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(54) **AIR-GAP MANIFOLD**

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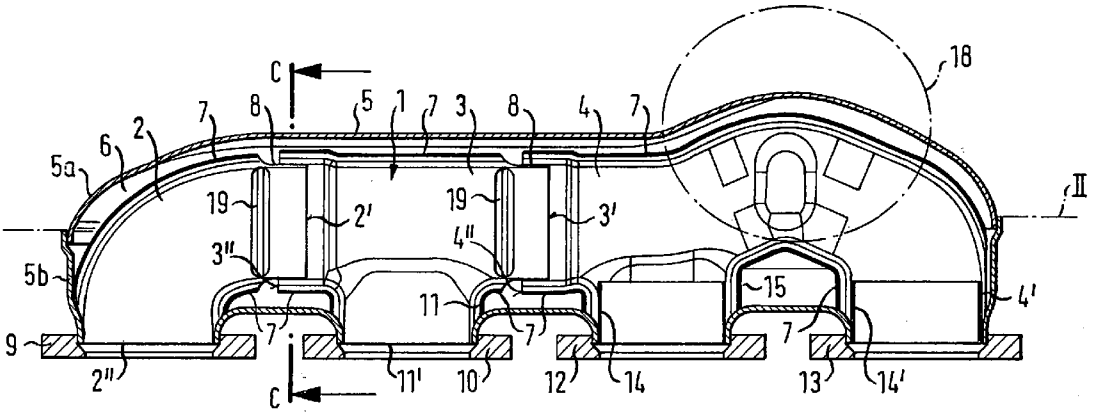
(57) **ABSTRACT**

An air-gap manifold for the connection of exhaust gas outlet openings of an internal combustion engine, in particular of a motor vehicle engine, to an exhaust gas intake opening of an exhaust gas system, having an interior part with a plurality of exhaust gas guides plugged into one another with a sliding fit, an exterior part surrounding the interior part and made gas-tight and an air-gap present between the interior part and the exterior part, wherein at least some of the exhaust gas guides of the interior part are formed by shells which are connected to one another by common reshaping at the rim, in particular by folding, in order to reduce the manufacturing costs.



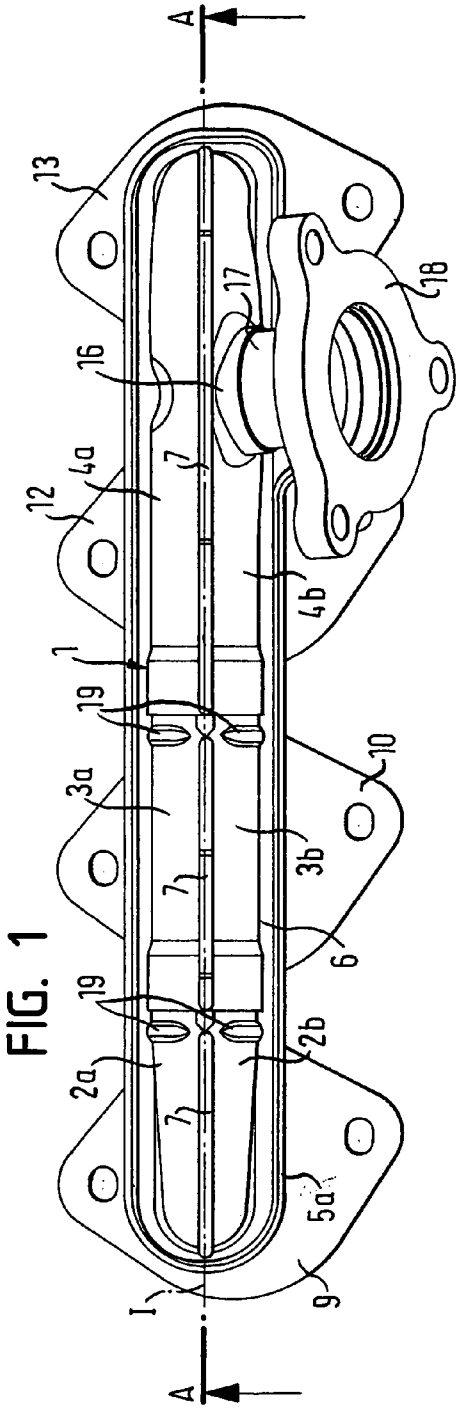

A
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FIG. 1

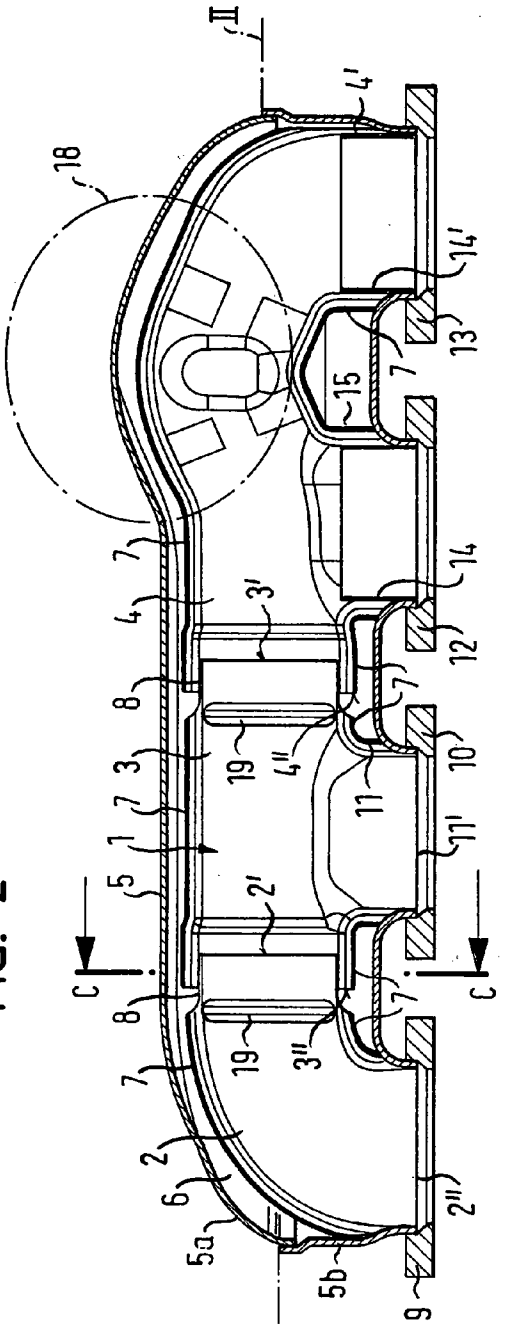
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FIG. 2

FIG. 3

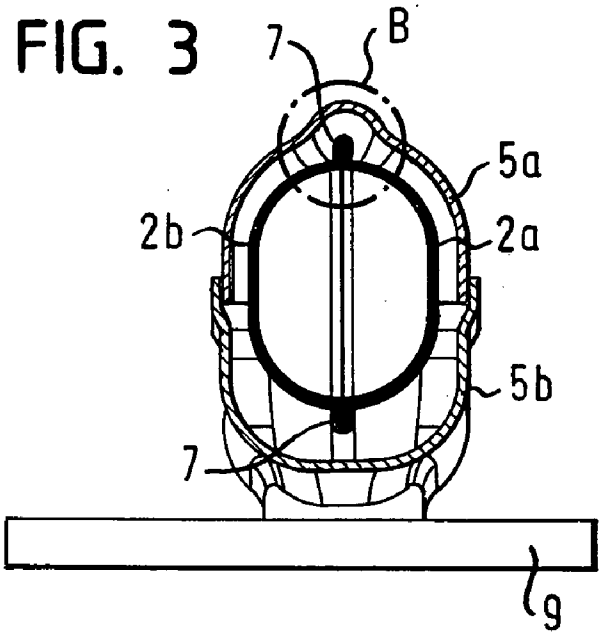
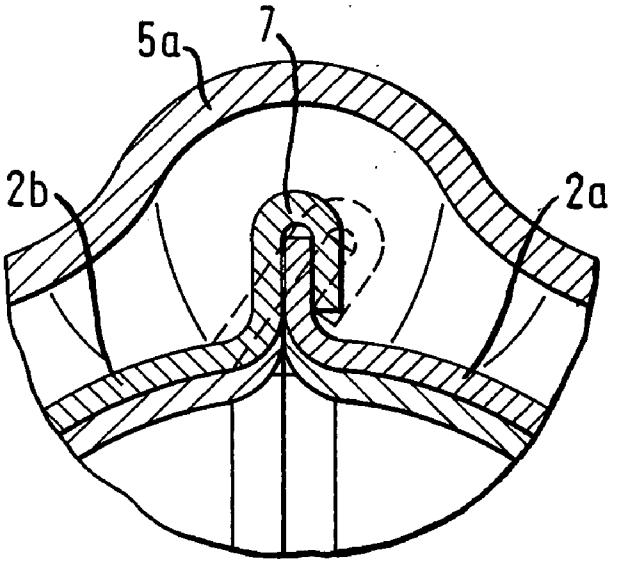


FIG. 4



AIR-GAP MANIFOLD

[0001] The present invention relates to an air-gap manifold for the connection of exhaust gas outlet openings of an internal combustion engine, in particular of a motor vehicle engine, to an exhaust gas intake opening of an exhaust gas system, having an interior part with a plurality of exhaust gas guides plugged into one another with a sliding fit, an exterior part surrounding the interior part and made gas-tight and an air-gap present between the interior part and the exterior part.

[0002] There are various possibilities of manufacturing such air-gap manifolds. Pipe bends are customary, with the pipes being able to be manufactured with particularly high accuracy by internal high pressure shaping. Such manufacturing processes are, however, comparatively cost-intensive. On the other hand, it is necessary for the manifolds to be made absolutely gas-tight outwardly in order to observe the emission regulations which are becoming more and more strict.

[0003] It is the underlying object of the invention to provide an air-gap manifold of the initially named kind which is favorable in manufacture, on the one hand, and permits the observation of the emission regulations, on the other hand.

[0004] This object is satisfied in that at least some of the exhaust gas guides of the interior part are formed by shells which are connected to one another by common reshaping at the rim, in particular by folding,.

[0005] The design of the exhaust gas guides of the interior part from shells is particularly cost-favorable in manufacture. On the one hand, the shells can be drawn cost-favorably. On the other hand, the connection of the shells by common reshaping at the rim, in particular by folding, is particularly favorable in manufacture. A large cost advantage results above all with respect to weld connections in particular when production free of weld splashes is necessary for exhaust manifolds for turbochargers. Only expensive laser and inert arc welding techniques can then be considered. The reshaping connection of the shells in accordance with the invention can be carried out free of weld splashes, on the one hand, and with a low effort, on the other hand. The leak tightness of the reshaped connection between the shells is sufficient since the exterior shell of the manifold is absolutely gas tight and a low non-tightness of the interior part therefore does not result in problems.

[0006] A further cost saving results if the exterior part also consists of shells. The exterior part can then also be manufactured comparatively cost-favorably. The assembly of the manifold is moreover simplified.

[0007] In particular sheet metal can be considered as the material for the shells of the interior part and/or of the exterior part. The metal sheet thickness of the interior part can be kept comparatively low since, in contrast to welding, no minimum thickness is required for the reshaped connection of the shells. Different types of steel, for example also austenitic steel, can thereby be used.

[0008] In order to ensure sufficient stiffness of the exhaust gas guides despite the thin material thickness, the shells of the interior part can be provided with beads. The shells of the exterior part can also have beads to increase the stiffness.

[0009] The shells of the exterior part are preferably welded to one another. A high leak tightness can thus be ensured. The weld connections can be arranged at the outside so that there is no risk of contamination of the interior of the exhaust manifold. More cost favorable welding processes can thereby also be used.

[0010] To prevent a displacement of the shells of the interior part in use, the interior shells can be latched to one another by individual spot welds. Since only individual spot welds are required to reliably prevent displacement, simple spot welding positions can be used for this without causing the costs to increase excessively. Alternatively or additionally, the shells can be molded jointly.

[0011] The exterior part preferably consists of two half-shells. The exhaust gas guides preferably likewise each consist of two half-shells. A particularly favorable manufacture and assembly is thus possible. It has also been found to be advantageous to arrange the separation planes of the interior shells and of the exterior shell approximately at right angles to one another.

[0012] A particularly advantageous use of the air- gap embodiment in accordance with the invention is provided in internal combustion engines with turbocharges, since the manifold in accordance with the invention can be produced particularly cost favorably free of weld splashes.

[0013] The manufacture of an air gap manifold in accordance with the invention preferably takes place such that the shells of the interior part each forming one part of the exhaust gas guides are first plugged into one another in accordance with the desired sliding fit arrangement, the shells each forming the other part of the exhaust gas guides are then likewise plugged into one another in accordance with the desired sliding fit arrangement and such that only then are the associated shells of the exhaust gas guides jointly connected to one another in that they are reshaped at the rim in pairs, in particular folded.

[0014] In accordance with the invention, it is not the individual exhaust gas guides which are first assembled from, for example, two shells each, with the exhaust gas guides formed in this manner being plugged into one another, but rather the plugging into one another takes place separately for each half of the interior part and only then are the two halves of all exhaust gas guides of the interior part simultaneously connected to one another. It can be ensured in this manner that the cross-sections of the exhaust gas guides are matched to one another in the sliding fit regions. No problems thereby occur on the joining together of the exhaust gas guides and a problem-free displacement of the individual exhaust gas guides with respect to one another can also be ensured in operation.

[0015] After the connection of all shells plugged into one another by common reshaping at the rim, in particular by folding, the shells of the respective exhaust gas guides are, where necessary, latched to one another by spot welds. The interior part is then inserted into the shells of the exterior part and these are connected to one another in a gas tight manner by welding.

[0016] The shells of the interior part are preferably made of sheet metal, in particular by deep drawing. Beads are preferably molded in to increase the stiffness of the shells. Two half-shells per exhaust gas guide are in particular produced and are then connected to one another simultaneously with the other half-shells.

[0017] A non-restricting embodiment of the invention is represented in the drawing and will be described in the following. There are shown, schematically in each case,

[0018] **FIG. 1** a plan view of an air gap manifold in accordance with the invention with a removed upper exterior shell;

[0019] **FIG. 2** a section through the air gap manifold of **FIG. 1** in accordance with the line A-A,

[0020] **FIG. 3** a section through the air gap manifold in accordance with the invention in accordance with the line C-C in **FIG. 2**; and

[0021] **FIG. 4** the detail B of **FIG. 3** in an enlarged representation.

[0022] The air gap manifold shown includes an interior part **1** having a plurality of exhaust gas guides **2**, **3**, and **4** plugged into one another with a sliding fit and an exterior part **5** surrounding the interior part **1** at a spacing and made in a gas tight manner. An air gap **6** is thereby formed between the interior part **1** and the exterior part **5** and effects a heat insulation of the exhaust manifold.

[0023] The exhaust gas guides **2**, **3** and **4** are each made of two half-shells **2***a* and **2***b*, **3***a* and **3***b*, **4***a* and **4***b* which are connected to one another at the rim side. The connection is a fold connection such as is shown in **FIG. 4**. The rim of the one half-shell **3***a* is bent around the rim of the other half-shell **3***b* for this. Subsequently, the fold **7** is positioned obliquely, as is shown by a chain-dotted line, to increase the strength of the connection.

[0024] The exhaust gas guides **2**, **3** and **4** are, as stated, plugged into one another with a sliding fit. For this purpose, the fold **7** ends at a respective end **2'**, **3'** of the exhaust gas guides **2** and **3** in front of the end of the respective exhaust gas guide **2**, **3**. A fold-free region **8** is thereby formed on which the associated end **3"**, **4"** of the respective adjacent exhaust gas guide **2**, **3** and **4** is arranged with sliding fit.

[0025] The other end **2"** of the exhaust gas guide **2** together with the exterior shell **5** is connected in a gas tight manner to a first intake flange **9**. A second intake flange **10** is connected in a gas tight manner to the exterior shell **5** and to the end **11'** of a side branch **11** of the exhaust gas guide **3**. Finally, third and fourth intake flanges **12**, **13** are connected in a gas tight manner to the exterior shell **5** and to one rigid sleeve **14**, **14'** each. The sleeve **14** sits with a sliding fit in a side branch **15** of the exhaust gas guide **4** and the sleeve **14'** likewise with a sliding fit in the second end **4'** of the exhaust gas guide **4**.

[0026] The exhaust gas guide **4** has a second branch **16** into which a further sleeve **17** is inserted with a sliding fit. This sleeve **17** together with the exterior part **5** is connected in a gas tight manner to an outlet flange **18**. A continuing pipe of a customary exhaust gas system can be connected to the outlet flange **18**. The intake flanges **9**, **10**, **12** and **13** can correspondingly be connected to exhaust gas outlet openings of an internal combustion engine.

[0027] The exterior part **5** likewise has two half-shells **5***a*, **5***b*. The separation plane I of the half shells **5***a* and **5***b*, however, extends at an angle of approximately 90° to the separation plane II of the half-shells **2***a*, **2***b*, **3***a*, **3***b*, **4***a* and **4***b* of the interior part **1** and approximately parallel to the plane of the flanges **9**, **10**, **12** and **13**.

[0028] The manufacture of the air-gap manifold shown substantially takes place such that first all half-shells **2***a*, **2***b*, **3***a*, **3***b*, **4***a* and **4***b* of the interior part **1** and **5***a* and **5***b* of the exterior part **5** are manufactured. Beads **19** can be introduced into the half-shells in this process. Then the respective one half-shells **2***a*, **3***a* and **4***a* of the interior part **1** are plugged into one another in accordance with the desired siding fit arrangement. The half-shells **2***b*, **3***b* and **4***b* of the interior part **1** are correspondingly plugged into one another. After the insertion of the sleeves **14** and **14'**, the half shells plugged into one another **2***a*, **3***a* and **4***a* as well as **2***b*, **3***b* and **4***b* are inserted into a reshaping tool. Then, all half-shells **2***a*, **2***b*, **3***a*, **3***b* and **4***a*, **4***b* associated with one another are connected to one another by folding at the rim side. If necessary, the half-shells **2***a*, **2***b*, **3***a*, **3***b*, **4***a* and **4***b* of the interior part **1** are each latched to one another by individual spot welds. A laser or MAG welding technique is used in this process in order to avoid damaging weld splashes.

[0029] The interior part is thus complete and is inserted into the lower shell **5***b* of the exterior part **5** after removal from the reshaping tool. The interior part **1** is then connected, in particular welded, together with this, in a gas tight manner to the intake flanges **9**, **10**, **12** and **13**. The sleeve **17** is then welded in a gas tight manner together with the upper shell **5***a* of the exterior part **5** to the outlet flange **18**. The upper shell **5***a* of the exterior part **5** is subsequently placed onto the lower shell **5***b* and is welded in a gas tight manner in the overlapping region. The two half-shells **5***a*, **5***b* of the exterior part **5** can be connected to one another by normal welding methods since the weld seam is at the outside.

[0030] Sliding fit connections can be established between the exhaust gas guides **2**, **3** and **4** by the manufacturing method described and can have a very tight fit despite the construction of the exhaust gas guides **2**, **3** and **4** from half-shells. Since the exhaust gas guides **2**, **3** and **4** do not have to be plugged into one another in the folded state, no problems also occur due to uneven roundings or cross-sections of the ends **2'**, **3"** and **3'**, **4"** of the exhaust gas guides **2**, **3** and **4** associated with one another.

[0031] The design of the interior part with sliding fits shown and described in another respect permits in a known manner a substantially unimpeded thermal expansion of the exhaust gas guides **2**, **3** and **4** of the interior part **1**, in particular a larger thermal expansion due to the greater heating of the interior part **1** with respect to the exterior part **5**. The exterior part **5**, on the other hand, ensures a high gas tightness of the air-gap manifold. In this manner, a properly suitable air-gap manifold can be manufactured at comparatively very low costs.

Reference Numeral List

[0032] **1** interior part

[0033] **2** exhaust gas guide

[0034] **2'** end of **2**

[0035] **2"** end of **2**

[0036] **2***a* half-shell

[0037] **2***a* half-shell

[0038] **3** exhaust gas guide

[0039] **3'** end of **3**

[0040] **3"** end of **3**

[0041] **3***a* half-shell

[0042] **3***a* half-shell

[0043] **4** exhaust gas guide

[0044] **4'** end of **4**

[0045] **4**" end of **4**

[0046] **4***a* half-shell

[0047] **4***a* half-shell

[0048] **5** exterior part

[0049] **5***a* half-shell

[0050] **5***a* half-shell

[0051] **6** air gap

[0052] **7** fold

[0053] **8** fold-free region

[0054] **9** intake flange

[0055] **10** intake flange

[0056] **11** branch of **3**

[0057] **11**' end of **11**

[0058] **12** intake flange

[0059] **13** intake flange

[0060] **14**, **14**' sleeve

[0061] **15** branch of **4**

[0062] **16** branch of **4**

[0063] **17** sleeve

[0064] **18** outlet flange

[0065] **19** bead

[0066] I separation plane

[0067] II separation plane

1. An air-gap manifold for the connection of exhaust gas outlet openings of an internal combustion engine, in particular of a motor vehicle engine, to an exhaust gas intake opening of an exhaust gas system, having an interior part (**1**) with a plurality of exhaust gas guides (**2**, **3**, **4**) plugged into one another with a sliding fit, an exterior part (**5**) surrounding the inner part (**1**) and made gas-tight and an air-gap (**6**) present between the interior part (**1**) and the exterior part (**5**), characterized in that

at least some of the exhaust gas guides (**2**, **3**, **4**) of the interior part (**1**) are formed by shells (**2***a*, **2***b*, **3***a*, **3***b*, **4***a*, **4***b*) which are connected to one another by common reshaping at the rim, in particular by folding.

2. An air-gap manifold in accordance with claim 1, characterized in that the exterior part (**5**) likewise consists of shells (**5***a*, **5***b*).

3. An air-gap manifold in accordance with claim 1, characterized in that the shells (**2***a*, **2***b*, **3***a*, **3***b*, **4***a*, **4***b*) of the interior part (**1**) and/or the shells (**5***a*, **5***b*) of the exterior part (**5**) consist of sheet metal.

4. An air-gap manifold in accordance with claim 1, characterized in that the shells (**2***a*, **2***b*, **3***a*, **3***b*, **4***a*, **4***b*) of the interior part (**1**) and/or the shells (**5***a*, **5***b*) of the exterior part (**5**) have beads (**19**).

5. An air-gap manifold in accordance with claim 3, characterized in that the shells (**5***a*, **5***b*) of the exterior part (**5**) are welded to one another.

6. An air-gap manifold in accordance with claim 1, characterized in that the shells (**2***a*, **2***b*, **3***a*, **3***b*, **4***a*, **4***b*) of the interior part are latched to one another, in particular by individual spot welds.

7. An air-gap manifold in accordance with claim 1, characterized in that the exterior part (**5**) consists of two half-shells (**5***a*, **5***b*).

8. An air-gap manifold in accordance with claim 1, characterized in that the shells (**2***a*, **2***b*, **3***a*, **3***b*, **4***a*, **4***b*) of the interior part (**1**) are half-shells.

9. An air-gap manifold in accordance with claim 8, characterized in that the separation plane (I) of the exterior shell (**5**) and the separation plane (II) of the interior shell (**1**) stand approximately at right angles to one another.

10. An air-gap manifold in accordance with claim 1, characterized by the use for an internal combustion engine with a turbocharger.

11. A method for the manufacture of an air-gap manifold for the connection of exhaust gas outlet openings of an internal combustion engine, in particular of a motor vehicle engine, to an exhaust gas intake opening of an exhaust gas system, the air gap manifold having an interior terior part (**1**) with a plurality of exhaust gas guides (**2**, **3**, **4**) plugged into one another with a sliding fit, an exterior part (**5**) surrounding the inner part (**1**) and made gas-tight and an air-gap (**6**) present between the interior part (**1**) and the exterior part (**5**), wherein at least some of the exhaust gas guides (**2**, **3**, **4**) of the interior part (**1**) are formed by shells (**2***a*, **2***b*, **3***a*, **3***b*, **4***a*, **4***b*) which are connected to one another by common reshaping at the rim, in particular by folding. characterized in that

the shells (**2***a*, **3***a*, **4***a*) of the interior part (**1**) each forming one part of the exhaust gas guides (**2**, **3**, **4**) are first plugged into one another in accordance with the desired sliding fit arrangement, the shells (**2***b*, **3***b*, **4***b*) each forming the other part of the exhaust gas guides (**2**, **3**, **4**) are then likewise plugged into one another in accordance with the desired sliding fit arrangement; and in that only then are the associated shells (**2***a*, **2***b*, **3***a*, **3***b*, **4***a*, **4***b*) of the exhaust gas guides (**2**, **3**, **4**) jointly connected to one another in that they are reshaped at the rim in pairs, in particular folded.

12. A method in accordance with claim 11, characterized in that the shells (**2***a*, **2***b*, **3***a*, **3***b*, **4***a*, **4***b*) of the interior part (**1**) are latched to one another by individual spot welds.

13. A method in accordance with claim 11, characterized in that the shells (**5***a*, **5***b*) of the exterior part (**5**) are welded to one another in a gas tight manner.

14. A method in accordance with claim 11, characterized in that the shells (**2***a*, **2***b*, **3***a*, **3***b*, **4***a*, **4***b*) of the interior part (**1**) and/or the shells (**5***a*, **5***b*) of the exterior part (**5**) consist of sheet metal.

15. A method in accordance with claim 11, characterized in that the shells (**2***a*, **2***b*, **3***a*, **3***b*, **4***a*, **4***b*) of the interior part (**1**) and/or the shells (**5***a*, **5***b*) of the exterior part (**5**) are provided with beads.

* * * * *