

[54] **EXHAUST GAS MANIFOLD**

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[22] Filed: **Dec. 3, 1971**

[21] Appl. No.: **204,494**

[52] U.S. Cl..... **60/322, 60/282, 60/323**

[51] Int. Cl..... **F01n 3/10**

[58] Field of Search..... 60/282, 322, 323;
180/40

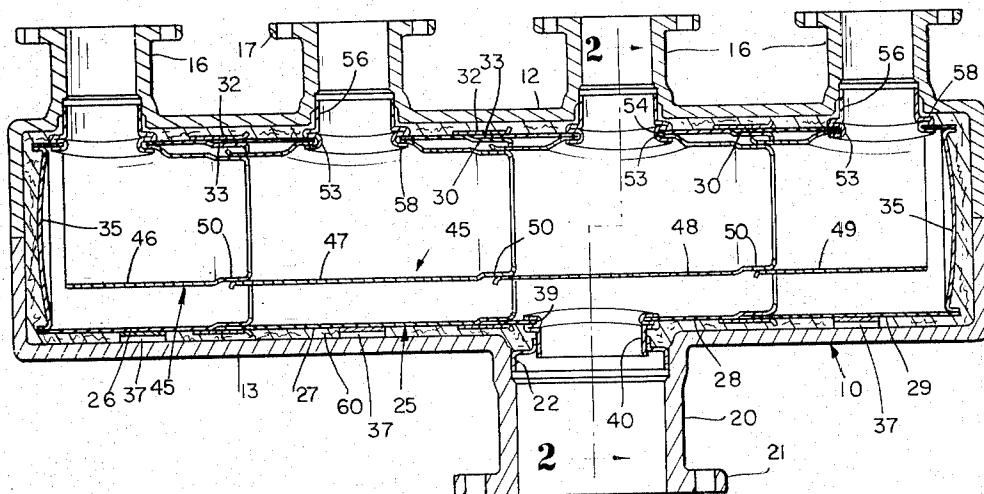
[57] **ABSTRACT**

An exhaust gas manifold for an internal combustion engine having an outer shell provided with a plurality of inlets adapted to be connected to the engine and an outlet adapted to be connected to an exhaust pipe. A closed intermediate shell is carried within the outer shell and is provided with an outlet carried in the outer shell outlet. An inner shell is carried within the intermediate shell in open communication therewith. A plurality of inlets carried in the outer shell inlets are open to the inner shell so that the exhaust gases enter said inner shell and pass therefrom into said intermediate shell from which they are discharged through the intermediate and outer shell outlets.

[56] **References Cited**
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14 Claims, 4 Drawing Figures



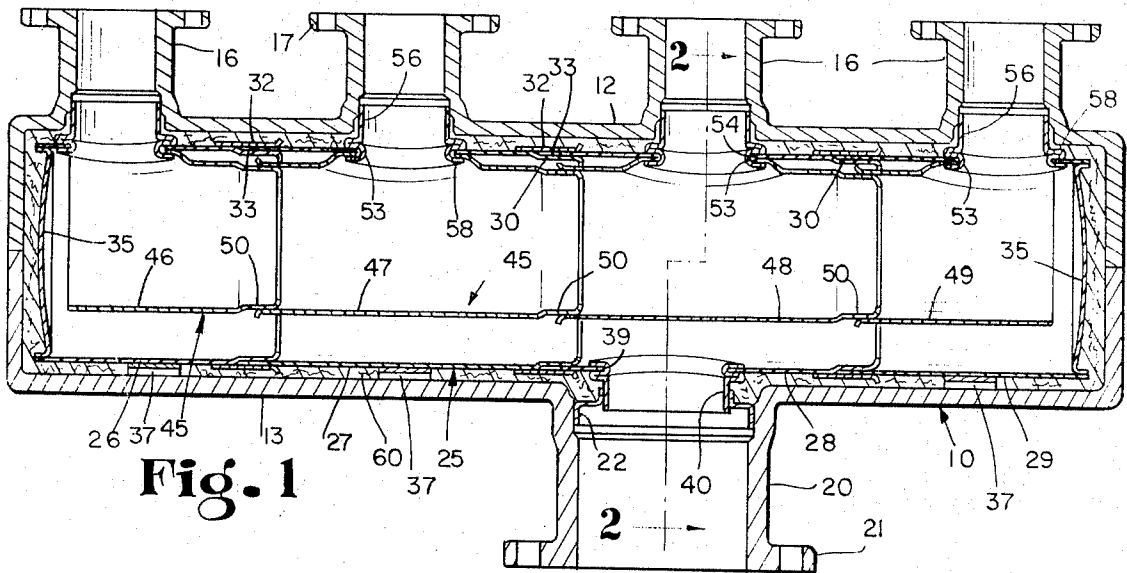


Fig. 1

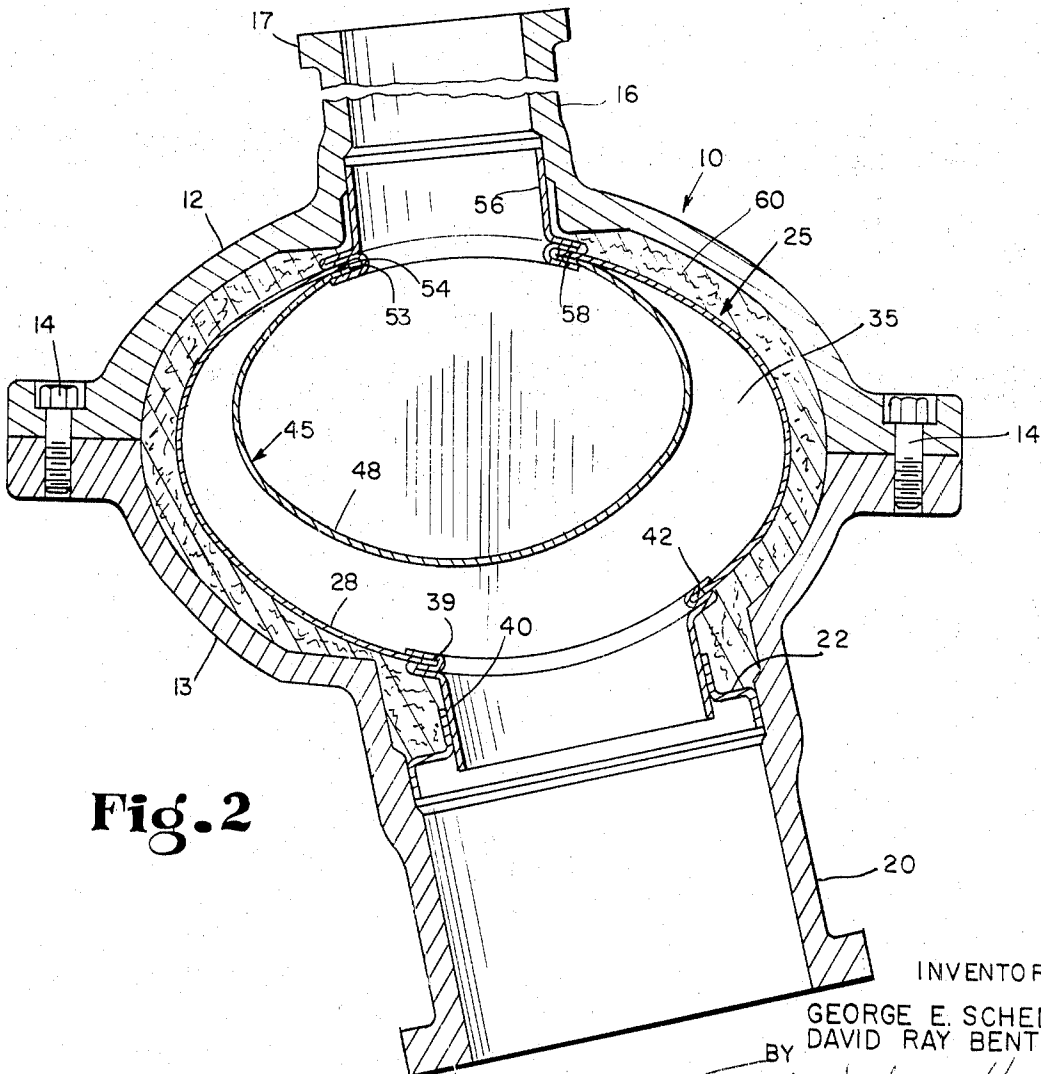


Fig. 2

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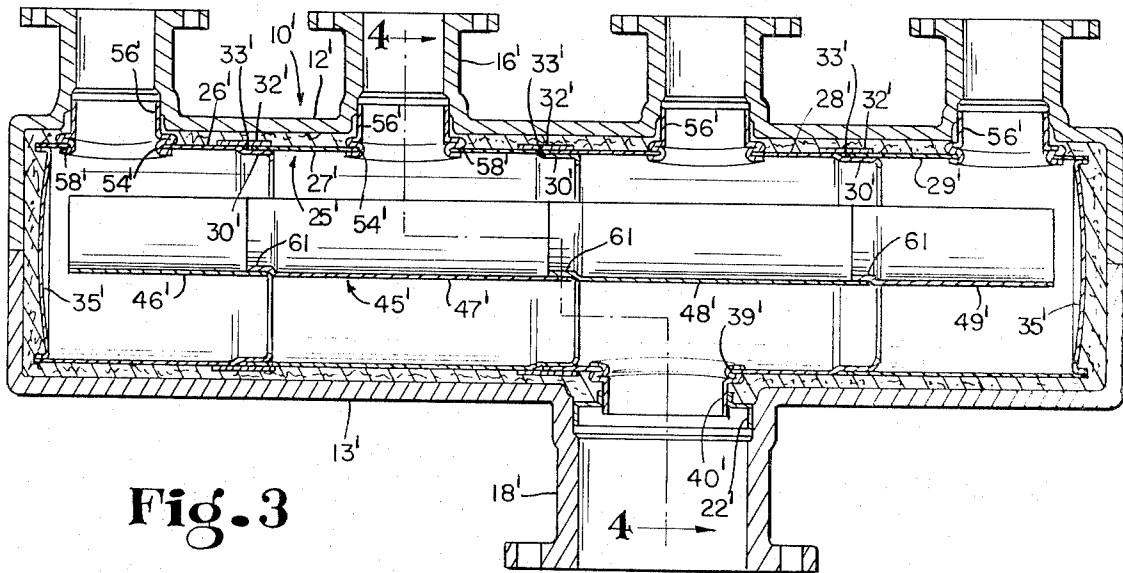


Fig. 3

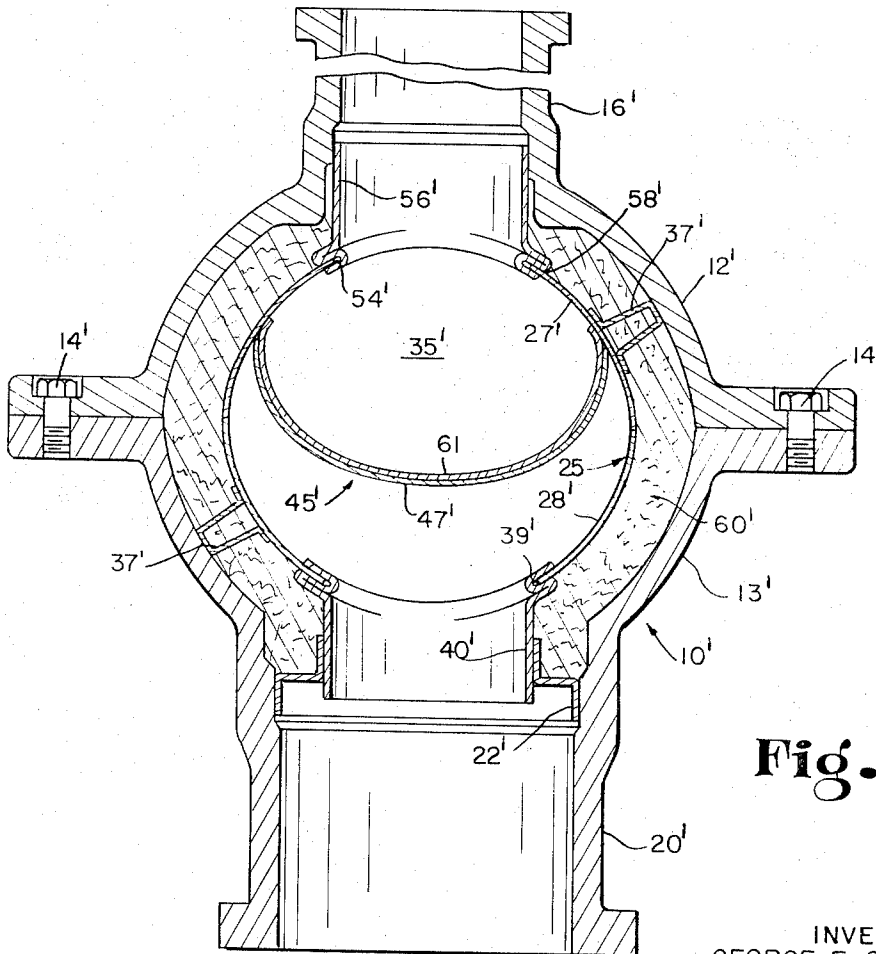


Fig. 4

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EXHAUST GAS MANIFOLD

BACKGROUND OF THE INVENTION

Internal combustion engines, particularly the internal combustion engines in motor vehicles, contribute a substantial amount of exhaust products to the atmosphere including substantial amounts of the oxides of nitrogen, hydrocarbons and carbon monoxide which are discharged from such engines in the exhaust gases. These pollutants when introduced into the atmosphere in sufficient quantities produce an atmospheric condition referred to as air pollution or smog.

Exhaust manifold gas temperatures will vary from 600° F. to over 1,800° F. depending upon where the temperatures are measured and the engine operating conditions. If the exhaust gases are permitted to be retained in the manifold at the higher temperatures for a relatively short period of time, and mixed homogeneously with air, the unburned hydrocarbons and carbon monoxide in the exhaust gases will be oxidized to thus reduce the amount of such pollutants that are discharged from the manifold. However, with the manifold designs heretofore employed, the mass of the manifold prevents it from being brought up to a high temperature quickly to achieve such oxidation. Further, because of its mass, the manifold can not retain a large volume of the exhaust gases therein so that the gases are not retained therein for a period sufficient to achieve any significant degree of oxidation.

The present invention provides a means of obtaining a higher sensible exhaust gas temperature quickly and for increasing the dwell time of the gases in the manifold, thereby providing homogeneous mixing of the exhaust gases and air while at the same time providing a lightweight manifold construction which will be able to withstand its inherent expansion and contraction due to the elevated temperatures caused by the oxidation of the smog-producing pollutants within the manifold.

SUMMARY OF THE INVENTION

In accordance with one form of the invention, there is provided an outer shell having a plurality of inlet conduits adapted to be connected to the exhaust ports of an internal combustion engine and an outlet conduit adapted to be connected to an exhaust pipe. Carried within said outer shell on a plurality of brackets in an intermediate shell comprising a plurality of slidably interfit sleeves with the outer ends of the outermost pair of said sleeves being closed by a pair of end caps. One of the sleeves has an outlet conduit projecting outwardly therefrom and slidably received in the outer shell outlet conduit. An inner shell is carried within the intermediate shell and comprises a plurality of open-ended slidably interfit sleeves. An inlet conduit is fixedly mounted on each pair of inner and intermediate shell-forming sleeves and is slidably received in one of the inlet conduits on said outer shell.

Thus, the exhaust gases pass successively through the inlet conduits, the inner shell, and the intermediate shell for discharge through the outlet conduits. And with the slidable constructions of the intermediate and inner shells and inlet and outlet conduits, said intermediate and inner shells are free to expand and contract with respect to the outer shell without warping.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings illustrate the invention. In such drawings:

FIG. 1 is a longitudinal medial section through an exhaust gas manifold embodying the invention;

FIG. 2 is an enlarged transverse section taken on the line 2—2 of FIG. 1;

FIG. 3 is a longitudinal medial section similar to FIG. 1, but showing a modified form of the invention; and

FIG. 4 is an enlarged transverse section taken on the line 4—4 of FIG. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In the embodiment of the invention as illustrated in FIGS. 1 and 2, the manifold is provided with an outer shell 10 conveniently formed as a pair of metal castings 12 and 13 rigidly interconnected by bolts 14. A plurality of longitudinally spaced inlet conduits 16 project outwardly from the casting 12 and are provided at their outer ends with mounting flanges 17 adapted to be connected to the exhaust ports of an internal combustion engine. An outlet conduit 20 projects outwardly from the casting 13 and is provided at its outer end with a mounting flange 21 adapted to be connected to an exhaust pipe. For reasons that will become more apparent hereinafter, a collar 22 is mounted in the outlet 20 and projects radially inwardly therefrom.

Carried within the outer shell 10 is an intermediate shell 25 formed from a plurality of longitudinally extending interfitting sheet-metal sleeves 26, 27, 28 and 29. As shown in FIG. 1, each of the sleeves 26—28 is offset radially inwardly, as at 30, and a collar 32 is mounted around each such shell in alignment with its offset 30 to define therewith an annular channel 33. Thus, as shown, sleeve 27 is slidably received in channel 33 on sleeve 26, sleeve 28 is slidably received in channel 33 on sleeve 27, and sleeve 29 is slidably received in channel 33 on sleeve 28. The ends of the shell 25 are closed by a pair of end caps 35 mounted on the opposed ends of sleeves 26 and 29. Each of the sleeves 26—29 is slidably supported on a plurality of arcuate brackets 37 mounted on the inner face of the outer shell 10 and projecting radially inwardly therefrom. Preferably, the brackets 37 are disposed opposite the inlets 56 for the sleeves 26, 27 and 29 for holding said inlets in the outer shell inlets 16. Thus, each of the sleeves is free to expand and contract with respect to each of the other sleeves and the outer shell 10.

As shown in FIGS. 1 and 2, an outlet opening 39 is formed in sleeve 28. An outlet conduit 40 is mounted in the opening 39 as by having its inner end deformed to define an annular channel 42 bindingly received over the circumferential edge of said opening. The conduit 40 projects outwardly from sleeve 28 and is slidably received in the outlet collar 22 mounted in the outer shell outlet 20. The conduit 40 and collar 22 also help retain the inlet 56 on shell 28 in its outer shell inlet 16.

An inner shell 45 is carried within the intermediate shell 25 and comprises a plurality of longitudinally extending sheet-metal sleeves 46, 47, 48 and 49 disposed in axial alignment with the intermediate shell-forming sleeves 26—29, respectively. As shown in FIG. 1, each of the shells 46—48 is offset radially inwardly at one of its ends, as at 50, with each of said offsets being slidably

received in the adjacent end of the next adjacent sleeve to thus permit each of said sleeves to expand and contract with respect to each of the other sleeves. The ends of the outermost sleeves 46 and 49 are spaced inwardly from the end caps 35 to thus dispose the inner shell 45 in open communication with the intermediate shell 25.

Each of the sleeves 46-49 is provided with an inlet opening 53 disposed in radial alignment with an inlet opening 54 formed in each of the sleeves 26-29. An inlet conduit 56 is connected to each of the sleeves 46-49, and to this end, the inner end of each of said inlet conduits 56 is deformed to define a channel 58 bindingly received over the circumferential edges of the openings 53 and 54. The outer end of each of the inlet conduits 56 is slidably received in one of the aligned inlet conduits 16 on the outer shell casting 12.

As shown in FIG. 2, the intermediate and inner shells 25 and 45 all in the form of closed curves and have elliptical cross-sections. And each of the inner shell-forming sleeves 46-49 is eccentrically carried within its associated intermediate shell-forming sleeves 26-29 so that the sleeves forming the intermediate and inner shells are disposed in abutting engagement immediately adjacent their inlet openings 53 and 54 but are spaced from each other throughout the remainder of their circumferential extents.

Conveniently, a compressible insulation 60 is interposed between the outer and intermediate shells 10 and 25 and in the space between their respective outlet conduits 20 and 40 for thus thermally insulating the outer shell from the intermediate shell. With the major portion of the inner shell 45 being spaced from the intermediate shell 25, there will thus be little thermal conductivity between said inner and outer shells.

In the operation of the manifold shown in FIGS. 1 and 2, the exhaust gases enter the manifold through the inlet conduits 16 and 56 where they are discharged into the inner shell 45. The gases exit the inner shell through the opposed ends of the inner shell sleeves 46 and 49 into the intermediate shell 25 for discharge through the outlet conduits 20 and 40. With the inner and intermediate shells being formed of sheet-metal, the exhaust gases will rapidly bring said shells up to a temperature substantially corresponding to the temperature of the gases entering the manifold. And by reason of the circuitous flow path through the manifold, said exhaust gases will be retained within the manifold for a period of time substantially greater than with a conventional manifold. This increased dwell time at a quickly elevated temperature will cause oxidation of the pollutants in the exhaust gases. With the spaced relationship between the several shells, the elevated temperature within the inner shell will be maintained without causing an excessive heating of the outer shell 10. Further, the sliding sleeved construction of the inner and intermediate shells permits the inner and outer shells to freely expand and contract without warping due to temperature changes within the manifold.

The embodiment of the invention illustrated in FIGS. 3 and 4 differs from the embodiment shown in FIGS. 1 and 2 in the construction of the inner shell. The construction of the outer shell 10' and intermediate shell 25' is identical to that previously described and illustrated in FIGS. 1 and 2 of the drawings.

Thus, the outer shell 10' can be formed as a pair of metal castings 2' and 3' rigidly interconnected by bolts 14'. A plurality of inlet conduits 16' project outwardly

from casting 12', and an outlet conduit 20' projects outwardly from casting 13'.

The intermediate shell 25', which is carried within and in spaced relation to the outer shell 10', is insulated from said outer shell by a layer of compressible insulation 60'. The shell 25' is formed from a plurality of longitudinally extending, slidably interfitting, sheet-metal sleeves 26', 27', 28' and 29'. Each of the sleeves 26'-28' is offset radially inwardly, as at 30', and a collar 32' extends around each such sleeve in alignment with the offset 30' therein to define with said offset an annular channel 33'. The adjacent end of the next adjacent sleeve is slidably received in each of the channels 33' to thus permit said sleeves to expand and contract with respect to each other. End caps 35' are mounted on the opposite ends of sleeves 26' and 29' to close the ends of the shell 25'. The sleeves 26' are slidably supported on a plurality of brackets 37' interposed between the outer and intermediate shells.

An outlet opening 39' is formed in sleeve 28', and an outlet conduit 40' is mounted in said openings, as by having its inner end deformed to form annular channel bindingly received over the circumferential edge of said opening. The conduit 40' projects outwardly and is slidably received in an outlet collar 22' mounted in the outer shell outlet 20'.

An inlet opening 54' is also formed in each of the sleeves 26'-29', and an inlet conduit 56' is connected to each of said sleeves as by having its inner end deformed to define a channel 58' bindingly received over the circumferential edge of its associated sleeve opening 54'. The outer end of each of the inlet conduits 56' is slidably received in one of the aligned inlet conduits 16' on the outer shell casting 12' and the inner end of each of said conduits is in open communication with an inner shell 45'.

The inner shell 45' is carried within the intermediate shell 25', and comprises a plurality of longitudinally extending sheet-metal plates 46', 47', 48', and 49' connected to the inner walls of the intermediate shell-forming sleeves 26'-29' respectively. As shown, each of the plates 46'-49' extends diagonally across its associated intermediate shell-forming sleeve and is connected along its longitudinal edges to said sleeve. Each of the plates 47'-49' is offset inwardly at one of its ends, as at 61. The offset 61 on each of the plates 47'-49', which is not connected to its associated intermediate shell-forming sleeve, is slidably received in the adjacent end of the next adjacent plate. Thus, as shown in FIG. 3, offset 61 on plate 47' is slidably received in the adjacent end of plate 46', offset 61 on plate 48' is slidably received in the adjacent end of plate 47', and offset 61 on plate 49' is slidably received in the adjacent end of plate 48'. In this manner, each of the plates is free to expand and contract with its associated intermediate shell-forming sleeve with respect to the other plates and shell-forming sleeves, as well as the outer shell 10'.

The operation of the embodiment illustrated in FIGS. 3 and 4 is like that of the embodiment shown in FIGS. 1 and 2. That is, the gases enter the manifold through the inlet conduits 15' and 56' where they are discharged into the inner shell 45'. The gases exit said inner shell at the opposite ends of the inner shell plates 46' and 49' into the intermediate shell 25' and are discharged through the outlet conduits 25' and 40'.

While the inner shell-forming plates 46'-49' have been illustrated as being nonperforated, they may, if desired, have perforations formed therein to thus provide a less restricted gas flow between the inner and intermediate shells for increasing gas flow rate through the manifold and reducing back pressure therein.

The embodiments have been illustrated as employing an outer shell formed as a metal casting. It is to be understood, of course, that said outer shell may be formed from sheet-metal components if desired. It is also contemplated that air may be introduced into the manifold, but this may be done in any convenient manner, such as for example, introducing it with the exhaust gases at the various manifold inlets connected to the engine exhaust ports.

We claim:

1. An exhaust gas manifold for an internal combustion engine, comprising an enclosed outer shell, a plurality of first inlet conduits and a first outlet conduit on said outer shell, an enclosed intermediate shell carried within said outer shell, a second outlet conduit on said intermediate shell projecting outwardly into said first outlet conduit, an inner shell carried within said intermediate shell in open communication therewith, means for permitting said intermediate shell to longitudinally expand and contract with respect to said outer shell, a plurality of second inlet conduits in open communication with said inner shell and projecting outwardly from openings formed in said intermediate shell into said first inlet conduits and means for permitting said inner shell to longitudinally expand and contract with respect to said intermediate shell and said second inlet and outlet conduits.

2. An exhaust gas manifold as set forth in claim 1 with the addition that means are provided for supporting said intermediate shell in spaced relation to said outer shell.

3. An exhaust gas manifold as set forth in claim 1 with the addition that a collar is mounted in said first outlet conduit and said second outlet conduit is slidably received in said collar whereby said first and second outlet conduits are disposed in spaced relation to each other and said second outlet conduit is movable with respect to said first outlet conduit.

4. An exhaust gas manifold for an internal combustion engine, comprising an enclosed outer shell, a plurality of first inlet conduits and a first outlet conduit on said outer shell, an enclosed intermediate shell carried within said outer shell, a second outlet conduit on said intermediate shell projecting outwardly into said first outlet conduit, an inner shell carried within said intermediate shell in open communication therewith, and a plurality of second inlet conduits in open communication with said inner shell and projecting outwardly from openings formed in said intermediate shell into said first inlet conduits, each of said intermediate and inner shells comprising a plurality of longitudinally extending slidably interfit sleeves with a pair of caps mounted on the sleeves of the intermediate shell at the opposite ends thereof.

5. An exhaust gas manifold as set forth in claim 4 in which means are interposed between said outer shell and each of the sleeves forming the intermediate shell for holding said intermediate and outer shells in spaced relation to each other.

6. An exhaust gas manifold as set forth in claim 4 in which the outermost ends of the outermost pair of

sleeves forming said inner shell are spaced from said pair of end caps.

7. An exhaust gas manifold for an internal combustion engine, comprising an enclosed outer shell, a plurality of first inlet conduits and a first outlet conduit on said outer shell, an enclosed intermediate shell carried within said outer shell, a second outlet conduit on said intermediate shell projecting outwardly into said first outlet conduit, an inner shell carried within said intermediate shell in open communication therewith, said inner shell comprising a plurality of longitudinally extending sleeves with each of said sleeves being slidably interfit in the next adjacent sleeve, and a plurality of second inlet conduits in open communication with said inner shell and projecting outwardly from the openings formed in said intermediate shell into said first inlet conduits.

8. An exhaust gas manifold for an internal combustion engine, comprising an enclosing outer shell, a plurality of first inlet conduits and a first outlet conduit on said outer shell, an enclosed intermediate shell carried within said outer shell, a second outlet conduit on said intermediate shell projecting outwardly into said first outlet conduit, an inner shell carried within said intermediate shell in open communication therewith, a plurality of second inlet conduits in open communication with said inner shell and projecting outwardly from openings formed in said intermediate shell into said first inlet conduits, said inner shell comprising a plurality of longitudinally extending sleeves, each of said sleeves being slidably interfit with the next adjacent sleeve, one of said second inlet conduits being in open communication with each of said sleeves, and means on said second inlet conduits for mounting them on said sleeves and interconnecting said sleeves and intermediate shell.

9. An exhaust gas manifold for an internal combustion engine, comprising an enclosed outer shell, a plurality of first inlet conduits and a first outlet conduit on said outer shell, an enclosed intermediate shell carried within said outer shell, a second outlet conduit on said intermediate shell projecting outwardly into said first outlet conduit, an inner shell carried within said intermediate shell in open communication therewith, a plurality of second inlet conduits in open communication with said inner shell and projecting outwardly from openings formed in said intermediate shell into said first inlet conduits, each of said intermediate and inner shells comprising a plurality of longitudinally extending slidably interfit sleeves in the form of closed curves, said second inlet conduit being mounted in an inlet opening in one of the intermediate shell-forming sleeves, each of said second inlet conduits being mounted in aligned inlet openings in the inner and intermediate shell-forming sleeves, each of said inner shell-forming sleeves abutting one of the intermediate shell-forming sleeves adjacent their aligned inlet openings, and means on each of said inlet conduits for interconnecting each pair of inner and intermediate shell-forming sleeves at their aligned inlet openings.

10. An exhaust gas manifold for an internal combustion engine, comprising an enclosed outer shell, a plurality of first inlet conduits and a first outlet conduit on said outer shell, an enclosed intermediate shell carried within said outer shell, a second outlet conduit on said intermediate shell projecting outwardly into said first outlet conduit, an inner shell carried within said inter-

mediate shell in open communication therewith, and a plurality of second inlet conduits in open communication with said inner shell and projecting outwardly from openings formed in said intermediate shell into said first inlet conduit, said intermediate shell comprising a plurality of slidably interfit sleeves, means closing the ends of said intermediate shell, and said inner shell comprising a plurality of plates mounted in and extending across said sleeves with each of said plates being slidably interfit with the next adjacent plate.

11. An exhaust gas manifold as set forth in claim 10 in which the outermost ends of the outermost pair of plates forming said inner shell are spaced from said means closing the ends of said intermediate shell.

12. An exhaust gas manifold as set forth in claim 10 in which at least one of said plates has a plurality of openings formed therein.

13. An exhaust gas manifold for an internal combustion engine, comprising an enclosed outer shell, a plurality of first inlet conduits and a first outlet conduit on said outer shell, an enclosed intermediate shell carried

within said outer shell, a second outlet conduit on said intermediate shell projecting outwardly into said first outlet conduit, an inner shell carried within said intermediate shell in open communication therewith, a plurality of second inlet conduits in open communication with said inner shell and projecting outwardly from openings formed in said intermediate shell into said first inlet conduits, said intermediate shell comprising a plurality of slidably interfit sleeves, means closing the ends of said intermediate shell, said inner shell comprising a plurality of plates mounted in and extending across said sleeves, each of said plates being slidably interfit with the next adjacent plate, said second inlet conduit being mounted on one of said sleeves, and one of said second inlet conduits being mounted on each of said sleeves.

14. An exhaust gas manifold as set forth in claim 1 with the addition that said first inlet and outlet conduits are movable with respect to said second inlet and outlet conduits, respectively.

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