June 19, 1973 G. E. SCHEITLIN ET AL 3,740,197

CATALYTIC CONVERTER

Filed May 10, 1971

4 Sheets-Sheet 1

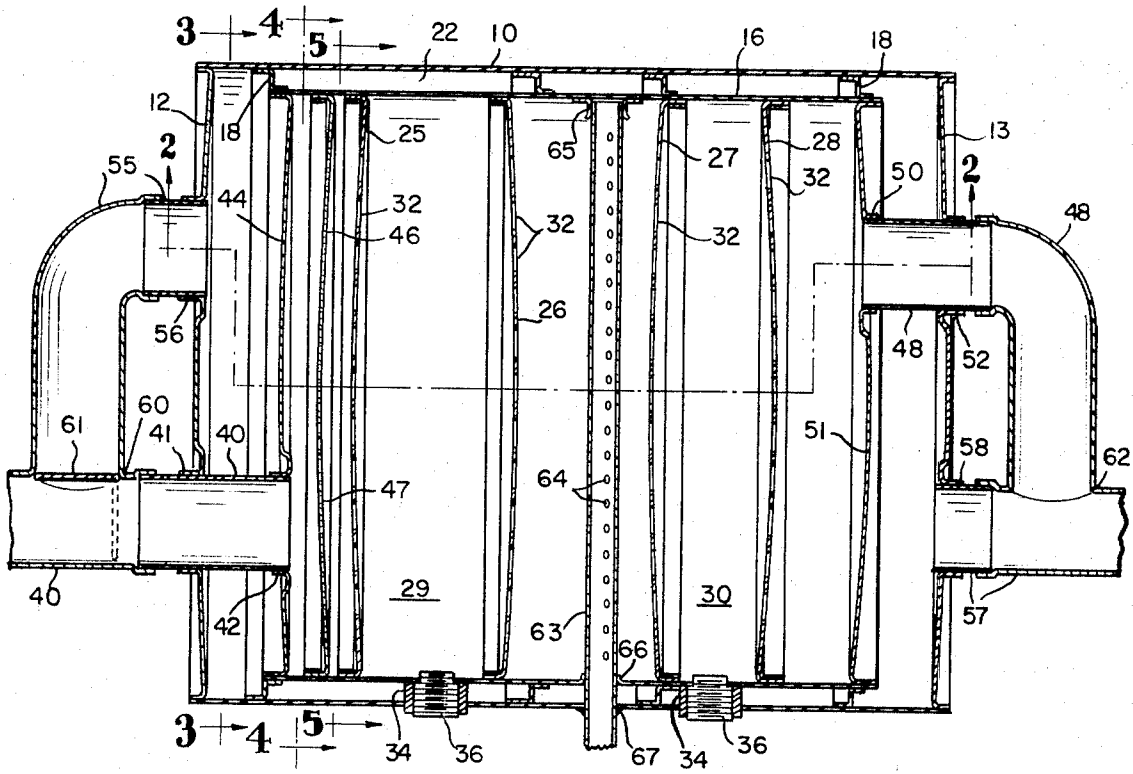

Fig. 1

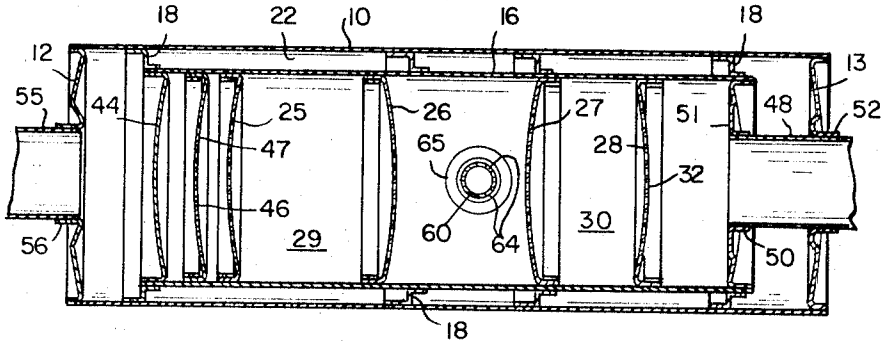

Fig. 2

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4 Sheets-Sheet 2

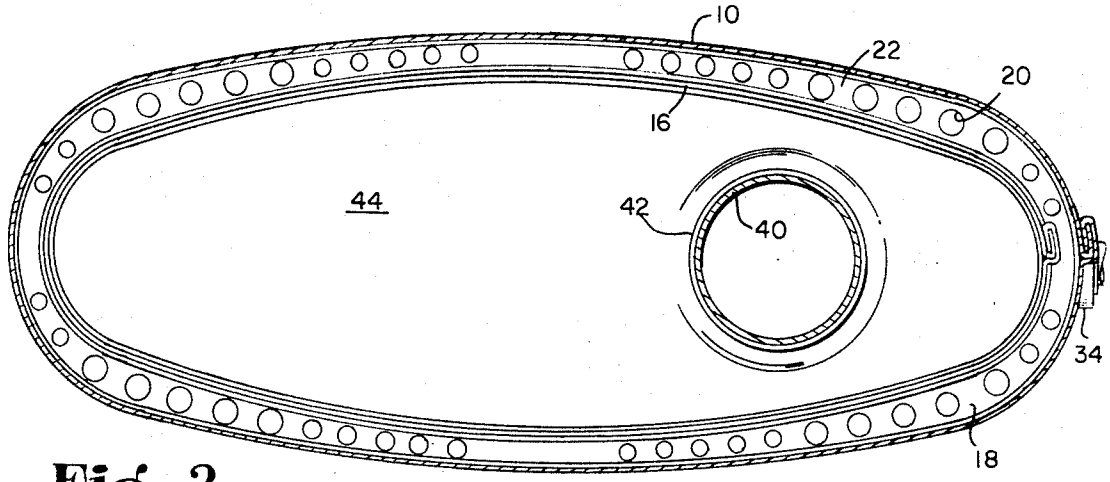

Fig. 3

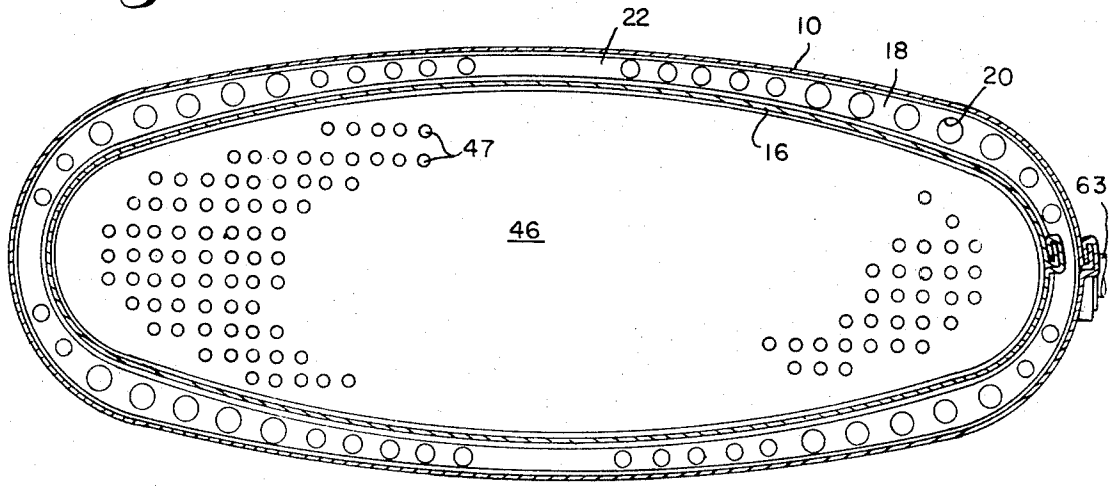

Fig. 4

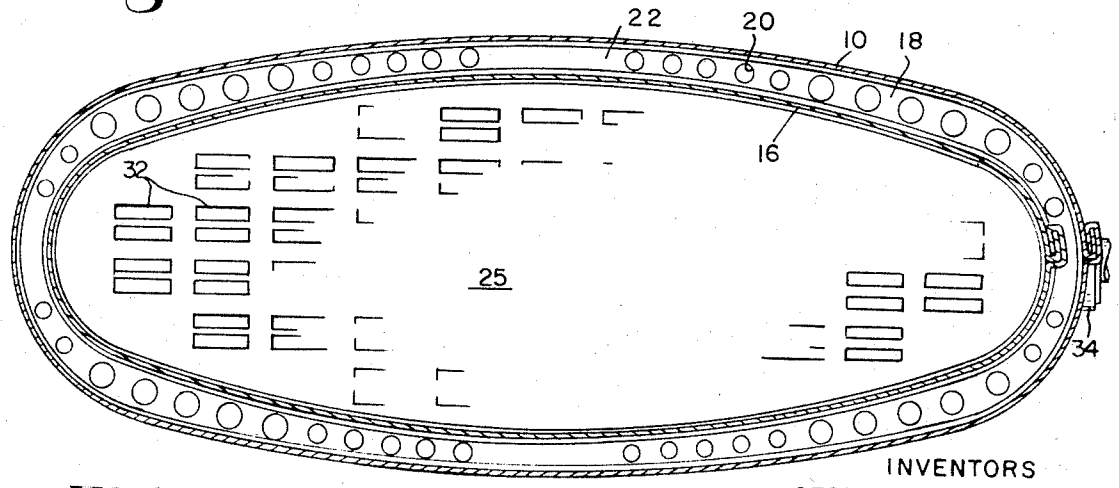

Fig. 5

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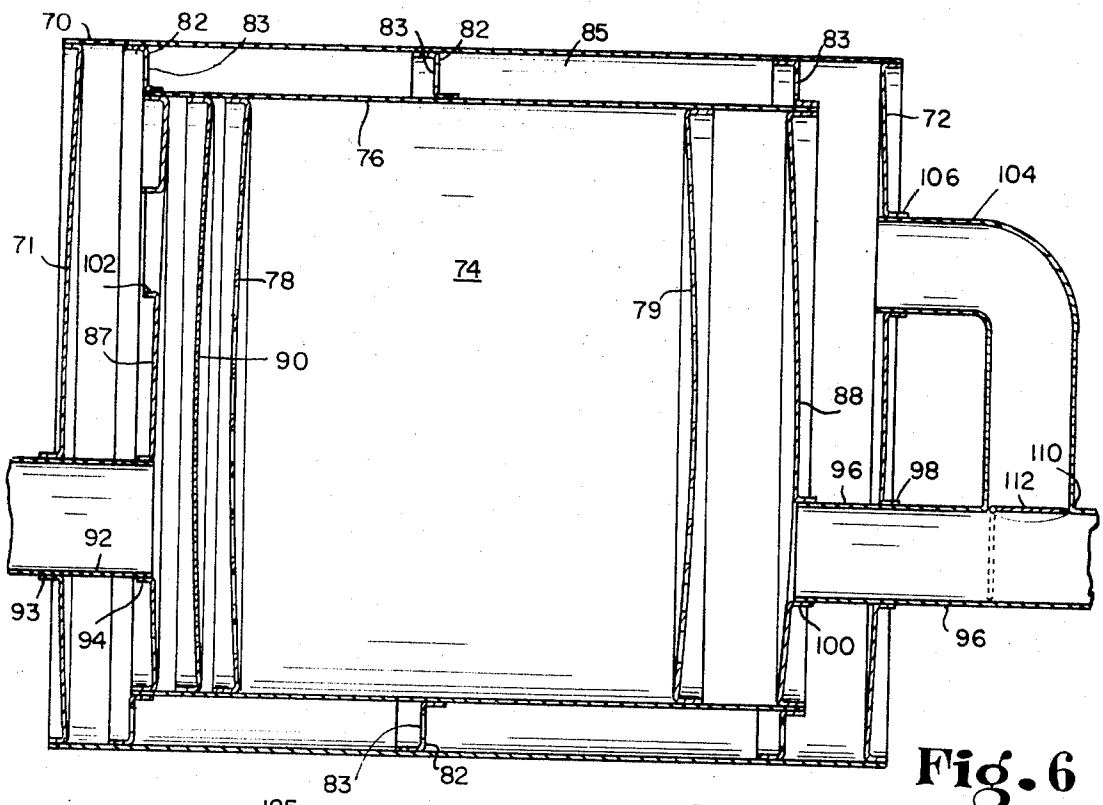

Fig. 6

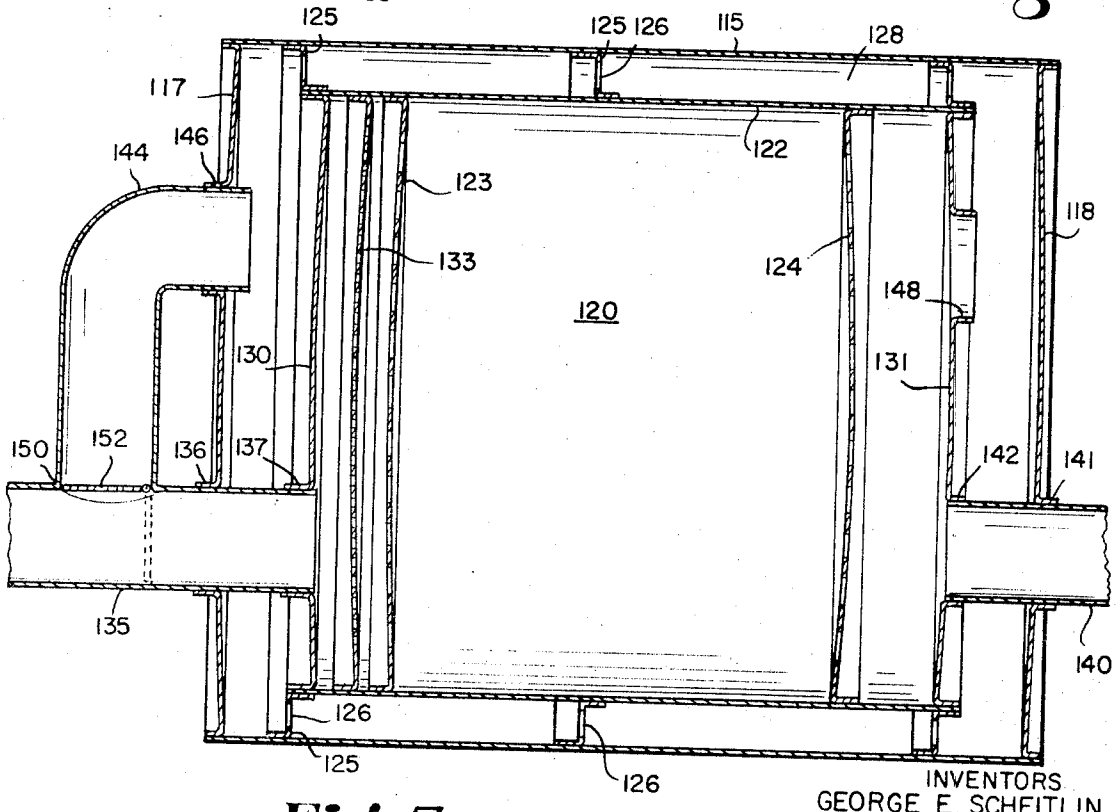

Fig. 7

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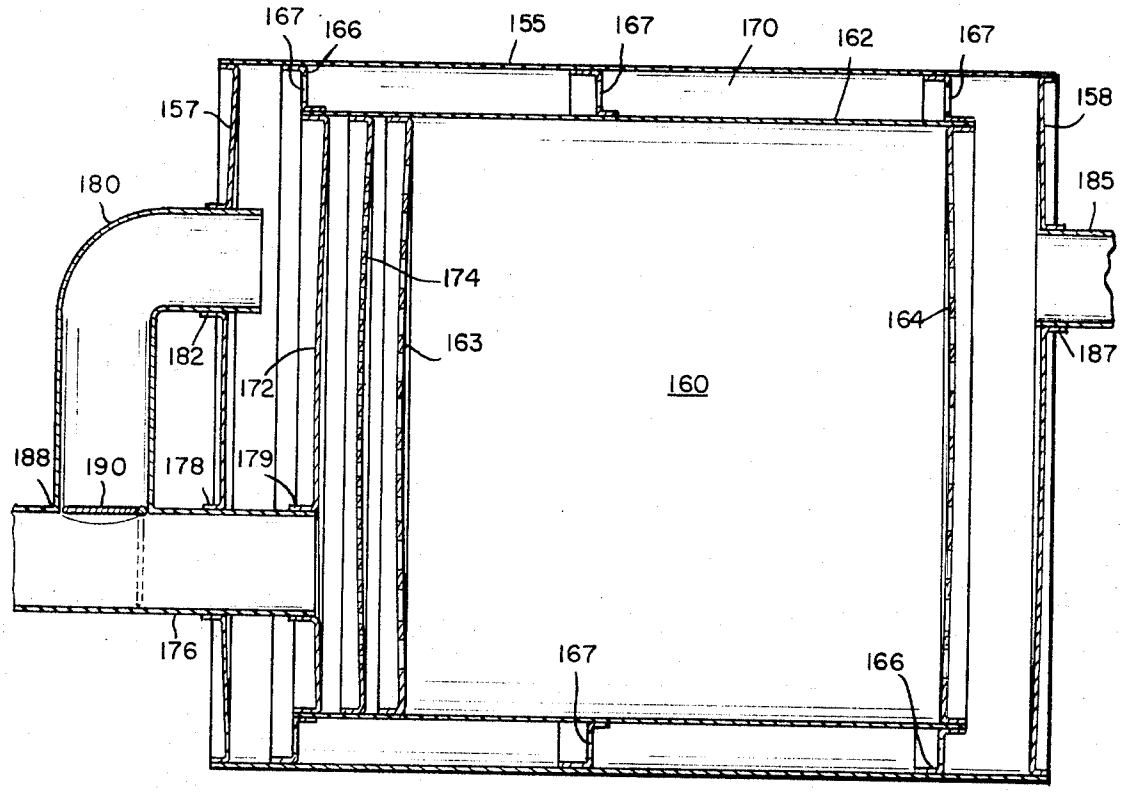

Fig. 8

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3,740,197

CATALYTIC CONVERTER

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Int. Cl. F01n 3/14; B01j 9/04
U.S. Cl. 23—288 F 7 Claims

ABSTRACT OF THE DISCLOSURE

A catalytic converter for removing noxious pollutants from an exhaust gas stream having a conversion chamber mounted therein. Gas inlets and outlets are prvoided in open communication with said chamber and with a bypass passage around said chamber. A valve is connected to said inlet or outlets for selectively controlling the gas flow through the converter so that the exhaust gases passing through the converter may or may not be subjected to the action of the conversion chamber depending upon the positioning of said valve.

BACKGROUND OF THE INVENTION

Catalytic converters for removing noxious pollutants from an automobile exhaust gas stream are known in the art. U.S. Pats. No. 2,991,160 and No. 3,090,677 show such a converter which also employs a bypass so that the exhaust gases moving therethrough may or may not be subjected to the action of a catalytic material for removing the pollutants therefrom, depending upon whether the exhaust gases are directed through, or bypassed around, the catalytic material.

The instant invention is concerned with an improved catalytic converter provided with a bypass for the catalytic material which can be simply and easily constructed, and which will prove sturdy and durable in use.

SUMMARY OF THE INVENTION

In accordance with one form of the invention, there is provided an elongated shell closed at its ends by a pair of end caps. A sleeve is carried within the shell, and a plurality of longitudinally spaced apertured plates extend across said sleeve to form therewith a plurality of longitudinally spaced conversion chambers adapted to hold catalytic material for removing the noxious pollutants in the exhaust gas stream passing through said chambers.

End plates are mounted in said sleeve outwardly from the outermost ends of the conversion chambers. And a first set of inlet and outlet conduits are mounted in the end caps with their inner ends terminating between said end plates and the outermost ends of the conversion chambers. In this manner, the exhaust gases moving through the converter between said first set of inlet and outlet conduits will be forced to flow through the conversion chambers to remove the pollutants therefrom.

The sleeve is spaced inwardly from the end caps and is supported in spaced relation to the shell by a plurality of supports extending around said sleeve with the space around the sleeve defining an annular bypass passage through the converter. A second set of inlet and outlet conduits are mounted in the end caps with their inner ends terminating outwardly of said end plates. Thus, said second set of inlet and outlet conduits are in open communication with said bypass passage so that the exhaust gases moving through the converter between said second set of inlet and outlet conduits will not pass through the conversion chambers.

The inlet conduits in said first and second sets of conduits are interconnected outside the extent of the converter, and a valve is located at their junction for selectively controlling the gas flow through the converter between the desired sets of inlet and outlet conduits.

Conveniently, a tube having a plurality of openings formed therein extends across the sleeve between the adjacent ends of a pair of the conversion chambers. Said tube is adapted to be connected to a source of pressurized air for supplying air to the conversion chamber interposed between it and the outlet conduit in said second set of inlet and outlet conduits so that said chamber can operate in an oxidizing atmosphere.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings illustrate the invention. In such drawing:

FIG. 1 is a longitudinal horizontal section of a catalytic converter embodying the invention;

FIG. 2 is a vertical section taken on the line 2—2 of FIG. 1;

FIG. 3 is an enlarged vertical section taken on the line 3—3 of FIG. 1;

FIG. 4 is an enlarged vertical section taken on the line 4—4 of FIG. 1;

FIG. 5 is an enlarged vertical section taken on the line 5—5 of FIG. 1;

FIG. 6 is a longitudinal horizontal section similar to FIG. 1, but showing a modified form of the converter;

FIG. 7 is a longitudinal horizontal section similar to FIG. 1, but showing another modified form of the converter; and

FIG. 8 is a longitudinal section similar to FIG. 1, but showing still another modified form of the converter.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The noxious pollutants in automobile exhaust systems can be generally classified into two basic groups; the oxidizable group—the noxious hydrocarbons and carbon monoxide, and the reducible group—the oxides of nitogen. These pollutants can be most effectively removed from the exhaust gases if they are reacted with catalysts which are selective for each group and under the optimum conditions of reaction. Thus, with the catalysts presently available, the most efficient removal of the pollutants from the exhaust gases can be achieved by reacting the exhaust gases with a catalyst selective for the oxides of nitrogen in a reducing or non-oxidizing atmosphere and by reacting the exhaust gases with a catalyst selective for carbon monoxide and the noxious hydrocarbons in an oxidizing atmosphere. This invention provides structure which, in addition to providing a means for permitting the exhaust gases to bypass such catalysts, also, if desired, makes the selective treatment of the exhaust gases possible.

In the embodiment shown in FIGS. 1–5, the converter comprises an elongated shell **10** closed at its ends by a pair of end caps **12** and **13** rigidly connected to said shell as by welding. A sleeve **16** is disposed within the shell **10** in spaced relation thereto and with its opposed ends terminating inwardly in spaced relation to the end caps **12** and **13**. The sleeve is supported within the shell on a plurality of longitudinally spaced annular supports **18**. Each of said supports has a plurality of openings **20** formed therein so that the space between the shell and sleeve defines an annular gas passage indicated at **22**.

As shown in FIGS. 1 and 2, four longitudinally spaced plates **25**, **26**, **27**, and **28**, are mounted in the sleeve **16** and extend thereacross. The plates **25** and **26**, together with the portion of the sleeve **16** interposed therebetween, define a first conversion chamber **29**, and in a like manner, the plates **27** and **28**, together with the portion of the sleeve interposed therebetween, define a second conversion chamber **30** in longitudinally spaced relation to the

chamber 29. Each of the plates 25–28 has a plurality of slotted openings 32 so that the gas can pass longitudinally through the two chambers 29 and 30.

The chambers 29 and 30 are adapted to hold any desired type of catalytic material or materials which effects conversion of the noxious pollutants in the exhaust gases into non-noxious components. Such catalysts may be in the form of pellets inserted into the chamber prior to assembling the plates 25, 28, 44 and 46 thereon. Conveniently, to refill the chambers, or to fill them after assembly, fill tubes 34 are mounted in the shell 10 and extend into the chambers 29 and 30, said tubes being closeable as by screw caps 36.

The exhaust gases to be reacted with the catalyst or catalysts are introduced into the converter through an inlet conduit 40 carried in a shouldered aperture 41 in end cap 12. The inner end of said conduit is carried in a shouldered aperture 42 formed in an imperforate end plate 44 mounted in the sleeve 16 and extending thereacross whereby said conduit forms a gas flow inlet for the chambers 29 and 30. In order to uniformly distribute the gas flow across the plate 25, which plate constitutes the inlet of chamber 29, a baffle plate 46 having a plurality of openings 47 formed therein is mounted in the sleeve 16 between the plates 25 and 44. After passing successively through the chambers 29 and 30, the gases are discharged from the converter through an outlet conduit 48 whose inner end is carried in a shouldered aperture 50 in an imperforate end plate 51 mounted in the shell 16 at the end thereof adjacent the end cap 13. Said conduit projects through and is supported in a shouldered aperture 52 formed in the end cap 13 and thus forms a gas flow outlet for the chambers 29 and 30.

As shown in FIG. 1, a second inlet conduit 55 is also mounted in the end cap 12 in a shouldered aperture 56 formed therein. In a like manner, a second outlet conduit 57 is also mounted in the end cap 13 in a shouldered aperture 58 formed therein. The inner ends of the conduits 55 and 57 are in open communication with the interior of converter outwardly from the end plates 44 and 51 and form a gas flow inlet and outlet for the bypass passage. Thus, the exhaust gases entering the converter through the inlet conduit 55 will move through the bypass passage 22 around the sleeve 16 and be discharged through the outlet conduit 57 without passing through either of the conversion chambers 29 and 30. Like the conduits 40 and 48, the conduits 55 and 57 are longitudinally offset from one another.

As shown in FIG. 1, the inlet conduits 40 and 55 are joined, as at 60, and are adapted to be connected upstream therefrom to an exhaust gas source (not shown). A valve 61 is located at the inlet conduit juncture 60 and is movable between its full line position shown in FIG. 1 in which the exhaust gases are directed through the chambers 29 and 30 and its dotted line position in which said gases are directed through the bypass passage 22. Conveniently, the outlet conduits 48 and 57 are joined, as at 62, and are adapted to be connected downstream therefrom to an exhaust pipe (not shown). As will be understood, a valve like valve 61 can be located in the outlet conduit juncture 62 for controlling the gas flow through the converter. Such a valve in the exhaust conduits can be employed in addition to, or in lieu of, the valve 61.

Conveniently, in order that the chamber 29 can operate in a non-oxidizing atmosphere and the chamber 30 in an oxidizing atmosphere, a tube 63 having a series of openings 64 therein extends across the sleeve 16 between the chambers 29 and 30. As shown, one end of said tube is supported in a bracket 65 mounted on the sleeve between the plates 26 and 27 and the opposite end of said tube projects outwardly through aligned openings 66 and 67 in the sleeve and shell for connection to a source of pressurized air. With the natural gas flow from the chamber 29 to the chamber 30, the air injected through the tube 63 will be swept along with the gas flow to the chamber 30 so that the catalyst therein will be in an oxidizing atmosphere while the catalyst in chamber 29 remains in a non-oxidizing atmosphere.

The embodiment shown in FIG. 6 differs from the embodiment shown in FIGS. 1–5 primarily in the construction of the gas flow inlet. Thus, the converter illustrated in FIG. 6 comprises an elongated shell 70 closed at its ends by a pair of end caps 71 and 72 rigidly connected thereto. The conversion chamber 74, which is adapted to hold catalytic material for removing the noxious pollutants from the exhaust gases is disposed within the shell 70 in spaced relation thereto. Said chamber is formed from a sleeve 76 having a pair of longitudinally spaced apertured plates 78 and 79 extending thereacross with the plate 78 forming the inlet end of the chamber and the plate 79 forming the outlet end thereof. The sleeve is supported within the shell on a plurality of longitudinally spaced annular supports 82 extending between said shell and sleeve. Each of said supports has a plurality of openings 83 so that the space between the shell and sleeve defines an annular bypass passage as indicated at 85.

A pair of imperforate end plates 87 and 88 are mounted in the sleeve 76 and extend thereacross outwardly from the plates 78 and 79, respectively. Conveniently, an apertured baffle plate 90 also extends across sleeve 76 between the plates 78 and 87 for uniformly distributing the gas flow into the inlet end of the chamber 74.

An inlet conduit 92 is carried in a shouldered aperture 93 in the end cap 71 with the inner end of said conduit projecting through a shouldered aperture 94 in the end plate 87 so that said conduit forms a gas flow inlet for the chamber 74. An outlet conduit 96 is carried in a shouldered aperture 98 in the end cap 72 with the inner end of said conduit being carried in a shouldered aperture 100 in the end plate 88 so that the conduit 96 forms a gas flow outulet for the chamber 74.

The gas flow inlet for the bypass passage 85 is formed by an opening 102 in the end plate 87, and the gas flow outlet for said passage is formed by an outlet conduit 104 carried in a shouldered aperture 106 in the end cap 72. The conduits 104 and 96 are joined, as at 110, and a valve 112 is mounted in the juncture 110. Said valve is movable between its full line position shown in FIG. 6 in which the exhaust gases pass successively through the inlet conduit 92 and chamber 74 and are then discharged through the outlet conduit 96 and its dotted line position shown in FIG. 6 in which said gases pass from the inlet conduit 92 through the inlet opening 102, whereupon they move through the bypass passage 85 and are discharged through the conduit 104.

The embodiment shown in FIG. 7 is like that shown in FIG. 6 except for gas flow inlet and outlet arrangement. Thus, the converter illustrated in FIG. 7 comprises an elongated shell 115 closed at its ends by a pair of end caps 117 and 118 rigidly connected thereto. The conversion chamber 120 adapted to hold the catalytic material is carried within the shell 115 in spaced relation thereto. Said chamber is formed by a sleeve 122 and a pair of longitudinally spaced apertured plates 123 and 124 extending thereacross with the plate 123 forming the inlet end of the chamber and the plate 124 forming the outlet end thereof. The sleeve is supported within the shell on a plurality of longitudinally spaced annular supports 125 extending between said shell and sleeve. Each of said supports has a plurality of openings 126 so that the spacee between said shell and sleeve defines an annular bypass passage as indicated at 128.

A pair of end plates 130 and 131 are mounted in the sleeve 122 and extend thereacross outwardly from the plates 123 and 124, respectively. Conveniently, an apertured baffle plate 133 extends across sleeve 122 between the plates 123 and 130 for uniformly distributing the gas flow in to the inlet end of the chamber 120.

An inlet conduit **135** is carried in a shouldered aperture **136** in the end cap **117** with the inner end of said conduit projecting through a shouldered aperture **137** in the end plate **130** so that said conduit forms a gas flow inlet for the chamber **120**. An outlet conduit **140** is carried in aligned shouldered apertures **141** and **142** in the end cap **118** and end plate **131**, respectively. The inner end of the conduit **140** terminates between the end plate **131** and the chamber plate **124** so that said conduit forms a gas flow outlet for the chamber **120**.

The gas flow inlet for the bypass passage **128** is formed by an inlet conduit **144** carried in a shouldered aperture **146** in end cap **117** with the inner end of said conduit terminating between said end cap and the end plate **130**. The gas flow outlet for the passage **128** is formed by an opening **148** formed in the end plate **131**.

As shown, the inlet conduits **135** and **144** are joined, as at **150**, and a valve **152** is mounted at the juncture **150**. Said valve is movable between its full line position shown in FIG. 7 in which the exhaust gases pass successively through the conduit **135** and chamber **120** and are then discharged through the outlet conduit **140** and its dotted line position shown in FIG. 7 in which said gases pass successively through the inlet conduit **144** and passage **128**, whereupon they are discharged through the opening **148** and conduit **140**.

The embodiment shown in FIG. 8 differs from the embodiments previously described primarily in the arrangement of the gas flow inlets and outlets. Thus, the converter illustrated in FIG. 8 comprises an elongated outer shell **155** closed at its end by a pair of end caps **157** and **158** rigidly connected thereto. The conversion chamber **160** adapted to hold the catalytic material is disposed within the shell **155** in spaced relation thereto. Said chamber is formed by a sleeve **162** having a pair of longitudinally spaced apertured plates **163** and **164** extending thereacross with the plate **163** forming the inlet end of the chamber and the plate **164** forming the outlet end thereof. The sleeve is supported within the shell on a plurality of longitudinally spaced annular supports **166** extending between said shell and sleeve. Each of said supports has a plurality of openings **167** so that the space between the shell and sleeve defines an annular bypass passage as indicated at **170**.

An end plate **172** is mounted in the sleeve **162** and extends thereacross outwardly from the plate **163**. Conveniently, an apertured baffle plate **174** also extends across the sleeve **162** between the plates **163** and **172** for uniformly distributing the gas flow into the inlet end of the chamber **160**.

An inlet conduit **176** forming the gas flow inlet for the chamber **160** is carried in aligned shouldered apertures **178** and **179** in the end cap **157** and the end plate **172**, respectively, with the inner end of said conduit terminating between the plates **172** and **174**. An inlet conduit **180** forming the gas flow inlet for the bypass passage **170** is carried in a shouldered aperture **182** in end cap **157**. The chamber **160** and passage **170** have a common gas flow outlet formed by an outlet conduit **185** mounted in a shouldered aperture **187** in end cap **158** with the inner end of said conduit terminating between said end cap and the plate **164**.

The conduits **176** and **180** are joined, as at **188**, and a valve **190** is mounted in the juncture **188**. Said valve is movable between its full line position shown in FIG. 8 in which the exhaust gases pass successively through the inlet conduit **176** and chamber **160** and are discharged through the outlet conduit **185** and its dotted line position shown in FIG. 8 in which said gases pass successively through the inlet conduit **180** and passage **170** and are discharged through the outlet conduit **185**.

While the embodiment shown in FIGS. 1–5 has been described as having a pair of conversion chambers and the embodiments shown in FIGS. 6–8 have been described as having a single conversion chamber, it is to be understood, of course, that any desired number of said chambers may be employed in any of the embodiments depending upon the number of apertured chamber end wall-forming plates that are employed.

We claim:

1. A catalytic converter for removing noxious pollutants from an exhaust gas stream, comprising an elongated shell, end caps closing the ends of said shell, first means forming a conversion chamber in said shell having an inlet end and an outlet end at the opposite ends thereof and adapted to hold catalytic material for removing the noxious pollutants from the exhaust gases passing therethrough, second means interconnecting said shell and first means supporting said chamber in spaced relation to said shell along the length of said chamber, said second means permitting gas flow therethrough whereby the space between said chamber and shell forms an open ended annular bypass passage extending completely around said chamber, an end plate mounted on said first means between said outlet end and the end cap adjacent thereto, gas flow inlet-forming means in open communication with said chamber and bypass passage, a first gas outlet conduit carried in one of said end caps with its inner end terminating between said outlet end of said chamber and said end plate, a second gas outlet conduit carried in said one end cap with its inner end terminating between said one end cap and said end plate, and valve means operatively connected to said first and second outlet conduits for selectively directing the gas flow through the chamber or said bypass passage.

2. A catalytic converter for removing noxious pollutants from an exhaust gas stream, comprising an elongated shell, end caps closing the ends of said shell, an elongated sleeve carried in said shell and adapted to hold catalytic material for removing the noxious pollutants from the exhaust gases passing therethrough, at least four apertured plates disposed in longitudinally spaced relationship and extending across said shell, said apertured plates defining a plurality of longitudinally spaced chambers along the length of said sleeve with the outermost pair of said plates forming an inlet end and outlet end for the outermost pairs of said chambers, means adapted to be connected to source of pressurized air disposed between a pair of said apertured plates defining the ends of a pair of adjacent chambers, means supporting said sleeve in spaced relation to said shell to form a bypass passage around said sleeve, first gas flow inlet-forming means in open communication with said sleeve, second gas flow inlet-forming means in open communication with said bypass passage, at least one gas flow outlet-forming means in open communication with said chamber and bypass passage, and valve means operatively connected to said first and second gas flow inlet-forming means for selectively directing the gas flow through said chambers or said bypass passage.

3. A catalytic converter for removing noxious pollutants from an exhaust gas stream comprising an elongated shell, end caps closing the ends of said shell, first means forming a conversion chamber in said shell having an inlet end and an outlet end and adapted to hold catalytic material for removing the noxious pollutants from the exhaust gases passing therethrough, a pair of end plates mounted on said first means between said chamber inlet and outlet ends and said end caps, second means supporting said chamber in spaced relation to said shell to form a bypass passage around said chamber, a first inlet conduit carried in one of said end caps with its inner end terminating between the inlet end of said chamber and the adjacent end plate to dispose said conduit in open communication with said chamber, a second inlet conduit carried in said one end cap with its inner end terminating between said one end cap and the end plate adjacent the inlet end of said chamber to dispose said conduit in open communication with said bypass passage, a

first outlet conduit carried in the other of said end caps with its inner end terminating between the outlet end of said chamber and the end plate adjacent thereto to dispose said conduit in open communication with said chamber, a second outlet conduit carried in said other end cap with its inner end terminating between said other end cap and end plate adjacent the outlet end of the chamber to dispose said conduit in open communication with said bypass passage, and valve means operatively connected to said first and second inlet conduits for selectively directing the gas flow through the chamber or said bypass passage.

4. A catalytic converter for removing noxious pollutants from an exhaust gas stream, comprising an elongated shell, end caps closing the ends of said shell, first means forming a conversion chamber in said shell having an inlet end and an outlet end and adapted to hold catalytic material for removing the noxious pollutants from the exhaust gases passing therethrough, second means supporting said chamber in spaced relation to the shell to form a bypass passage around said chamber, a pair of end plates mounted on said first means between said chamber inlet and outlet ends and said end caps, a first inlet conduit carried in one of said end caps with its inner end terminating between said inlet end of said chamber and the adjacent end plate to dispose said conduit in open communication with said chamber, a second inlet conduit carried in said one end cap with its inner end terminating between said one end cap and the end plate adjacent the inlet end of said chamber to dispose said second inlet conduit in open communication with said bypass passage, a first outlet conduit carried in the other of said end caps with its inner end terminating between the outlet end of said chamber and the end plate adjacent thereto to dispose said first outlet conduit in open communication with said chamber, a second outlet conduit carried in said other end cap with its inner end terminating between said other end cap and the end plate adjacent the outlet end of the chamber to dispose said second outlet conduit in open communication with bypass passage, and valve means located in at least one of said inlet conduits or outlet conduits for selectively directing the gas flow through said chamber or said bypass passage.

5. A catalytic converter for removing noxious pollutants from an exhaust gas stream, comprising an elongated shell, end caps closing the ends of said shell, first means forming a conversion chamber in said shell having an inlet end and an outlet end and adapted to hold catalytic material for removing the noxious pollutants from the exhaust gases passing therethrough, second means supporting said chamber in spaced relation to said shell to form a bypass passage around said chamber, a pair of end plates mounted on said first means between said chamber inlet and outlet ends and said end caps, an inlet conduit carried in one of said end caps with its inner end terminating between the inlet end of said chamber and the end plate adjacent the inlet end of said chamber, an opening formed in said end plate adjacent the inlet end of said chamber, a first outlet conduit carried in the other of said end caps with its inner end terminating between the outlet end of said chamber and the end plate adjacent thereto to dispose said first outlet conduit in open communication with said chamber, a second outlet conduit carried in said other end cap with its inner end terminating between said other end cap and the end plate adjacent the outlet end of said chamber to dispose said second outlet conduit in open communication with said bypass passage, and valve means located in said outlet conduits for selectively directing the gas flow through said chamber or bypass passage.

6. A catalytic converter for removing noxious pollutants from an exhaust gas stream, comprising an elongated shell, end caps closing the ends of said shell, first means forming a conversion chamber in said shell having an inlet end and an outlet end and adapted to hold catalytic material for removing the noxious pollutants from the exhaust gases passing therethrough, second means supporting said chamber in spaced relation to said shell to form a bypass passage around said chamber, a pair of end plates mounted on said first means between said chamber inlet and outlet ends and said end caps, a first inlet conduit carried in one of said end caps with its inner end terminating between the inlet end of said chamber and the adjacent end plate to dispose said first inlet conduit in open communication with said chamber, a second inlet conduit carried in said one end cap with its inner end terminating between said one end cap and the end plate adjacent the inlet end of said chamber to dispose said second inlet conduit in open communication with said bypass passage, an outlet conduit carried in the other of said end caps with its inner end terminating between the outlet end of said chamber and the end plate adjacent thereto to dispose said outlet conduit in open communication with said chamber, an opening formed in the end plate adjacent the outlet end of the chamber, and valve means located in said inlet conduits for selectively directing the gas flow through said chamber or said bypass passage.

7. A catalytic converter for removing noxious pollutants from an exhaust gas stream, comprising an elongated shell, end caps closing the ends of said shell, first means forming a conversion chamber in said shell having an inlet end and an outlet end and adapted to hold catalytic material for removing the noxious pollutants from the exhaust gases passing therethrough, second means supporting said chamber in spaced relation to said shell to form a bypass passage around said chamber, an end plate mounted on said first means between said inlet end and the end cap adjacent thereto, a first inlet conduit carried in the end cap adjacent the chamber inlet end with its inner end terminating between said end plate and the chamber inlet end to dispose said first inlet conduit in open communication with said chamber, a second inlet conduit carried in the end cap adjacent the chamber inlet end with its inner end terminating between the end cap in which it is carried and said end plate to dispose second inlet conduit in open communication with said bypass passage, an outlet conduit carried in the end cap adjacent the chamber outlet end and in open communication with said chamber and bypass passage, and valve means located in said inlet conduits for selectively directing the gas flow through the chamber or said bypass passage.

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BARRY S. RICHMAN, Primary Examiner

U.S. Cl. X.R.

60—288, 299, 301