

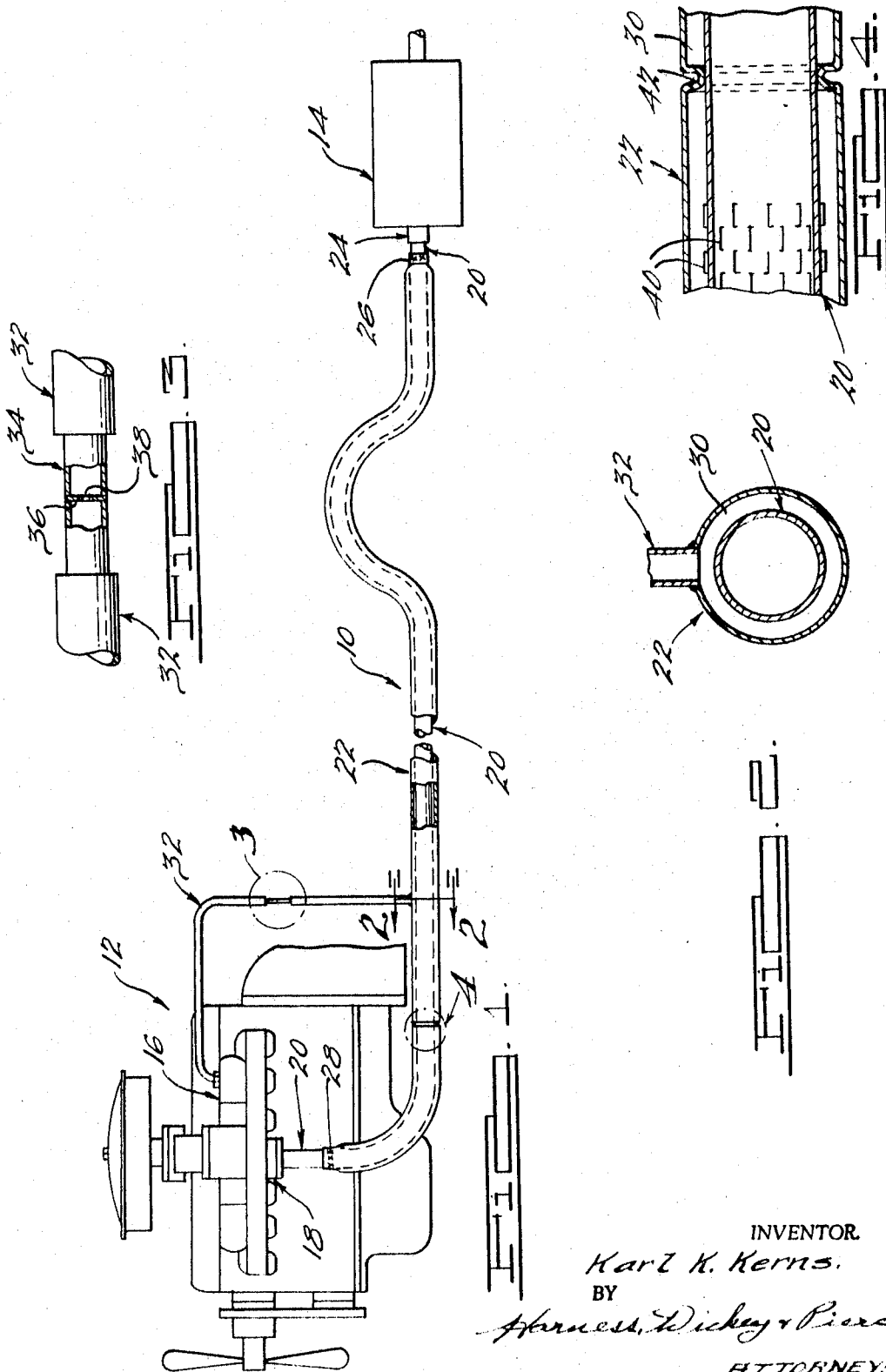
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EXHAUST SYSTEM

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EXHAUST SYSTEM

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8 Claims

ABSTRACT OF THE DISCLOSURE

The exhaust tube section of an exhaust system includes over at least a portion of its length spaced concentric tubes which provide a chamber around the inside exhaust gas carrying tube that is connected by a conduit to the intake manifold of an engine so that the insulative properties of vacuum in the chamber around the inside tube serve to retain heat and improve the operation of a catalyst unit connected to the end of an exhaust pipe.

This invention relates generally to exhaust systems for internal combustion engines, and more particularly, to an insulated exhaust conduit for communicating exhaust gases between an automotive engine and an exhaust gas purifier or afterburner.

Because it is essential that the operating temperatures of catalytic exhaust gas purifiers and afterburners are maintained at a relatively high level, it is desirable to insulate the exhaust conduit communicating the exhaust gases from the automotive engine to these devices so that the latent exhaust gas heat may be efficiently transmitted thereto along with the exhaust gases. It has been found, however, that most insulating materials are of a relatively low density and low strength when placed around an automotive exhaust conduit, and thus they require an additional protective cover to prevent severe abrasive damage. In general, the present invention is directed toward a highly effective and extremely durable insulated exhaust conduit which incorporates two substantially coextensive, concentric tubes, the radially outermost of which forms an air-tight insulating chamber around the radially innermost tube. The present invention is further directed toward means for selectively communicating the vacuum conditions existing within the automotive engine's intake manifold to the insulating chamber such that a vacuum insulating medium is maintained therein.

It is accordingly a primary object of the present invention to provide an exhaust conduit for communicating exhaust gases from an automotive engine to an exhaust gas purifier or afterburner, which conduit comprises a pair of concentric tubes that define an exhaust gas transmitting chamber and a vacuum insulating chamber surrounding the exhaust gas transmitting chamber.

It is another object of the present invention to provide an exhaust conduit of the above character which is provided with means for maintaining a vacuum insulating medium in the vacuum chamber during quick accelerations and for automatically reducing the vacuum insulating medium during heavy throttle operation.

It is still another object of the present invention to provide an exhaust conduit of the above character wherein the vacuum source for the vacuum insulating medium is provided by the vacuum conditions in the automotive engine's intake manifold.

It is yet another object of the present invention to provide an exhaust conduit of the above character which operates to attenuate certain objectionable exhaust gas sounds produced during operation of its associated automotive engine.

Other objects and advantages of the present invention will become apparent from the following detailed descrip-

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tion taken in conjunction with the accompanying drawing, wherein:

FIGURE 1 is a side elevational view, partially broken away, of a preferred embodiment of the exhaust conduit of the present invention, as seen in operative association with an automotive engine and catalytic exhaust gas purifier;

FIGURE 2 is a transverse cross-sectional view taken along the line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged side elevational view, partially broken away, of the structure illustrated within the circle 3 of FIGURE 1; and

FIGURE 4 is an enlarged longitudinal cross-sectional view of the structure illustrated within the circle 4 of FIGURE 1.

Referring now to FIGURE 1 of the drawing, an exhaust conduit 10, in accordance with a preferred embodiment of the present invention, is shown in operative association with an internal combustion engine, generally designated 12, and a catalytic type exhaust gas purifier 14. The engine 12 includes an intake manifold 16 and an exhaust manifold 18, the latter of which communicates exhaust gases produced during operation of the engine 12 to the exhaust conduit 10. These exhaust gases are then transmitted through the conduit 10 to the purifier 14 where the unburned hydrocarbons and CO in the gases are removed therefrom. It may be noted that although specific reference is made herein to the operative combination of the exhaust conduit 10 with the catalytic purifier 14, the conduit 10 is readily adapted to be used with any of a number of well known types of exhaust gas afterburners.

The exhaust conduit 10 comprises a pair of annular concentric tubes 20 and 22, the former of which is communicable at one end with the exhaust manifold 18 of the engine 12 and at the opposite end with an inlet bushing 24 of the purifier 14. The tube 22 extends around and is substantially coextensive of the tube 20, and is formed with swaged or necked down sections 26 and 28 at its opposite ends. The sections 26 and 28 are spotwelded or similarly joined to the outer periphery of the tube 20 in a manner such that air-tight joints are provided between the tubes 20 and 22 at the opposite ends of the tube 22.

As best seen in FIGURE 2, the outer periphery of the tube 20 and the inner periphery of the tube 22 define an annular chamber, generally designated 30, which surrounds and is substantially coextensive of the tube 20. In a preferred construction of the exhaust conduit 10, the radial distance between the outer periphery of the tube 20 and the inner periphery of the tube 22 is between $\frac{1}{4}$ and $\frac{3}{16}$ of an inch. Also, the tube 20 is preferably of a minimum gauge (approximately .042 inch) for satisfactory hot corrosion life and for minimizing warm-up time. The annular chamber 30 is adapted to provide an insulating medium around the tube 20 so that the maximum amount of latent exhaust gas heat will be communicated to the purifier 14 by the exhaust gases as they are transmitted through the interior of the tube 20, thus maintaining the purifier 14 at the desired operating temperature.

Referring now to FIGURES 1 and 3, a tubular vacuum conduit 32 communicates the intake manifold 16 of the engine 12 with the chamber 30 and, accordingly, the vacuum conditions existing within the intake manifold 16 will be transmitted to the interior of the chamber 30. A vacuum control orifice housing 34 is mounted in-line in the vacuum conduit 32 and is formed with a transversely extending partition section 36 within which is formed a vacuum control orifice 38. The size of the orifice 38 is selected such that during idling or rapid acceleration of the engine 12, a relatively high vacuum is maintained within the chamber 30; and during long, heavy

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throttle operation of the engine 12, where a substantially greater quantity of exhaust gases is transmitted to the purifier 14, and where a relatively large amount of latent heat removal or dissipation is desired to prevent overheating of the purifier 14, a relatively low vacuum will be maintained in the chamber 30.

It will be noted that the control orifice housing 34 also functions to provide flame stop means for preventing an induction backfire which might occur within the manifold 16 from propagating into the interior of the chamber 30, thereby causing serious damage to both the engine 12 and the entire exhaust system therefor.

In an alternative construction of the present invention, a suitable check valve device may be provided in the vacuum conduit 32 to function in essentially the same manner as the orifice 38 in maintaining a relatively high vacuum in the chamber 30 during engine idling and accelerating conditions, and in reducing the vacuum in the chamber 30 during heavy throttle operation of the engine 12.

Referring now to FIGURE 4, it will be seen that the upstream (left) end of tube 20 is formed with a bank of small flat louvers, generally designated 40, which communicate the interior of the tube 20 with the insulating chamber 30. By thus louvering the tube 20, the chamber 30 is adapted to function, not only as an insulating chamber as previously described, but also as an exhaust sound attenuating chamber to remove certain objectionable exhaust gas sounds produced during operation of the engine 12. The tube 22 may be swaged inwardly or necked down into engagement with the outer periphery of the tube 20, as seen at 42, to control the volume of the chamber 30 which functions to attenuate the exhaust gas sound. The bank of louvers 40, together with the necked-down section 42 of the tube 22 may be located along the tubes 20 and 22, respectively, in accordance with the frequency or range of frequencies of exhaust sound that is desired to be attenuated, it being apparent that as the volume of the sound attenuating section of the chamber 30 increases, (i.e., as the necked-down section 42 of the tube 22 is located further toward the right end of the tube 22), the chamber 30 will attenuate lower exhaust sound frequencies. It may be noted that tests have shown that forming the louvers 40 in the tube 20 does not seriously impair the insulating properties of the chamber 30, and thus the chamber 30 effectively serves the dual purpose of retaining sufficient latent exhaust gas heat within the exhaust gases communicated through the tube 20, while simultaneously attenuating or removing certain objectionable exhaust gas sounds from these gases.

An exemplary method of fabricating the exhaust conduit 10 comprises the steps of initially concentrically aligning or orienting the tubes 20 and 22. The interior of the radially innermost tube 20 and the chamber 30 would thereafter be filled with sand, water or a similar economical removable medium. The tubes 20 and 22 then could be simultaneously bent to the desired configuration on a horizontal mandrel or similar type pipe bending apparatus without causing any undesirable restriction of the chamber 30 or the tube 20. Upon completion of the bending operation, the removable medium would be removed from the interior of the tube 20 and the chamber 30, and the opposite ends of the tube 22 could be swaged inwardly and joined to the tube 20, as seen at 26 and 28 in FIGURE 1.

During normal operation of the engine 12, exhaust gases are transmitted from the engine's exhaust manifold 18 through the tube 20 to the purifier 14, where any unburned hydrocarbons and CO in the exhaust gases are removed therefrom. The vacuum conditions existing within the intake manifold 16 are transmitted through the vacuum conduit 32 into the chamber 30 where this vacuum acts to insulate the exhaust gases passing through the tube 20 so that the latent exhaust gas heat of these gases is transmitted to the purifier 14 to maintain the

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purifier 14 at the desired operating temperature. During idling conditions or rapid acceleration of the engine 12, the control orifice 38 maintains a relatively high vacuum within the chamber 30, thereby effecting a correspondingly high degree of heat retention by the chamber 30. During long, heavy throttle operation of the engine 12, where there is a relatively continuous flow of exhaust gases to the purifier 14, and where it is desired to have a relatively large amount of heat removal, the orifice 38 effects a reduction in the vacuum conditions within the chamber 30, thereby effecting a corresponding reduction in the insulating properties of the conduit 10.

While it will be apparent that the preferred embodiment herein illustrated is well calculated to fulfill the objects above stated, it will be appreciated that the exhaust conduit 10 of the present invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. In a heat retaining exhaust pipe for an automotive engine,
 - an elongated exhaust gas transmitting tube,
 - an elongated tubular shell surrounding said tube and forming an air-tight chamber therearound, and
 - means communicating said chamber with the intake manifold of said engine in a manner such that vacuum conditions existing within said engine will be transmitted to said chamber.
2. In an insulated exhaust pipe for an automotive engine having an intake manifold,
 - a pair of substantially coextensive, annular concentric tubes,
 - the radially outermost of said tubes having its opposite ends swaged inwardly into engagement with the radially innermost of said tubes,
 - said tubes defining a substantially air-tight annulus surrounding said radially innermost tube, and
 - conduit means communicating said annulus with said intake manifold of said engine.
3. In combination in an exhaust system for an automotive engine,
 - a catalytic exhaust gas purifier,
 - an elongated exhaust gas transmitting tube communicating said purifier with said engine,
 - an elongated tubular shell surrounding said tube and forming an air-tight chamber therearound, and
 - means communicating said chamber with the intake manifold of said engine in a manner such that vacuum conditions existing within said engine will be transmitted to said chamber.
4. In an exhaust system for an automotive engine having an intake manifold,
 - a catalytic exhaust gas purifier,
 - an elongated exhaust conduit communicating said purifier with said engine,
 - said exhaust conduit comprising a pair of substantially coextensive and concentric tubes,
 - the radially outermost of said tubes having its opposite ends joined to the radially innermost of said tubes in substantially air-tight joints,
 - the inner periphery of said radially outermost tube and the outer periphery of said radially innermost tube defining an annulus which surround said radially innermost tube,
 - conduit means communicable at one end with said intake manifold and at the opposite end with said annulus, and
 - means for controlling the pressure in said annulus including a control orifice in said conduit means.
5. In a combination insulated and exhaust sound attenuating conduit for an automotive engine having an intake manifold,
 - a pair of substantially coextensive, annular concentric tubes,

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said tubes being joined at their opposite ends and forming a substantially air-tight annular therebetween, and

conduit means communicating said annulus with said intake manifold of said engine,

the radially innermost of said tubes being formed with a bank of louvers communicating the interior of said radially innermost tube with said annulus.

6. In an exhaust system for an automotive engine having an intake manifold,

an exhaust gas purifier,

an elongated exhaust conduit communicating said purifier with said engine,

said conduit comprising a pair of substantially co-extensive and concentric tubes,

said tubes having their opposite ends joined and defining a substantially air-tight annulus therebetween,

the radially innermost of said tubes being formed with a bank of louvers communicating said annulus with the interior of said radially innermost tube,

the radially outermost of said tubes being necked down into engagement with said radially innermost tube and thereby at least partially defining an exhaust sound attenuating chamber in said annulus, and

conduit means communicable at one end with said intake manifold and at the opposite end with said annulus.

7. In an exhaust system for an internal combustion engine including a source of vacuum, an elongated tubular

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exhaust gas conduit, said conduit including a first tube adapted to transmit exhaust gases therethrough, said conduit including a second tube disposed in a generally surrounding relationship with respect to said first tube and spaced from it to define a chamber surrounding the first tube, said first and second tubes being secured together to exclude outside air pressure from said chamber, and conduit means connecting said chamber to said vacuum source so that said chamber is at less than atmospheric pressure and serves to insulate said first tube.

8. The invention set forth in claim 7 wherein said conduit means includes an orifice inhibiting rapid changes of vacuum in the conduit means.

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