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[54] **EXHAUST GAS MANIFOLD**

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[52] **U.S. Cl.** **137/608,** 60/282, 60/322, 60/323

[51] **Int. Cl.** **F01n 7/00,** F17d 1/00

[58] **Field of Search** 181/40, 42, 62; 60/323, 60/322, 282; 137/608

[56] **References Cited**

UNITED STATES PATENTS

3,505,028	4/1970	Douthit	181/40 UX
2,078,754	4/1937	Day	101/40
2,423,574	7/1947	Barrett	181/40 UX
2,513,229	6/1950	Bourne et al.	181/40
2,537,203	1/1951	Bourne et al.	181/40
3,043,094	7/1962	Nichols	181/40 X
3,227,241	1/1966	Mattoon	181/40 X
3,233,697	2/1966	Slayter et al.	181/40 X

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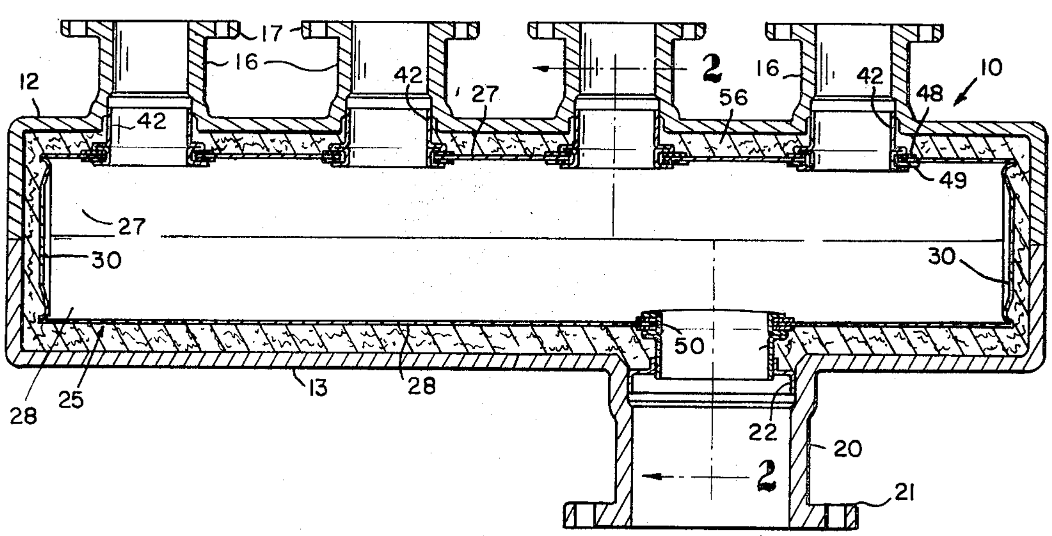
[57] **ABSTRACT**

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. An inner shell assembly is carried within the outer shell and is provided with inlets slidably connected thereto and an outlet carried in the outer shell inlets and outlet, respectively.

8 Claims, 7 Drawing Figures



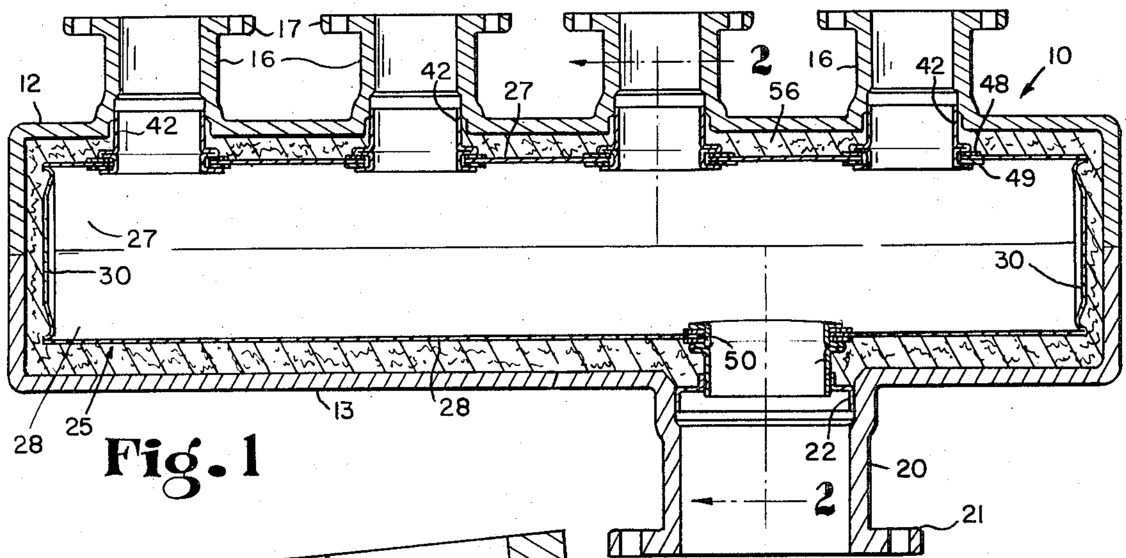


Fig. 1

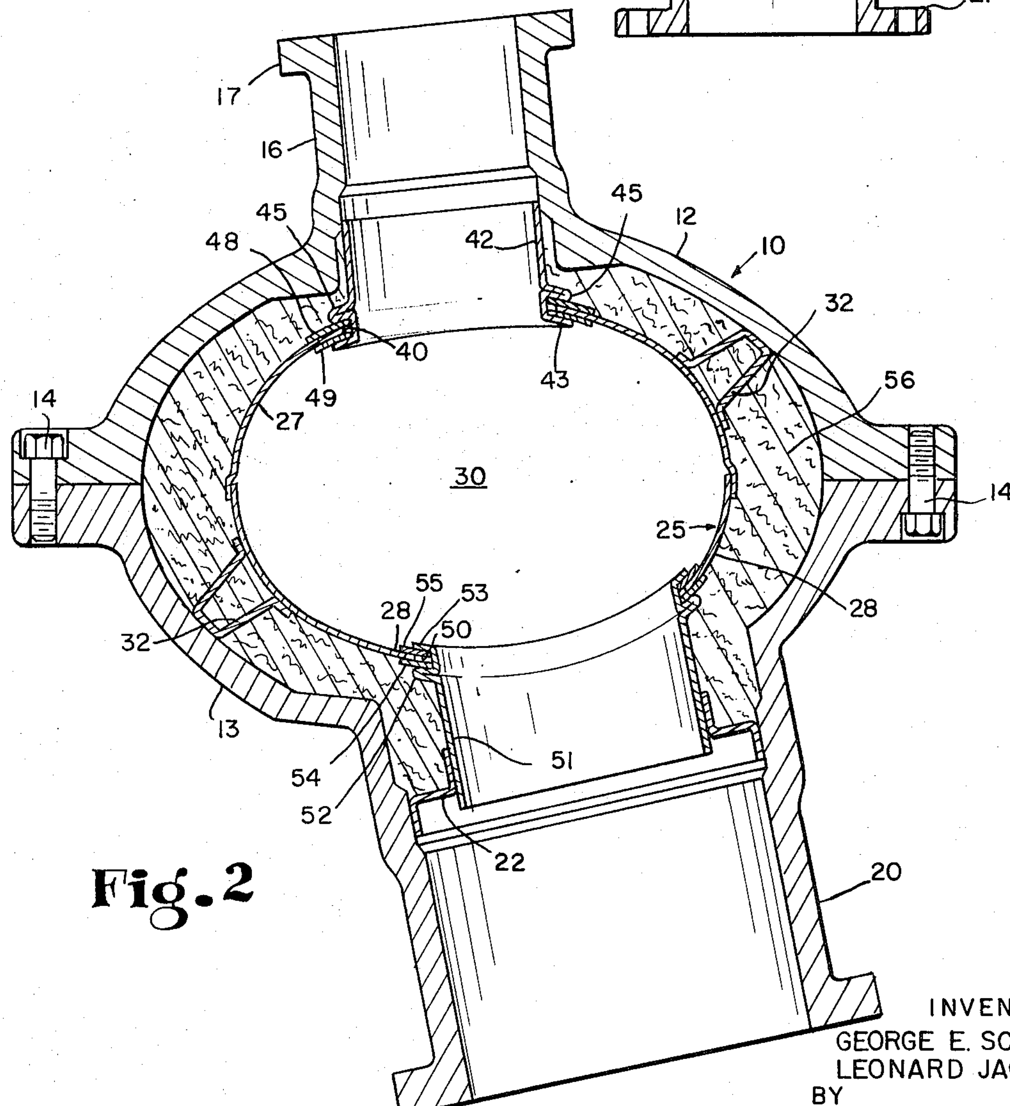


Fig. 2

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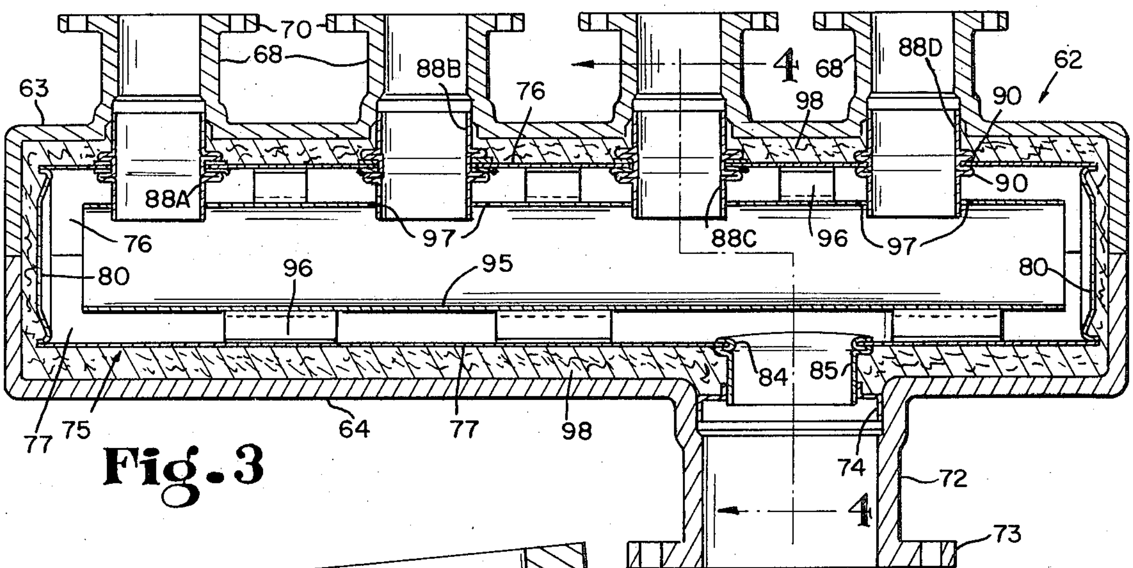

Fig. 3

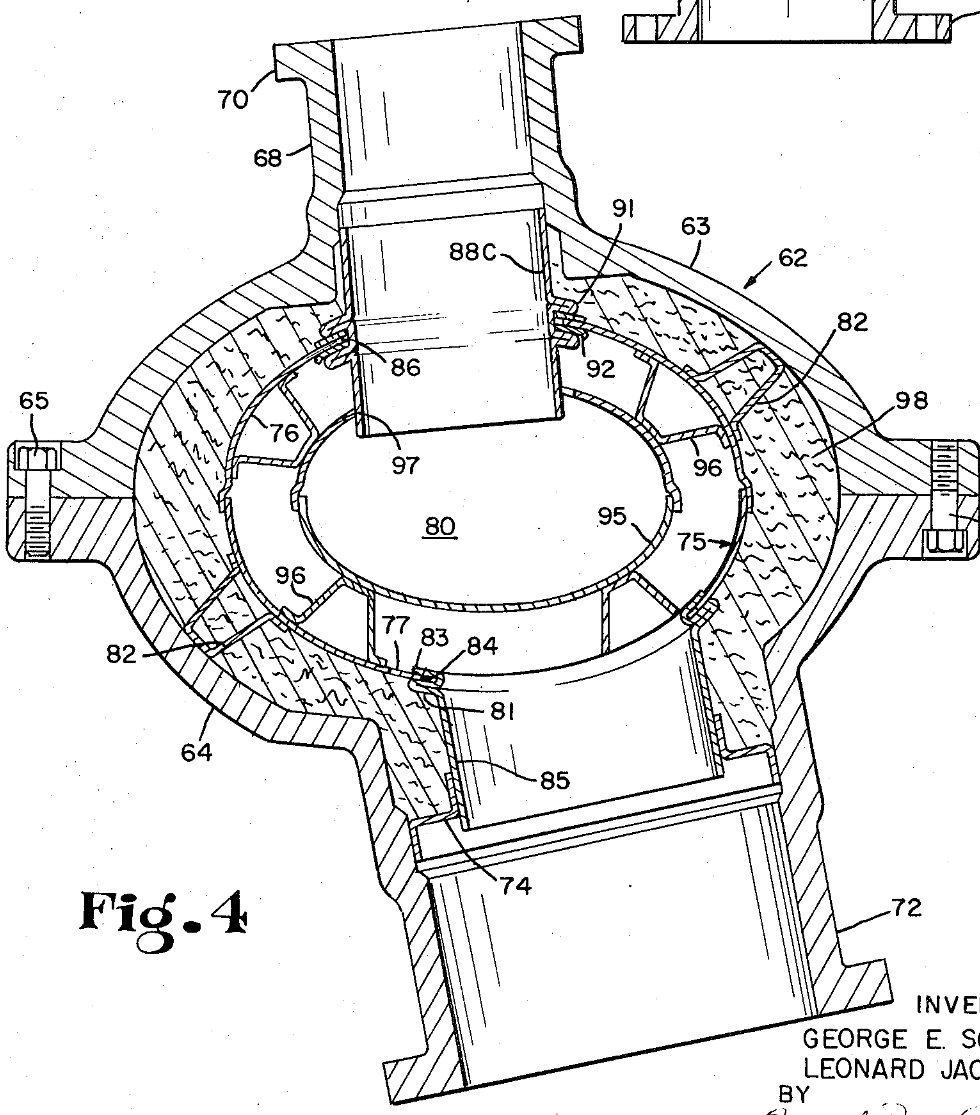

Fig. 4

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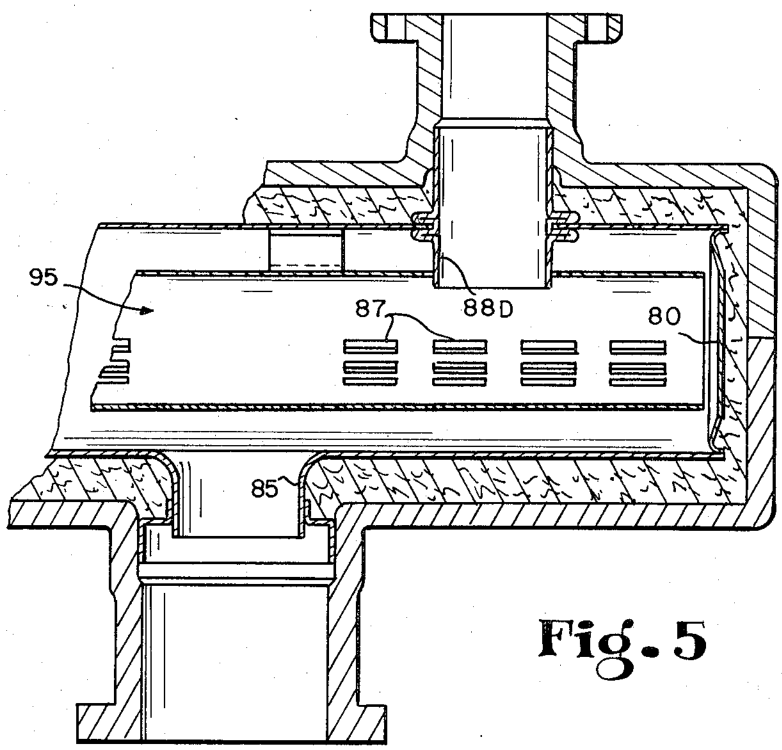

Fig. 5

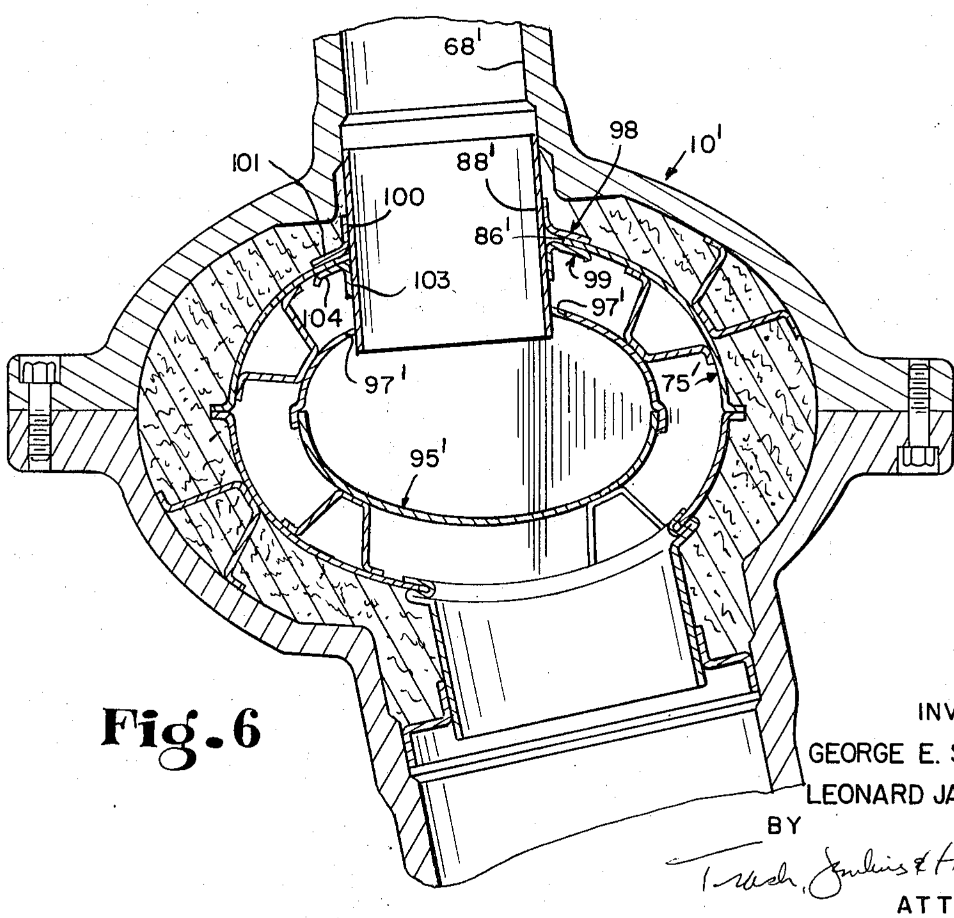

Fig. 6

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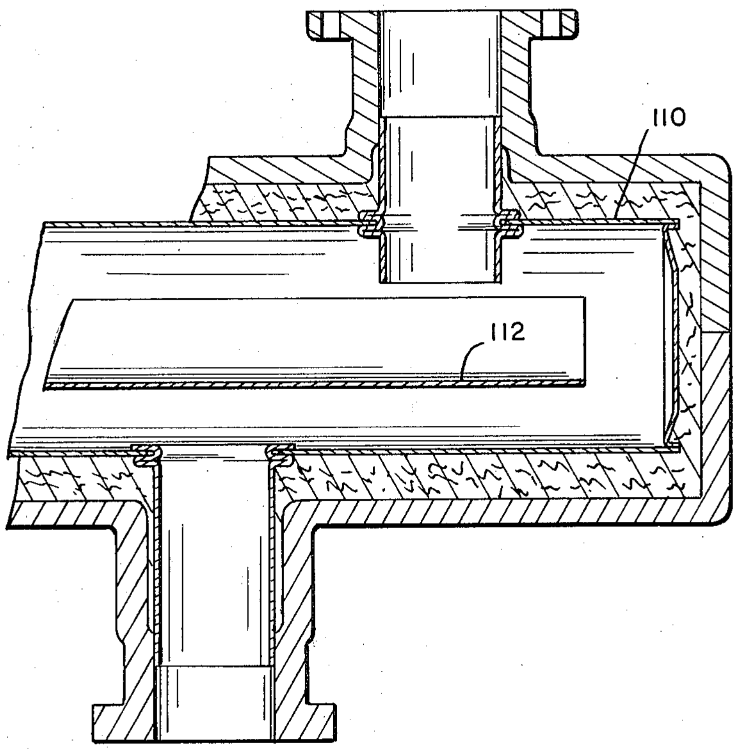

Fig. 7

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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 1800° 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 is a closed inner shell assembly. An outlet conduit is slidably connected to the inner shell assembly and projects outwardly therefrom and is slidably received in the outer shell outlet conduit. A plurality of inlet conduits are also slidably mounted on said inner shell assembly and project outwardly therefrom and are slidably received in the inlet conduits on said outer shell.

Thus, the exhaust gases pass through the inlet conduits into the inner shell assembly for discharge through the outlet conduits. And with the slidable connections between the inlet and outlet conduits and the inner shell assembly, said inner shell assembly is 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;

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

FIG. 5 is a fragmentary longitudinal section showing a modified form of the inner shell shown in FIG. 4;

FIG. 6 is a transverse section similar to FIG. 4, but showing a modified form of the inlet conduit mounting; and

FIG. 7 is a fragmentary longitudinal section showing a modified form of the inner shell shown in FIGS. 4 and 5.

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 inner shell assembly. Said assembly comprises an inner shell formed from an elongated sleeve **25** having a pair of interconnected shell-forming halves **27** and **28**. Said shell is closed at its opposite ends by a pair of end caps **30** rigidly connected to the shell halves **27** and **28** and spaced from the ends of the outer shell **10**. The shell **25** is slidably supported in the shell **10** on a plurality of longitudinally spaced brackets **32** mounted on shell **25**. As shown, shell **25** has a length and cross-section substantially less than shell **10**, and thus the brackets **32** retain the shell **25** in spaced relation to shell **10** throughout their extents.

As best shown in FIG. 2, shell half **27** is provided with a plurality of longitudinally spaced inlet openings **40** disposed in alignment with the inlet conduits **16** on the outer shell casting **12**. An inlet conduit **42** is mounted in each of the openings **40** with its outer end slidably received in the aligned inlet conduit **16**. Each of the conduits **42** has its inner end bent radially outwardly to define a flange **43** and its portion spaced axially outwardly from the flange **43** folded to form a radially extending bead **45**. The bead **45** and flange **43** are disposed on opposite faces of the wall of the shell half **27** in which the opening **40** is formed. A pair of annular washers **48** and **49** are disposed around the opening **40** on opposite faces of the shell half **27** with the washer **48** interposed between said shell half and the bead **45** and the washer **49** interposed between the shell half **27** and the flange **43**. The opening **40** has an elliptical cross-section with its elongated axis parallel to the longitudinal axis of the shell **25** to thus permit said shell to expand and contract with respect to the inlet conduits **42**. The washers **48** and **49** acting in combination with the deformations **43** and **45** in the inlet conduits **42**, however, completely cover any space between the edges of the opening 40 and the conduits 42. As shown in FIG. 2, washers 48 and 49 have an arcuate cross-sections corresponding to the curvature of the shell 25 to thus prevent any rotational movement of said washers as would permit said gas leakage outwardly through the elliptical configuration of the opening 40.

Shell half 28 is provided with an elliptically shaped outlet opening 50 having its elongated axis oriented parallel with the longitudinal axis of shell 25. An outlet conduit 51 projects outwardly from opening 50 and is slidably received in collar 22 in the outer shell outlet conduit 20. The inner end of the conduit 51 is slidably connected to the inner shell 25 in the same manner as the inlet conduits 42. Thus, the inner end of the conduit 51 is deformed to define a radially extending, axially spaced bead 52 and flange 53 disposed on opposite faces of the shell half 28. Washers 54 and 55 having arcuate cross-sections corresponding to the cross-section of the shell half 28 are interposed between said shell half and the bead 52 and flange 53. Thus, the shell 25 is slidably connected to the outlet conduit 51 and can expand and contract with respect to the said conduit without any gas leakage into the space between the inner shell assembly and the outer shell.

A compressible insulation 56 is interposed between the outer shell 10 and inner shell 25 and in the space between their respective inlet and outlet conduits for thus thermally insulating the outer shell from the inner shell.

In operation of the manifold shown in FIGS. 1 and 2, the exhaust gases enter through the inlet conduits 42 where they are discharged into the inner shell 25. The gases exit said inner shell through its outlet conduit 51. The slidable interconnections between the inner shell and its inlet and outlet conduits permit said inner shell to expand and contract with respect to the outer shell due to changes in termperature.

In the embodiment shown in FIGS. 3 and 4, the manifold has an outer shell 62 formed from a pair of metal castings 63 and 64 interconnected by bolts 65. A plurality of longitudinally spaced inlet conduits 68 project outwardly from the casting 63 and are provided at their outer ends with mounting flanges 70 adapted to be connected to the exhaust ports of an internal combustion engine. An outlet conduit 72 projects outwardly from the casting 64 and is provided at its outer end with a mounting flange 73 adapted to be connected to an exhaust pipe. A collar 74 is mounted within the outlet 72 and projects radially inwardly therefrom.

Carried within the outer shell 62 is an inner shell assembly comprising an intermediate shell 75 and an inner shell 95. The intermediate shell 75 comprises an elongated sleeve formed from a pair of interconnected shell havles 76 and 77 closed at their ends by a pair of end caps 80. The shell 75 is slidably supported in the shell 62 on a plurality of longitudinally spaced brackets 82 mounted on the shell 75. As shown, the shell 75 has a length substantially shorter than the length of the shell 62, and thus the brackets 82 retain shell 75 in spaced relation to shell 62 throughout their extents.

As shown in the drawings, shell half 77 is provided with an outlet opening 84, and an outlet conduit 85 projects outwardly from said opening and is slidably received in the collar 74 in the outer shell outlet 72. As contrasted to the outlet conduit 51 in FIG. 2, the conduit 85 is fixedly connected to the shell 75. Such connection is effected by forming an axially spaced bead

81 and flange 83 on the inner ends of the conduit, which flange and bead are bindingly received over the circumferential edge of the opening 84.

Shell half 76 is provided with a plurality of longitudinally spaced inlet openings 86 disposed in alignment with the inlet conduits 68 on the outer shell casting 63. Inlet conduits 88-A, 88-B, 88-C, and 88-D are mounted in the openings 86 with their outer ends slidably received in the aligned inlet conduits 68 and their inner ends projecting radially inwardly into the intermediate shell 75. Intermediate its length, each of the inlet conduits 88-A, 88-B, 88-C, and 88-D has formed therein a pair of radially extending, axially spaced beads 90 disposed on opposite faces of the wall of the shell half 76 in which the openings 86 are formed. A pair of annular washers 91 and 92 is disposed around each of conduits 88-A, 88-B, 88-C on opposite faces of the shell half 76 and interposed between said shell half and one of the inlet conduit beads 90. The openings 86 have slightly elliptical cross-sections with their elongated axis parallel to the longitudinal axis of the shell 75 to thus permit said shell to expand and contract with respect to the inlet conduits 88-A, 88-B, and 88-C with the washers 91 and 92 acting in combination with the inlet conduit beads 90 thereon to completely cover any space between the edges of the openings 86 and the conduits 88-A-C. As shown in FIG. 4, the washers 91 and 92 have an arcuate cross-section corresponding to the curvature of the shell 75 to thus prevent any rotational movement of said washers such as would permit gas leakage outwardly through the elliptical configuration of the opening 86. Inlet conduit 88-D is fixedly connected to the shell 75 as by having its beads 90 bindingly crimped around the circumferential edge of its associated shell opening 86.

The inner shell 95, which is in the form of an elongated sleeve, is carried within the intermediate shell 75 with its open ends spaced inwardly from the end caps 80. Desirably, the end of the shell 95 adjacent the intermediate shell outlet 84 is spaced closer to its adjacent end cap 80 than the opposite end of the inner shell. Said inner shell is slidably supported within the intermediate shell 75 on a plurality of brackets 96 mounted in said intermediate shell. The inner shell 95 has a plurality of inlet openings 97 in which the inner ends of the inlet conduits 88 are received. As shown, the openings 97 are substantially larger than the conduits 88 to thus permit relative movement between the inner shell 95 and said inlet conduits.

As with the embodiment shown in FIGS. 1 and 2, a compressible insulation 98 is interposed between the outer shell 62 and the inner shell assembly and in the space between their respective outlet conduits 72 and 85 for thus thermally insulating the outer shell from the inner shell assembly. And with the inner shell 95 being spaced from the intermediate shell 75 throughout its entire extent, there will thus be little thermal conductivity between the inner and outer shells.

In the operation of the manifold shown in FIGS. 3 and 4, the exhaust gases enter through the inlet conduits 68 and 88 A–D where they are discharged into the inner shell 95. The gases exit said inner shell through its open opposed ends into the intermediate shell 75 for discharge through the outlet conduits 72 and 85. The slidable interconnections between the several shells permit the intermediate and inner shells to expand and contract with respect to each other and with respect to the outer shell due to changes in temperature. With the intermediate shell 75 being fixedly connected to the inlet conduit 88-D and outlet conduit 85, said shell will expand and contract from its fixed points of connections thereto.

In the embodiment shown in FIG. 3, the open ends of the inner shell 95 are in substantial spaced relation to the end caps 80 on the intermediate shell so that the exhaust gases can freely move from the inner to the intermediate shell with-out creating any appreciable back pressure. As shown in FIG. 5, should it be desired to increase the dwell time of the gases within the inner shell 95 or increase the turbulance within the shells, the length of said inner shell can be extended such that its ends are in proximate relation to the end caps 80, and a plurality of louvered openings 87 can be formed in the inner shell 95. The openings 87 can also be employed for reducing the back pressure in the manifold. Although the openings 87 can be disposed in any desired location, it is preferable to dispose them out of axial alignment with the inlet conduits 88 A–D and outlet conduit 85 so that the exhaust gases entering the inner shell through the conduits 88 A–D will not be immediately discharged through said louvered openings and out said outlet conduit. It is to be understood that openings like openings 87 can be employed in any of the embodiments, if desired.

FIG. 6 shows a modified form of the inlet conduit mounting for the manifold shown in FIGS. 3 and 4. In this modification, each of the inlet conduits 88′ projects through an enlarged opening 86′ in the intermediate shell 75′. As shown, the outer end of the inlet conduit 88′ is slidably carried in one of the inlet conduits 68′ on the outer shell 10′, and its inner end projects through an enlarged inlet opening 97′ in the inner shell 95′. It is to be understood, of course, that the inner, intermediate and outer shells 95′, 75′ and 10′ in FIG. 5 may have the same construction as the inner, intermediate and outer shells 95, 75 and 10 shown in FIGS. 3 and 4.

In order to mount each of the inlet conduits 88′ on the intermediate shell 75′, a pair of axially spaced radially projecting brackets 98 and 99 are mounted on the conduit 88′. As shown, bracket 98 comprises an annular sleeve 100 received around, and fixedly connected to, the outer face of the conduit 88′. Said sleeve is continuous with a radially projecting flange 101 slidably received against the outer face of the intermediate shell 75′. Bracket 99 also comprises an annular sleeve 103 extending around, and fixedly connected to, the conduit 88′ and continuous with a radially projecting flange 104 slidably carried against the inner face of shell 75′. Thus, the inlet conduits 88′ and shell 75′ are movable with respect to each other to prevent any warping or distortion during thermal contraction and expansion. However, with the flanges 101 and 104 having a greater circumferential extent than the openings 86′, and with said flanges being in tight sliding engagement with the shell 75′, there will be no gas leakage around the connections of the inlet conduits to the intermediate shell.

The embodiment shown in FIG. 7 differs from the other embodiments only in the construction of the inner shell assembly. In this embodiment, the inner shell assembly comprises an intermediate shell 110 like the shells 25 in FIG. 2 and 75 in FIG. 6 having any of the inlet and outlet conduit connections previously described. Instead of employing an inner shell having a closed curve configuration like the inner shells 95 in FIG. 5 and 95′ in FIG. 6, however, the inner shell comprises an elongated plate 112 having an arcuate crosssection The plate 112 extends diametrically across the shell 110 and is connected along its longitudinal edges thereto. The ends of said plate are spaced inwardly from the ends of the shell 110 to permit gas flow between the inner and intermediate shells. If it is desired to increase said gas flow, the inner-shell forming plate 112 can be provided with a plurality of louvered openings, like the opening 87 shown in FIG. 5.

In each of the embodiments, the inner shell assembly is slidably connected to all or all but one of the inlet conduits so that it is free to expand and contract with respect to the outer shell. It is also slidably or fixedly connected to the outlet conduit. When such fixed connections are employed, such as in the case of the conduits 88-D and 85 in FIGS. 3 and 4, the inner shell assembly expands and contracts from such fixed connections with the other sliding connections of the other inlet conduits permitting such expansion and contraction movements. When all of the connections between the inner shell assembly and the inlet and outlet conduits are slidable, said assembly will be free to expand and contract from any point throughout its extent.

While each of the embodiments has 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 will be introduced into the manifold, but this may be done in any convenient or desired 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 inner shell assembly carried within said outer shell in spaced relation thereto, said inner shell assembly having a plurality of inlet openings and an outlet opening formed in the wall thereof, a second outlet conduit projecting outwardly from said inner shell assembly outlet opening and slidably carried in said first outlet conduit, a plurality of second inlet conduits projecting outwardly from said inner shell assembly inlet openings and slidably received in said first inlet conduits, and means slidably interconnecting a plurality of said second inlet conduits and said second outlet conduit to said inner shell assembly for movement of said second inlet and outlet conduits radially with respect to said assembly and thereby permitting movement of said assembly with respect to said outer shell.

2. An exhaust gas manifold as set forth in claim 1 in which said inner shell assembly comprises an elongated sleeve, a pair of end caps closing the ends of said sleeve, and a plate extending across said sleeve with its ends in spaced relation to said end caps, said second inlet and outlet conduits being interconnected to said sleeve.

3. An exhaust gas manifold as set forth in claim 1 in which said inner shell assembly comprises a first sleeve having its ends closed to form an intermediate shell, and a second open-ended sleeve carried in said first sleeve to form an inner shell, means for slidably sup-

porting said first sleeve in spaced relation to said outer shell and second sleeve, said second inlet conduits are interconnected to said intermediate shell with their ends projecting through inlet openings in said inner shell, said inner shell inlet openings being substantialy larger than said second inlet conduits, said second outlet conduit is interconnected to said intermediate shell, and said first and second outlet conduits are disposed adjacent one end of said manifold with the spacing between the ends of the first and second sleeves at said one end of the manifold being less than the spacing between the opposite ends of said first and second sleeves.

4. An exhaust gas manifold as set forth in claim **1** in which said inner shell assembly comprises a first sleeve having its ends closed to form an intermediate shell, and a second open ended sleeve carried in said first sleeve to form an inner shell, said second inlet conduits being interconnected to said intermediate shell with their inner ends projecting through inlet openings in said inner shell, said inner shell inlet openings being substantially larger than said second inlet conduits whereby said inner shell is movable with respect to said conduits, said second outlet conduit is interconnected to said intermediate shell, and means are provided for slidably supporting said first sleeve in spaced relation to said outer shell and second sleeve.

5. An exhaust gas manifold as set forth in claim **4** with the addition that said second sleeve has a plurality of second openings formed therein disposed out of alignment with said second inlet and outlet conduits.

6. An exhaust gas manifold as setforth in claim **4** in which one of said second inlet conduits is fixedly connected to said intermediate shell.

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 inner shell assembly carried within said outer shell in spaced relation thereto, said inner shell assembly having a plurality of inlet openings and an outlet opening formed in the wall thereof, a second outlet conduit projecting outwardly from said inner shell assembly outlet opening into said first outlet conduit, a plurality of second inlet conduits projecting outwardly from said inner shell assembly inlet openings into said first inlet conduits, and means slidably interconnecting a plurality of said second inlet conduits to said inner shell assembly comprising a pair of axially spaced radially extending members projecting outwardly from each of said second inlet conduits and disposed on the opposite faces of the inner shell assembly wall in which said inlet openings are formed, and a washer interposed between each of said members and one of said opposite wall faces.

8. An exhaust gas manifold as set forth in claim **7** with the addition that said inner shell assembly wall is in the form of a closed curve, said inlet openings are generally elliptical, and the washers disposed against the faces of said wall have arcuate cross-sections.

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