EUROPEAN PATENT SPECIFICATION

SILENCER FOR A GAS FLOW
SCHALLDÄMPFER FÜR GASSTROM
SILENCIEUX POUR UN ECOULEMENT DE GAZ

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References cited:
US-A- 3 690 606
US-A- 4 762 540
US-A- 5 166 479

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Description

Background of the Invention

[0001] The present invention is directed to a silencer for a gas flow. That is, the present invention is directed to a device which reduces noise generated when a high pressure gaseous fluid is expanded to ambient pressure. In addition, the present invention permits the fluid discharge to be directed in a desired manner.

[0002] The release of a gas from a pressurized gas source through an apertured pipe has many industrial uses. One example is in the field of gas turbines, for example used for the generation of electricity. It has been found to be desirable to provide preheating for the inlet air being admitted to the turbine, for example for preventing ice buildup on air intakes and filters during cold weather operation. To this end, a "bleeder" line has been used to connect the turbine with the air inlet system. Thus, a small amount of hot gas from the turbine is supplied under pressure to the air inlet through an appropriate system of pipes. Apertured pipes are used to release the heated, pressurized gas at the air inlet.

[0003] While this system has been useful, the release of the gas through the apertured pipes results in an objectionable, high-pitched whine, and in fact, the emitted noise is so significant that the apertured pipes have come to be known as "piccolo" tubes. The noise creates an unpleasant environment for workers and those living or working near such facilities.

[0004] Previous efforts to reduce the noise generated from the escape of the gas from the apertured pipes have suffered from air flow distribution problems and high installation costs. See U.S. Patent Nos. 5,166,479, 3,960,239 and 3,949,828.

[0005] Another effort to reduce the noise is explained in US-A-4,884,657. According to this document a muffler includes a cylindrical body, a gas passage pipe insertedly mounted within the cylindrical body, and a sound absorber mounted upon the gas passage pipe in an encircling manner. Gas is discharged from the gas passage pipe through the cylindrical body and sound absorber. The cylindrical body has a disk-like partitioning wall axially dividing the interior space thereof. The gas passage pipe has an outer flange and a plurality of pawls cooperating with the flange so as to clamp the partitioning wall therebetween.

[0006] This type of muffler is intended to be disposed within an exhaust gas passage of an automobile engine or the like but in applications as discussed above the noise reduction would be insufficient.

Summary of the Invention

[0007] The present invention proceeds from a muffler according to US-A-4,884,657 and provides a silencer for a gas flow which is effective for reducing the noise generated by an apertured pipe while maintaining desired gas flow characteristics. The silencer of the present invention is easily and economically produced and installed, and is suitable for retrofit applications.

[0008] The silencer for a gas flow of the present invention comprises a tubular gas flow member having a sidewall, an open first end for connection to a gas supply, a closed second end, and at least one opening in the sidewall for passage of gas from the interior of the gas flow member. A porous, noise-reducing member surrounds the tubular gas flow member at least at the location of the first opening in the sidewall. The noise-reducing member is in turn surrounded by a shell which is essentially fluid-tightly secured to the tubular gas flow member. The shell is provided with a second opening for passage of gas which has passed through the opening in the sidewall of the tubular gas flow member. The opening of the tubular gas flow member and the opening of the shell are spaced circumferentially from each other sufficiently so that the gas escaping through the opening in the sidewall of the tubular gas flow member is forced to pass through the noise-reducing member to reach the opening in the shell.

Brief Description of the Drawings

[0009] FIGURE 1 is a schematic side view of a gas turbine system with which the present silencer for a gas flow can be used.

[0010] FIGURE 2 is an end view of the air inlet of Fig. 1.

[0011] FIGURE 3 is a perspective view of the silencer for a gas flow of the present invention.

[0012] FIGURE 4 is a sectional view of the silencer of Fig. 3.

[0013] FIGURE 5 is a sectional view similar to Fig. 4 of a further embodiment of the present invention.

[0014] FIGURES 6 through 8 are views illustrating various mesh patterns which can be used for the noise-reducing material used with the silencer of the present invention.

Detailed Description of the Invention

[0015] Referring to Figs. 1 and 2, an example of one application where the silencer of the present invention will be described, namely use in a gas turbine system. The turbine system generally includes air inlet 10, the turbine 12 and air outlet 14. The air inlet in turn can include components such as a rain hood 16 and an insect grill for preventing precipitation, insects and environmental debris from entering the turbine system. The inlet air passes through air filters 18 to plenum 20 and from there to the turbine 12.

[0016] In order to preheat the inlet air, a bleeder line 22 extends from the turbine to the air inlet. As can be seen in Fig. 2, the heated air under pressure from the turbine is passed from the bleeder line to supply pipe 24, and then to header tubes 26. The air is then released
from the header tubes through the silencers 28 of the present invention in a manner discussed in more detail below.

[0017] Referring to Figs. 3 and 4, the silencer 28 of the present invention includes three principle components, tubular gas flow member 30, noise-reducing member 38 and shell 40. The tubular gas flow member 30 has a closed end 32 and an open end 34. In the application illustrated in Figs. 1 and 2, the open end 34 of the tubular gas flow member 30 is in fluid communication with header tube 26, for accepting gas flow passing from turbine 12 through bleeder line 22, supply pipe 24 and the header tube. In the case of gas turbine systems, the gas supplied to the tubular gas flow member will generally be under a pressure of about 5-14 bar (70 to 200 psi) gauge.

[0018] The noise-reducing member is a highly porous material which surrounds the sidewall of the tubular gas flow member at least in the area of openings 36. The porosity of the noise-reducing member is desirably at least 75%, preferably at least about 85%. The porosity is determined by the formula \( \{ 1 - \text{-(weight of the member/weight of the same volume of solid material)} \} \times 100 \). In one embodiment, the noise-reducing member can be made of wire mesh which is wrapped around the tubular gas flow member, with a porosity of 87.5%. The noise-reducing member can be made of other materials satisfying the physical requirements of the conditions of use, for example metal and ceramic sponges having the desired porosity. The mesh is preferred for many uses because it is easy to handle and permits ready customization of products, i.e. the noise reduction can be tailored to specific needs by increasing or decreasing the number of layers in the wrap.

[0019] Shell 40 surrounds the noise-reducing member 38. In a preferred embodiment, the shell 40 is formed from a single, thin rectangular sheet which is wrapped around the noise-reducing member. For example, the shell may be formed from a 16 gauge stainless steel sheet. In this embodiment, the sheet can be held in the desired configuration with straps 42. Advantageously, these straps can be similar to the clamps used to hold rubber hose in place. Alternatively, welding or a buckle-type system can be used. End plates 46 are used to seal between the tubular gas flow member 30 and the shell 40. It is preferred that, at one end of the shell, the end plate 46 is fixed both to the shell and the tubular gas flow member, while at the other end of the shell the end plate is secured only to the shell. This permits a small amount of relative movement between the shell and end plate combination and the tubular gas flow member, to accommodate expansion and contraction of the materials. The seal between the end plate and the tubular gas flow member and between the end plate and the shell should be essentially fluid-tight. That is, while it may be uneconomical or practically impossible to provide a seal which is absolutely fluid-tight, the seal should be fluid-tight within the limits of practicality.

[0020] Opening 44 permits the discharge of gas from the interior of the shell 40. In the illustrated embodiment, the discharge opening 44 is defined by the facing edges of the rectangular sheet which is used to form the shell 40. That is, the width of the sheet used to form shell 40 is selected so that the edges will not meet when the sheet is wrapped around the noise-reducing member 38, thereby leaving a longitudinal slot through which gas can escape.

[0021] In order to force gas from the interior of the tubular gas flow member 30 to pass through noise-reducing member 38 before it is released through the opening 44 in shell 40, the opening 36 in the sidewall of the tubular gas flow member should be circumferentially misaligned with the opening 44 in the shell. Thus, as gas exits from the tubular gas flow member into the noise-reducing member, it is confined by shell 40 until it reaches opening 44, passing through the noise-reducing material the entire time. The gas is virtually fully expanded by the time it reaches the opening 44, with the large majority of expansion taking place after passage through the openings 36 but before reaching opening 44.

[0022] It is preferred that the openings 36 and 44 be separated circumferentially by an angular distance of at least 90°, this spacing being based upon the centers of the openings. In the embodiment illustrated in Fig. 4, the spacing is 180°. While the opening 44 in the shell can be made in any desired configuration, the formation of the opening as a longitudinal slot is advantageous since it allows the size of the opening to be maximized while maintaining the largest possible distance from the openings 36 in the tubular gas flow member.

[0023] In the embodiment of Fig. 5, the tubular gas flow member is provided with diametrically opposed openings 36, and the shell is provided with diametrically opposed openings 44. It can be seen that this arrangement of openings maintains a circumferential spacing of at least 90° between the openings 36 and 44 (again based on centers). This arrangement may be advantageous in some applications since it can reduce the total number of silencers needed for a given installation. For example, the number of silencers 28 in Fig. 2 would be reduced. In addition, in some cases the passage of gas over the wires in a wire mesh noise-reducing member may tend to regenerate noise. The embodiment of Fig. 5 will have reduced gas velocity in the noise-reducing member, which lessens the possibility of noise regeneration.

[0024] As can be seen in Fig. 3, it is possible to provide one tubular gas flow member 30 with several groups of openings in its sidewall, with each group of openings having its own associated noise-reducing member 38 and shell 40. In the embodiment of Fig. 3, there are two such groups. Generally, each group will include from 3 to 12 openings, depending on the specific application in question. The openings will usually be arranged linearly, although a staggered arrangement would be acceptable, keeping in mind that each of the
openings should be spaced a circumferential distance of at least 90 degrees from the opening in the shell.

[0025] The thickness of the layer of the noise-reducing member 38 will depend upon the specific application and the desired amount of noise reduction. In the case of a silencer for use in the gas turbine system described above, the ratio of the inside cross-sectional area of the tubular gas flow member 30 to the cross-sectional area of the noise-reducing member 38 may range from 1:1 to 1:10, with 1:2 to 1:6 being the range normally used. Again, in the illustrated gas turbine system, the length of the silencer 28 illustrated in Fig. 3 will be nearly 210 cm (7 feet) long. The outer diameter of the tubular gas flow member 30 will be about 60 mm (2.375 inches) and the inner diameter of shell 40 is about 114 mm (4.5 inches), with the difference reflecting the thickness of the noise-reducing member 38, in this example slightly more than 25 mm (1 inch). In the case of the gas turbine system, it is desired to reduce the noise level to less than 85 decibels at a distance of 91 cm (3 feet) from the air inlet.

[0026] The size of the openings 36 and 44 will depend upon the desired air flow and the desired noise reduction. In the illustrated gas turbine system, the openings 36 can be circular and have a diameter in the range of about 2 mm to 13 mm (0.08 inch to 0.5 inch), for example about 4 mm (11/64 inch). This will maintain pressure in the tubular gas flow member at 2 bar (30 psi) gauge or more to provide a sonic flow, which maximizes the gas flow and prevents the upstream passage of noise. In this case, the opening 44 is about 38 mm (1.5 inches) wide.

[0027] Generally, the area of the opening 44 will be about 75 to 2000 times the total area of the openings 36 in the tubular gas flow member, depending on temperature and pressure. For most gas turbine systems, the area of the opening 44 will be about 200 times greater than the total area of the openings 36. In any event, the width of the opening 44 in circumferential terms should not be greater than 90°. If the opening 44 is too narrow, the opening 44 itself will regenerate noise. If the opening 44 is too wide, inadequate noise reduction may result.

[0028] The materials used for the silencer of the present invention will depend upon the intended operating environment. The present invention can be used over wide ranges of temperature and pressure. For example, the temperature may range from -45 to 800°C (-50 to 1500°F), more particularly ambient to 410°C (800°F). The pressure can range up to several hundred bar (thousand psig), normally about 1 to 35 bar gauge (15-500 psig). In the case of the gas turbine application described above, stainless steel, particularly 304 or 304L stainless steel, is a preferred material for the tubular gas flow member and the shell in view of the relatively high temperatures involved. Other metals or ceramics can be used as desired. In this case, the noise-reducing member 38 is formed from a stainless steel wire mesh. One example is a knitted, 100 density wire mesh formed from 0.28 mm (.011 inch) diameter 304 stainless steel wire, available from Metex of Edison, New Jersey. While the knit pattern for the mesh illustrated in Fig. 6 is particularly useful, other patterns could be used as well, including the woven pattern of Fig. 7 or the hexagonal "chicken wire" pattern of Fig. 8. In some cases, the knit or woven mesh will be produced in a tubular form. In such a case, it is not necessary to "open" the tube to apply the mesh to the tubular gas flow member for the purposes of the present invention. The mesh tube can be wrapped as a double layer in a flattened condition.

[0029] When wire mesh is applied to the tubular gas flow member as the noise-reducing member, the inner end of the mesh, i.e. the end adjacent the tubular gas flow member, need only be secured to the tubular gas flow member sufficiently to hold the mesh in place during wrapping. Adhesive tape or suitable adhesives can be used for this purpose. The wrapping itself generally will be sufficient to hold the inner end in place during use. However, the outer end of the mesh, i.e. the end adjacent the shell, should be secured more firmly. In the case of metal wire mesh, this can be done by the use of a suitable number of hog rings, or by stitching the outer end to the underlying layers, for example with stainless steel wire. In addition, it is preferred to have the outer end of the mesh at a circumferentially remote position with respect to opening 44, preferably at least 90°, so that if the outer end happens to come loose, the chances of it escaping through opening 44 are lessened.

[0030] Again, in the gas turbine system application for the present silencer, the tubular gas flow member 30 can have end 32 closed with a stainless steel end cap. Similarly, the end plate 46 can be made of stainless steel, as can the straps 42.

[0031] It can be seen that the present invention provides a silencer for a gas flow which is readily adaptable to many applications, provides excellent control for the air flow, can be installed easily and economically, and which is useful for either new or retrofit construction. While the present silencer has been illustrated in connection with a gas turbine system, it will be understood that it can be used in any application in which air or any other gaseous fluid is being vented to a reduced pressure through a relatively thin pipe. While a detailed description of the invention has been provided above, the present invention is not limited thereto, and further modifications will be apparent to those skilled in the art. Rather, the invention is defined by the following claims.

Claims

1. A silencer for a gas flow, comprising:

   a tubular gas flow member (30) having a sidewall, an open first end (34) for connection to a gas supply and a closed second end (32), the sidewall being provided with a first opening (36) for passage of gas from the interior of the gas
flow member;
a porous, noise-reducing member (38) surrounding the tubular gas flow member at least at the location of the first opening in the sidewall;
and a shell (40) surrounding the noise-reducing member, essentially fluid-tightly secured to the tubular gas flow member, provided with a second opening (44) for passage of gas which has passed through the first opening (36), the first opening being spaced circumferentially from the second opening sufficiently so that gas passing through said first opening is forced to pass through the noise-reducing member to reach the second opening, characterized in that the second opening (44) extends substantially the length of the shell.

2. The silencer of claim 1, wherein the first and second openings (36, 44) are spaced apart circumferentially by an angular distance of at least 90 degrees.

3. The silencer of claim 1, wherein the noise-reducing member (38) comprises a wire mesh which is wrapped around the tubular gas flow member.

4. The silencer of claim 1, wherein the sidewall of the tubular gas flow member (30) is provided with a plurality of first openings (36), arranged into at least two groups, with one porous, noise-reducing member (38) being provided for each of the groups of first openings, the noise-reducing members being longitudinally separated from each other.

5. The silencer of claim 4, wherein one shell (40) is provided for each of the noise-reducing members, the shells being longitudinally separated from each other.

6. The silencer of claim 1, wherein the shell has first and second ends, the silencer further comprising first and second plates (46) disposed at the first and second ends of the shell for substantially fluid-tightly sealing the shell to the tubular gas flow member (30).

7. The silencer of claim 6, wherein the first plate (46) is fixed to the tubular gas flow member (30) and relative movement is permitted between the second plate (46) and the tubular gas flow member.

8. The silencer of claim 1, wherein the shell (40) is in the form of a sheet wrapped around the noise-reducing member (38), and the second opening (44) is formed by a gap between facing edges of the sheet.

9. The silencer of claim 1, wherein the noise-reducing member has a porosity of at least about 75%.

10. The silencer of claim 9, wherein the noise-reducing member has a porosity of a least 85%.

11. The silencer of claim 3, wherein the wire mesh is in the form of a flattened tube which is wrapped around the tubular gas flow member.

12. The silencer of any of claims 1 - 11 for use with a gas turbine system, wherein the open first end (34) is adapted for receiving a flow of pressurized hot gas from a gas turbine (12).

13. The silencer of claim 12 wherein said second opening (44) has an area which is about 75 to 2000 times greater than the total area of said first openings (36).

14. The silencer of claim 1, 12 or 13 wherein the first openings (36) are arranged as at least two groups with one noise-reducing member being provided for each of the groups of first openings, the noise-reducing members (38) being longitudinally separated from each other.

15. The silencer of claim 14, wherein one shell (40) is provided for each of the noise-reducing members (38), the shells being longitudinally separated from each other.

16. The silencer of claim 3 in combination with claim 12 or 13, wherein the wire mesh is in the form of a flattened tube which is wrapped around the tubular gas flow member.

Patentansprüche

1. Schalldämpfer für einen Gasstrom,

mit einem röhrenförmigen Gasstromelement (30) mit einer Seitenwand, die eine erste Öffnung (36) für das Durchströmen von Gas aus dem Inneren des Gasstromelements aufweist, mit einem offenen ersten Ende (34) zum Anschluss an eine Gaszuführungseinrichtung und einem geschlossenen zweiten Ende (32); mit einem porösen, geräuschmindernden Element (38), das das röhrenförmige Gasstromelement mindestens am Ort der ersten Öffnung in der Seitenwand umgibt;
und mit einem das geräuschmindernde Element umgebenden Mantel (40), der im wesentlichen fluiddicht an dem röhrenförmigen Gasstromelement befestigt ist und eine zweite Öffnung (44) für den Durchlass von durch die erste Öffnung (36) zugeströmtten Gas aufweist und
die erste Öffnung in Umfangsrichtung hinreichend weit von der zweiten Öffnung beabstandet ist, so dass durch die erste Öffnung hindurchströmenden Gas, durch das geräuschmindernde Element hindurchströmen muss, um die zweite Öffnung zu erreichen, dadurch gekennzeichnet, dass sich die zweite Öffnung (44) im wesentlichen über die Länge des Mantels erstreckt.

2. Schalldämpfer nach Anspruch 1, bei dem die erste und die zweite Öffnung (36, 44) in Umfangsrichtung um einen Winkel von wenigstens 90 Grad voneinander beabstandet sind.

3. Schalldämpfer nach Anspruch 1, bei dem das geräuschmindernde Element (38) ein Drahtgeflecht aufweist, das um das röhrenförmige Gasströmelement herumgewickelt ist.

4. Schalldämpfer nach Anspruch 1, bei dem die Seitenwand des röhrenförmigen Gasströmelementes (30) mit mehreren ersten Öffnungen (36) versehen ist, die in wenigstens zwei Gruppen angeordnet sind und bei dem ein poröses, geräuschminderndes Element (38) für jede Gruppe erster Öffnungen vorgesehen ist, und die geräuschmindernden Elemente in Längsrichtung voneinander getrennt sind.

5. Schalldämpfer nach Anspruch 4, bei dem ein Mantel (40) für jedes geräuschmindernde Element vorgesehen ist und die Mäntel voneinander in Längsrichtung getrennt sind.


7. Schalldämpfer nach Anspruch 6, bei dem die erste Platte (46) an dem röhrenförmigen Gasströmelement (30) befestigt ist und zwischen der zweiten Platte (46) und dem röhrenförmigen Gasströmelement eine Relativbewegung zugelassen ist.

8. Schalldämpfer nach Anspruch 1, bei dem der Mantel (40) in Form eines Blechs um das geräuschmindernde Element (38) herumgewickelt und die zweite Öffnung (44) von einem Spalt zwischen den einen gegenüberliegenden Kanten des Blechs gebildet ist.

9. Schalldämpfer nach Anspruch 1, bei dem das geräuschmindernde Element eine Porosität von wenigstens etwa 75 % aufweist.

10. Schalldämpfer nach Anspruch 9, bei dem das geräuschmindernde Element eine Porosität von wenigstens 85 % aufweist.

11. Schalldämpfer nach Anspruch 3, bei dem das Drahtgeflecht die Form einer abgeflachten Röhre hat, die um das röhrenförmige Gasströmelement herumgewickelt ist.


13. Schalldämpfer nach Anspruch 12, bei dem die zweite Öffnung (44) eine Fläche aufweist, die etwa 75 bis 2000 mal größer als die Gesamtfläche der ersten Öffnungen (36) ist.

14. Schalldämpfer nach Anspruch 1, 12 oder 13, bei dem die ersten Öffnungen (36) in wenigstens zwei Gruppen mit einem geräuschmindernden Element für jede der Gruppen erster Öffnungen angeordnet sind und die geräuschmindernden Elemente (38) voneinander in Längsrichtung getrennt sind.

15. Schalldämpfer nach Anspruch 14, bei dem ein Mantel (40) für jedes geräuschmindernde Element (38) vorgesehen ist und die Mäntel in Längsrichtung voneinander getrennt sind.


Revendications

1. Silencieux pour un écoulement de gaz, comprenant :

   un élément tubulaire (30) d'écoulement de gaz comportant une paroi latérale, une première extrémité ouverte (34) pour raccord à une alimentation en gaz et une seconde extrémité fermée (32), la paroi latérale étant pourvue d'une première ouverture (36) destinée à laisser passer un gaz provenant de l'intérieur de l'élément d'écoulement de gaz ;

   un élément poreux (38) de réduction de bruit entourant l'élément tubulaire d'écoulement de gaz au moins au niveau de l'emplACEMENT de la première ouverture de la paroi latérale ; et

   une enveloppe (40) entourant l'élément de réduction de bruit, fixée essentiellement de manière étanche à l'élément tubulaire d'écoule-
ment de gaz, pourvue d'une seconde ouverture (44) destinée à laisser passer un gaz qui a traversé la première ouverture (36), la première ouverture étant espacée circonférentiellement de la seconde ouverture suffisamment pour que le gaz qui traverse ladite première ouverture soit contraint de traverser l'élément de réduction de bruit pour atteindre la seconde ouverture, caractérisée en ce que la seconde ouverture (44) s'étend sensiblement sur la longueur de l'enveloppe.

2. Silencieux selon la revendication 1, dans lequel les première et seconde ouvertures (36, 44) sont espacées circonférentiellement d'une distance angulaire d'au moins 90 degrés.

3. Silencieux selon la revendication 1, dans lequel l'élément (38) de réduction de bruit comprend un treillis métallique qui est enroulé autour de l'élément tubulaire d'écoulement de gaz.

4. Silencieux selon la revendication 1, dans lequel la paroi latérale de l'élément tubulaire (30) d'écoulement de gaz est pourvue d'une pluralité de premières ouvertures (36), agencées en au moins deux groupes, un élément poreux (38) de réduction de bruit étant prévu pour chacun des groupes de premières ouvertures, les éléments de réduction de bruit étant espacés longitudinalement l'un de l'autre.

5. Silencieux selon la revendication 4, dans lequel une enveloppe (40) est prévue pour chacun des éléments de réduction de bruit, les enveloppes étant espacées longitudinalement l'une de l'autre.

6. Silencieux selon la revendication 1, dans lequel l'enveloppe comporte des première et seconde extrémités, le silencieux comprenant en outre des première et seconde plaques (46) disposées au niveau des première et seconde extrémités de l'enveloppe pour rendre sensiblement étanche l'enveloppe par rapport à l'élément tubulaire (30) d'écoulement de gaz.

7. Silencieux selon la revendication 6, dans lequel la première plaque (46) est fixée à l'élément tubulaire (30) d'écoulement de gaz et dans lequel un déplacement relatif est permis entre la seconde plaque (46) et l'élément tubulaire d'écoulement de gaz.

8. Silencieux selon la revendication 1, dans lequel l'enveloppe (40) a la forme d'une tôle enroulée autour de l'élément (38) de réduction de bruit, et dans lequel la seconde ouverture (44) est formée par un espace entre les bords qui se font face de la tôle.

9. Silencieux selon la revendication 1, dans lequel l'élément de réduction de bruit a une porosité d'au moins environ 75 %.

10. Silencieux selon la revendication 9, dans lequel l'élément de réduction de bruit a une porosité d'au moins 85 %.

11. Silencieux selon la revendication 3, dans lequel le treillis métallique a la forme d'un tube aplati qui est enroulé autour de l'élément tubulaire d'écoulement de gaz.

12. Silencieux selon l'une quelconque des revendications 1 à 11 pour utilisation avec un système de turbine à gaz, dans lequel la première extrémité ouverte (34) est conçue pour recevoir un écoulement de gaz chaud sous pression provenant d'une turbine à gaz (12).

13. Silencieux selon la revendication 12, dans lequel la seconde ouverture (44) présente une superficie qui est d'environ 75 à 2000 fois supérieure à la superficie totale desdites premières ouvertures (36).

14. Silencieux selon la revendication 1, 12 ou 13, dans lequel les premières ouvertures (36) sont agencées en au moins deux groupes, un élément de réduction de bruit étant prévu pour chacun des groupes de premières ouvertures, les éléments (38) de réduction de bruit étant espacés longitudinalement les uns des autres.

15. Silencieux selon la revendication 14, dans lequel une enveloppe (40) est prévue pour chacun des éléments (38) de réduction de bruit, les enveloppes étant espacées longitudinalement l'une de l'autre.

16. Silencieux selon la revendication 3 en combinaison avec la revendication 12 ou 13, dans lequel le treillis métallique a la forme d'un tube aplati qui est enroulé autour de l'élément tubulaire d'écoulement de gaz.