**Title**: DAMPER FOR VENTILATION SYSTEMS

**Abstract**: The invention pertains to a damper disposed to regulate an air flow opening for passage of an air flow in a ventilation duct, and a ventilation system comprising such a damper. The damper comprises a disk and a mounting part, the mounting part is disposed to mount the damper in the ventilation duct, whereupon the air flow opening is formed between the inside of the ventilation duct and the periphery of the disk, and the disk is disposed to be movable between an opened and a closed position in order to regulate the size of the air flow opening. The disk is characterized in that the disk has an extension in the plane of the disk, the damper contains an air-permeable material, the air-permeable material is mounted on the disk, at least at the periphery of the disk, a portion of the air-permeable material extends past the edge of the disk with a length in the plane of the disk being at least 5% of the extent of the disk and it is designed to be located in the air flow opening when the damper is arranged in the ventilation duct.

**Diagram**: [Diagram of damper for ventilation systems]
DAMPER FOR VENTILATION SYSTEMS

TECHNICAL FIELD

Ventilation of residences, buildings and other structures containing both supply and exhaust air ventilation.

PRIOR ART

Ventilation systems commonly occurring in structures, especially in rooms such as bedrooms and bathrooms, often contain a ventilation duct to one end of which a fan is connected. At the other end, one or more ventilation devices or dampers are arranged. One or more dampers and plenum boxes are arranged in the ventilation duct and the ventilation system in order to regulate the air flow at various points along the ventilation duct. This ventilation duct often extends over several different rooms in the building for ventilation of these rooms. The damper is often controllable in the ventilation duct, and it provides an adjustable air flow opening in conjunction with the ventilation duct, by which the air flow through or past the damper and through or between the ventilation duct and outside rooms can be regulated. Since the damper is connected to the ventilation duct, the air flow in and out of the ventilation duct can be regulated by changing the size of the air flow opening through an adjusting of the damper's position in the ventilation duct.

The air flow through a ventilation system depends on factors such as the fan's power, dimensions of the ventilation duct, and the damper's position which regulates the size of the air flow opening. By the ventilation duct dimension is meant here its cross sectional area. When the ventilation system contains one or more ventilation diffusers and dampers there are generally adjusted so that the different ventilation diffusers and dampers have different sizes for the corresponding air flow opening in order to adjust in this way the pressure distribution in the ventilation system. By adjusting the air flow opening for the different ventilation diffusers and dampers, unnecessary high pressure can be throttled away. In this way, a predetermined air flow can be provided through the respective ventilation diffuser and damper, i.e., a desired degree of ventilation can be achieved in all the rooms in which one or more ventilation diffusers are arranged, or in various parts of the ventilation system. Too low an air flow means inadequate ventilation, while too high an air flow means increased energy expenses.
The air flow, i.e., the quantity of supply air or exhaust air, is generally set by the customary practice, depending on the dimensions of the ventilation duct. In order to achieve this air through flow, a certain pressure distribution is required in the ventilation system.

One problem with these systems is that they produce noise, which can be experienced as a nuisance. Therefore, limit values exist for these ventilation systems on the maximum recommended level of sonic power. Sound is produced in particular by air flow through openings to the surroundings, but also in openings past dampers placed inside ventilation ducts, which openings are air flow openings.

The limit values on the allowed level of sonic power produced at such air flow openings place limits on how large a pressure drop can be produced across dampers, i.e., what degree of opening the respective damper can have. This also places limits on the air flow which can be achieved through the damper.

As mentioned above, a ventilation system normally contains a plurality of dampers but also ventilation diffusers at various distances from the fan. Since the pressure generated by the fan is lowest at the damper/ventilation diffuser which is situated furthest away from the fan, this damper/ventilation diffuser is adjusted at maximum opening, i.e., this damper/ventilation diffuser has maximum size of the air flow opening. The pressure required across this damper/ventilation diffuser in order to create a specified air flow determines the operating conditions of the fan. In order to minimize the energy consumption, the pressure drop should be as low as possible.

At the same time, a specified air flow also needs to be obtained across other dampers and ventilation diffusers which are placed closer to the fan and thus experience a higher pressure from the fan. Thus, a certain degree of throttling of the pressure across the respective dampers and ventilation diffusers, or a certain degree of pressure drop is required, so that the specified air flow is neither too high nor too low. But the recommended highest level of sonic power sets bounds on how much pressure can be throttled across a damper, on account of the sound produced by air flow through and past the damper and/or the ventilation diffuser. As shall be described in further detail below, factors such the size of the damper's air flow opening, the damper's dimensions, and the size of an air flow through it influence the level of sonic power which is generated in the damper when air flows through it. Therefore, the degree of throttling of the pressure at a damper which can be achieved at maximum across a damper, without exceeding the recommended highest level of sonic power, should be as high as possible in order
to achieve effective ventilation through the entire ventilation system. Thus, taken together, these factors set limits on the ventilation system.

A ventilation system for air supply ventilation has been described above. The same holds accordingly for air exhaust ventilation.

SUMMARY OF THE INVENTION

One purpose of the invention is to provide a damper and a ventilation system which solves or at least diminishes the aforementioned problems.

The above purpose is accomplished with the aid of a damper and a ventilation system according to the respective independent claims, with preferred variants as defined in the respective subclaims.

The damper according to the invention is used to regulate the flow in ventilation ducts. More specifically, the invention pertains to a damper for regulating of an air flow opening for passage of an air flow in a ventilation duct. The damper is arranged in the ventilation duct so that an air flow opening is formed between an inside of the ventilation duct and the damper in which air flow opening the air can pass through the damper.

The damper according to the invention is disposed in the ventilation duct such that an air flow opening is formed between an inside of the ventilation duct and the damper in which air flow opening the air can pass through the damper substantially across the plane of the damper when the damper is designed to be displaced and/or when it is displaced within the ventilation duct or when the damper, such as a pivoting damper, is located in a substantially closed position inside the ventilation duct.

The damper according to the invention is disposed in the ventilation duct such that an air flow opening is formed between an inside of the ventilation duct and the damper in which air flow opening the air can pass through the damper substantially in parallel with the plane of the damper when the damper, such as a pivoting damper, is located in a substantially opened position inside the ventilation duct.

The placing of an air-permeable material in the air flow opening has proven to be surprisingly effective at reducing or even eliminating the occurrence of noise while at the same time preserving the desirable ventilation properties. The air-permeable material and its placement in the air flow opening contribute to reducing or even preventing the formation of turbulence. The
air-permeable material placed in the air flow opening counteracts the occurrence and also reduces vibrations and generation of unwanted sound which can otherwise be formed in the damper.

Moreover, the air-permeable material which is placed in the air flow opening contributes to reducing the turbulence and thus vibrations and occurrence of noise which is otherwise formed in the damper and further propagated in the ventilation system. The air-permeable material which is placed in the air flow opening reduces the turbulence and vibrations and lessens the occurrence of noise in the damper upon inflow and outflow of air through the damper, so that unwanted sound is not further propagated in the ventilation system.

By placing the air-permeable material in the air flow opening so that the air flow passes through the air-permeable material, turbulence and vibrations are reduced and the occurrence of noise in the damper upon inflow and outflow of air through the damper is eliminated, so that unwanted sound is not further propagated in the ventilation system, nor does it occur elsewhere in the flow of air through the damper. These benefits and effects are achieved with the damper according to the invention in its characteristic of an air supply diffuser or air exhaust diffuser.

The air-permeable material is disposed so that, when air flows through the air flow opening, at least a portion of the air flow passes through the air-permeable material.

The air-permeable material can be arranged discontinuously along the periphery and/or at least one edge of the damper.

The air-permeable material can be arranged so that it covers the air flow opening at least partly. Measurements have shown that effective soundproofing is achieved even when the filter does not cover the entire air flow opening. The air-permeable material can be arranged so that it covers the air flow opening by at least a part or fraction when the air flow opening/damper is closed to the maximum. The air-permeable material can be configured, e.g., with such a thickness that it covers a certain fraction of the size of the air flow opening. By the size of the air flow opening is meant its size in a direction substantially perpendicular to the intended air flow direction.

The air-permeable material can be arranged so that it covers the air flow opening almost entirely when the air flow opening is closed to the maximum and covers the air flow opening partly when the air flow opening is partly open.
The air-permeable material can be arranged such that it covers the air flow opening almost entirely when the air flow opening/damper is closed to the maximum but leaves a partly open gap between the inside of the ventilation duct and the air-permeable material.

The damper is preferably configured so that the size of the air flow opening is adjustable. In this way, an air flow through the damper can be adjusted. As described above, the pressure drop and air flow in the ventilation system are determined by factors such as the fan power and the dimensions of the ventilation duct. By adjusting the size of the air flow opening, the pressure across the damper can be throttled, and the pressure distribution in the ventilation system can be adjusted to obtain an effective ventilation in all rooms connected to the ventilation system.

The size of the air flow opening can be adjusted continuously or in steps between a maximum open position and a closed position and values lying in between. When the air flow opening is in a closed position, substantially no air flow can occur through the damper. When the air flow opening and/or the damper are in a closed position, a slight/marginal/predetermined air flow can also be allowed to occur through the damper. At the maximum open position, the air flow opening has its maximum size. How large the air flow opening is in the maximum open position depends on the specific design of the damper. In particular, this value is determined by the dimension of the ventilation duct to which the damper is designed to be connected.

The damper achieves a reduction in the noise production, or possibly a soundproofing through the air-permeable material. The air-permeable material, which for example can be a fibrous material, preferably containing fibers made of PET (polyester), is preferably porous. When air flows through the air-permeable and porous material, the air current is dispersed on account of the porosity of the material.

The velocity of an air flow, or an air current, through the air-permeable material is determined by the resistance which the air flow encounters upon passing through the air-permeable material. This resistance is affected by how long a path through the material the air must travel, as well as the degree of porosity of the material. The longer the path of the air through the air-permeable material, the lower its velocity.

The air flow velocity profile, taken in cross section across the material and in a direction substantially perpendicular to the air flow direction, will thus depend at each point on the length of the section traveled by the air flow through the air-permeable material. The velocity profile thus presents lower velocities the longer the path traveled by the air flow through the material.
An air-permeable material arranged in the air flow opening therefore contributes to creating an advantageous velocity profile for the air flow through the damper, in regard to reduced sonic power level. This reduces, but also eliminates the occurrence of noise effectively, while at the same time achieving desirable ventilation qualities.

The air-permeable material arranged in the air flow opening reduces and prevents the formation of turbulence. The air-permeable material arranged in the air flow opening reduces and also counteracts and reduces the occurrence of vibrations in the damper. Air-permeable material arranged in the air flow opening reduces and prevents the generation of unwanted sound in and because of the damper. The air-permeable material reduces but can also totally eliminate the occurrence of turbulence which can create noise in the damper and prevents any unwanted sound from being further propagated in the ventilation system.

The air-permeable material can preferably contain a fibrous material. Such a fibrous material can be a material whose fibers are made of PET. The porous air-permeable material can consist, for example, of a filter material, such as a coarse filter of class G3 or G4, but also other material which has high porosity and good air permeation capability is possible, such as foam or molded structures. Preferably, a material with even higher porosity than the coarse filters mentioned above can be used. It has also been found that the more fine the fiber threads, the better the soundproofing achieved.

The air-permeable material can contain substantially radially arranged bristles, where the air is allowed to pass between the individual bristles. The air-permeable material according to this aspect can have various sizes, various thicknesses of bristle, and various density between the bristles in order to achieve the desired effect of the air-permeable material in the ventilation system. These bristles are arranged in corresponding manner in the air flow opening as the air-permeable material.

Furthermore, the soundproofing qualities are affected by the thickness and/or the configuration of the porous air-permeable material. The pressure drop across the air-permeable material is affected by factors such as the material thickness and its degree of porosity. A thin disk of an air-permeable material with low porosity can therefore produce a pressure drop comparable with a thicker disk of an air-permeable material with high porosity. It has been shown that especially good soundproofing qualities can be achieved with an air-permeable material with relatively high porosity and a thickness such as covers at least the larger portion of the air flow opening.
The air-permeable material can be deformable, and it can be arranged to be at least partly deformed in relation to the size of the air flow opening. When the air-permeable material is arranged to at least partly cover the air flow opening when closed, it will consequently be deformed in response to essentially every change in size of the air flow opening. The air-permeable material is deformed when the size of the air flow opening is less than the thickness of the air-permeable material in the plane of the damper. The thickness of the air-permeable material is defined here as a dimension of the air-permeable material substantially across the direction of the air flow when the damper, being a pivoting damper, is substantially closed. The air-permeable material is then deformed when the size of the air flow opening is less than the height of the air-permeable material in the plane of the damper. The height of the air-permeable material is defined here as a dimension of the air-permeable material substantially across the direction of the air flow when the damper, being a pivoting damper, is substantially closed. The air-permeable material is deformed when the size/internal diameter of the ventilation duct is less than the extension of the damper when the damper, being a pivoting damper, is substantially closed.

The damper described here with air-permeable material can also be mounted in existing ventilation systems. It can be installed in a ventilation system designed for constant flow, or in a system designed for adjustable fans.

The damper according to the invention is disposed to regulate an air flow opening for passage of an air flow in a ventilation duct. The damper comprises a disk and a mounting part, the mounting part is disposed to mount the damper in the ventilation duct, whereupon the air flow opening is formed between the inside of the ventilation duct and the periphery of the disk, and the disk is disposed to be movable between an opened and a closed position in order to regulate the size of the air flow opening. This disk has an extension in the plane of the disk, the damper contains an air-permeable material, the air-permeable material is mounted on the disk, at least at the periphery of the disk, a portion of the air-permeable material extends past the edge of the disk with a length in the plane of the disk being at least 5% of the extent of the disk and it is designed to be located in the air flow opening when the damper is arranged in the ventilation duct.

With an air-permeable material which extends past the outer non-air permeable edge of the disk and in the air flow opening and which has at least a length making up 5% of the extent of the disk, i.e., 5% of its diameter in the case of round disks, 5% of its width or height in the case of...
rectangular disks, the air-permeable material affects the air flow at the edge of the disk and decreases the pressure drop at the edge of the disk. Since the pressure drop is decreased, the occurrence of sound is also diminished. Because the air-permeable material is arranged to affect the air flow in a relatively large portion of the air flow opening, it brings the advantage that the pressure drop and thus the production of sound is diminished more than if an air-permeable material were only arranged precisely at the edge of the disk.

According to one aspect, the air-permeable material can contain bristles. The bristles ensure that the air-permeable material can extend relatively far beyond the disk and at the same time exhibit good air-permeable qualities which diminish the pressure drop at the edge of the disk. The bristles have a stiffness in their lengthwise component so that they can extend into the air flow opening at the same time as being flexible in the air flow direction and reducing the pressure drop at the edge of the disk.

According to one aspect, the bristles can extend from the disk in the plane of the disk, which means that they can be mounted in an effective way on the disk.

According to one aspect, said length can be at least 10% of the extension of the disk, which means that the air-permeable material can influence a larger portion of the air flow and influence it for a longer time and thereby reduce the pressure drop and production of sound even more.

According to one aspect, said length can be at least 15% of the extension of the disk, which means that the air-permeable material can influence a larger portion of the air flow and influence it for a longer time and thereby reduce the pressure drop and production of sound even more.

According to one aspect, said length is designed to correspond to the size of the air flow opening in its closed position, which means that the air-permeable material can influence the air flow for a longer time and thereby reduce the pressure drop and production of sound even more.

According to one aspect, the air-permeable material can be mounted on the disk such that when it is arranged in the air flow opening the air flow passes through said portion of the air-permeable material when the damper is disposed in a position between the opened and closed position.
According to one aspect, the air-permeable material can be mounted on the disk such that the air flow in the air flow opening passes entirely through the air-permeable material when the damper is arranged in the closed position.

According to one aspect, the air-permeable material can be mounted on the disk such that the air flow in the air flow opening does not pass through the air-permeable material when the damper is arranged in the opened position.

According to one aspect, the air-permeable material can be mounted on the edge of the disk.

According to one embodiment, the size of the air flow opening can be designed to be regulated when the disk of the damper pivots in the ventilation duct.

According to one embodiment, the size of the air flow opening can be designed to be regulated when the disk of the damper is displaced inside the ventilation duct.

According to one embodiment, the disk can be round and the damper can be designed to interact with a ventilation duct with a circular cross section.

According to one embodiment, the extension of the air-permeable material inside the ventilation duct is adapted to at least partly cover the periphery of the damper's disk.

According to one embodiment, the extension of the air-permeable material inside the ventilation duct is adapted to at least partly cover the periphery of the disk.

According to one embodiment, the size and/or shape of the air-permeable material is adapted to at least partly cover the periphery of the damper's disk.

According to one embodiment, the size and/or shape of the air-permeable material is adapted to at least partly cover the outer region of the extension before the damper's disk.

According to one aspect, the shape of the air-permeable material can correspond to the shape of the edge and/or periphery of the disk.

According to one embodiment, the placement of the air-permeable material inside the ventilation duct is either upstream or downstream or both in relation to the disk of the damper looking in the direction of the air flow.

According to one aspect, the invention pertains to a ventilation system comprising at least one damper according to any one of the preceding embodiments and a ventilation duct as well as a
fan connected to the ventilation duct and disposed so as to create an air flow through the air
flow opening past the damper's disk and through the ventilation duct.

According to one aspect, the size of the air flow opening can be continuously or stepwise
adjusted between a maximum opened and a closed position as well as values lying in between.

According to another aspect, the size of the air flow opening depends on the position of the disk
in relation to the ventilation duct.

The air-permeable material can be arranged in a number of different ways in the damper in
order to influence a velocity profile in the air flow opening so that a sound reducing effect is
achieved. Typically, at least a potion of the air-permeable material can be arranged at the
periphery of the damper or the damper's disk so that the outermost portion of the disk facing
the air flow opening contains air-permeable material.

According to one aspect, the air-permeable material can be arranged as a disk of air-permeable
material arranged in parallel with a disk, either before or after the disk in the air flow direction,
and the material extends radially in the air flow opening. The portion of such a disk of air-
permeable material which lies against a disk surface or surfaces can in other embodiments
comprise a perforation or perforations.

According to one aspect, a margin of a disk can comprise a groove or recess such as a rim for
easy mounting of wedging of an air-permeable material, which can be ring shaped.

According to one aspect, the air-permeable material can be arranged between two disks of the
same or different diameter while the air-permeable material can have a diameter which is
greater than the two damper disks.

According to one aspect, the disk has a thickness wherein the air-permeable material can extend
around at least one corner of the outer edge of the disk, e.g., from/to the front side of the disk or
from/to the back side of the disk.

According to one aspect, the disk has a thickness wherein the air-permeable material can extend
around/across the corner and/or the corner at the outer edge of the disk and/or edges from the
front side of the disk to the back side of the disk or vice versa.

According to all aspects, the air-permeable material can have elastic properties and/or the air-
permeable material can contain an elastic component or part.
According to one aspect, according to the invention the size of the air flow opening can be regulated when the disk of the damper is displaced within the ventilation duct and transversely to the longitudinal direction of the ventilation duct.

According to one aspect, a disk can also be perforated so that a predetermined basic flow/throttling of the air through the ventilation duct is always allowed to exist even when the damper is substantially entirely closed or entirely closed with no gap or with a partly open gap between the inside of the ventilation duct and the disk of the damper.

DESCRIPTION OF FIGURES

Figure 1 shows a schematic view of a ventilation system.

Figure 2 shows schematically a damper of the prior art.

Figure 3 shows schematically a damper per an embodiment according to the invention.

Figure 4a shows an embodiment according to the invention with circular damper.

Figure 4b shows a perspective view of an embodiment according to the invention with circular damper.

Figure 5a shows an embodiment according to the invention with square damper.

Figure 5b shows schematically a embodiment according to the invention with square damper.

Figure 6a shows a cross section of an embodiment with single air-permeable material.

Figure 6b shows a cross section of an embodiment with double air-permeable material.

Figure 7a shows a cross section of part of an embodiment according to the invention.

Figure 7b shows a cross section of part of an embodiment according to the invention.

Figure 7c shows a cross section of part of an embodiment according to the invention.

SPECIFICATION OF EMBODIMENTS

Figure 1 illustrates schematically a ventilation system 1 of a type commonly occurring in various buildings, as described in the introduction. The ventilation system 1 comprises a
ventilation duct 2 to which a plurality of ventilation dampers 10 are connected. The ventilation dampers 10 as shown in Fig. 2 can be arranged at various positions along the ventilation duct 2 in which an air flow 30 is streaming. The ventilation duct 2 as illustrated in Fig. 1 can have one or more branches to which one or more ventilation dampers 10 and air diffusers 4 can be connected. The ventilation system 1 also comprises a fan 17. The fan 17 is designed to generate a pressure in the ventilation system, so that forced ventilation can be achieved. The ventilation system 1 as illustrated in Fig. 1 can be installed in buildings, e.g., residences, and the ventilation duct 2 can extend across several rooms for ventilation of these rooms. It can be a supply air ventilation or an exhaust air ventilation.

Figure 2 illustrates a ventilation damper 10 of the prior art. The ventilation damper 10 comprises a disk which is arranged in a ventilation duct 2. The damper 10 is adjustably disposed in relation to the ventilation duct 2 and an air flow 30, so that the size of an air flow opening 7 can be adjusted. As described above, an air flow through the ventilation damper 10 can be adjusted by adjusting the size of the air flow opening 7. As illustrated in Fig. 1, the ventilation damper 10 can be mounted directly in a ventilation duct 2, whose opening emerges from a wall or a ceiling. The ventilation duct has an inside 3 and the air flow 30 can move in a direction illustrated by an upper continuous black arrow and in an opposite direction illustrated by a lower broken white arrow.

Figure 3 illustrates a damper 10 designed to produce soundproofing as compared to the above-described known ventilation damper 10. The damper 10 comprises a disk 11, an air-permeable material 29 and a mounting part 18. The disk 10 is connected to the mounting part 18. The mounting part 18 is designed to mount the damper 10 in the ventilation duct 2. The damper 10 is designed to be connected to a ventilation duct 2, as described above for the known ventilation damper 10. The damper 10 can be used in various types of ventilation system 1. For example, it can be connected to a ventilation system of the type illustrated in Fig. 1. It can be connected to existing ventilation systems. The damper 10 can be a supply air damper or an exhaust air damper. When the damper 10 is mounted on a ventilation duct 2, an air flow opening 7 is formed, which is part of the flow duct through the damper 10, which is located between the inside 3 of the ventilation duct and the disk 11 of the damper.

The damper 10, which is also illustrated in Fig. 3-6b, contains substantially elements corresponding to those described above with regard to the known damper illustrated in Fig. 2. The damper 10 according to the invention on the other hand also contains an air-permeable
material 29, which is arranged in the air flow opening 7 in order to achieve soundproofing. This damper 10 will be described in further detail in regard to Fig. 3-5.

Fig. 4b and Fig. 5b show exploded views of the damper 10 according to two embodiments of the invention. The damper 10 contains a disk 11 and a porous air-permeable material 29. The disk 11 can be viewed as an air duct defining element, where an air flow opening 7 is formed between an edge/periphery/corner/region 12 containing at least one corner/edge/periphery 12a/12b of the disk and at least a portion of the inside 3 of the ventilation duct. The design of the damper comprising a disk 11 will therefore affect the air flow through the damper 10, both in regard to air flow resistance and acoustical properties.

When a damper 10 is arranged in the ventilation duct 2, an air flow opening 7 will be formed between the inside 3 of the ventilation duct and the edge 12a of the disk 11. The disk 11 is adjustably arranged relative to the ventilation duct 2, so that the size of the air flow opening 7 is adjustable.

The damper's disk 11 is advantageously circular or circular-cylindrical in configuration. The disk 11 can also be asymmetrical, quadrangular, e.g., square or rectangular, but also a polygon with more or fewer than four corners. It has preferably an outer diameter less than an inner diameter of a ventilation duct 2 where it will be installed. The damper 10 can thus be designed for direct mounting in a ventilation duct 2. Since there are standard dimensions for ventilation ducts, the damper 10 can be designed with corresponding standard dimensions. To facilitate the direct mounting in a ventilation duct, the damper 10 can be provided with a mounting part 19 of the prior art.

In one example, the damper 10 comprises a round disk 11 with a diameter d of 100 mm and the air-permeable material extends at least 5 mm past the edge 12, 12a of the disk 11.

In one example, the damper 10 comprises a quadrilateral disk 11 with a width s of 100 mm and a height s' of 200 mm and the air-permeable material 29 extends at least 5 mm past the edge 12, 12a along the width s of the disk 11 and at least 10 mm past the height s' of the disk 11.

Fig. 4a and 5a illustrate the damper 10 in cross section or in plan projection. As can be seen from the illustrations, the air-permeable material 29 is arranged such that when air flows through the air flow opening 7 at least a portion of the air flow passes through the air-permeable material 29. The air-permeable material 29 is arranged so as to at least partly cover the air flow.
opening 7. In the embodiment per Fig. 3, the air-permeable material covers substantially the entire air flow opening 7.

The air-permeable material 29 is mounted on the disk 11 at least at the periphery 12, 12b of the disk 11. The air-permeable material 29 is mounted on the disk such that a portion 19 of the air-permeable material 29 extends past the edge 12, 12a of the disk 11 with a length X, X’ in the plane of the disk 11 which is at least 5% of the extension d, s, s’ of the disk 11 and is designed to be located in the air flow opening 7 when the damper is arranged in the ventilation duct 2. The length X, X’ of the portion 19 of the air-permeable material 29 which extends outside of the disk 11 is thus at least 5% of the disk diameter in the case of round disks and at least 5% of its width or height in the case of quadrilateral disks.

According to one aspect, the air-permeable material 29 is mounted in this way at the edge 12, 12a of the disk 11.

The air-permeable material 29, according to one aspect, can comprise bristles. The bristles can be arranged so that the bristles extend from the disk 11 in the plane of the disk 11.

According to one aspect, said length X, X’ can be at least 10% or at least 15% of the extension d, s, s’ of the disk 11. According to one aspect, said length X, X’ can correspond to the size of the air flow opening 7 in its closed position.

The air-permeable material 29 is designed to make up at least a portion of the air flow opening 7. The air flow opening 7 has the form of a peripheral gap between the inside 3 of the ventilation duct and the disk 11. The air-permeable material 29 is designed to cover at least partly the air flow opening gap 7 between the inside 3 of the ventilation duct and the disk 11. The air flow opening 7 has the form of a peripheral gap between the inside 3 of the ventilation duct and the periphery 12b of the disk. The air-permeable material 29 is designed to cover at least partly the air flow opening gap 7 between the inside 3 of the ventilation duct and the periphery 12b of the disk when the damper is disposed in its closed position or between the closed and opened position. The air flow opening 7 has the form of a peripheral gap between the inside 3 of the ventilation duct and the edge 12a of the disk. The air-permeable material 29 is designed to cover at least partly the air flow opening gap 7 between the inside 3 of the ventilation duct and the edge 12a of the disk. The air-permeable material 29 is placed in the gap of the air flow opening 7.
The edge/periphery 12a/12b of the disk can have a rectangular or arched, preferably a convex rounded form, substantially with no sharp edges. The size of the air flow opening is defined as the least distance between the inside 3 of the ventilation duct and the disk 11. In the sample embodiment of Fig. 3, this size is defined as the perpendicular distance between the inside 3 of the ventilation duct and the closest situated portion of the edge 12a which can be rounded. It is possible to employ air-permeable material of different thickness. Fig. 6a-b illustrate an air-permeable material 29 substantially in the form of a disk, e.g., according to the form illustrated in Fig. 4a-b and 5a-b. The air-permeable material 29 in other embodiments can substantially take on the shape of a ring whose size and extension basically correspond to the disk illustrated in Fig. 4-6. Alternatively, an air-permeable material 29 can have a shape where the peripheral ring 29 has a size and extension basically corresponding to the disk illustrated in Fig. 4-6. The air-permeable material can be configured and arranged so that it covers the air flow opening 7 by at least a portion or fraction when the air flow opening 7 is closed to the maximum. It can advantageously be arranged so that it basically covers the air flow opening 7 entirely when the air flow opening is closed to the maximum, as illustrated in Fig. 3. It can advantageously be arranged so as to produce a gap along at least a portion of the air flow opening 7 when the air flow opening is closed to the maximum, through which gap a minimal air flow can always move during operation of the ventilation system. This is accomplished in that the air-permeable material 29 has a portion which extends past the edge of the disk and which extends across the entire or a portion of the size of the air flow opening. The air-permeable material does not necessarily need to be equally thick and/or have the same height throughout, but instead it can have varying thickness and/or height. The air-permeable material also does not necessarily need to have the same porosity throughout, but instead it can have varying porosity.

In the embodiments illustrated in Fig. 3 and Fig. 4a-4b and Fig. 5a-5b, the air-permeable material 29 is arranged on one side of the disk. When an air flow 30 moves through the damper 10, at least a portion of this air flow will pass through the air-permeable material 29 on its way through the damper 10. If one considers the air flow's velocity profile across the air flow opening 7, the air-permeable material will contribute to giving the air flow a lower velocity across the edge 12a of the disk.

A rounded form of the corner/edge 12/12a of the disk and/or the air-permeable material can further influence the air flow velocity, where the rounded edges will give rise to a gradual acceleration of the air flow 30 when it arrives against the rounded edge and a gradual velocity decrease in the air flow 30 after the rounded edge. This reduces the level of eddies and
turbulence in the air flow 30. The air-permeable material 29, and also the rounded form of the
air-permeable material 29, will therefore contribute to creating a velocity profile of the air flow
through the duct 2 which is favorable to the sonic power level, by reducing the velocity of the
air flow near the surfaces in the damper 10.

As described above, the size of the air flow opening can be adjusted, by which an air flow 30
through the damper 10 can be adjusted. The size of the air flow opening 7 is continuously or
stepwise adjustable between a maximum open position and a closed position as well as values
lying in between. The damper 10 can be designed so that the size of the air flow opening cannot
be adjusted to more than a maximum open position, i.e., the maximum distance between the
inside 3 of the ventilation duct and the edge 12a of the disk has been reached and the damper 10
cannot be further opened. In the fully closed position, the least possible distance between the
inside 3 of the ventilation duct and the edge 12a of the disk has been reached. In the open
position, essentially no air flow passes through the air-permeable material 29 when the air flow
opening 7 has its maximum/largest size.

According to one aspect, the air-permeable material can be mounted on the disk such that when
it is arranged in the air flow opening, the air flow passes through said portion of the air-
permeable material when the damper is disposed in a position between the opened and closed
position.

According to one aspect, the air-permeable material can be mounted on the disk such that the
air flow in the air flow opening passes entirely through the air-permeable material when the
damper is arranged in the closed position.

According to one aspect, the air-permeable material can be mounted on the disk such that the
air flow in the air flow opening 7 does not pass through the air-permeable material 29 when the
damper 11 is arranged in the opened position. In the opened position, the edge 12, 12a of the
disk 11 is directed toward the air flow so as not to hinder or affect the air flow. The air-
permeable material 29 extends in this position in the direction of the air flow.

According to one aspect, the air-permeable material 29 can be mounted at the edge 12, 12a of
the disk 11. The air-permeable material 29 extends from the edge 12, 12a of the disk 11 and
into the air flow opening 7.

The air-permeable material 29 is arranged so that air in an air flow 30 through the damper 10 is
dispersed. This can be realized by the porosity of the air-permeable material. The air-permeable
material 29 is moreover preferably made of a fibrous material, where the individual fibers are substantially randomly oriented. The porous air-permeable material 29 can moreover preferably be a fibrous material where the individual fibers are substantially oriented in one direction. The air-permeable material 29 can moreover preferably be a fibrous material where the individual fibers are in part randomly and in part directionally oriented. This helps to distribute and disperse an air current flowing through the air-permeable material 29, and thereby influence the sound pattern produced upon air flow through the damper 10.

The air-permeable material 29 can be deformable, and it can be arranged to be at least partly deformed in relation to the size of the air flow opening 7. This is especially advantageous when the porous air-permeable material 29 has a thickness such that it covers the entire air flow opening 7 when it is open to the maximum, i.e., when the damper 10 is entirely opened and the air flow opening 7 has its maximum/largest size. The air-permeable material 29 can contain substantially radially arranged bristles.

The presence of a porous air-permeable material 29 thus broadens the working range for the ventilation system 1, and especially the damper 10 according to the invention, so that a suitable pressure distribution can be adjusted in the ventilation system 1 at the same time as a specified air flow is achieved and the standards for sonic power levels are not exceeded.

Figure 7a-c show a number of further embodiments of the invention in which the air-permeable material 29 is mounted on the edge 12a of the disk 11 and is tangentially projecting from the edge 12a of the disk. Other geometries or combinations of the embodiments illustrated in Fig. 7a-7c, 4a-4b, 5a-5b are also conceivable. What is common to all embodiments is that the thickness of at least the portion of the air-permeable material 29 which is arranged in the air flow opening 7 can be adapted so as to cover substantially the entire or a portion of the size of the air flow opening. Alternatively or in addition to a mechanical fastening via clamping of the air-permeable material 29 against the side of the disk, the air-permeable material can be fastened to the damper 10 by adhesive material, for example. Figure 7a shows an edge/periphery/corner/region 12 with dashed lines containing an edge/periphery 12a/12b. Figure 7b shows an edge/periphery/corner/region 12 with dashed lines containing two edges/peripheries 12a/12b. Figure 7c shows an edge/periphery/corner/region 12 with dashed lines containing an edge/periphery 12a/12b corresponding to the embodiment in Figure 7a. The air-permeable material 29 can extend across/along at least a portion of a periphery 12b, as in Figures 6a, 6b and 7b. The air-permeable material 29 can extend across/along at least a portion
of at least one edge 12a, as in Figures 7a-c. The air-permeable material 29 can extend across two corner regions 12 and across/along at least one portion of the edge 12a and at least partly across/along each of the two peripheries 12b as in Figure 7b. The air-permeable material 29 can extend across at least a portion of a periphery 12b, as in Figure 6a, and at least partly across two peripheries 12b, as in Figure 6b. The air-permeable material 29 can extend from the edge 12a.

As shown in Fig. 4a, the air-permeable material 29 can have the form of a circular disk. Such a configuration makes possible a mechanical fastening of the air-permeable filter as described above.

According to one aspect, the form of the air-permeable material 29 can correspond to the form of the edge 12, 12a and/or periphery 12, 12b of the disk. In the event that the disk 11 is a round disk 11, the air-permeable material 29 has the form of a ring. In the event that the disk 11 is a quadrilateral disk 11, the air-permeable material 29 has a quadrilateral form. According to this aspect, the air-permeable material 29 is only situated at the periphery 12, 12b of the disk 11, which means that the occurrence of the pressure drop and noise can be maximized while at the same time achieving a cheap and simple construction. A further advantage of this aspect is that the risk of dirt and particles adhering to the air-permeable material 29 is lessened (since its area is decreased), while at the same time achieving the benefits of decreased occurrence of noise.

In the present, the damper 10 has been described primarily as an air supply damper (supply air flow illustrated in Fig. 1 by solid black arrows at far left and in the upper pipe at far right and with dashed white arrows in the middle pipe/supply air diffuser and in the pipe elbow at far right). However, the technical teaching is equally applicable to exhaust air dampers (exhaust air flow illustrated in Fig. 1 by dashed white arrows at far left and in the upper pipe at far right and solid black arrows in the middle pipe/exhaust air diffuser and in the pipe elbow at far right). A ventilation system for supply air ventilation is specified below. Exhaust air ventilation works in a corresponding way to that mentioned above.

In Figures 1-7c, all dimensions such as those of damper 10 and its component parts are chosen as illustrative nonexclusive examples of conceivable dimensions according to the invention.

Figure 5a-b shows an embodiment according to the invention with square damper 10 containing a disk 11 and air-permeable material 29.

Figure 6a shows a cross section of an embodiment of the damper 10 with single air-permeable material 29 arranged in parallel with a disk 11. In Figure 6a, the air-permeable material 29 is
arranged along one side of the disk 11, but in other embodiments the material 29 can be arranged on either side of the disk 11.

Figures 4a-6a define the size D, S, S' of the air-permeable material 29 which is adapted to at least partly cover the periphery 12b of the damper's disk 11 and/or the outer region of the extension d, s, s' for the damper's disk 11 and/or the edge region 12 of the extension d, s, s' for the damper's disk 11. Figure 6b shows a cross section of an embodiment with double air-permeable material 29 arranged in parallel with a disk 11. Here, two layers of air-permeable material 29 are arranged on the disk 11. One layer of air-permeable material 29 is arranged on the right side/surface of the disk 11 and another layer of air-permeable material 29 is arranged on the left side/surface of the disk 11.

Throughout in Figures 4a-7c the designations with upper case D, S, S' are outer measurements and largest diameters/widths/lengths/measurements/dimensions, while the designations with lower case d, s, s' involve inner measurements and smaller diameters/widths/lengths/measurements/dimensions of the disk. The designations X, X' involve the differences between the above measurements, that is, the length by which the air-permeable material 29 extends past the edge of the disk. Also see the explanations in the following nomenclature.

The ventilation duct 2 as defined is by definition a so-called tight duct, i.e., the ventilation duct 2 in which the invention is used is not air-permeable and has, for instance, no perforations through the envelope surface/thickness of the ventilation duct.
NOMENCLATURE

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<td>Ventilation system</td>
</tr>
<tr>
<td>2</td>
<td>Ventilation duct</td>
</tr>
<tr>
<td>3</td>
<td>Inside of ventilation duct</td>
</tr>
<tr>
<td>4</td>
<td>Air diffuser (air exhaust or supply device)</td>
</tr>
<tr>
<td>5</td>
<td>Air flow opening</td>
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<tr>
<td>6</td>
<td>Damper</td>
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<tr>
<td>7</td>
<td>Disk</td>
</tr>
<tr>
<td>8</td>
<td>Edge/periphery/corner region of disk</td>
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<td>9</td>
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<td>12a</td>
<td>Periphery of disk</td>
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<tr>
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<td>Mounting part</td>
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<td>Measurement/dimension/size in a second dimension on the disk, e.g., in y or x-component.</td>
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<tr>
<td>24</td>
<td>Diameter of the air-permeable material</td>
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<td>25</td>
<td>Difference between measurement/dimension/size/diameter or breadth/width/size at margin/edge/periphery of the disk and the air-permeable material.</td>
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<td>26</td>
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<tr>
<td>27</td>
<td>Measurement/dimension/size in a second dimension on the air-permeable material, e.g., in y or x-component.</td>
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PATENT CLAIMS

1. Damper (10) disposed to regulate an air flow opening (7) for passage of an air flow (30) in a ventilation duct (2), wherein

the damper comprises a disk (11) and a mounting part (18), the mounting part (18) is disposed to mount the damper in the ventilation duct (2), whereupon the air flow opening (7) is formed between the inside of the ventilation duct (2) and the periphery (12, 12b) of the disk (11), and

the disk (11) is disposed to be movable between an opened and a closed position in order to regulate the size of the air flow opening (7), characterized in that

the disk (11) has an extension (d, s, s') in the plane of the disk (11),

the damper (10) contains an air-permeable material (29),

the air-permeable material (29) is mounted on the disk (11), at least at the periphery (12, 12b) of the disk (11),

a portion (19) of the air-permeable material (29) extends past the edge (12, 12a) of the disk (11) with a length (X, X') in the plane of the disk (11) being at least 5% of the extension (d, s, s') of the disk (11) and it is designed to be located in the air flow opening (7) when the damper is arranged in the ventilation duct (2).

2. Damper (10) according to claim 1, wherein the air-permeable material (29) contains bristles.

3. Damper (10) according to any one of claims 1 or 2, wherein the bristles extend from the disk (11) in the plane of the disk (11).

4. Damper (10) according to any one of the preceding claims, wherein said length (X, X') is at least 10% of the extent (d, s, s') of the disk (11).

5. Damper (10) according to any one of the preceding claims, wherein said length (X, X') is at least 15% of the extent (d, s, s') of the disk (11).

6. Damper (10) according to any one of the preceding claims, wherein said length (X, X') is designed to correspond to the size of the air flow opening (7) in its closed position.

7. Damper (10) according to any one of the preceding claims, wherein the air-permeable material (29) is mounted on the disk (11) so that when it is disposed in the air flow opening (7) the air flow passes through said portion (19) of the air-permeable material (29) when the damper (10) is disposed in a position between the opened and closed position.
8. Damper (10) according to any one of the preceding claims, wherein the air-permeable material (29) is mounted on the disk (11) such that the air flow in the air flow opening (7) passes entirely through the air-permeable material (29) when the damper (11) is arranged in the closed position.

9. Damper (10) according to any one of the preceding claims, wherein the air-permeable material (29) is be mounted on the disk (11) such that the air flow in the air flow opening (7) does not pass through the air-permeable material (29) when the damper (11) is arranged in the opened position.

10. Damper (10) according to any one of the preceding claims, wherein the air-permeable material (29) is mounted on the edge (12, 12a) of the disk (11).

11. Damper (10) according to any one of the preceding claims, wherein the size of the air flow opening (7) is designed to be regulated when the disk (11) of the damper pivots in the ventilation duct (2).

12. Damper (10) according to any one of the preceding claims, wherein the disk (11) is round and the damper (10) is designed to interact with a ventilation duct (2) with a circular cross section.

13. Damper (10) according to any one of the preceding claims, wherein the extension (D, S, S') of the air-permeable material (29) inside the ventilation duct (2) is designed to at least partly cover the periphery of the disk (11).

14. Damper (10) according to any one of the preceding claims, wherein the extension (D, S, S') of the air-permeable material (29) inside the ventilation duct (2) is designed to at least partly cover an edge (12, 12a) of the damper's disk (11).

15. Damper (10) according to any one of the preceding claims, wherein the placement of the air-permeable material (29) inside the ventilation duct (2) is either upstream or downstream or both with respect to the damper's disk (11) as seen in the direction of the air flow (30).

16. Damper (10) according to any one of the preceding claims, wherein the shape of the air-permeable material (29) corresponds to the shape of the edge (12, 12a) and/or periphery (12, 12b) of the disk (11).

17. Ventilation system (1) comprising at least one damper (10) according to any one of the preceding claims, a ventilation duct (2) and a fan (17) connected to the ventilation duct and disposed so as to create an air flow through the air flow opening (7) past the damper's disk (11) and through the ventilation duct.
18. Ventilation system (1) according to any one of the preceding claims, wherein the size of the air flow opening (7) is continuously or stepwise adjustable between an opened position and a closed position and values lying in between.

19. Ventilation system (1) according to claim 14, wherein the size of the air flow opening (7) depends on the position of the disk (11) in relation to the ventilation duct (2).
A. CLASSIFICATION OF SUBJECT MATTER

According to International Patent Classification (IPC) or both national classification and IPC

INV. F24F13/06 F24F13/24
ADD.

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F24F

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

Electronic database consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>GB 726 882 A (IAIN MAXWELL STEWART) 23 March 1955 (1955-03-23) abstract; figures</td>
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Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search
27 September 2016

Date of mailing of the international search report
06/10/2016

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