust purifier for employment with an automobile having a variable speed gasoline powered internal combustion engine, an exhaust conduit discharging into said purifier and an air inspirator for supplying air to said conduit in an amount to support catalytic oxidation of exhaust gas contaminants at speeds substantially above idling, the improvement comprising valve means in said conduit upstream of said inspirator restricting said conduit during conditions of a low rate of flow of exhaust gases and

moving in the opening direction under conditions of increasing exhaust gas pressure, a by-pass conduit having its inlet end connected to said first-mentioned conduit upstream of said valve and its discharge end connected to said conduit downstream of said inspirator and an air inspirator for supplying air to the by-pass conduit in an amount to support catalytic oxidation of exhaust gas contaminants at a low rate of flow of exhaust gases, each of said air inspirators having check valves to prevent the flow of exhaust gases therethrough.

2. In the combination of a catalytic exhaust purifier, an automobile having a variable speed gasoline powered internal combustion engine, an exhaust conduit discharging into said purifier and an air inspirator for supplying air to said conduit in an amount to support catalytic oxidation of exhaust gas contaminants at speeds substantially above idling, the improvement comprising a valve in said conduit upstream of said inspirator, a linkage connected to the throttle of the engine to cause said valve to restrict said conduit during conditions of a low rate of gas flow and move said valve in the direction of opening as said throttle is opened, a by-pass conduit having its inlet end connected to said first-mentioned conduit upstream of said valve and its discharge end connected to said conduit downstream of said inspirator and an air inspirator for supplying air to the by-pass conduit in an amount to support catalytic oxidation of exhaust gas contaminants at a low rate of flow of exhaust gases, each of said air inspirators having a check valve to prevent the flow of exhaust gases therethrough.

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