The invention relates to a silencer (1), in particular a vehicle silencer, having a continuous pipe (2) as well as a first resonator chamber (14) and a second resonator chamber (15) each surrounding the pipe (2) and being arranged one behind the other, with the shell (3) of the pipe (2) having at least one first opening (7) which opens into the first resonator chamber (14), and at least one second opening, which opens into the second resonator chamber (15). In order to allow a more flexible manufacturability, the resonator chambers (14, 15) are formed from a first housing part (4) and a second housing part (5), each having a shell embodied around an axis, and the length of the shell of the one housing part (4, 5), as seen in axial direction, is at least half of the length of the other housing part (5, 4), and the housing parts (4, 5) are slid inside each other and overlap their shells at least in parts, and in the overlapping region (6), the shell exterior face (4a) of the first housing part (4) rests against the shell interior face (5b) of the second housing part (5), and in at least the overlapping region (6), the shell exterior face (4a) of the first housing part (4) and the shell interior face (5b) of the second housing part (5) each have a constant cross-section as seen in axial direction, and the housing parts (4, 5) have a recess on each side facing away from the overlapping region (6), which recess the pipe (2) passes through.
SILENCER AND METHOD FOR MANUFACTURING THE SAME

[0001] The invention relates to a silencer, in particular a vehicle silencer, having a pipe forming a flow duct as well as a first resonator chamber and a second resonator chamber, each surrounding the pipe and being arranged one behind the other in axial direction, with the pipe in its shell having at least one first opening which opens into the first resonator chamber, and at least one second opening which opens into the second resonator chamber. The invention also relates to a vehicle having a silencer, and a method for manufacturing a silencer.

[0002] A silencer of that kind is disclosed in document EP 1400662 B1. This publication discloses two resonator chambers that are arranged one behind the other in axial direction and separated from the flow duct by a perforated plate. The manufacture of the silencer designed according to the principle of a Helmholtz resonator is expensive and elaborate. In order to produce silencers having different resonator volumes it is in each case also required to produce different parts and provide them in accordance with the case of application. Thus, the manufacturing process flexibility is not very flexible.

[0003] WO 07101412 A1 discloses a silencer of modular type of construction and method of producing it. For this purpose, a number of fluid guide elements forming a labyrinth of channels and resonator chambers is provided. A continuous pipe is not provided, design and construction are very complex and require a number of component parts, the composition of which is very elaborate.

[0004] Document DE 736635 A discloses a silencer comprising one or several chambers, where the gases flow along inside the shell of the silencer. This being the case, two chambers are in each case connected to one another by an annular space.

[0005] The internal pipe is not embodied to be continuous but opens with a first pipe connecting piece, coming from one side, into a central chamber. From there, the fluid flows into an annular space via radial openings, is redirected there and lead into a further chamber. The second pipe connecting piece of the silencer projects into this further chamber. This construction is very much different from the above-mentioned silencer and its assembly requires comparably many individual components that not only have to be positioned exactly but also need to be supported in order to achieve sufficient stability.

[0006] DE 10 2008 015353 A1 discloses a charging device, in particular an exhaust turbocharger for a vehicle having a silencer based on the principle of a resonant absorber for reducing the sound generated by the charging device. This being the case, a shell and an insert element together form the silencer. The silencer is thus an integral part of the charging device. The insert element formed from plastic material can be screwed to the shell of the charging device. A continuous exhaust pipe is not provided. This solution is only suitable for certain applications and needs to be adapted exactly to the design of the charging device.

[0007] WO 1205248 A2 discloses a wide-band damper for charge air lines of an internal combustion engine with turbocharger. This solution does not include a continuous pipe but discloses pipe sections arranged one behind the other, and each of them being separated from another by an annular gap, with the gap connecting the interior of the fluid line with the resonator chamber arranged outside. This is a very special solution and difficult to produce due to its design and requires a high number of components. Furthermore, the mechanical stability is low.

[0008] DE 10 2010 020064 A1 discloses a silencer arrangement for a particularly charged vehicle internal combustion engine. This comprises a shell wherein a flow duct is designed, with a resonator chamber being arranged outside the flow duct. The silencer arrangement simultaneously forms a coupling between a hose section and an exhaust turbocharger. This being the case, two shell parts are inserted into one another, and the faces touching each other are embodied to have a conical shape and rest against one another in the predefined position. Design and manufacture of such a construction is complex and limited to a predefined resonator volume. If other resonance conditions are required to be created for certain applications, it results to be necessary to provide the component parts with essentially different dimensions. This requires additional effort already when the individual parts are being prefabricated.

[0009] Finally, also JP 2008082386 A, DE 19957597 B4, DE 4219249 A1 and DE 3020492 C2 disclose silencer constructions which, however, are different from the present invention.

[0010] An essential disadvantage of the known silencers or the production methods is that for manufacturing silencers having different resonator volumes, the required components are to be adapted to the respective resonator volume. This means that individually dimensioned components have to be used depending on the desired resonator volume. This requires an increased effort already when the components are being prefabricated. Also during assembly, these components are to be considered individually. These requirements also have a negative influence on the costs of the silencer.

[0011] The objective of the present invention is to provide a silencer and a manufacturing method not having these disadvantages and where the manufacture of different silencers having different resonator volumes does not require additional effort when it comes to the prefabrication of the components and their assembly. This invention will allow reliable, mechanically stable and efficiently damping silencers to be manufactured.

[0012] By means of an above-mentioned silencer this objective is achieved by the fact that the resonator chambers are formed by a first and a second housing part, each housing part having a shell designed around an axis, and the length of the shell of the one housing part is in axial direction at least the half of the length of the shell of the other housing part, and that the housing parts are slid inside each other and their shells overlap each other at least in parts, with the shell exterior face of the first housing part resting again the shell interior face of the second housing part in the overlapping region, and the shell exterior face of the first housing part and the shell interior face of the second housing part each have a constant cross-section in axial direction, and that the housing parts each have a recess, where the flow duct extends through.

[0013] The advantage of such a construction resides in the fact that the housing parts can be slid into each other to different extents other during manufacture, depending on the desired resonator volume. The housing parts are—before being fixed to one another, e.g. welded—telescopic, and the shell faces rest against one another in the different telescopic positions in the overlapping region.

[0014] The feature, according to which the shell exterior face of the first housing part and the shell interior face of the
second housing part each have a constant cross-section or cross-sectional contour in axial direction, at least in the overlapping region, allows a telescopic ability with shell faces continuously resting against each other during assembly. The cross-section concerned extends in this case perpendicularly with respect to the axial direction.

0015] Only when the correct relative position of the housing parts has been achieved by telescoping, the housing parts will be fixed. Thus, a high degree of flexibility is achieved, without the requirement that differently dimensioned housing parts have to be produced for different resonator volumes.

0016] Usually, the recesses (provided for the pipe or the flow duct) are arranged on the side of the respective housing part facing away from the overlapping region.

0017] It is preferred that the pipe is embodied to be continuous at least in the region surrounded by the resonator chambers, and passes through the recesses of the housing parts. As a result, a particularly simple manufacture including only a few parts is allowed.

0018] It is alternatively possible that the pipe running inside is made of two parts that are slid inside each other, thus forming a continuous flow duct.

0019] It is preferred that the shell exterior face of the first housing part and the shell interior face of the second housing part each have a constant cross-section as seen in axial direction in the majority of their regions. Apart from the simple construction this allows a maximum of telescopic ability during manufacture and thus a large extent of variability of the resonator volume.

0020] It is preferred that the housing parts are each embodied to be cylindrical and the shell exterior face of the first housing part and the shell interior face of the second housing part each have a circular cross-section. This allows a simple telescoping during manufacture, and twisting the housing parts slightly against each other can help to overcome possible resistances.

0021] It is preferred that the shells of the housing parts each have, as seen in axial direction, a constant shell thickness at least in the overlapping region, preferably continuously. It is thus possible for the shells or also all housing parts to be produced of sheets of metal having a constant thickness, which results in an advantageous reduction of weight.

0022] It is preferred that the length of the shell of one housing part is in axial direction at least two thirds, preferably three quarters, of the length of the shell of the other housing part, with preferably the shells of the housing parts being essentially of the same length. Thus, the maximum possible extent to which the housing parts can be slid inside each other during manufacture becomes large, with the result that a maximum of flexibility during the manufacturing process in terms of the resonator volume is ensured.

0023] It is preferred that the housing parts have an end face on each side facing away from the overlapping region, in which end faces the recesses for the passage of the pipe or the flow duct are embodied. The end faces limit the resonator chambers in axial direction and their recesses form a connection to the pipe.

0024] It is preferred that the housing parts are in each region of their recesses connected with the pipe to seal towards the outside in an airtight manner. No additional cover or shell creating airtightness is thus required. The housing parts directly limit the resonator chambers towards the outside.

0025] It is preferred that the housing parts are welded to each other in their overlapping region. This is a measure that is easily to realize and ensures not only mechanical stability but also an airtight closure. It is alternatively possible to create a force-locked connection, e.g. by means of clips.

0026] It is preferred that the shell of the one housing part and the shell of the other housing part each form a part of the external wall of the silencer. This is a space- and material-saving solution, since no further outer shell is required.

0027] It is preferred that the housing parts seal the resonator chambers towards the outside in an airtight manner. This feature as well aims at reliability, simplicity and savings in terms of space.

0028] It is preferred that the shell (of the second housing part) lying within the overlapping region has a beading at its edge. The beading or the eversion simplifies the insertion of the first housing part into the second housing part. In addition, the beading at the housing part provides protection against injuries. Due to this fact, it is possible to use also very thin sheets of metal. The stability is increased by this measure as well.

0029] It is preferred that a separating wall separating the resonator chambers from each other, is arranged in one of the housing parts, with the separating wall having a recess for the passage of the pipe or the flow duct. The separating wall is in this case fixed to the housing part and can already be present at the prefabricated housing part, so that no additional measures for separating the resonator chambers are being required during assembly.

0030] It is preferred that the housing parts are clamped between two profiles, which profiles are each situated at a pipe section extending outside the resonator chambers. These pipe sections can each be designed as an (integral) part of the pipe extending inside the resonator chambers, or each fixed to the interior pipe as a separated pipe section. This does not only allow a fixation at the pipe but also a correct positioning which guarantees that the first openings open into the first resonator chamber and the second openings open into the second resonator chamber. It is additionally possible to use the profiles as connection profiles for a hose or a connecting pipe.

0031] It is preferred that the housing parts are made of metal sheets, preferably stainless steel sheets. The housing part is preferably formed as a deep-drawn pot. Such a measure allows saving weight when thin wall thicknesses are used and do not have a negative influence on stability.

0032] It is preferred that region of the pipe which is surrounded by the resonator chambers is formed from a first part of the pipe and a second part of the pipe, the end regions of which parts are inserted into each other, with the first housing part surrounding the first pipe section and the second housing part surrounding the second pipe section. It is thus possible to co-form also the pipe extending inside when the housing parts are being assembled, with the result that the production process is getting even easier.

0033] It is preferred that at least one of the parts of the pipe is formed to be integral with the housing part surrounding it, preferably from a deep-drawn piece of sheet metal. This measure reduces the required components and provides a high mechanical stability. By way of a deep-drawing process, the integral part is provided with two functionalities, namely the housing functionality and the design of the flow duct.

0034] It is preferred that the integral part forms a projection, which rests against a pipe section at least parts of which
extend outside the resonator chambers, and is held from outside by a profile, preferably a spring clip, with the result that the projection is in radial direction arranged between the pipe section and the profile. This simplifies the assembly and the fixation of the individual components.

It is preferred that the separating wall is formed to be integral with one of the parts of the pipe, preferably with the part of the pipe slid on the other part of the pipe, preferably formed from a deep-drawn metal sheet, with the result that it is possible to continue simplifying the silencer and its manufacture.

It is preferred that at least one circumferentially extending sealing ring is inserted in the overlapping region between the shell exterior face of the first housing part and the shell interior face of the second housing part. If these two housing parts are not welded, a force-locked connection can reliably be sealed by means of an O-ring.

It is preferred that in the shell of the first housing part and/or in the shell of the second housing part, an annularly extending holding for the sealing ring is embodied, with preferably the holding being formed from a bow-shaped course of the shell. Thus, the sealing ring remains fixed during the telescoping (adjusting the resonator volume).

The objective is also achieved by a vehicle, in particular a road vehicle, having a silencer, in particular a turbocharger silencer, which is arranged on the discharge side of a turbocharger, with the silencer being embodied according to one of the preceding explanations. It is preferred that the silencer is a turbocharger silencer which is arranged on the discharge side of a turbocharger. The turbocharger silencer serves for reducing the sound emissions on the discharge side of the turbocharger. The silencer may be plugged onto a short pressure hose directly at the outtake of the turbocharger and fixed, e.g. by means of a spring band clamp.

The objective is also achieved by a method for manufacturing a silencer having a pipe forming a flow duct as well as a first resonator chamber and a second resonator chamber, each surrounding the pipe and being arranged one behind the other in axial direction, with the pipe in its shell having at least one first opening which opens into the first resonator chamber, and at least one second opening, which opens into the second resonator chamber. The method is characterized by that a first housing part and a second housing part, each having a recess for the flow duct, and each having a shell which is designed around an axis, and can be slid inside one another successively along the axis, are provided for forming the resonator chambers, and the length of the shell of the one housing part as seen in axial direction is at least the half of the length of the other housing part, and the shell exterior face of the first housing part rests against the shell interior face of the second housing part in the different telescopic positions, and that the prefabricated housing parts are telescopically slid inside one another to a defined extent in order to form the resonator chambers and to adjust a defined resonator volume of a resonator chamber.

As already stated above, the large advantage of the invention resides in the fact that the silencer is made of originally separated housing parts which can be telescoped inside one another to a large extent. For this purpose, the lengths of the shells of the housing parts are accordingly dimensioned (shell length of one housing part is at least the half of the shell length of the other housing part). The continuous pipe, that supports the housing parts in assembled state of the silencer or whereon they rest, ensures that the silencer only requires a few components.

In order to achieve a certain resonator volume of a resonator chamber, it is only required for the first housing part to be slid inside the second housing part to the desired extent. The shell faces resting against one another already form a kind of form-fitting connection which can also be reliably sealed by way of a force-locked connection or by welding.

It is possible that a different resonator volume is required for another application or for meeting customer requirements. In contrast to prior art it is according to the invention not required to provide differently dimensioned components. It is rather possible to use the same housing parts. Only the extent to which the housing parts are slid inside one another is different from the other application. It is thus possible to use standardized and consequently cost-efficiently produced (identical) housing parts for embodying different resonator volumes.

It is preferred that the pipe is embodied to be continuous and that the housing parts are slid on the pipe, so that the pipe passes through the recesses of the housing parts, with the result that a reliable construction which is easy to produce is achieved.

It is preferred that the housing parts are welded to one another once the resonator volume of a resonator chamber has been adjusted by sliding the housing parts inside one another, with the result that a reliable and air-tight connection is achieved.

It is preferred that the prefabricated housing parts have an end face on each side facing away from the overlapping region, which end face can have a recess corresponding to the external diameter of the pipe and the housing parts are slid onto the pipe, so that the at least one first opening opens into the first resonator chamber and the at least one second opening opens into the second resonator chamber.

It is preferred that the housing parts are prefabricated as pot-shaped parts the bottoms of which have a recess for the pipe. This can e.g. achieved by deep-drawing.

It is preferred that one of the housing parts is provided with a separating wall, which—in an assembled state—separates the first resonator chamber from the second resonator chamber. The separating wall can be prefabricated together with the concerned housing part, so that only an assembly of the individual components has to be performed. The position of the separating wall in the housing part is responsible for the volume of the other resonator chamber. It is possible for the separating wall to be inserted into the housing part at the desired place as a separated part, e.g. as an annular wall having a flanged edge, and connected to the housing part, e.g. by welding.

It is preferred that the region of the pipe which is surrounded by the resonator chambers is formed from a first part of pipe and a second apart of pipe, the end sections of which are slid inside one another, and the first housing part surrounds the first part of pipe and the second housing part surrounds the second pipe section.

It is preferred that at least one of the parts of the pipe are formed integrally with the housing part surrounding it, preferably by way of deep-drawing a piece of sheet metal.

It is preferred that in the overlapping region, at least one circumferentially extending sealing ring is inserted between the shell exterior face of the first housing part and the shell interior face of the second housing part.
The invention thus allows the provision of a modular system of a silencer for manufacturing a silencer having a pipe, with the silencer having at least one first opening and at least one second opening in its shell, which second opening is axially spaced apart from the first opening, as well as having a first housing part and a second housing part which each have a recess for the passage of the pipe or the flow duct, with the housing parts being capable of being slid telescopically inside each other, so that at least parts of their shells overlap, with the shell exterior face of the first housing part resting against the shell interior face of the second housing part in the overlapping region, and the housing parts can be slid onto the pipe, so that the pipe passes through the recesses. For a better understanding of the invention the latter is explained in more detail with reference to the following figures.

The heavily simplified schematics show:

FIG. 1 a silencer according to the invention;
FIG. 2 a first and a second housing part before assembly;
FIG. 3 the housing parts from FIG. 2 in assembled state;
FIG. 4 the housing parts from FIG. 2 in assembled state with a smaller resonator volume of the first resonator chamber being embodied as compared to FIG. 3;
FIG. 5 a vehicle having a turbococharger silencer according to the invention;
FIG. 6 a variant of a silencer according to the invention in cross-section;
FIG. 7 the silencer from FIG. 6 in perspective view.

It must first be stated that in the various embodiments described, identical parts have been marked with the same reference identifiers and the same parts descriptions. It is therefore possible to transfer the disclosures contained in the overall description to the identical parts with the same reference identifiers or the same parts descriptions. The selected positioning terms are used in the description, such as top, bottom, side etc., which refer directly to the described and the depicted figures and which can be correspondingly transferred to the new position in the event of a change in position. Furthermore, individual characteristics or combinations of characteristics from the various embodiments shown and described can present independent or inventive solutions, or solutions according to the present invention.

The embodiments illustrated as examples represent possible variants of the silencer, and it should be pointed out at this stage that the invention is not specifically limited to the variants specifically illustrated, and instead the individual variants may be used in different combinations with one another and these possible variations lie within the reach of the person skilled in this technical field given the disclosed technical teaching. Accordingly, all conceivable variants which can be obtained by combining individual details of the variants described and illustrated are possible and fall within the scope of the invention.

For the sake of order, finally, it should be pointed out that, in order to provide a clearer understanding of the structure of the silencer, it and its constituent parts are illustrated to a certain extent out of scale and/or on an enlarged scale and/or on a reduced scale. The fundamental function of the independent inventive solutions can be taken from the description.

FIG. 1 shows a silencer according to the invention, which is formed from a continuous pipe 2 and from two resonator chambers 14, 15 surrounding the pipe 2. The pipe 2 is a flow duct, i.e. the medium is lead therein between the entrance and the exit of the silencer 1. Should the silencer be downstream a turbococharger, the medium lead is compressed air. The pipe 2 continuously extends between a first pipe section 11 and second pipe section 12. First and second pipe section 11, 12 extend on both sides outside (or at least partially outside) the resonator chambers 14, 15 and form the entrance and the exit of the silencer 1.

The shell 3 of the pipe 2 has first openings 7 spread across the circumference and opening into the first resonator chamber 14, and second openings 8 spread across the circumference and opening into the second resonator chamber 15. The first openings 7 and the second openings 8 are of different size. Also the volumes of the two resonator chambers 14, 15 are of different size. The resonator chambers 14, 15 are formed from a first housing part 4 and a second housing part 5. This being the case, the housing parts 4, 5 are slid into one another, so that the shells of the housing parts 4, 5 overlap in an overlapping region 6. This being the case, the shell exterior face 4a of the first housing part 4 rests against the shell interior face 5b of the second housing part 5. It is preferred that the shells of the housing parts 4, 5 are welded to one another in the overlapping region 6, so that the resonator chambers 14, 15 are sealed to be airtight to the outside.

In the second housing part 5, there is additionally a separating wall 20, which separates the resonator chambers 14, 15 from each other thus creating volumes independent thereof. The separating wall 20 is embodied to be an annular wall having a flanged exterior edge which is welded to the shell interior face 5b, and a flanged interior edge which rests against the exterior face of the pipe 2 in a loose manner or is also welded thereto.

The housing parts 4, 5 are cylindrical, each having one end face 9, 10 facing away from the overlapping region 6. Recesses 21, 22 are embodied in the end faces 9, 10 where the pipe 2 passes through, i.e. protrudes to the outside. The recesses 21, 22 preferably correspond to the external diameter of the pipe 2, and it is preferred that in this section, an airtight sealing between the housing parts 4, 5 and the pipe 2 is created. The profiles 16, 17 which will be described in more detail below contribute to this sealing.

The housing parts 4, 5 are held, preferably clamped, between profiles 16, 17. The profiles 16, 17 are each embodied or fixed to the pipe sections 11, 12 extending on both sides of the silencer 1 outside the resonator chambers 14, 15. It is also possible for these profiles to be simultaneously embodied for serving as a possibility to connect a further pipe or a hose connection, in particular for allowing an air-tight sealing of a line here.

For the sake of completeness, in FIG. 1 also the shell exterior face 5a of the second housing part 5 and the shell interior face 4b of the first housing part 4 are indicated. The shell thickness of both housing parts 4, 5 is continuously constant. The external diameter of the first housing part 4 essentially corresponds to the internal diameter of the second housing part 5. The edge of the second housing part 5 has a circumferential beading 13 which makes it easier to insert the first housing part 4 into the second housing part 5.

The principle of manufacturing a silencer 1 according to the invention can now be described on the basis of the FIGS. 2 to 4. During the process of manufacturing, firstly, two housing parts 4, 5 which can be telescopically slid inside each other are provided. For this purpose, the shell exterior face 4a
of the first housing part 4 and the shell interior face 5b of the second housing part 5 have a cross-sectional contour which is constant as seen in axial direction.

[0072] The pre-produced housing parts 4, 5 already have recesses 21, 22 for letting the pipe 2 pass through. While the silencer 1 is being assembled, the two housing parts 4, 5 are slid inside each other and the extent as to how far they are inserted into each other is determined by the resonator volume to be achieved. According to application or for meeting customer’s requirements, this modular system allows adjusting any desired resonator volume. It is not necessary to produce specific or individually dimensioned components. It is only required to take into consideration the extent to which the components are inserted into one another during assembly, whereas the housing components used are always embodied to be identical.

[0073] For the sake of simplicity, the pipe 2 is not shown in FIGS. 2 to 4. It is possible for the two housing parts 4, 5 to be slid onto the pipe 2 from opposite directions before being inserted into each other. It is alternatively possible to insert the two housing parts 4, 5 into each other at first and to slide them onto the pipe 2 afterwards.

[0074] The separating wall 20 accommodated in one of the housing parts 5 can also be inserted and fixed at the desired distance to the corresponding end face 10 during manufacture of the housing parts, so that also any variation of the volume of the second resonator chamber 15 is allowed.

[0075] FIG. 3 shows a variant where the volume of the first resonator chamber 14 is relatively great. It can e.g. be desired for another application that the resonator volume is designed to be smaller. For achieving this, it is according to the invention only required to slide the first housing part 4 a little further into the second housing part 5 during manufacture, so that a situation according to FIG. 4 results.

[0076] The length L1, L2 of the shells as seen in axial direction (as well as the position of the separating wall 20) defines how far the housing parts 4, 5 can be slid inside each other. It is preferred that the length L1, L2 of the shell of one of the housing parts 4, 5 is at least the half of the shell length L1, L2 of the shell of the other housing part 5, 4. In particularly preferred embodiments, the lengths L1, L2 of the shells brought in line with each other to a larger extent and the length L1 of the one shell is at least one third, particularly preferably three quarters, of the length L2 of the other shell. The embodiment shown in FIG. 1, the shells of the two housing parts 4, 5 are essentially of the same length.

[0077] The housing parts 4, 5 are preferably made of sheet metal, in particular stainless steel sheets. This being the case, the pot-shaped housing parts 4, 5 are deep-drawn metal sheets.

[0078] FIG. 5 finally shows a vehicle 19 having a turbocharger 18 and a silencer 1 attached to the discharge side of the turbocharger 18. This represents a preferred application field of the silencer 1 according to the invention.

[0079] FIG. 6 shows a preferred variant of a silencer 1 according to the invention. Here, the region of the pipe 2 surrounded by the resonator chambers 14, 15 is formed from a first part of pipe 2a and a second part of pipe 2b with the first housing part 4 surrounding the first part of pipe 2a, and the second housing part 5 surrounding the second part of pipe 2b. The first openings 7 are situated in the shell of the first part of pipe 2a and the second openings 8 are situated in the shell of the second part of pipe 2b. The end regions of the parts of pipe 2a, 2b are slid inside each other. The extent of the telescoping is determined by the overlapping of the housing parts 4, 5 and thus by the resonator volume.

[0080] In this embodiment, the silencer is composed of two halves, and the telescoping of the housing parts involves the telescoping of the parts of pipe.

[0081] The second part of pipe 2b is integrally formed with the housing part 5 surrounding it and preferably made of a deep-drawn piece of sheet metal.

[0082] This one-part piece additionally forms a projection 23 which rests against a pipe section 12 at least partially extending outside the resonator chambers 14, 15 and is held by a profile 17, preferably a spring clip, from outside, with the result that the projection 23 is arranged between the pipe section 12 and the profile 17 as seen in radial direction.

[0083] The separating wall 20 is integrally formed—preferably from a deep-drawn piece of sheet metal—with the first part of pipe 2a, which is slid onto the other part of pipe 2b. On this basis, an opposed variation of the resonator volumes of both resonator chambers 14, 15 is allowed (see FIG. 6).

[0084] In the following, an aspect of the invention will be described, which is also applicable to the embodiments of FIGS. 1 to 4. At least one circumferentially extending sealing ring 24 is inserted in the overlapping region 6 between shell exterior face 4a of the first housing part 4 and the shell interior face 5b of the second housing part 5.

[0085] This being the case, the shell of the first housing part 4 and/or the shell of the second housing part 5 has an annularly extending holding 25 for the sealing ring 24, and it is preferred that the holding 25 is formed by a bow-shaped course of the shell.

[0086] Referring to FIG. 6 attention is drawn to the fact that it is possible that at least one of the pipe sections 11, 12 running outside the resonator chambers can be embodied as a component separate from the internal pipe 2 and fixed thereto. Additionally or alternatively, it is possible that at least one of the two pipe sections 11, 12 are integrally formed with a housing part 4, 5.

[0087] FIG. 6 e.g. shows the (left) pipe section 11 being integrally formed with the first housing part 4, preferably from a deep-drawn piece of sheet metal.

[0088] The (right) pipe section 12 is embodied as a separated component and connected to the pipe (here the second part of pipe 2b).

[0089] FIG. 7, finally, shows the outside of a silencer having a very compact design.

LIST OF REFERENCE NUMERALS

[0090] 1 Silencer
[0091] 2 Pipe
[0092] 2a First part of pipe
[0093] 2b Second part of pipe
[0094] 3 Shell
[0095] 4 First housing part
[0096] 4a Shell exterior face
[0097] 4b Shell interior face
[0098] 5 Second housing part
[0099] 5a Shell exterior face
[00100] 5b Shell interior face
[00101] 6 Overlapping region
[00102] 7 First opening
[00103] 8 Second opening
[00104] 9 End face
[00105] 10 End face
1. Silencer (1), in particular a vehicle silencer, having a pipe (2) forming a flow duct and having a first resonator chamber (14) and a second resonator chamber (15), each surrounding the pipe (2) and being arranged one behind the other in axial direction, with the pipe (2) having in its shell (3) at least one first opening (7) which opens into the first resonator chamber (14), and at least one second opening (8) which opens into the second resonator chamber (15), wherein the resonator chambers (14, 15) are formed from a first housing part (4) and a second housing part (5) which each have a shell embodied around an axis, with — as seen in axial direction — the length of the shell of the one housing part (4, 5) being at least the half of the length of the shell of the other housing part (5, 4); and wherein the housing parts (4, 5) are slid inside each other and their shells overlap at least in parts, and in the overlapping region, the shell exterior face (4a) of the first housing part (4) rests against the shell interior face (5b) of the second housing part (5), and the shell exterior face (4a) of the first housing part (4) and the shell interior face (5b) of the second housing part (5) each have a constant cross-section as seen in axial direction, at least in the overlapping region (6), and wherein the housing parts (4, 5) each have a recess (21, 22) where the flow duct extends through.

2. Silencer according to claim 1, wherein the majorities of the sections of the shell exterior face (4a) of the first housing part (4) and the shell interior face (5b) of the second housing part (5) each have a constant cross-section as seen in axial direction.

3. Silencer according to claim 1, wherein the housing parts (4, 5) are each designed to be cylindrical and, the shell exterior face (4a) of the first housing part (4) and the shell interior face (5b) of the second housing part (5) each have a circular cross-section.

4. Silencer according to claim 1, wherein as seen in axial direction, the length of the shell of the one housing part (4, 5) is at least two thirds, preferably three quarters, of the length of the shell of the other housing part (5, 4), and it is particularly preferred that the shells of the housing parts (4, 5) are essentially of the same length.

5. Silencer according to claim 1, wherein at least in the overlapping region (6), preferably continuously, the shells of the housing parts (4, 5) have a constant shell thickness as seen in axial direction in each case.

6. Silencer according to claim 1, wherein the housing parts (4, 5) have an end face (9, 10) on each side facing away from the overlapping region (6), in which end faces the recesses (21, 22) for the passage of the pipe (2) are formed.

7. Silencer according to claim 1, wherein the housing parts (4, 5) are in each of their regions of their recesses (21, 22) connected to the pipe (2) in a manner airtight to the outside.

8. Silencer according to claim 1, wherein the housing parts (4, 5) are welded to each other in their overlapping region (6).

9. Silencer according to claim 1, wherein the shell of the one housing part (4) and the shell of the other housing part (5) each form a part of the external wall of the silencer (1).

10. Silencer according to claim 1, wherein the housing parts (4, 5) seal the resonator chambers (14, 15) in a manner airtight to the outside.

11. Silencer according to claim 1, wherein the shell lying outside in the overlapping region (6) has a beading (13) at its edge.

12. Silencer according to claim 1, wherein in one of the housing parts (5), a separating wall (20) is situated which separates the resonator chambers (14, 15) from each other, and the separating wall (20) has a recess for the passage of the pipe (2).

13. Silencer according to claim 1, wherein the housing parts (4, 5) are clamped between two profiles (16, 17) which are each situated at a pipe section (11, 12) extending outside the resonator chambers (14, 15).

14. Silencer according to claim 1, wherein the housing parts (4, 5) are made of sheet metal, preferably of stainless steel sheet.

15. Silencer according to claim 1, wherein the region of the pipe (2) surrounded by the resonator chambers (14, 15) is formed from a first part of pipe (2a) and a second part of pipe (2b) which are slid inside each other in their end regions, with the first housing part (4) surrounding the first part of pipe (2a), and the second housing part (5) surrounding the second part of pipe (2b).

16. Silencer according to claim 15, wherein at least one of the parts of pipe (2b) is formed to be integral with the housing part (5) surrounding it, and is preferably made of a deep-drawn piece of sheet metal.

17. Silencer according to claim 16, wherein the integrally formed part forms a projection (23) which rests against a pipe section (12) at least partially extending outside the resonator chambers (14, 15), and is held from outside by a profile (17), preferably a spring clip, so that the projection (23) is in radial direction arranged between the pipe section (12) and the profile (17).

18. Silencer according to claim 15, wherein the separating wall (20) is integrally formed with one of the parts of pipe (2a, 2b), preferably with the part of pipe (2a) slid on the other part of pipe (2b), and is preferably made of a deep-drawn piece of sheet metal.

19. Silencer according to claim 1, wherein at least one circumferentially extending sealing ring (24) is inserted in the overlapping section (6) between the shell exterior face (4a) of the first housing part (4) and the shell interior face (4b) of the second housing part (5).

20. Silencer according to claim 19, wherein in the shell of the first housing part (4) and/or in the shell of the second housing part (5), an annularly extending holding (25) for the sealing ring (24) is embodied, with the holding (25) being preferably formed from a bow-shaped course of the shell.

21. Vehicle (19), in particular a road vehicle, having a silencer (1), in particular a turbocharger silencer, which is arranged on the discharge side of a turbocharger (18), wherein the silencer (1) is a silencer according to claim 1.
22. Method for manufacturing a silencer according to claim 1, having a pipe (2) forming a flow duct as well as a first resonator chamber (14) and a second resonator chamber (15) each surrounding the pipe (2) and being arranged one behind the other, with the pipe (2) in its shell (3) having at least one first opening (7) which opens into the first resonator chamber (14), and at least one second opening (8), which opens into the second resonator chamber (15), wherein for forming the resonator chambers (14, 15), a first housing part (4) and a second housing part (5) are provided each having a recess (21, 22) for the flow duct, and a shell embodied around an axis, and which can be telescopically slid inside each other along the axis, with the length of the shell of the one housing part (4; 5), as seen in axial direction, being at least the half of the length of the shell of the other housing part (5; 4), and with the shell exterior face (4a) of the first housing part (4) resting against the shell interior face (5b) of the second housing part (5) in different telescopic positions, and wherein for forming the resonator chambers (14, 15) and for adjusting a defined resonator volume of a resonator chamber (15), the prefabricated housing parts (4, 5) are telescopically slid inside each other to a corresponding extent.

23. Method according to claim 22, wherein the housing parts (4, 5) are slid on the pipe (2), so that the pipe (2) passes through the recesses (21, 22) of the housing parts (4, 5).

24. Method according to claim 22, wherein the housing parts (4, 5) are welded to each other in their overlapping region (6) after the resonator volume of a resonator chamber (14) has been adjusted by sliding the housing parts (4, 5) into each other.

25. Method according to claim 22, wherein the prefabricated housing parts (4, 5) have an end face (9, 10) on each side facing away from the overlapping region (6), in which end face (9, 10) a recess (21, 22) corresponding to the external diameter of the pipe (2) is embodied, and wherein the housing parts (4, 5) are slid on the pipe (2) so that at least one first opening (7) opens into the first resonator chamber (14) and at least one second opening (8) opens into the second resonator chamber (15).

26. Method according to claim 22, wherein the housing parts (4, 5) are prefabricated as pot-shaped parts the bottoms of which have the recess (21, 22) for the passage of the flow duct.

27. Method according to claim 22, wherein one of the housing parts (5) is provided with a separating wall (20) which, in assembled state, separates the first resonator chamber (14) from the second resonator chamber (15).

28. Method according to claim 22, wherein in the region surrounded by the resonator chambers (14, 15), the pipe (2) is formed from a first part of pipe (2a) and a second part of pipe (2b) which are slid inside each other in their end regions, with the first housing part (4) surrounding the first part of pipe (2a) and the second housing part (5) surrounding the second part of pipe (2b).

29. Method according to claim 28, wherein at least one of the parts of pipe (2b) is formed to be integral with the housing part (5) surrounding it, preferably by deep-drawing a piece of sheet metal.

30. Method according to claim 22, wherein in the overlapping region (6) at least one circumferentially extending sealing ring (24) is inserted between the shell exterior face (4a) of the first housing part (4) and the shell interior face (5b) of the second housing part (5).

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