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(54) **SILENCER FOR A FIREARM**

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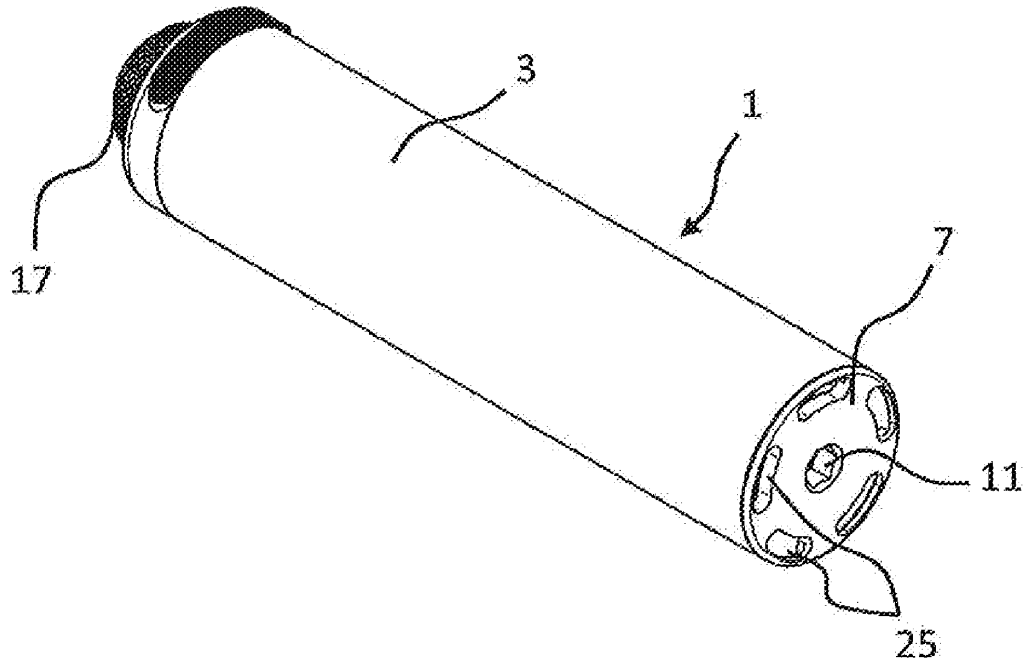
(57) **ABSTRACT**

A silencer for a firearm, in particular a repeating weapon, an automatic or semiautomatic firearm, a single or multi-loader, or the like, with an outer tube margining a hollow body of the silencer, an inner tube arranged in the hollow body, which margins a projectile channel on the inside in the radial direction and carries at least one sound-reflecting and/or -absorbing element, such as a sound impact wall with projectile passage opening, wherein the outer tube and the inner tube margin an annular space in which sound-absorbing filler material and/or a sound-absorbing lining are optionally arranged, a front wall facing the firearm with a projectile entry opening and a front end wall facing away from the firearm with a projectile exit opening, wherein at least one exchange opening is formed in the inner tube for a gas exchange between the projectile channel and the annular space and at least one vent opening is additionally formed in the front end wall, in particular at the radial height of the annular space, and the annular space provides a gas communication between the at least one exchange opening and the at least one vent opening.



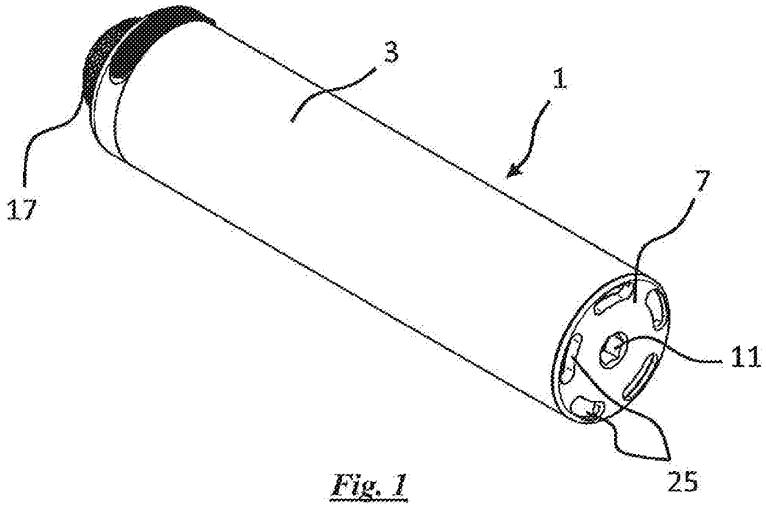


Fig. 1

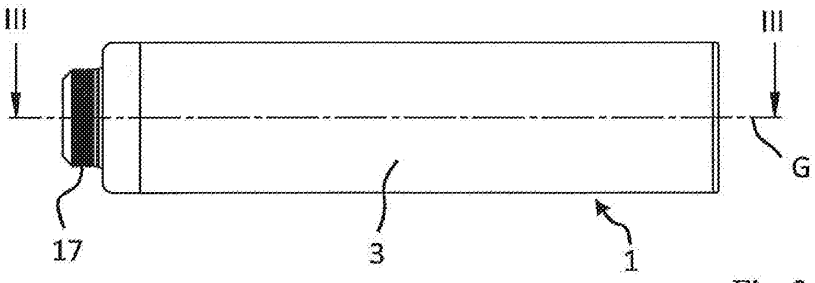


Fig. 2

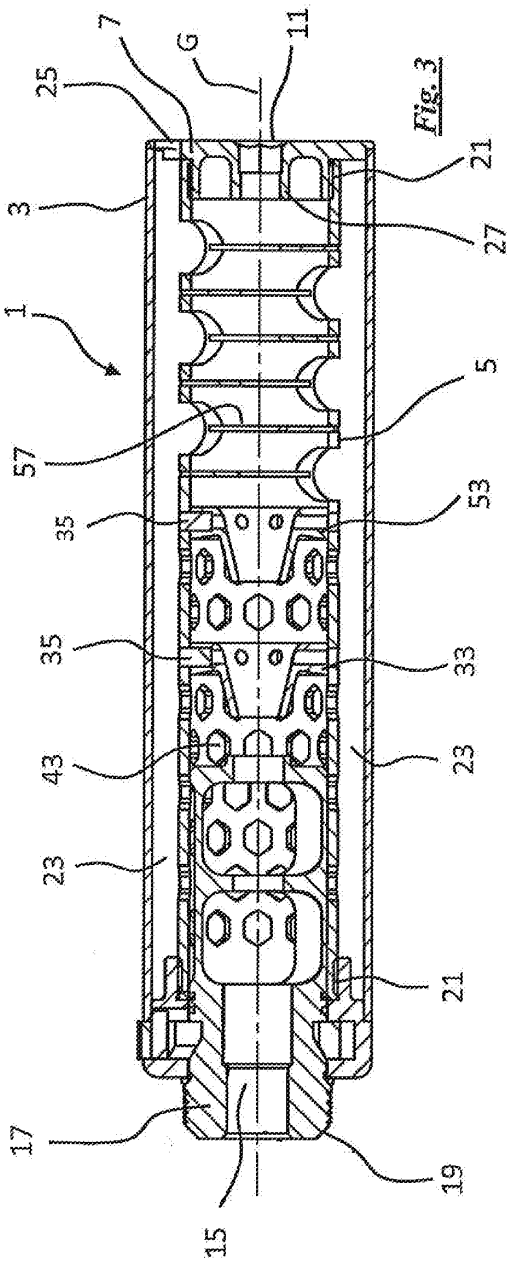


Fig. 3

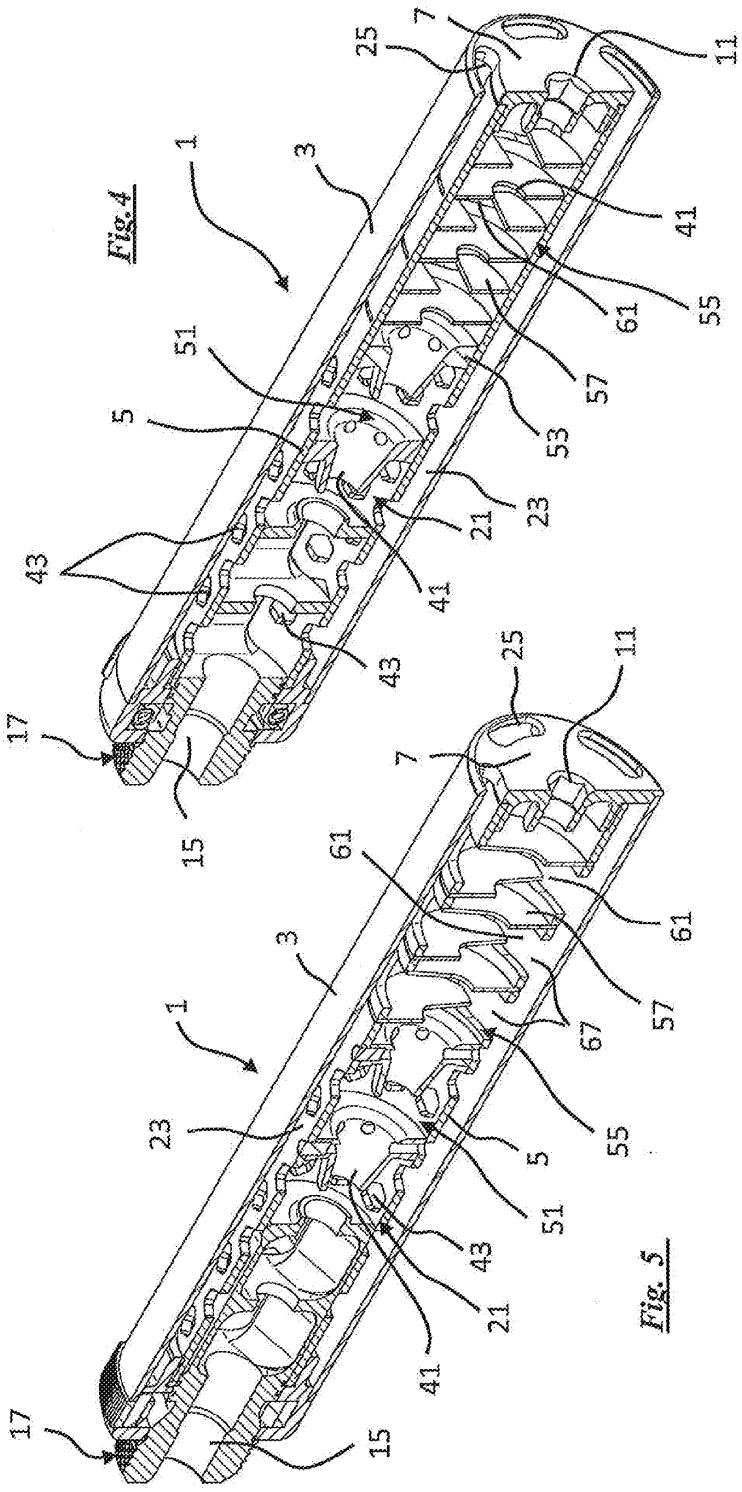


Fig. 4

Fig. 5

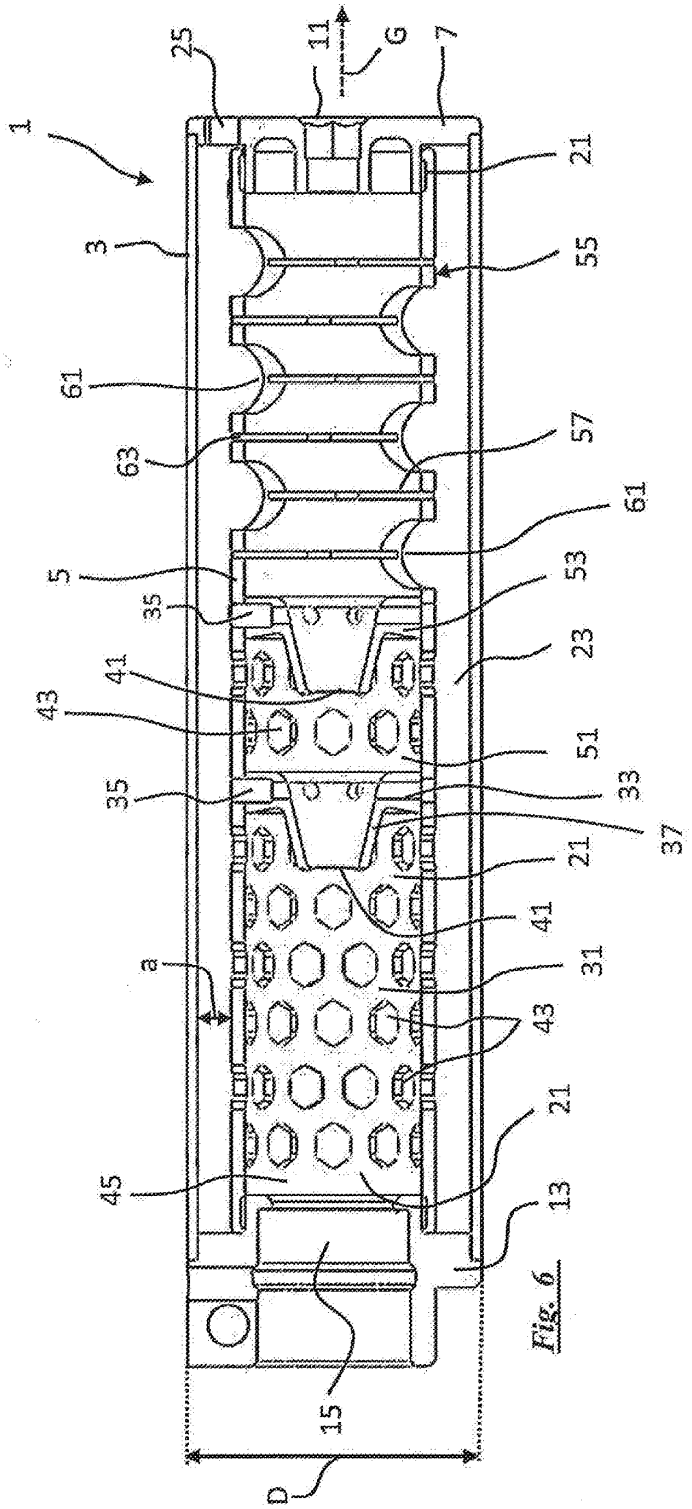

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Fig. 6

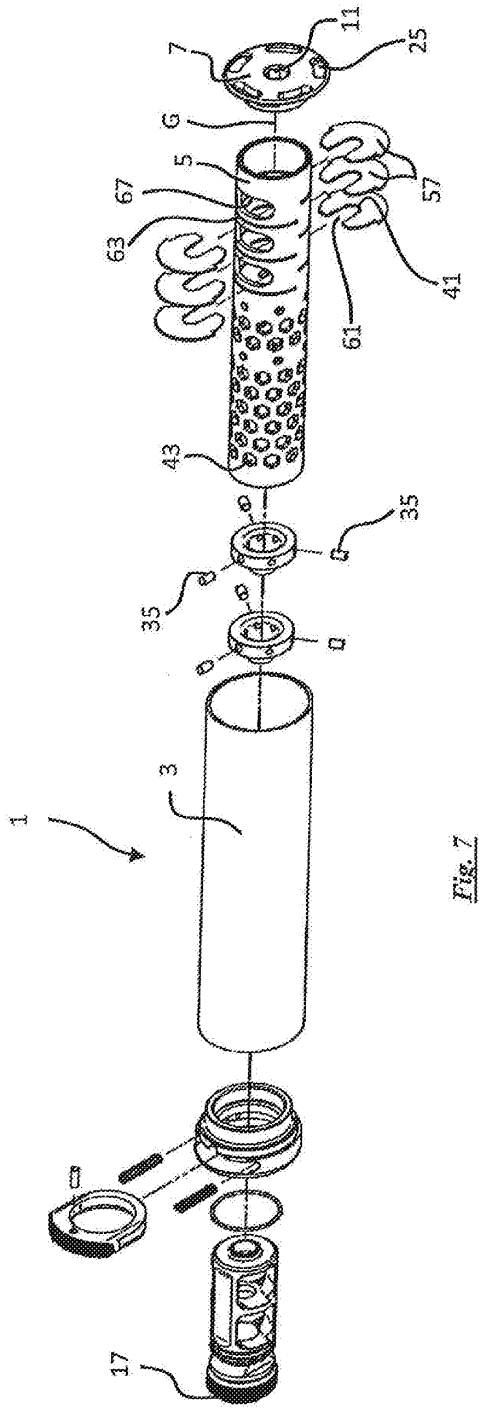

Fig. 7

SILENCER FOR A FIREARM

[0001] The invention relates to a silencer for a firearm, in particular to an automatic or semiautomatic fire arm, a repeating weapon, a single or multi-loader with an outer tube which margins a hollow body of the silencer. All silencer elements, such as damping and/or reflection elements and sound directing elements, are arranged in a hollow body of the silencer.

[0002] A silencer is known from DE 1 553 874 A1. The silencer is provided for a handgun and comprises an outer tube in which a plurality of funnel-formed wall inserts comprising projectile passage openings being aligned to each other is mounted. An inner tube is arranged in the entry area of the hollow body facing the firearm which comprises a plurality of radial passage openings in a linear long hole form which allows a muzzle gas transfer into annular space compartments being arranged radially at the outside of the inner tube in which a sound absorbing filler material, such as a pore comprising material or a fine wire mesh, is arranged to increase the sound absorbing effectivity of the silencer. Gas and compression waves reach the outer ring chamber compartments via the passage openings which, beside the exchange opening are self-contained in a gastight manner to at least partially eliminate and extinguish sound-waves of the muzzle blast via reflection or absorption. In particular in the event of fast firing salves with multiple shots fired in quick succession, there is the specific problem of removal of muzzle gases expanding at the muzzle of the weapon tube. There, also unburned powder residues burn instantly, which effect is known as muzzle fire or fireball at the muzzle. The silencer shall control the expansion and cooling of the gases and avoid abrupt deflagration. In particular with supersonic projectiles, the muzzle blast is considerable as soon as a projectile being accelerated to supersonic strikes atmospheric pressure at the end of the weapon tube. The silencer shall be suitable to effectively release the explosive heat into the environment in order to avoid thermal overloading of the silencer elements.

[0003] It turned out that in the event of high firing frequencies, the known silencers are exposed to a strong thermal load and gas pressure load which increases in favor of better sound absorption. At the high firing frequencies, which are further increased in modern automatic or semi-automatic firearms, the muzzle blast gas pressure adds up and causes the thermal load to increase such that even filler materials or sound reflection or absorbing elements being protected by the inner tube can be damaged.

[0004] It is an object of the invention to overcome the disadvantages of the prior art, in particular to provide a silencer for a firearm, in particular a repeating weapon, an automatic or a semiautomatic firearm, a single or multi-loader, wherein in particular the above-mentioned known silencer shall be improved with as little modification as possible and/or increasing the thermal and mechanical resistance even at high firing frequencies and by maintaining a sufficient sound absorption and spark extinguishing.

[0005] The object is solved by the features of claim **1**. Therefore a silencer for a firearm, in particular a repeating weapon, an automatic or semiautomatic firearm, a single or multi-loader or the like, is provided. The silencer has an outer tube which is usually formed by a cylindrical metal tube which has no opening on its closed circumferential surface. The outer tube can be formed by multiple parts to simplify the installation of sound reflection and/or absorbing elements and/or muzzle gas redirecting elements into the inside of the silencer. The outer tube defines on the inside a hollow body of the silencer in which an inner tube is arranged which margins a projectile channel of the silencer in radial direction on the inside. The inner tube is designed to firmly support at least one sound reflection and/or absorbing element, such as a sound impact wall with projectile passage opening, for example an impact sheet with projectile passage opening. According to the invention the silencer has an annular space which in radial direction on the inside is margined by an inner tube and radially on the outside by an outer tube. Preferably, the annular space extends over the entire axial length of the silencer. Optionally, a sound absorbing filler material and/or a sound absorbing lining is arranged in the annular space. Preferably, the filler material is a porous material, such as a metal foam, or a braid, woven fabric, knitted fabric, or fleece, in particular of metal (wire) or another heat-resistant material. The inner tube protects the filler material and/or the lining from direct thermal and mechanical stress peaks caused by the muzzle gas. The silencer has a front wall facing the weapon with a central projectile entry opening through which the projectile fired by the firearm can enter the silencer, with muzzle gas upstream and downstream of the projectile. Further, the silencer according to the invention has a front end wall facing away from the weapon with a central projectile exit opening through which the projectile leaves the silencer. In order to ensure a cooling in particular circulating muzzle gas exchange flow between the projectile channel and the annular space, at least one exchange opening, preferably a plurality of exchange openings, is formed into the inner tube. Further, at least one venting opening, preferably two, three, more than three, four and five, preferably less than ten venting openings, is additionally formed in the front end wall, in particular on the radial height of the annular space to release the gas to the outside into the atmosphere. Further, the annular space provides exclusively longitudinally to the annular space a direct, uninterrupted gas communication between the at least one exchange opening through which the muzzle gas enters the annular space and the at least one venting opening, wherein it shall be clear that not the entire muzzle gas which reaches the annular space via the at least one exchange opening necessarily exits through the at least one venting opening. It has been found that in the event of a plurality of fired shots, the gas pressure inside the projectile channel is significantly higher than in the annular space such that due to the direct gas communication through the venting opening, a large part of the muzzle gas that has flowed into the annular space can also be released to the outside of the silencer via the at least one venting opening.

[0006] A spark from the venting opening is particularly avoided, if the entire annular space comprises a sound-absorbing material, such as the porous material, over its entire length extension. However, it has also been shown that with gap-shaped annular spaces having a radial distance of a few millimeters or a few centimeters depending on the caliber, a spark continuation can even be excluded when the annular space is not layered with filler material.

[0007] In a preferred embodiment of the invention, the annular space is designed such that in the inside of the annular space, muzzle gas flowed in through the at least one exchange opening can leave at the at least one venting opening, without having to leave the annular space. This is achieved by the formation of the additional venting opening

at the front end wall which is in particular in connection or in communication with each exchange opening in the inner tube. This direct gas communication between the at least one exchange opening and the alt least one venting opening provides an excellent venting of the silencer and thus a cooling- and pressure release mechanism such that even in the event of fast firing salves, the functional elements within the silencer remain damage free, even if being designed in classic manner.

[0008] In a further development of the invention, the inner tube margins the annular space in that gas flowing into the hollow body reaches the annular space exclusively through the projectile channel and the at least one exchange opening. The controlled feeding ensures that the inner tube is dimensioned according to the expected load. It should thereby be noted that the dimension of the at least one exchange opening, in particular in case of a multiple arrangement of exchange openings, does not lead to a too strong weakening of the inner tube.

[0009] In a preferred embodiment of the invention, the annular space extends substantially over its entire length between the front walls, substantially gas permeable and/or barrier free. Preferably, no radially protruding, either arranged on the inside of the outer tube or on the outside of the inner tube, radial annular space compartments are provided such that an unimpeded flow through of the muzzle gas longitudinal to the annular space is ensured.

[0010] Alternatively, one or more gas permeable radial walls for dividing the annular space in multiple annular space compartments can be arranged in the annular space such that for example different filling materials and/or linings can be arranged in the respective different annular space compartments. Thereby, a position individual adjusting of the absorption and reflection behavior of the silencer can be achieved. The gas permeable radial wall can be perforated or can comprise at least one passage between adjacent annular space compartments such that the direct gas communication between the exchange opening and the venting opening is provided longitudinal and in the annular space.

[0011] In a preferred embodiment of the invention, the annular space concentrically completely, in particular uniformly, circulates the inner tube. A radial distance between the outer tube and the inner tube can preferably be smaller than the radius of the cylindrical inner tube, in particular is smaller than the half, a third, or a fourth of the radius of the cylindrical inner tube, in particular to form the above mentioned inner space gap. Preferably, the axial distance between the inside of the outer tube and the outside of the inner tube is smaller than 30% of the outer diameter of the outer tube of the silencer, preferably the axial distance is smaller than 25% or 20%. In a preferred embodiment, the radial distance is between 5% and 30%, in particular 5% and 15%. Preferably, the axial distance is smaller than 5% with respect to the outer diameter of the tube.

[0012] Preferably, the radial distance between the outer tube and the inner tube in circumferential direction and/or in projectile flight direction of the annular space is constant. Alternatively or additionally, the outer tube and the inner tube can be a cylindrical metal tube with a wall thickness of at least 0.5 mm and at the most 10 mm. Preferably, a wall thickness between 1 mm and 3 mm shall be chosen.

[0013] In a preferred embodiment of the invention, the projectile channel is divided into multiple channel compartments. Further, in particular the inner tube can form, in the course of a channel expansion chamber connecting to the projectile entry opening, at least one exchange opening with an at least partially linear opening border. In particular, the at least one exchange opening, preferably in the area of the channel expansion chamber, is designed polygonal, in particular hexagonal, preferably honeycomb cell-shaped. Multiple rows of exchange openings being displaced in axial flight direction can be formed in the area of the channel expansion chamber in the inner tube. Preferably, each row comprises multiple exchange openings being displaced in circumferential direction, in particular arranged on the same axial height, wherein in particular axially adjacent exchange openings are displaced to axially adjacent rows in circumferential direction. Preferably all exchange openings being formed in the inner tube are equally dimensioned and designed in the area of the channel expansion chamber and/or of a channel intermediate chamber being described below.

[0014] Preferably, the channel expansion chamber is margined in axial projectile flight direction by an in particular first sound reflection element with projectile passage opening which can be designed as sound impact plate, in particular as impact sheet. Further, the particular first sound reflection element can comprise a central section forming a projectile passage opening which is funnel-formed tapering to the projectile passage opening, wherein in particular the tapering direction is opposite to the projectile flight direction. Alternatively or additionally, a channel intermediate chamber can connect to a particular first sound reflection element with projectile passage opening margining the channel expansion chamber in axial projectile flight direction in which preferably at least a second exchange opening, in particular being identical to the at least one first exchange opening also formed in the channel expansion chamber, can be formed into the inner tube. Preferably, the channel intermediate chamber is margined by a second sound reflection element with projectile passage opening in axial projectile flight direction, wherein in particular the second sound reflection element is formed as sound impact plate, in particular impact sheet. Preferably, the second sound reflection element has a central section forming the projectile passage opening which is formed funnel-shaped, in particular tapering to the projectile passage opening, wherein in particular the tapering direction is opposite to the projectile flight direction and/or the second sound reflection element is substantially equally designed to the first sound reflection element.

[0015] In a further development of the invention, at least one sound reflection element, such as a sound impact plate, in particular an impact sheet, extending radially to the inside is firmly supported by the inner tube. The at least one sound reflection element is provided with a projectile passage opening and/or an additional exchange opening, in particular a third exchange opening, is arranged in the inner tube on the axial position of the sound reflection element. The additional exchange opening extends axially flight upwards and flight downwards in excess of the sound reflection element with respect to the axial position of the sound reflection element. Thereby, the sound reflection element can be attached to the inner tube, in particular preferably attached via a transition fit or a press-fit. The sound reflection element can extend in excess of the projectile flight axis towards the additional exchange opening in such a way that the muzzle gas passing

the sound reflection element is deflected radially to the outside in the annular space in order to particularly feed the additional or third exchange opening which is larger, preferably twice as large, than the at least first exchange opening.

[0016] In a preferred embodiment of the invention, the sound absorbing and/or reflection element is preferably removably, in particular exchangably, attached to the inner tube via a dowel pin or a press pin. Thereby, the dowel pin or the press pin can be inserted into a bore respectively in the inner tube and optionally also in a support basis of the sound reflection and/or absorbing element adjacent to the inner tube. The sound reflection and/or absorbing element per se can also be firmly inserted into a slit recess formed in the inner tube in particular according to a transition fit or press-fit.

[0017] In a further development of the invention, a channel end chamber being margined by the front end wall is radially margined by the inner tube in which at least one additional in particular third sound reflection element, such as a sound impact plate, preferably an impact sheet, with projectile passage opening is provided. Preferably, three, four, five, or more sound reflection elements, in particular of the same design, are attached in the channel end chamber at the inner tube. The sound reflection elements are particularly arranged to each other in an equal axial distance, wherein in particular the sound reflection element comprises a bypass opening adjacent to the projectile passage opening substantially on the radial height of the inner tube, in particular combined with an exit opening in the inner tube in such a way that muzzle gas is at least partially deflected at the sound reflection element radially to the outside to the bypass opening and at least partially introduced into the second exchange opening in the annular space.

In a preferred embodiment of the invention, more than two or three venting openings, preferably four or more venting openings, are formed into the front end wall which preferably comprises a particularly arc-shaped long hole form. Additionally, the at least one long hole-shaped venting opening can comprise a continuous long hole extension in the passage direction thereof, wherein preferably a collective arc line of the venting openings lies on a circuit being concentric to the middle axis of the silencer. The radius of the circuit is smaller than the radius of the outer circumference of the outer tube and larger than the radius of the projectile exit opening. A constant hole width of the long hole shaped venting opening is preferably smaller than the largest cross sectional dimension of the projectile exit opening. Preferably, a hole width of the long hole shaped venting opening is smaller than one fifth, one sixth, or one seventh of the outer diameter of the outer tube. Preferably, the particular arc-shaped long hole venting opening forms more than 10%, 20%, or 30% of the entire front end wall surface. Alternately or additionally less than 90% or 80%, preferably between 40% and 80%, can be realized by the rigid material, such as metal, of the front wall.

[0018] In a preferred embodiment of the invention, the inner tube directly connects to an inside of the front end wall encompassing the projectile exit opening such that the entire muzzle gas entering the hollow body of the silencer reaches the projectile channel via the projectile entry opening. Preferably, the inner tube is attached gastight to an inside of the front end wall such that muzzle gas reaches the annular space exclusively via the at least one exchange opening. Preferably, the inner tube extends along the entire axial length extension of the hollow body towards the projectile exit opening. The inner tube can be attached gastight to an inner side of the front end wall such that in particular muzzle gas between the annular space and the projectile channel can exclusively flow back and forth and particularly circulate in cooling manner via the at least one exchange opening. Preferably, a ratio between the entire circumferential surface of the inner tube to the passage cross-section surface of the at least one exchange opening in the front end wall is larger than 1, preferably larger than 2 or 3.

[0019] In a preferred embodiment of the invention, the sound-absorbing filling material is a porous material, such as a foam-like material, for example a metal foam, or a wire braid or a wire mesh, in particular formed from metal or another thermally resistant material.

Preferred embodiments are described in the dependent claims.

[0020] Further characteristics, advantages and features of the invention become apparent by the following description of a preferred embodiment of the invention by the enclosed drawings showing in:

[0021] FIG. **1** a perspective view of the silencer according to the invention;

[0022] FIG. **2** a side view of the silencer according to FIG. **1**;

[0023] FIG. **3** a cross-sectional view along the intersection line according to FIG. **2**;

[0024] FIG. **4** a perspective cross-sectional view of the silencer according to the invention as shown in the FIGS. **1** to **3**;

[0025] FIG. **5** a further perspective cross-sectional view which is rotated by 90° compared to the view shown in FIG. **4**;

[0026] FIG. **6** a silencer according to the invention without the already mounted muzzle brake shown in the FIGS. **1** to **5**; and

[0027] FIG. **7** an explosive view of the silencer according to the invention to be mounted on a muzzle brake.

[0028] In the FIGS. **1** to **7**, the silencer according to the invention is generally indicated with the reference sign **1**. The silencer **1** according to the invention has as main components an outer tube **3** with cylindrical cross-sectional shape, an inner tube **5** with cylindrical cross-section being interspersed with recesses, a front end wall **7** which defines a projectile exit opening **11**, and a front face **13** with a projectile entry opening **15** to be coupled with the firing arm (not shown), wherein the face wall **13** on the side of the firearm can optionally be replaced by silencer-unrelated components, such as a muzzle brake **17** which can be coupled to the silencer **1** via a detachable fastening device **19**. Both side wall ends **7**, **13** are each screwed with an end side (screw connection **21**) to the inner tube **5**.

[0029] The outer tube **3** is, depending on the screwing situation, axially clamped between the front ends **7**, **13**. The axial direction is determined by the projectile flight direction G. In order to apply the clamping and screwing forces, the projectile exit opening **11** can be designed polygonal or with multiple edges to engage an Allen key.

[0030] The inner tube **5** is located on the inside concentrically to the outer tube **3** and defines on the inside the projectile channel **21** through which the projectile (not shown) flies from the projectile entry opening **15** to the

projectile exit opening **11**. The outer tube **3** margins on the inside the entire sound body cavity.

[0031] Between the inside of the outer tube **3** and the outside of the inner tube **5**, an annular space **23** is formed which continuously extends in circumferential direction and in projectile flight direction G. Thereby, the axial distance between the inside of the outer tube **3** and the outside of the inner tube **5** remains constant in circumferential direction and in axial projectile flight direction G. The axial distance a can, according to the invention, be smaller than 40% of the outer diameter D of the outer tube **3**. Preferably the axial distance a is smaller than 25%, 20% or 15% of the outer diameter D. In the described case, the axial distance a is about 10% relative to the outer diameter D. However, the axial distance a shall not be less than 5% relative to the outer diameter D.

[0032] The annular space **23** extends from the front wall **15** continuously without radial barrier or wall indentation on the opposite side to the front end wall **7**. Substantially on the radial height of the annular space **23**, multiple venting openings **25** are formed into the front end wall **7**. The venting openings **25** are, as can be seen in FIG. **1**, designed in a curved long shape, wherein an arc line extends longitudinal to a circular line with constant radial distance to the axis G. The five venting openings **25** extend concentrically around the projectile exit opening **11** and are completely formed into the material of the front end wall **7**. It is also possible that the venting openings **25** are at least partially, in particular radially to the outside, margined from the inside or an inside heel of the outer tube **3**. Together with the projectile exit opening **11**, the venting openings **25** form more than 10% of the cross-sectional surface of the total inner cross-section of the outer tube **3**, wherein the remainder is formed by the material, in particular the rigid material, such as metal, of the front end wall **7**.

[0033] The front end wall **7** has a prolongation axially protruding to the inside which substantially continuously connects to the Allen key formed projectile exit opening **11**.

[0034] At the entry side, the silencer **1** comprises a channel expansion chamber **31** which is flight upwards margined by the front end **13** and downstream by a sound reflection element which is, in the example illustrated in the Figures, realized as sound impact plate **33**. The first sound impact plate **33** on the side of the channel expansion chamber is exchangably attached to the inner tube **5** via a mounting pin **35** and extends from the inside of the inner tube **3** in a first arm section radially to the inside to which a central section **37** is connected which is designed as a funnel. The funnel-formed central section **37** extends in a tapering manner contrary to the projectile flight direction G to the front wall **13** and defines coaxially a first passage opening **41**. As can be seen in the FIGS. **3** to **6**, the inner tube **5** in the channel expansion chamber **31** is provided with a plurality of honeycomb cell-shaped exchange openings **43** which enable a gas transfer between the projectile channel **45** being margined by the inner tube **5**, in particular of the channel expansion chamber **31**, and the annular space **23**. Due to the continuous, separating wall free extension of the annular space **23**, the muzzle gas entering the annular space **23** can escape towards the front end wall **7** at the venting openings **25** without necessarily having to return again into the projectile channel **45** over an additional exchange opening being arranged flight downwards in axial direction G.

[0035] According to the invention, a sound-absorbing filler material or a sound-absorbing lining (both not shown in detail) can be integrated into the annular space **23**, wherein the filler material or the lining can extend over all areas of the annular space **23** and can completely fill the same.

[0036] Alternatively, the annular space **23** can for example be separated into annular space compartments by means of perforated gas-permeable separating walls in order to integrate different sound-absorbing filler materials and/or sound-absorbing fillers into the annular space **23**. In this way, the sound-absorbing effect can be adjusted individually to the position longitudinal to the projectile flight direction G. Due to the tubular structure, the inner tube **5** serves as protective shield for the sound-absorbing filler material and/or the sound-absorbing lining in the annular space **23**.

[0037] It shall be clear that the gas exchange between the annular space **23** and the projectile channel **45** can also be carried out beyond the channel expansion chamber **31** such that not the entire muzzle gas entering the annular space **23** has to exit via the venting openings **25** at the silencer **1**. Also muzzle gas returning into the projectile channel **45** can exit the silencer **1** via the projectile exit opening **11**.

[0038] As can be seen in the FIGS. **3** to **7**, the exchange openings **43** are arranged in rows being axially displaced to each other which extend arranged next to each other in the same axial middle distance. The rows are essentially equally designed such that all distances between the honeycomb cell-shaped exchange openings **43** are constant at a minimum distance which ensures that the inner tube **5** is not weakened too much by material removal.

[0039] In particular the special honeycomb hexagonal shape of the exchange openings **43** ensures a high number of relatively large opening cross-sections without substantially destabilizing the inner tube **5**.

[0040] As can be particularly seen in FIG. **6**, two adjacent rows of exchange openings **43** are displaced by one exchange opening width in circumferential direction such that a minimum distance is not exceeded while ensuring a high exchange opening density.

[0041] Flight downwards to the channel expansion chamber, a channel intermediate chamber **51** is provided which is flight downwards margined by the first sound impact wall **33**. In circumferential direction, the channel intermediate chamber **51** is margined by the inner tube **5**. Flight downwards, the channel intermediate chamber **51** is margined by a second sound impact wall **53** which is designed identical to the first sound impact wall **33** in form and mounting. In the inner tube section of the channel intermediate chamber **51**, two rows of honeycomb cell-shaped exchange openings **43** are provided. The channel intermediate chamber **51** is located approximately on the half axial length of the entire extension of the silencer **1** and has less than the half of the volume of the channel expansion chamber **21**.

[0042] In the flight downwards connection to the channel intermediate chamber **51**, a channel end chamber **55** is formed whose axial expansion approximately corresponds to that of the channel expansion chamber **21**.

[0043] The channel end chamber **55** is flight downwards margined by the second sound impact wall **53** and in circumferential direction by the inner tube **5**, wherein the axial margin is flight downwards realized by the front end

wall **7**. Muzzle gas within the channel end chamber **55** can reach the outside of the sound body via the projectile exit opening **11**.

[0044] In the channel end chamber **55**, six second sound reflection elements in the form of a second type of sound impact wall are arranged which are designated in the following as third sound impact walls **57**.

[0045] For the mounting of the third sound impact wall **57**, a mounting slit **63** is formed linear into the inner tube **5** at an axial position in the inner tube **5** in which the third sound impact wall **57** can be inserted and fastened. Therefore, a transition fit or a press-fit could be considered. For mounting the sound reflection element in the inside of the silencer **1**, the outer tube **3** is designed in several parts.

[0046] Each sound impact element **33**, **53**, **57** comprises a separate projectile passage opening **41** coaxial to the projectile entry opening **15** and the projectile exit opening **11**.

[0047] From the slit mounting, the third sound impact wall **57** extends almost completely to the opposite end and forms there an axial bypass opening **61** which radially ends in the projectile passage opening **41**. In combination with the axial bypass opening **61**, an additional type of exchange opening **67** is formed opposite it in the inner tube **5** which is radially opposite the bypass opening **61** of the sound impact wall **57**, wherein the additional exchange opening is designated as second exchange opening **67**. The second exchange opening **67** has a long form extending in circumferential direction which ends are rounded off.

[0048] The muzzle gas reaching the channel end chamber **55** which enters over the projectile passage opening **41** from the channel intermediate chamber **51** into the channel end chamber **55** is at least partially redirected by the third sound impact wall **57** radially to the outside and reaches the second exchange opening **67** in the annular space **23**. This muzzle gas can also reach via the annular space **23** and the respective venting openings **25** the outside of the silencer **1**.

[0049] With the inventive silencer **1** and the arrangement of a continuous annular space **23** from the one front side **13** to the other front side **7** as a continuous volume around the projectile channel **21** blended in the inner tube **5**, it is achieved on the one hand that in particular when using an absorbing filling material, such as metal foam, wire mesh, etc., a high absorption damping is achieved, and on the other hand the spark formation is already in the course of the projectile flight direction G initially extinguished and reduced such that a venting option exists at the venting openings **25**, in particular if several shots are fired from the firearm in short intervals. A so-called gas accumulation inside the silencer **1** which also causes the silencer to overheat and supports spark formation is improved due to the additional venting via the venting openings **25**.

[0050] In particular, the venting openings prevent a gas accumulation in the system of a firearm with silencer. Thus, the repeating process can function without any problems.

[0051] The features disclosed in the above description, the Figures, and the claims can either individually or in any combination be important for the realization of the invention in the various embodiments.

REFERENCE SIGNS

[0052] **1** silencer
[0053] **3** outer tube
[0054] **5** inner tube
[0055] **7** front end wall
[0056] **11** projectile exit opening
[0057] **13** front wall
[0058] **15** projectile entry opening
[0059] **17** muzzle brake
[0060] **19** removable mounting device
[0061] **21** projectile channel
[0062] **23** annular space
[0063] **25** venting opening
[0064] **31** channel expansion chamber
[0065] **33** first sound impact wall
[0066] **35** mounting pin
[0067] **37** central section
[0068] **41** projectile passage opening
[0069] **43** honeycomb cell-shaped exit opening
[0070] **45** projectile channel
[0071] **51** channel intermediate chamber
[0072] **53** second sound impact wall
[0073] **55** channel end chamber
[0074] **57** third sound impact wall
[0075] **61** bypass opening
[0076] **63** slit
[0077] **67** second exchange opening
[0078] a radial distance
[0079] D outer diameter
[0080] G projectile flight direction

1. A silencer for a firearm, in particular a repeating weapon, an automatic or semiautomatic firearm, a single or multi-loader, or the like, with an outer tube margining a hollow body of the silencer an inner tube arranged in the hollow body, which margins a projectile channel on the inside in the radial direction and supports at least one sound-reflecting and/or sound-absorbing element, such as a sound impact wall with a projectile passage opening, wherein the outer tube and the inner tube margin an annular space in which a sound-absorbing filler material and/or a sound-absorbing lining are optionally arranged, a front wall facing the firearm with a projectile entry opening and a front end wall facing away from the firearm with a projectile exit opening, wherein at least one exchange opening is formed in the inner tube for a gas exchange between the projectile channel and the annular space and at least one venting opening is additionally formed in the front end wall, in particular at the radial height of the annular space, and the annular space provides a gas communication between the at least one exchange opening and the at least one venting opening.

2. The silencer according to claim **1**, in which the annular space is designed such that in an inside of the annular space, muzzle gas flowing in through the at least one exchange opening can leave the annular space at the at least one venting opening, without having to leave the annular space, and/or the inner tube margins the annular space in that gas flowing into the hollow body reaches the annular space exclusively through the projectile channel and the at least one exchange opening.

3. The silencer according to claim **1**, in which the annular space extends substantially barrier free substantially over an entire length of the silencer between the front wall, the front end wall and/or one or more radial walls are arranged in the annular space to divide the annular space into a plurality of annular space compartments in which in particular different filling materials and/or linings are placed, wherein the at

least one radial wall is perforated or comprises at least one transition passage between adjacent annular space compartments.

4. The silencer according to claim **1**, in which the annular space concentrically completely encircles the inner tube and/or a radial distance between the outer tube and the inner tube is smaller than the radius of the cylindrical inner tube, in particular is smaller than a half, a third, or a fourth of the radius of the cylindrical inner tube and in which the radial distance between the outer tube and the inner tube in circumferential direction and/or in projectile flight direction of the annular space is constant and/or the outer tube and the inner tube is a cylindrical metal tube with a wall thickness of at least 0.5 millimeters (mm) and at the most 10 mm, in particular between 1 mm and 3 mm.

5. The silencer according to claim **1**, in which the projectile channel is divided into a plurality of channel compartments and/or in which, in particular, the inner tube forms, in particular in the course of a channel expansion chamber connecting to the projectile entry opening, at least one exchange opening with an at least partially linear opening border, wherein preferably the at least one exchange opening in the area of the channel expansion chamber is designed polygonal, in particular hexagonal, preferably honeycomb cell-shaped, wherein in particular a plurality of rows of exchange openings being displaced in an axial direction are formed in the area of the channel expansion chamber in the inner tube, wherein preferably each of the plurality of rows comprises a plurality of exchange openings being displaced in a circumferential direction, in particular arranged on a same axial height, wherein in particular axially adjacent exchange openings are displaced to axially adjacent rows in the circumferential direction, wherein preferably each of the plurality of exchange openings being formed in the inner tube are equally dimensioned and designed in the area of the channel expansion chamber.

6. The silencer according to claim **5**, in which the channel expansion chamber is margined in an axial projectile flight direction by an in particular first sound reflection element with projectile passage opening which is designed as a sound impact plate, in particular an impact sheet, and/or comprises a central section forming a projectile passage opening the central section is funnel-formed tapering to the projectile passage opening, wherein in particular a tapering direction of the central section is opposite to the projectile flight direction, and/or in which a channel intermediate chamber connects to a particular first sound reflection element with projectile passage opening margining the channel expansion chamber in the axial projectile flight direction in which at least a second exchange opening, in particular being identical to the at least one exchange opening formed in the channel expansion chamber, is formed into the inner tube, in particular being identical to the at least one exchange opening in the channel expansion chamber, and/or which is margined by a second sound reflection element with a projectile passage opening in the axial projectile flight direction, wherein in particular the second sound reflection element is formed as a second sound impact plate, in particular a second impact sheet, and/or comprises the central section forming the projectile passage opening which is formed funnel-shaped, in particular tapering to the projectile passage opening, wherein in particular the tapering direction is opposite to the projectile flight direction and/or the second sound reflection element is substantially equally designed to the first sound reflection element.

7. The silencer according to claim **1**, in which at least one sound reflection element, such as a sound impact plate, in particular an impact sheet, extending radially to the inside is supported by the inner tube wherein the at least one sound reflection element is provided with a projectile passage opening and/or an additional exchange opening, in particular a third exchange opening, is arranged in the inner tube on the axial height of the sound reflection element which extends axially flight upwards and flight downwards in excess of the sound reflection element with respect to the axial position of the sound reflection element, wherein in particular the sound reflection element is attached to the inner tube, in particular preferably attached via a transition fit or a press-fit, and/or extends in excess of the projectile flight axis towards the second exchange opening in such a way that muzzle gas passing the sound reflection element is deflected radially to the outside in the annular space, wherein in particular the additional exchange opening or third exchange opening is larger, preferably twice as large, than the at least first exchange opening.

8. The silencer according to claim **7**, in which the sound-absorbing element and/or the at least one reflection element is preferably removably, in particular exchangably, attached to the inner tube via a dowel pin or a press pin, wherein preferably the dowel pin or press pin is inserted into a suitable recess or bore respectively in the inner tube and optionally also in a support basis of the at least one sound reflection element and/or the sound-absorbing element adjacent to the inner tube, and/or wherein the at least one sound reflection element and/or the sound-absorbing element is firmly inserted into a slit recess of the inner tube in particular according to a transition fit or press-fit.

9. The silencer according to claim **1**, in which a channel end chamber being margined by the front end wall is radially margined by the inner tube in said inner tube at least one additional in particular third sound reflection element, such as a sound impact plate, preferably an impact sheet, with the projectile passage opening is provided, wherein preferably three, four, five, or more sound reflection elements, in particular of the same design, are attached in the channel end chamber at the inner tube said sound reflection elements are particularly arranged to each other in an equal axial distance, wherein in particular each of the sound reflection elements comprises a bypass opening adjacent to the projectile passage opening substantially on the radial height of the inner tube which is particularly combined with an exit opening in the inner tube in such a way that muzzle gas is at least partially deflected at each of the sound reflection elements radially to the outside to the bypass opening and at least partially introduced into the annular space via the at least one exchange opening.

10. The silencer according to claim **1**, in which the at least one venting opening comprises more than two or three venting openings, preferably four or more venting openings, that are formed into the front end wall which preferably comprises a particularly arc-shaped long hole form, and/or at least one long hole-shaped venting opening comprises a continuous long hole extension in a passage direction thereof, wherein preferably a collective arc line of the at least one venting openings lies on a circuit being concentric to a middle axis of the silencer wherein in particular a constant width of the long hole-shaped venting opening is

smaller than a largest cross-sectional dimension of the projectile exit opening and/or a hole width of the long hole hole-shaped venting opening is smaller than one-fifth, one-sixth, or one-seventh of the outer diameter of the outer tube, wherein in particular the particular arc-shaped long hole-shaped venting opening forms more than 10%, 20%, or 30% of the front end wall and/or less than 90% or 80%, preferably between 40% and 80%, is realized by a rigid material, such as metal, of the front end wall.

11. The silencer according to claim **1**, in which the inner tube directly connects to an inside of the front end wall encompassing the projectile exit opening such that an entire muzzle gas entering the hollow body of the silencer reaches the projectile channel via the projectile entry opening, and/or is in particular attached gastight to an inside of the front end wall such that the muzzle gas reaches the annular space exclusively via the at least one exchange opening, and/or in which the inner tube extends along the entire axial length extension of the hollow body towards the projectile exit opening, and/or the inner tube is attached gastight to an inner side of the front end wall such that in particular the muzzle gas between the annular space and the projectile channel can exclusively flow back and forth via the at least one exchange opening, and/or in which a ratio between a closed wall surface of the inner tube and a passage cross-section surface of the at least one exchange opening in the front end wall is larger than 1, preferably larger than 2 or 3.

12. The Silencer according to claim **1**, in which the sound-absorbing filler material is a porous material, such as a foam-like material, for example a metal foam, or a braid, fleece, knitting, knitted fabric, woven fabric, in particular is formed from a metal or another thermally resistant material.

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