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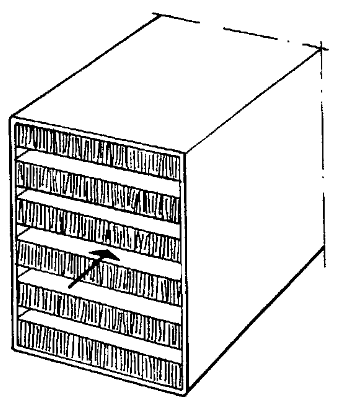

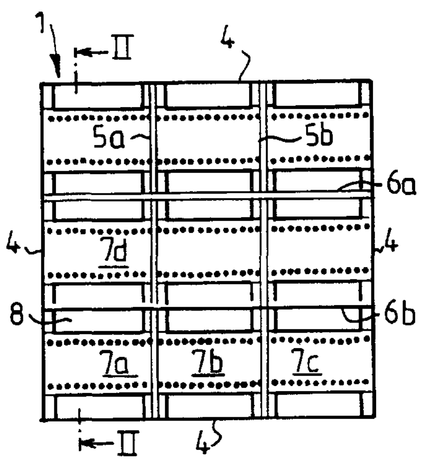

(57) Abstract: The present invention relates to a sound-absorbing channel element for a flowing medium. The channel element (1) has an inlet (2) connected to a sound source and an outlet (3), and is defined by outer walls (4) extending in the flow direction. In order to achieve simplified construction of sound-absorbers in a gas outlet channel, as well as greater efficiency and lower resistance, the channel element (1) in accordance with the invention is provided with partition walls (5, 6) running in the direction of flow. These divide the channel element (1) into several part-channels (7). Each part-channel (7) is provided with sound-absorbing members (8). The channels are of different lengths. The invention also relates to a set of channel element modules for modularised construction of such a channel element, and also a gas outlet channel where equivalent principles are applied. Finally, the invention relates to a method of manufacturing such a channel element, wherein this is composed of a set of channel element modules, and a method of suppressing the sound in a gas outlet channel wherein the channels are divided into part-channels in corresponding manner.

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EXHAUST SYSTEM

Technical Field

The present invention relates in a first aspect to a sound-absorbing channel element of the type described in the preamble to claim 1, in a second aspect to a set of channel element modules of the type described in the preamble to claim 15, in a third aspect to a gas outlet channel of the type described in the preamble to claim 16, in a fourth aspect to a method of manufacturing a channel element of the type described in the preamble to claim 19, in a fifth aspect to a method of sound suppression of the type described in the preamble to claim 20, and in a sixth aspect to a use as claimed in claim 21.

The invention is primarily designed for use in gas outlets from large gas turbines and the like, but is not limited to these applications.

Background art

With the object of reducing the sound emitting particularly from the mouth of a ventilation system or an exhaust system, it is known to arrange one or more sound-absorbers in the gas channel of the system. "Sound-absorber" is ordinarily taken to mean a device that is capable of consuming sound energy. This may be achieved by the sound energy being converted to some other form of energy, such as heat, which can be drawn off and cooled. In the following the term "resistive suppresser" refers to a device in a gas channel that is capable of absorbing sound, i.e. converting the sound energy to another form of energy. The term "absorber" refers in the following to an apparatus capable of reducing sound and having the suppressing quality of reducing sound.

A typical embodiment of a resistive suppresser is a circular or square pipe whose sides exposed to the flow of gas are coated with an absorbent of a porous medium of small connected cavities. A conventional sound-absorber of this type, intended for a ventilation system, is described in GB patent 212 22 56. Another resistive suppresser intended for an exhaust system is revealed as already known in US patent 2,826,261. Mineral wool or glass wool is generally used as absorbent, said wool including adhesive so that it acquires a coherent structure. The absorbent may be protected by a porous surface layer, e.g. a perforated sheet, in order to achieve longer life and better mechanical stability at high gas velocities. Such a resistive suppresser acquires sound-absorbing properties that cover a wide range of frequencies and, besides being dependent on the thickness and through-flow velocity of the absorbent, is also dependent on the length and inner area of the suppresser.

The relationship between the thickness of the absorbent and the length of the sound waves in the sound is decisive for the suppression at lower frequencies. Perfectly satisfactory suppression is achieved for sound frequencies at which the thickness of the absorbent is greater than a quarter wavelength of the sound. The sound-absorption properties then decrease drastically for sound having lower frequencies, which has greater wavelengths. Even when the ratio between wavelength and absorbent thickness is about 1/8, the absorption is only half, and at a ratio of 1/16 it is only 20% of the absorption obtained at a ratio of 1/4. Since a certain absorption capacity still remains, sufficient absorption is in many cases obtained by increasing the length of the total absorbent in the gas transport system. The cross-sectional area of the gas transport system is also of significance for the decrease in sound obtained, since the decrease in the upper frequency register of the sound decreases with increased cross-sectional area.

One problem with the resistive suppresser is thus that the absorbent layer must be made extremely thick if it is to absorb low frequencies. This involves large constructional volume. However, a thinner absorbent layer can be compensated by a greater total length of the suppresser. This results in increased expense for the reduction in sound obtained. Another problem is that the pressure reduction in the system must be limited. The sound-absorbing properties for low frequencies are also dependent on where the sound-absorber is placed along the system. It is often found that the properties obtained in the laboratory, particularly at low frequencies, and described in brochures, are seldom achieved in practice. This leads to substantial over-dimensioning in order to be sure of achieving sufficient sound-absorption.

Another known way of reducing the sound emission from a gas transport system is to prevent the sound from spreading in the channel. This can be achieved by arranging reactive obstacles in the gas channel. Such an obstacle is obtained by creating a sound in counter-phase to the sound in the channel, so that this is extinguished. This technique is preferably used in "active sound-absorption. The counter-directed sound is created by a loudspeaker placed in the channel. However, exceptionally controllable conditions are required for an active system to function.

Another method of reducing the sound that reaches the mouth of the channel is to insert obstacles to prevent the approaching sound wave. This type of sound-absorber consumes substantially no energy and is usually termed a reactive suppresser. A reactive suppresser operates in accordance with two main principles. The first type is a reflection suppresser. This entails an increase in the cross-sectional area, the increased area giving rise to a reflection wave that is propagated in opposite direction to the propagation of the sound. From the functioning point of view, the obstacle can be considered as a wall from which the sound bounces back. The other type is a resonance suppresser, which influences the propagation of the sound in a channel. In this case the obstacle may be considered as a “pitfall” into which the approaching sound “falls” on its way to the mouth.

Resonance sound-absorbers comprise two main types, i.e. quarter-wave suppressers and so-called Helmholtz resonators. The latter is tuned for only one frequency whereas a quarter-wave suppresser is tuned for a certain tone but also influences its odd harmonics. The quarter-wave suppresser usually comprises a closed pipe connected to the channel, with a length corresponding to a quarter wavelength of the sound to be suppressed. Its absorbing properties usually cover an extremely narrow frequency range. One problem with a quarter-wave suppresser is that the length must be tuned to the frequency of the sound to be prevented. Another problem with a reactive suppresser, extremely difficult to solve, is that it is extremely sensitive to placing in the system. By considering the obstacle as a “pitfall” into which the approaching sound shall “fall down”, the importance will easily be understood of correctly placing the mouth of the pit in relation to the “step length”, i.e. the length of the sound-wave. A “pit” placed incorrectly allows the sound to “step over” without resistance. To obtain maximum absorption effect, therefore, the mouth of a quarter-wave suppresser must be placed in a pressure maximum of the sound field in the channel.

A large number of arrangements also exist which combine the methods described above, in various ways. However, the problem is usually that the various components find themselves at points where they are not efficient. In order to compensate the unpredictable properties, therefore, conventional sound-absorbing systems are often greatly over-dimensioned and this leads to expensive, heavy and bulky plants with high-pressure drop.

Sound-absorption arrangements in transport systems for gas in which the gas temperature fluctuates involve additional complications since the sound wavelength alters with the temperature. If the temperature of the gas increases from 20^{o}C to 900^{o}C, the sound velocity and thus the wavelength increases twice as much. The properties of a suppresser that functions well at normal temperature will therefore deteriorate, particularly in the low frequency range, when the gas is heated. This usually results in the sound-suppressing arrangements in transport systems with hot gases often being extremely large. Another problem with gas transport systems for hot gases is the risk of condensation forming. The sound absorbent in the sound-absorber usually consists of thermal insulation and the inside of the sound-absorber will become so cold that liquids dissolved in the hot gas will condense on the metal casing outside the absorbent. The condensed liquids are capable of converting combustion remnants in the gas being transported, such as sulphur compounds and hydrocarbon, to acid, which corrodes metal, for instance. Condensation may even cause particles to collect in the system.

WO 98/27321 describes a sound-absorber for a channel in which a gaseous medium flows from an inlet to an outlet with a sound source at the inlet, wherein the problems discussed above are to a great extent overcome. The sound-absorber consists of a number of modules, each module being composed of a reflection suppresser and a reactive suppresser arranged on each side thereof, the length of the reflection suppresser and each reactor suppresser is substantially the same.

However, the advantages gained with the sound-absorber known through WO 98/27321 are limited to applications up to a certain size. For larger systems, i.e. where the length of the sound-wave is typically much less than the cross-sectional dimension of the channel, this sound-absorber is insufficient. This is because the sound propagation in such cases does not take place as a flat wave. Examples of systems of this type are exhaust channels for a gas turbine for power generation. For gas turbines in the order of magnitude of 20-200 NM, the exhaust channel has a cross-sectional dimension of 3-9 m. In this area the sound is not propagated as a flat wave for the relevant frequencies.

In such plants a baffle sound-absorber is conventionally used which is normally designed and manufactured locally in each individual case. Such a sound-absorber is often mounted in a horizontal part of the exhaust system before the bend that leads on to its vertical part. To obtain the required sound-absorption, such sound-absorbers often include a large volume of absorbent material. The free through-flow area will therefore constitute a relatively small part of the total cross-sectional area of the channel, typically approximately 40-60 %. The flow rate will be high, approximately 40-50 m/s, and the pressure drop will be considerable. For this reason the cross-sectional area of the channel must be increased. These sound-absorbers normally have a length of about 4 m and a through-flow area of 9-80 m^2. The sound-absorber is constructed as a large unit and is therefore difficult to build, handle and service. The rest of the exhaust gas system is not used for sound-absorption purposes.

Description of the invention

Bearing in mind the above background, the object of the invention is to provide devices and means for sound-absorption of the type described in the introduction, that are suitable when the flowing medium is conducted through channels having large cross-sectional dimensions, that permit low pressure drop and small constructional dimensions in comparison with known technology, that offer rational manufacture and operation of the plant and enable efficient sound-absorption.

"Large cross-sectional dimensions" in this application implies that the least cross-sectional dimension of the channel is considerably greater than the dominating wavelength of the sound generated by the sound source, i.e. the area where the sound is no longer propagated as a flat wave.

As regards the first aspect of the invention this object is achieved by a channel element of the type described in the preamble to claim 1 being given the special features as defined in the characterizing part of the claim.

Thanks to the channel element being divided into part-channels, propagation of the sound can take place in each part-channel as a flat wave. This creates favourable conditions for achieving efficient sound-absorption in each part-channel with members arranged in each part-channel. A plurality of channel elements may advantageously be arranged one after the other in a gas outlet channel if necessary. A maximum sound-absorbing ability for a certain length of a part-channel exists for a certain wavelength. Since the channels are of different lengths, they will together cover a spectrum of the sound wavelengths, thus giving a favourable total effect. The division into part-channels enables the total quantity of absorbent material to be reduced in comparison with conventional technology. The advantage is thus achieved that the free through-flow area increases, amounting to around 50-80 % of the total through-flow area in gas turbine applications. The flow rate is thus reduced by around 25-40 % and the pressure losses are greatly reduced.

In accordance with a first preferred embodiment of the channel element in accordance with the invention, it is composed of a plurality of channel element modules, each forming a part-channel. This has the advantage that the channel element can be rationally adapted to different operating conditions and sizes without requiring a tailor-made design. The modularisation allows the channel element or elements to be combined using factory-made standard modules. This enables rational handling and low demands for skilled knowledge when constructing the plant, while still ensuring satisfactory and predictable sound-absorbing qualities in the system.

Division of the channel element into part-channels can easily be achieved by each part-channel being constructed from a pipe running in the direction of flow and preferably, but not necessarily, being circular-cylindrical. This therefore constitutes a preferred embodiment of the channel element in accordance with the invention.

Under certain circumstances it may be advantageous to make the division of the channel element into part-channels one-dimensioned, whereas under other circumstances it may be advantageous with a two-dimensional division. These alternatives therefore constitute different preferred embodiments. The partition walls dividing the channels may be flat sheets that divide the channel into a diamond-patterned matrix. The partition walls may also be such that triangular or hexagonal channels, or channels of some other shape, are formed, or they may consist of pipes.

In accordance with another preferred embodiment of the invention the partition walls are rigidly joined to the outer walls of the channel element. This is very beneficial since a reinforcing effect is achieved. The need for reinforcements on the outer side of the channel element is therefore eliminated, thereby entailing another saving in cost.

A simple way of ensuring that the part-channels are different lengths is for the outlet and inlet of the channel element to form different angles to the direction of flow. This therefore constitutes a further preferred embodiment of the invention. One of the angles is suitably a right angle.

In yet another preferred embodiment of the invention the sound-absorbing member in a part-channel is composed of a resistive and a reactive sound-absorbing member. Such a combination provides efficient sound-absorption of both the long and the short wavelengths in the sound, the resistive member preferably absorbing short waves and the reactive member absorbing the longer waves. The reactive member is suitably designed as a quarter-wave resonator. Thanks to being able to use much less absorbent material with such a design of the sound-absorption member than would normally be the case, the advantage is also gained of reducing decay and loss of absorbent material, i.e. of fiber being gradually torn off and disappearing out. Such decay and loss reduces the efficiency of a sound-absorber.

A simple, efficient and space-saving embodiment is obtained if the sound-absorbing member comprises a partition wall separating a passage through the part-channel from a side chamber in the part-channel, the side chamber being connected to the passage through the opening members and the partition wall having a sound-absorbing layer on the side of the partition wall facing the passage. The side chamber thus constitutes a resonator and the sound-absorbing layer constitutes a resistive sound-absorber. Such a construction of the sound-absorbing member thus constitutes a further preferred embodiment of the channel element in accordance with the invention.

In accordance with yet another advantageous embodiment of the invention the channel element is included in a set of channel elements in which the outlets and/or inlets are complementary with each other. Such a set allows the channel elements to be arranged close together in series in the direction of flow. A sound-absorbing unit is thus obtained that utilises a large part of the length of the exhaust channel. This also ensures that the openings of the sound-absorbing members will be arranged at a correct position in the direction of flow.

The embodiments described above and other advantageous embodiments are defined in the subordinate claims to claim 1.

The object from the second aspect of the invention has been achieved by a set of channels having the features defined in the characterizing part of claim 15.

The use of a set of such modules enables rational provision of a channel element, thereby gaining the advantages described above for the first preferred embodiment of the channel element. Since the set includes modules of different lengths, a channel element can easily be obtained in which the part-channels have different lengths, with the resultant advantages, as described above.

The object from the third aspect of the invention is achieved by a gas outlet channel of the type described in the preamble to claim 16 having the features defined in the characterizing part of the claim. The same principle concept is utilised here as for the channel element claimed in claim 1, but applied to a gas outlet channel as a whole. Corresponding advantages to those described for the channel element of the invention are therefore gained.

A gas outlet channel constructed in this manner can therefore be produced less expensively as regards both performance and maintenance, with lower flow resistance and better sound-absorbing properties than a conventional gas outlet channel.

The type of gas outlet channel to which the invention refers normally has a bend between a horizontal and a vertical part of the channel. With conventional sound-absorbers it is difficult to place parts of these rationally in the bend. With a gas outlet channel in accordance with the invention, the bend can also advantageously be utilised for sound-absorption, thereby enabling better use to be made of the extra sound-reduction offered by the bend itself.

The above and other preferred embodiments of the gas outlet channel of the invention are defined in the subordinate claims to claim 16.

Advantages similar to those described above are gained through the additional aspects of the invention relating to the methods defined in claims 19 and 20 and the use defined in claim 21.

Description of the drawings

Figure 1 is a view in perspective of a conventional sound-absorber,

Figure 2 is a section transverse to the direction of flow, through a channel element in accordance with a first embodiment of the invention,

Figure 3 is a section along the line II-II in Figure 1,

Figure 4 shows a detail from Figure 2,

Figure 5 is a section corresponding to that shown in Figure 2, through a channel element in accordance with a second embodiment of the invention,

Figure 6 is a section along the direction of flow, through a gas outlet channel in accordance with the invention,

Figures 7 and 8 illustrate modular construction of alternative embodiments of the invention,

Figure 9 is a diagram illustrating the sound-absorption as a function of the frequency.

Figure 1 shows the construction of a sound-absorber in a conventional gas channel. A number of thick absorbent layers A are arranged parallel to the direction of flow in the channel. As can be seen, a large part of the area is taken up by the absorbent material, which results in high pressure drop, high flow rate and large cross-sectional dimensions.

Figures 2 and 3 illustrate transverse and longitudinal sections, respectively, in the channel element 1 in accordance with one embodiment of the invention. The channel element is designed to constitute a part of a gas outlet channel from a gas turbine in which the gas outlet channel is composed of a plurality of similar channel elements. Outlet gas flows through the channel element 1 as seen from left to right in Figure 3. The left side 2 of the element is thus the inlet and is connected to the gas turbine. The right side of the element, the outlet 3, is connected to the outlet of the gas outlet channel. The channel element is defined by outer walls 4. In the example shown the cross section of the channel element is quadratic, but it can of course have optional shape such as rectangular, circular or other shapes. In the example shown the channel element has a side length of about 4.5 m, which is what is necessary for a gas turbine with a capacity of 40 MW. Between partition walls 5a, 5b running in a first direction, and partition walls 6a, 6b running in a direction perpendicular thereto, the channel module is divided into part-channels 7a, 7b, 7c, 7d, etc. Each of these is approximately 1.5 m square. Sound-absorbing members 8 are arranged in each part-channel. An advantageous embodiment of this is described in more detail with reference to Figure 3. As can be seen in Figure 3, the outlet 3 is inclined in relation to the direction of flow, whereas the inlet 2 is perpendicular thereto. The part-channels thus have different lengths. Groups of three part-channels have the same length.

An embodiment, in which all part-channels are of different length, e.g. with the outlet 3 also forming an angle to the normal plane of the figure, also lies within the scope of the invention. Each length of a part-channel makes this maximally efficient for a certain wavelength of the low-frequency sound.

Figure 4 shows a part-channel 7 on a larger scale, in the same perspective as in Figure 3. The part-channel is the one designated 7a in Figures 2 and 3, but the following is also applicable to the other part-channels. Adjacent to the upper and lower defining walls 6b and 4, respectively, in the figure, a side chamber 10a, 10b, respectively, is limited by a partition wall 11a, 11b, respectively, from a central passage 9 through which the gas flows. Each partition wall is provided with a layer 12, 12b of sound-absorbing material. The layers 12a, 12b face towards the passage 9. One or more openings 13a, 13b, are also provided in each partition wall, so that the side chambers communicate with the passage. The openings 13a, 13b have a total area of substantially the same size as the through-flow area of the passage 9. In this embodiment the sound-absorbing member has both resistive and reactive sound-absorbing properties.

The resistive sound-absorbing member consists of the layers 12a, 12b and is designed to efficiently absorb sound in the high and medium frequency ranges. The sound-absorption capacity decreases with decreasing frequency. The sound-absorbing layers are made of heat-resistant wool with long fibres. This may be glass or rock wool fibres, for instance, but other ceramic or synthetic fibres are also possible. Glass fibres, which are long and coarse, are the most suitable.

The reactive sound-absorbing member consists of the side chambers 10a, 10b and is designed as a resonance suppresser of quarter-wave type.

A resonance suppresser absorbs sound within a narrow frequency range. The absorption characteristic of the quarter-wave suppresser is related to odd multiples of a quarter wavelength of the sound. The absorption effect then declines very rapidly upwardly and downwardly in the frequency range. If a quarter-wave suppresser is to provide any absorption effect at all, its mouth must be placed in the system so that the resonance motion is initiated. This only occurs effectively when the mouth is located at a point in the sound field where the relevant frequency has a pressure peak. It is therefore important for the openings 13a, 13b to be located at such a point in the sound field, which is a quarter wavelength from the nearest pressure node.

A channel element of the type shown in Figures 2 and 3 can advantageously be constructed from modules in which each module consists of one or more part-channels. If each part-channel constitutes a module with its side 1.5, these modules can be combined to cover gas turbine plants of different sizes. Typical dimensioning is as stated in the following table:

Power, MW	Number of modules	Total area, m^2	Channel width, m
20	2x2 = 4	9	3.0
40	3x3 = 9	20	4.5
80	4x4 = 16	36	6.0
120	5x5 = 25	56	7.5
180	6x6 = 36	81	9.0

In a section corresponding to that in Figure 2, Figure 5 shows a channel element in accordance with a second embodiment. In this case the part-channels 7' are formed of a number of pipes 56' accommodated between the outer walls 4' of the channel element. The figure is schematic in order to reveal the principle of dividing up the channel. Components such as sound-absorption members, etc., have thus been omitted in this figure. However, it will be understood that a sound-absorbing member equivalent to those shown in Figures 2-4 is arranged inside each pipe 56'. The spaces between the pipes may be open, closed or provided with sound-absorbing absorbent.

Figure 6 shows how the exhaust channel of a gas turbine plant can be combined from a plurality of channel elements 1a-e, each of the type shown in Figures 1 and 2. The exhaust channel has an inlet 14 connected to a gas turbine 15, and an outlet 16. The exhaust channel has a horizontal part 17, a bend 18 and a vertical part 19.

Channel elements are arranged in both the horizontal and the vertical parts of the exhaust channel. Thanks to the design of the elements, the bend can also be used to suppress sound. The channel elements have inlets and outlets adapted to inlets and outlets of adjacent elements. Either the inlet or the outlet of each channel element is at right angles to the direction of flow, while the other is inclined 27.5° to the perpendicular. In longitudinal direction the gas outlet channel may accommodate more elements than are shown, both in the horizontal and the vertical parts. A large part of the longitudinal extension of the gas outlet channel can therefore be used for sound absorption so that great total sound-reducing effect is obtained.

Although all the channel elements shown in Figure 6 are substantially identical, Figure 7 shows an example where channel elements 101a, 101b and 102 are arranged in the area of the bend, the element 102 deviating in shape from the other two. Both outlet and inlet of the element 102 form an inclined angle to the direction of flow, whereas either the outlet or the inlet of the other two elements is perpendicular to the direction of flow. Figure 8 shows another embodiment of a channel element 201, composed of three groups of channel modules. A first group of modules 208a-208e has inlet and outlet perpendicular to the direction of flow. A total of 90 modules is required to produce the bend shown, 30 in each part-section. These modules are of different lengths, but are otherwise the same. There are 18 modules of each length. A second group of modules is designated 308. They are identical and have one perpendicular end and one end at 30^{o} to the perpendicular. 6 x 6 x 2 = 72 of these are included. A third group of modules, 408, are designed like the modules 308 but somewhat shorter. The modules 408 are all of the same length and 6 x 6 x 2 = 72 of these are included. The channel element 201 is intended to constitute a bend in the gas outlet pipe and, in the example shown, is designed for a channel with 9-meter sides.

Figure 9 illustrates the sound-absorption characteristic for the gas outlet channel in Figure 6. The curve represents the sound-absorbing effect from the quarter-wave resonator with a maximum in the frequency range 30-40 Hz. The resistive suppression, curve b, is most efficient in the medium frequency range with a maximum at about 700 Hz. The absorption effect of the bend increases with increased frequency, as shown in curve c. The total absorption is represented by curve d.

CLAIMS

1. A sound-absorbing channel element having large cross-sectional dimensions (1; 101, 102; 201) for a flowing medium, and having an inlet (2) connected to a sound source (15) and an outlet (3), which channel element is defined by outer walls (4) extending in the flow direction, **characterized** in that the channel element is divided into part-channels (7) running in the direction of flow, each part-channel being provided with sound-absorbing means (8), and at least some of the part-channels (7) being of different lengths and comprising sound-absorbing means tuned for different frequencies.

2. A channel element as claimed in claim 1, **characterized** in that it is composed of a plurality of channel element modules, each forming one or more part-channels or part of a part-channel.

3. A channel element as claimed in either of claims 1 or 2, **characterized** in that the part-channels (7) are constructed from a plurality of pipes (56') running in the direction of flow.

4. A channel element as claimed in either of claims 1 or 2, **characterized** in that said part channels are constructed from at least one partition wall (5) running in a first direction transverse to the direction of flow.

5. A channel element as claimed in either of claims 1 or 2, **characterized** in that said part channels are constructed from at least one partition wall (5) running in a first transverse direction and at least one second partition wall (6) running in a second transverse direction to the direction of flow.

6. A channel element as claimed in any one of claims 1-5, **characterized** in that the part channels (7, 7') are constructed from partition walls (56, 5') that are rigidly joined to the outer walls (4) of the channel element.

7. A channel element as claimed in any one of claims 1-6, **characterized** in that said inlet (2) is located in a plane forming a first angle to the direction of flow and in that said outlet is located in a plane forming a second angle (3) to the direction of flow, which first and second angles are different.

8. A channel element as claimed in claim 7, **characterized** in that one of said angles is a right angle and the other is 67.5°.

9. A channel element as claimed in any one of claims 1-8, **characterized** in that at least some of said sound-absorbing means (8) comprise both resistive (12) and reactive (10) sound-absorbing means.

10. A channel element as claimed in claim 9, **characterized** in that the reactive sound-absorbing means is a resonator (10).

11. A channel element as claimed in claim 10, **characterized** in that the resonator is a quarter-wave resonator (10).

12. A channel element as claimed in claim 11, **characterized** in that the sound-absorbing means (8) comprises a partition wall (11) separating a passage (9) through the part-channel (7) from a side chamber (10) in the part-channel, which side chamber (10) is connected to the passage (9) through the opening member (13) comprising at least one opening, and which partition wall (11) comprises a layer (12) of sound-absorbing material on at least the side of the partition wall (11) facing the passage (9).

13. A channel element as claimed in claim 12, **characterized** in that the opening member (13) has an area in the same order of magnitude as the through-flow area of the passage (9).

14. A set of channel elements in which each channel element consists of a channel element as claimed in any one of claims 1-13, **characterized** in that each channel element has an inlet and/or an outlet that is complementary with an outlet and/or inlet, respectively, of another channel element in the set.

15. A set of channel elements for use in a channel element of the type claimed in any one of claims 1-13, **characterized** in that the set comprises modules of different lengths but having substantially the said cross-sectional dimensions.

16. A gas outlet channel having an inlet (14) connected to a sound source (15) and an outlet (16), which channel is defined by outer walls extending in the

flow direction of the gas, **characterized** in that the channel comprises a plurality of channel elements (1) as claimed in any one of claims 1-13.

17. A gas outlet channel as claimed in claim 16, **characterized** in that the channel elements (1) constitute a set of the type claimed in claim 14.

18. A gas outlet channel as claimed in either of claims 16 or 17, which channel comprises a bend (18), **characterized** in that at least one (1b, 1c) of the channel elements is arranged in the bend (18).

19. A method of manufacturing a channel element as claimed in any one of claims 1-13, **characterized** in that the channel element is composed of a set of channel element modules of the type claimed in claim 15.

20. A method of suppressing the sound in a gas outlet channel having an inlet connected to a sound source and an outlet, which channel is defined by outer walls extending in the direction of flow of the gas, **characterized** in that the channel is composed of a plurality of channel elements of the type claimed in any one of claims 1-15.

21. The use of channel elements as claimed in any one of claims 1-14 for sound-absorption in a gas outlet channel of the type claimed in any one of claims 16-18.

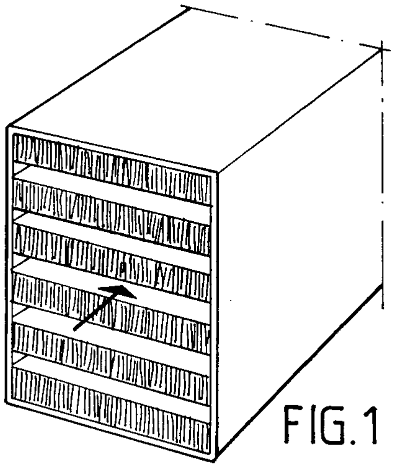


FIG.1

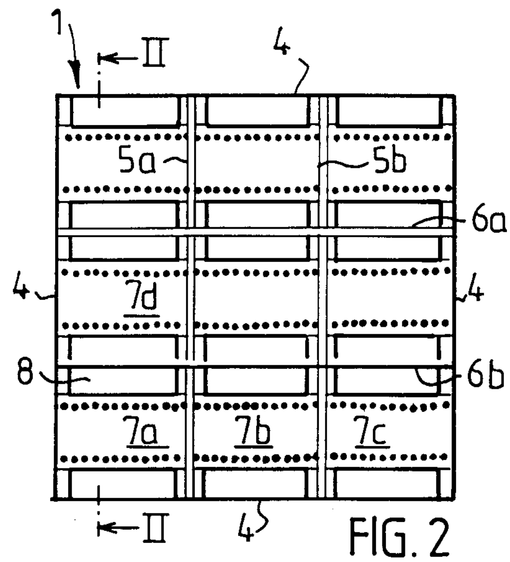


FIG. 2

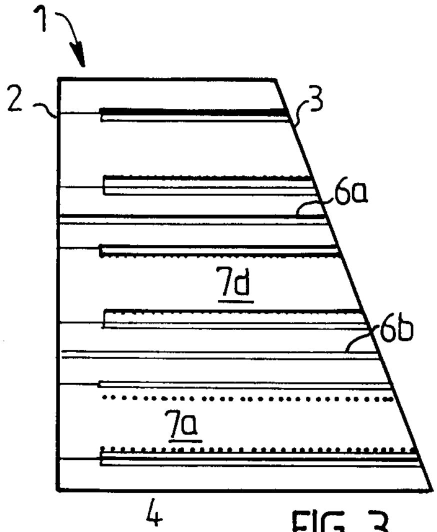


FIG. 3

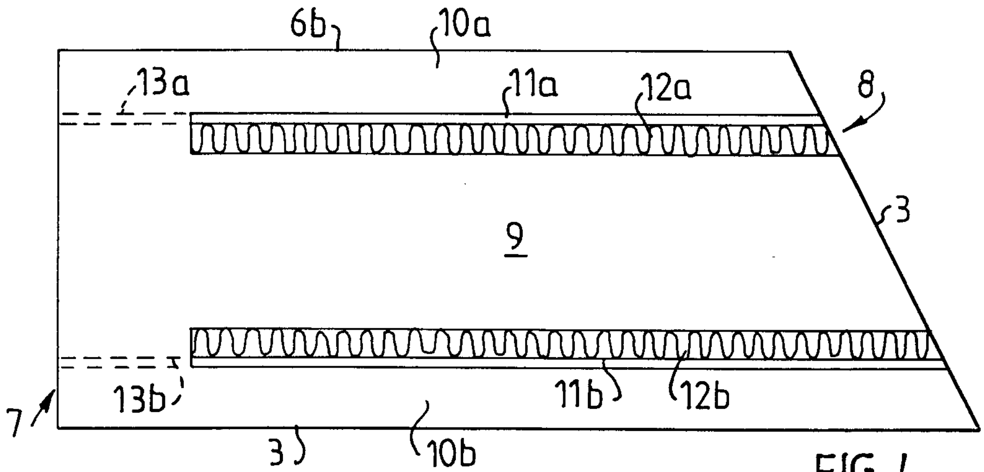


FIG. 4

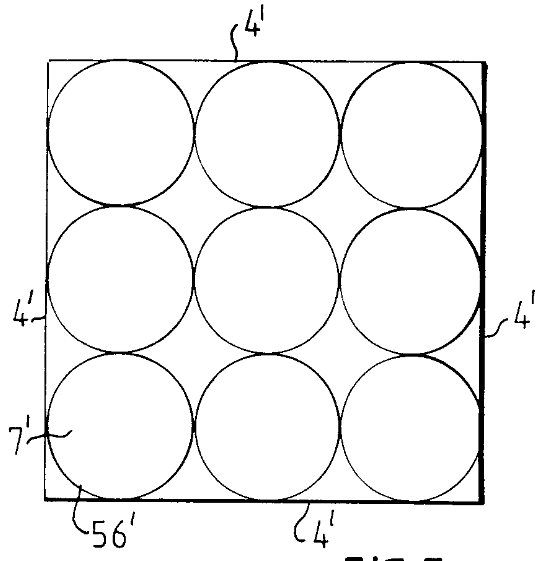
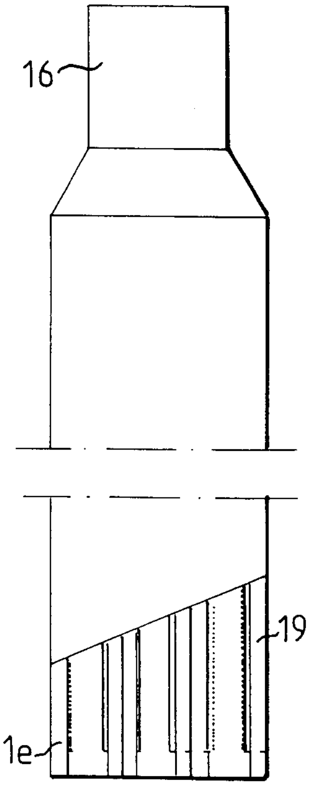


FIG.5



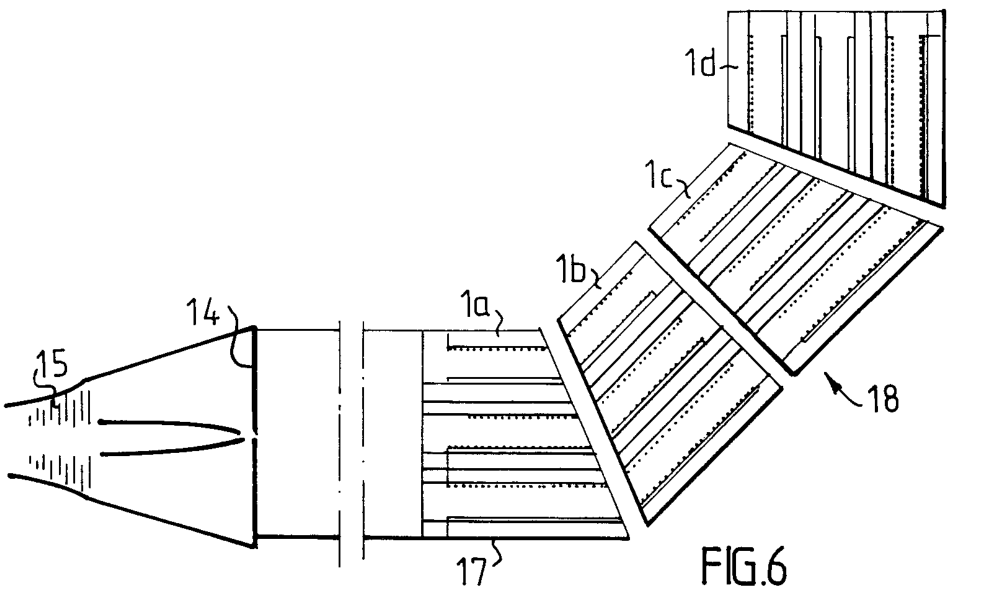


FIG.6

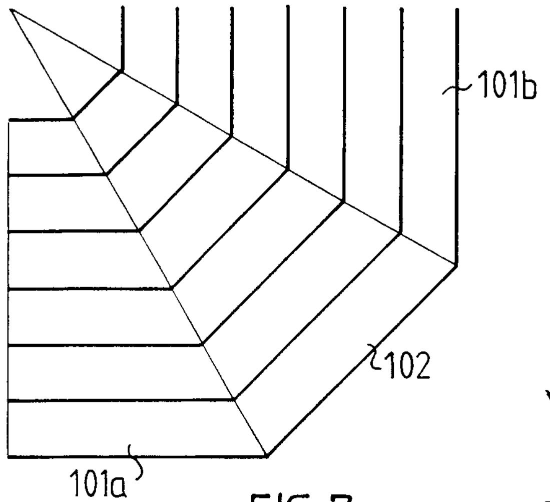


FIG. 7

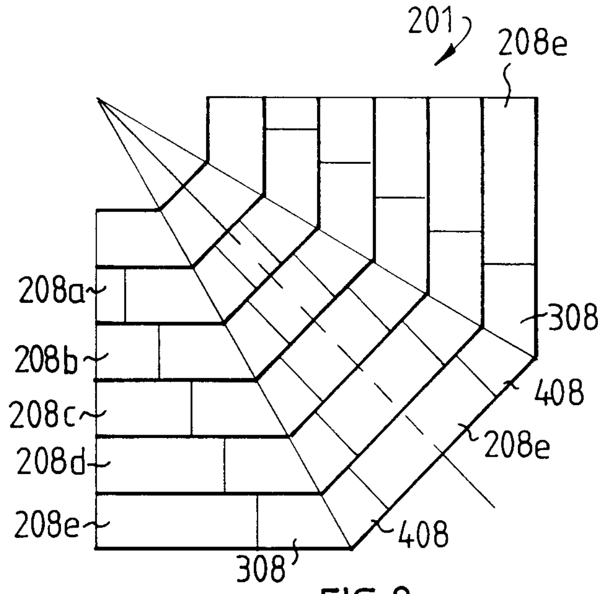


FIG. 8

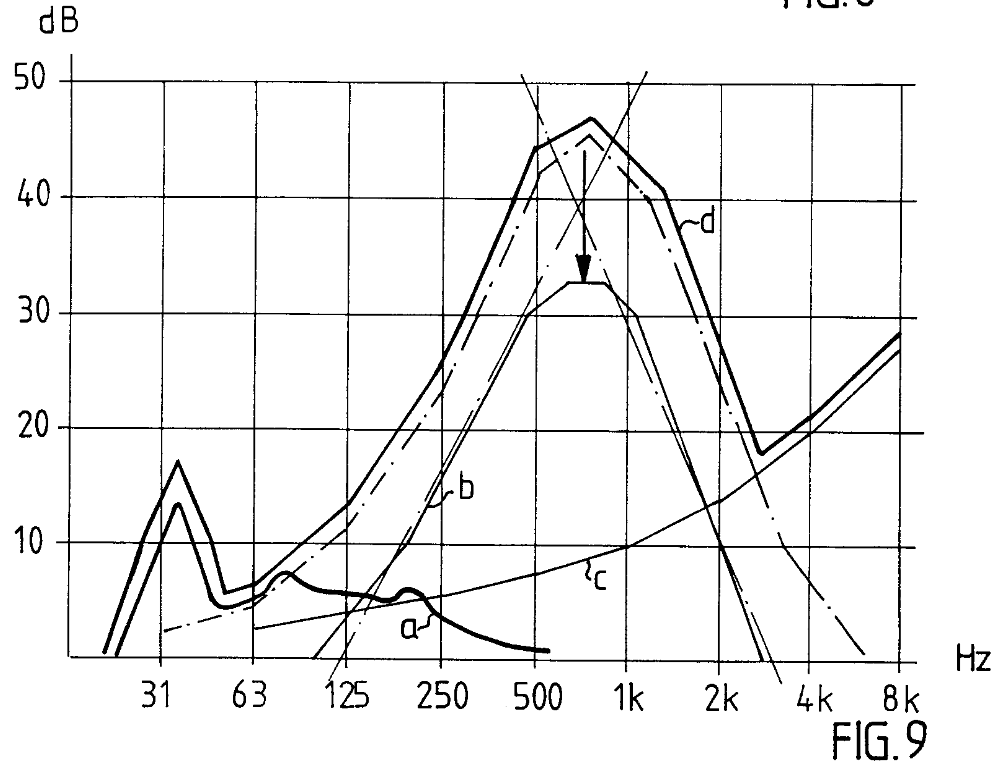


FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/02461

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F01N 1/04 // F02C 7/24
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: F01N, F02C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3602333 A (SHUNJI KOBAYASHI ET AL), 31 August 1971 (31.08.71), column 3, line 73 - column 4, line 41, figures 4-6, abstract --	1-21
A	US 4753319 A (VINCIGUERRA), 28 June 1988 (28.06.88), abstract --	
A	US 3726359 A (DIERL ET AL), 10 April 1973 (10.04.73), figures 1-9, abstract --	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 March 2001	22-03-2001
Name and mailing address of the ISA Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Dan Ionesco Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 00/02461

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 3739872 A (MCNAIR), 19 June 1973 (19.06.73), figures 1-4, abstract --	
A	WO 9935378 A1 (SILENTOR NOTOX A/S), 15 July 1999 (15.07.99), figures 1-4, abstract -- --------	

INTERNATIONAL SEARCH REPORT
Information on patent family members

05/02/01

International application No.
PCT/SE 00/02461

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		EP 1060328 A	20/12/00