

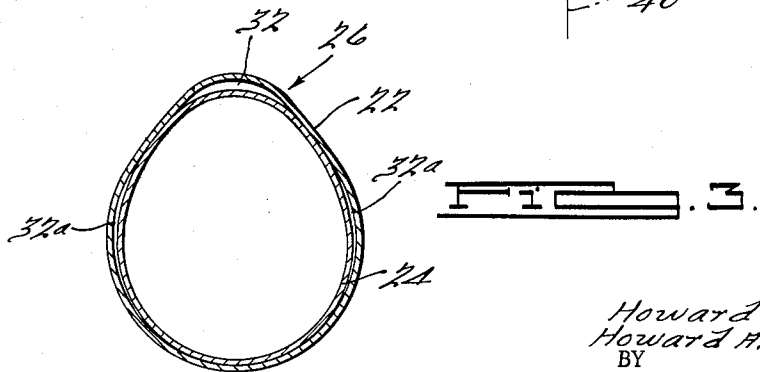
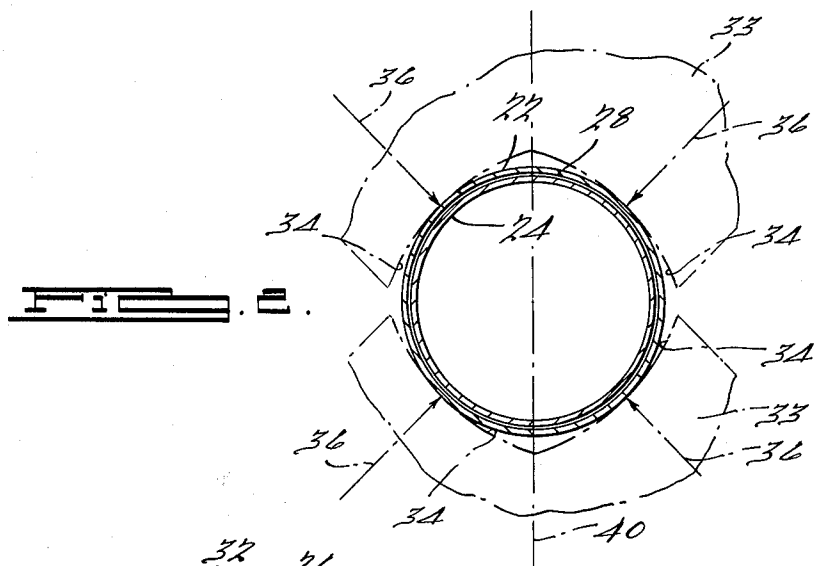
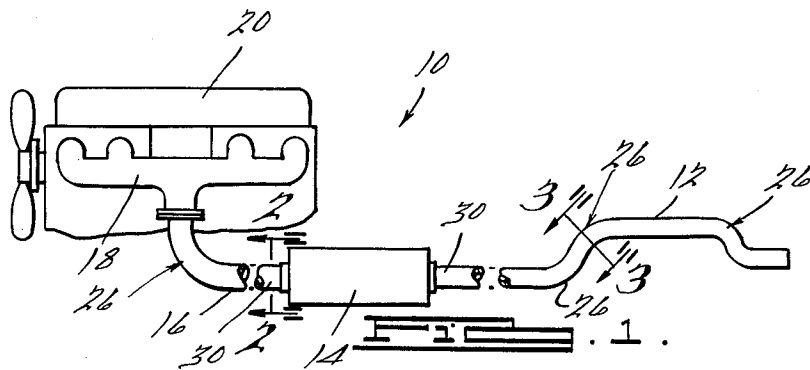
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EXHAUST SYSTEM

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3,209,787

EXHAUST SYSTEM

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This invention relates to an improved conduit assembly for conducting exhaust gases from internal combustion engines which is well adapted for use in the exhaust systems of automotive vehicles.

It is an object of the invention to provide an inexpensive exhaust gas conduit having a minimum pipe ring, side noise, and heat throw-off, and which may be readily bent.

The invention achieves this and other objects by means of a laminated assembly in which a clearance is provided between the inner and outer layers over most of their circumferences. This spacing is such as to permit relatively inexpensive and high speed bending of the assembly and, at the same time, give better silencing than single walled pipes or various other spacings.

Other objects, advantages and novel features of the invention will become apparent from the following description, claims, and drawings wherein:

FIGURE 1 is a schematic view of a conventional exhaust system for the internal combustion engine of a motor vehicle;

FIG. 2 is an enlarged cross-sectional view taken along the line 2-2 of FIG. 1; and

FIG. 3 is an enlarged cross-sectional view taken along the line 3-3 of FIG. 1, showing the after-shaped somewhat exaggerated.

Referring to the drawings, the exhaust system 10 comprises a tail pipe section 12, a muffler 14, and an exhaust pipe section 16. These are connected to the exhaust manifold 18 of an internal combustion engine 20. The tail pipe and exhaust pipe sections 12 and 16 each comprise an outer pipe 22 and an inner pipe 24 of suitable metal, such as low carbon steel or stainless steel. These are preferably seam-welded pipes. The pipes are bent as illustrated at 26 according to the vehicle chassis and underbody construction between which the pipe sections must fit. The inner and outer pipes are sized so that the inner diameter of the outer pipe is larger than the outer diameter of the inner pipe whereby there is a slight space or clearance between them as indicated at 28 throughout the straighter portion 30 thereof. Thus, assuming perfect roundness, straightness, and concentricity, this spacing may exist all the way around the adjacent portions of the pipes or, if not concentric, they may be in substantially line contact engagement along a line of tangency between the adjacent portions thereof. At the bends, as shown in FIG. 3, only relatively small areas of clearance as shown at 32 and 32a may exist due to the fact that during the bending operation the outer pipe 22 is reduced in diameter to become engaged with the inner pipe along substantial areas of their adjacent surfaces. It is desirable to employ a bending operation that will leave clearances such as 32 and 32a and preferably so that they communicate with clearance 28 so as to improve the acoustics. The pipes may be flared, ball jointed, or coated.

It has been found that a certain range of pipe dimensions gives the best acoustic results while still permitting standard bending without fracture, collapse, or wrinkling of one or both of the layers. The best sizes for the usual current United States automotive requirements are (a) 1 7/8" O.D. inner tube of .048" wall thickness and 2" O.D. outer tube with .036" wall thickness and (b) outer tube of 2 1/4" O.D. and .042" wall thickness and inner tube of 2 1/8" O.D. and .042" wall thickness. Tubing of these O.D. sizes are available on the open market (or can be readily made

on a tube mill from open market flat stock) and they can be merely put together, one inside the other, and bent according to requirements. The normal dimensional variations in these sizes of tubing or stock are permissible without adverse effects. The optimum clearance between the inner and outer layers is .050" (on the diameter) but for two layer laminates clearances in the range of about .015" to about .060" are satisfactory for various inner and outer tube combinations in the range of .036" to .060" thickness. As a rule of thumb, the nominal O.D. of the outer pipe should be no more than about 1/8" larger than the nominal O.D. of the inner pipe and its wall thickness should be such as to give a clearance in the range of .015"-.060" on the diameter. These clearances give what shop men would describe as a "slightly loose" fit between the two pipes. The bends 26 serve to hold the two pipes together in proper position.

While it is within the broad purview of the invention to use other suitable bending techniques to make bends 26, it is definitely preferred and advantageous to use the technique described in a copending U.S. application, Serial No. 215,601, filed August 8, 1962, and assigned to the assignee hereof. A horizontal bender with a mandrel or a vertical bender can be used. In accordance with the copending application, bending dies 33 such as schematically illustrated in FIG. 2 by the dot-dash lines are used, the upper die illustrated corresponding to a section through the ram and the lower to a section through one of the wing dies. Bending is in the plane 40 and the tops of the tubes in FIG. 2 will be on the inner bending radius while the bottom will be on the outer bending radius. The cross sectional shapes of the bending dies 33 are preferably as shown by surfaces 34 so that the initial contacts and bending forces 36 are applied to the pipes at points offset about 45° from the plane 40.

After bending, cross sections through the bent portion will be somewhat non-circular and tend to be egg-shaped as indicated in FIG. 3. The inner and outer tubes will be radially compressed together on the side of the bend (bottom of FIG. 3) and in the areas around the points of application of forces 36 and this will hold the two tubes in fixed relative longitudinal positions. In most, if not all, bends there will be a gap 32 at the inside (top) end of the major axis and somewhat smaller gaps 32a at the ends of the minor axis, as seen in FIG. 3, and these communicate with the clearance 28 between the pipes in the straight portions.

While the presently preferred embodiment is of two layers as described above, various modifications may be made to improve the acoustic and heat throw-off characteristics while still retaining good bending characteristics. Thus, an asbestos layer or tube may be inserted between tubes 22 and 24. If clearances are maintained on the high end (i.e., .050-.060 inch), layers or tubes of steel or aluminum of about .015" thickness may be inserted between the tubes 22 and 24, leaving a clearance of up to .020-.030". Such asbestos or metal layers would preferably be coextensive with the tubes 22 and 24 and therefore form an intermediate laminate.

While it will be apparent that the embodiments of the invention herein disclosed are well calculated to fulfill the objects of the invention, it will be appreciated that the invention is susceptible to additional modification, variation, and change without departing from the proper scope or fair meaning of the subjoined claims.

We claim:

1. A sound deadening pipe assembly for conveying the exhaust gases from an internal combustion engine comprising an outer pipe, an inner pipe received in said outer pipe with a slightly loose fit so that substantial portions of the adjacent surfaces of said pipes are spaced apart in the straight sections of said exhaust pipe assembly, at least

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one bend formed in said exhaust pipe assembly, at least the outer of said pipes having a smooth wrinkle-free surface in said bend and being deformed into a slightly egg-shaped configuration through said bend, portions of said inner and outer pipes being in tight engagement in said bend for fixing said pipes in a predetermined relative position, other portions of said pipes in said bend being out of engagement with a clearance therebetween providing for an area for metal to flow during bending of said pipes into said bend without collapsing or wrinkling thereof.

2. A sound deadening pipe assembly as set forth in claim 1 wherein the outer diameter of the portion of the outer pipe in the straight section being no more than about $\frac{1}{8}$ " larger than the outside diameter of the inner pipe in such straight portion, the wall thickness of said outer pipe being such that its inner diameter is in the range of approximately .015 to .060 of an inch larger than the outer diameter of said inner pipe in the straight section.

3. A sound deadening pipe assembly for conveying the exhaust gases of an internal combustion engine comprising an outer pipe, an inner pipe received in said outer pipe with a slightly loose fit so that substantial portions of adjacent surfaces of said pipes are spaced apart in the straight section of said exhaust pipe assembly, at least one bend formed in said exhaust pipe assembly, at least said outer pipe having a smooth wrinkle-free surface throughout said bend and being deformed in a substantially egg-shaped configuration throughout said bend, said egg-shaped portion of said outer pipe defining a major axis that lies in the plane of said bend and a minor axis, portions of said inner and outer pipes in said bend being in tight engagement between said major and minor axes for fixing said pipes in a predetermined relative position, the portion of said pipes along the side of the said major axis on the inside of said bend being out of engagement with a clear-

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ance therebetween providing for an area for metal to flow during bending of said pipes into said bend without collapsing or wrinkling thereof.

4. A sound deadening pipe assembly as set forth in claim 3 wherein the outer diameter of the portion of the outer pipe in the straight section being no more than $\frac{1}{8}$ " larger than the outside diameter of the inner pipe in such straight portion, the wall thickness of said outer pipe being such that its inner diameter is in the range of approximately .015 to .060 of an inch larger than the outer diameter of said inner pipe in the straight section.

5. A sound deadening pipe assembly as set forth in claim 3 wherein the narrow part of the egg-shaped portion of the outer pipe being on the inside of the bend.

6. A sound deadening pipe assembly as set forth in claim 3 wherein the inner and outer pipes are both egg-shaped in the bend.

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