

## DESCRIPTION

TITLE OF THE INVENTION: DISCHARGE HEAD HAVING SILENCING MEANS  
FOR GASEOUS FIRE-EXTINGUISHING EQUIPMENT

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TECHNICAL FIELD

[0001]

The present invention relates to a discharge head that is installed in gaseous fire-extinguishing equipment that uses a fire-extinguishing agent gas, such as nitrogen, carbon dioxide, or a fluorine compound, so as to discharge the fire-extinguishing agent gas into a fire suppression target space. More particularly, the present invention relates to a discharge head for gaseous fire-extinguishing equipment that has a silencing means for reducing noise that occurs when the fire-extinguishing agent gas is discharged.

BACKGROUND ART

[0002]

When gaseous fire-extinguishing equipment that uses a fire-extinguishing agent gas, such as nitrogen, carbon dioxide, or a fluorine compound, is activated for extinguishing fire, the fire-extinguishing agent gas is discharged in a manner that causes the concentration of the fire-extinguishing agent gas in a fire suppression target space to reach the fire-extinguishing concentration in a predetermined period of time.

[0003]

At this time, the fire-extinguishing agent gas is discharged from a discharge head that is installed on a ceiling, wall, or the like in order to discharge the fire-extinguishing agent gas into a fire suppression target space. There are several discharge heads for gaseous fire-extinguishing equipment that have conventionally been widely used. FIG. 13(a) illustrates a discharge head 10A that includes an orifice 20 at an exit portion thereof connected to a pipe through which a fire-extinguishing agent gas is supplied, and directly discharges the fire-extinguishing agent gas through the orifice 20 into a fire suppression target space. FIG. 13(b) illustrates a discharge head 10B that includes an orifice 20 and a conical deflector (deflection member) 50 at an exit portion thereof connected to a pipe through which a fire-extinguishing agent gas is supplied, and discharges the fire-extinguishing agent gas through the orifice 20, and then deflects the fire-extinguishing agent gas by the deflector (deflection member) 50 into a fire suppression target space. FIG. 13(c) illustrates a discharge head 10C that includes an orifice (not illustrated) and a conical tube-shaped horn (diffusion member) 60 at an exit portion thereof, and discharges a fire-extinguishing agent through the orifice, and then diffuses the fire-extinguishing agent by the horn (diffusion member) 60 into a fire suppression target space.

[0004]

Thus, in the conventional discharge heads 10A, 10B, and

10C for gaseous fire-extinguishing equipment, the flow rate of the fire-extinguishing agent gas discharged from the discharge head is limited by the orifice 20 so that a plurality of discharge heads typically provided in a fire suppression target space discharge equal amounts of the fire-extinguishing agent gas. For this reason, it has been known that a high level of noise (specifically, noise of at least 120 dB) is generated when the fire-extinguishing agent gas is discharged from the discharge head.

10 [0005]

Incidentally, the gaseous fire-extinguishing equipment is operated on the premise that there are no people in the fire suppression target space. Therefore, noise (vibrations) generated when the fire-extinguishing agent gas is discharged from the discharge head has conventionally been considered to present no problems and has never been addressed.

[0006]

However, there have recently been findings that evacuation of the fire suppression target space may not be completed before activation of the gaseous fire-extinguishing equipment, that noise generated when the fire-extinguishing agent gas is discharged from the discharge head may have an adverse effect on neighboring people, that noise (vibrations) may cause failure of delicate devices such as information and communication devices. Based on these findings, the present applicant has previously proposed a technique for reducing noise generated when the fire-

extinguishing agent gas is discharged (see, for example, Patent Documents 1 and 2).

#### CITATION LIST

##### 5 PATENT LITERATURE

[0007]

Patent Document 1: Japanese Unexamined Patent Application  
Publication No. 2011-125673

Patent Document 2: Japanese Unexamined Patent Application  
10 Publication No. 2013-169333

#### SUMMARY OF INVENTION

##### TECHNICAL PROBLEM

[0008]

15 The above discharge head having a silencing means for  
gaseous fire-extinguishing equipment that has been proposed by  
the present applicant includes, as the silencing means, a block-  
shaped silencing member made of a porous material that allows  
gas to pass therethrough and that is disposed at an exit portion  
20 of an orifice. This discharge head has a small size and is  
capable of having an improved noise reduction ratio.

[0009]

Incidentally, for discharge heads having a silencing  
means, the porous material used as the silencing means reduces  
25 the flow speed of the fire-extinguishing agent gas during  
discharging, and therefore, the performance of diffusing the

fire-extinguishing agent gas inevitably tends to be lower than that of discharge heads that do not have a silencing function.

As the silencing performance is further improved, the performance of diffusing the fire-extinguishing agent gas decreases. As the diffusion performance is further maintained, the silencing performance becomes lower. Thus, there is a trade-off.

A recent piece of fire-extinguishing equipment that is capable of discharging the fire-extinguishing agent gas for a longer period of time can have a lower flow rate of the fire-extinguishing agent gas than that of commonly used ones. Whereas this fire-extinguishing equipment has advantages such as a smaller pressure relief opening area and a smaller tube diameter, this fire-extinguishing equipment also has a problem that the diffusion performance is reduced due to a lower flow rate of the fire-extinguishing agent gas. This problem becomes significant particularly when the fire suppression target space has a large floor area for its volume, such as an underfloor space. As used herein, the underfloor space refers to a fire suppression target space having a dimension H in the height direction of, for example, as small as about 300 mm compared to typical fire suppression target spaces. An example of the underfloor space is an underfloor space of a server room, such as that illustrated in FIG. 14.

[0010]

With the problems with the discharge head having a

silencing means for gaseous fire-extinguishing equipment in mind, it is an object of the present invention to provide a discharge head having a silencing means for gaseous fire-extinguishing equipment that has improved performance of  
5 diffusing the fire-extinguishing agent gas without a reduction in silencing performance, and therefore, can be effectively used for fire-extinguishing equipment having a low flow rate due to a longer period of time of discharge of the fire-extinguishing agent gas, and a fire suppression target space having a large  
10 floor area for its volume.

#### SOLUTION TO PROBLEM

[0011]

To achieve the object, the discharge head having a  
15 silencing means for gaseous fire-extinguishing equipment according to the present invention is a discharge head having a silencing means for gaseous fire-extinguishing equipment using a fire-extinguishing agent gas, for discharging the fire-extinguishing agent gas into a fire suppression target space.  
20 The silencing means includes a silencing member that is disposed at an exit portion of an orifice and that is made of a porous material that allows gas to pass therethrough. The silencing member includes an exposed section having a circumferential end surface open to the atmosphere, and a high-speed discharge  
25 section from which the fire-extinguishing agent gas is discharged in particular directions at a discharge speed higher

than that of the exposed section. The exposed section and the high-speed discharge section are separate sections.

[0012]

In this case, a direction in which the fire-extinguishing agent gas is discharged from the exposed section and a direction in which the fire-extinguishing agent gas is discharged from the high-speed discharge section may be generally parallel to each other, may form a predetermined angle that is an acute angle, or may form an angle of generally 90°.

10 [0013]

The silencing member forming the exposed section may have a cylindrical tubular, cylindrical, or polygonal shape, or a shape expanded outward beyond other portions.

[0014]

15 The porous material for the silencing member may have voids having a pore diameter that becomes smaller in a direction in which gas flows.

[0015]

20 The high-speed discharge section may be in contact with a passage hole formed in a peripheral surface of a discharge head body.

A plurality of the high-speed discharge sections may be formed in a peripheral surface of a discharge head body at equal angular intervals.

25 [0016]

The exposed section may be interposed between the high-

speed discharge sections.

[0017]

The exposed section may be arranged on an upstream side and the high-speed discharge section may be arranged on a downstream side in a direction in which the fire-extinguishing agent gas flows into the discharge head.

[0018]

A distance between a center of the discharge head and a surface of the exposed section from which the fire-extinguishing agent gas is discharged may be greater than a distance between the center of the discharge head and a surface of the high-speed discharge section from which the fire-extinguishing agent gas is discharged.

[0019]

A diffusion part configured to uniformly diffuse the fire-extinguishing agent gas passed through the orifice may be provided between the orifice, and the exposed section and the high-speed discharge section.

## ADVANTAGEOUS EFFECTS OF INVENTION

[0020]

The discharge head having a silencing means for gaseous fire-extinguishing equipment according to the present invention has improved performance of diffusing the fire-extinguishing agent gas without a reduction in silencing performance, and therefore, can be effectively used for fire-extinguishing

equipment having a low flow rate due to a longer period of time for which the fire-extinguishing agent gas is discharged, a fire suppression target space having a large floor area for its volume, and the like.

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#### BRIEF DESCRIPTION OF DRAWINGS

[0021]

[FIG. 1] FIG. 1 is a perspective view illustrating an appearance of a first example of a discharge head having a silencing means for gaseous fire-extinguishing equipment according to the present invention.

[FIG. 2] FIG. 2 is a cross-sectional view of the discharge head of FIG. 1.

[FIG. 3] FIG. 3 is a cross-sectional view illustrating a second example of the discharge head having a silencing means for gaseous fire-extinguishing equipment according to the present invention.

[FIG. 4] FIG. 4 is a perspective view illustrating an appearance of a third example of the discharge head having a silencing means for gaseous fire-extinguishing equipment according to the present invention.

[FIG. 5] FIG. 5 is a cross-sectional view of the discharge head of FIG. 4.

[FIG. 6] FIG. 6 is a perspective view illustrating an appearance of a fourth example of the discharge head having a silencing means for gaseous fire-extinguishing equipment

according to the present invention.

[FIG. 7] FIG. 7 is a perspective view illustrating an appearance of a fifth example of the discharge head having a silencing means for gaseous fire-extinguishing equipment according to the present invention.

[FIG. 8] FIG. 8 is a cross-sectional view of the discharge head of FIG. 7 taken along direction A.

[FIG. 9] FIG. 9 is a cross-sectional view of the discharge head of FIG. 7 taken along direction B.

10 [FIG. 10] FIG. 10 is a perspective view illustrating an appearance of a sixth example of the discharge head having a silencing means for gaseous fire-extinguishing equipment according to the present invention.

15 [FIG. 11] FIG. 11 is a cross-sectional view of the discharge head of FIG. 10.

[FIG. 12] FIG. 12 is a cross-sectional view illustrating a seventh example of the discharge head having a silencing means for gaseous fire-extinguishing equipment according to the present invention.

20 [FIG. 13] FIG. 13 is a diagram for describing conventional discharge heads for gaseous fire-extinguishing equipment.

[FIG. 14] FIG. 14 is a schematic diagram illustrating a server room.

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DESCRIPTION OF EMBODIMENTS

[0022]

Embodiments of a discharge head having a silencing means for gaseous fire-extinguishing equipment according to the present invention will be described below with reference to the accompanying drawings.

[0023]

FIGS. 1 and 2 illustrate a first example of the discharge head having a silencing means for gaseous fire-extinguishing equipment according to the present invention.

10       The discharge head 1A having a silencing means for gaseous fire-extinguishing equipment is installed in gaseous fire-extinguishing equipment that uses a fire-extinguishing agent gas in order to discharge the fire-extinguishing agent gas into a fire suppression target space. The silencing means includes a  
15       silencing member 4 that is made of a porous material that allows gas to pass therethrough and is disposed at an exit portion of an orifice 31. The silencing member 4 has an exposed section 4A, the circumferential end surface of which is open to the atmosphere, and a high-speed discharge section 4B, from which  
20       the fire-extinguishing agent gas is discharged in particular directions at a discharge speed higher than that of the exposed section 4A. The exposed section 4A and the high-speed discharge section 4B are separate sections.

[0024]

25       For example, as illustrated in FIG. 14, the discharge head 1A includes: a discharge head body 2 that is attached to the top

surface of an underfloor space of a server room (the lower surface of a floor F), and is coupled to a pipe (not illustrated) for supplying the fire-extinguishing agent gas; an orifice plate 3 that forms an orifice 31 and is removably disposed in the discharge head body 2; and a block-shaped silencing member 4 that is made of a porous material that allows gas to pass therethrough and is disposed at an exit portion of the orifice 31.

[0025]

10           The discharge head body 2 includes an upper structural body 2A that has a circular transverse cross-sectional shape, and forms a coupling portion to a pipe, and a lower structural body 2B that is screwed and attached to the upper structural body 2A.

15           [0026]

          The orifice plate 3, in which the orifice 31 is formed, is removably disposed at the discharge head body 2 from an opening of the discharge head body 2 to which a pipe is coupled. The orifice plate 3 can be selected from those having a plurality of types of orifices 31, depending on a condition such as an installation place.

[0027]

          In addition, the larger-diameter portion side of the orifice 31 preferably faces the silencing member 4.

25           As a result, the fire-extinguishing agent gas can be caused to uniformly flow from a center portion to a peripheral

portion of the silencing member 4, resulting in uniform noise occurring at portions of the silencing member 4 where the fire-extinguishing agent gas is discharged, and a further increase in the noise reduction factor.

5 [0028]

The block-shaped silencing member 4 made of a porous material may have a monolithic structure, or alternatively, as described in this example, may have a composite structure including a first member 41, a second member 42, and a third  
10 member 43 that covers the outer peripheral portion of an upper portion of the second member 42.

[0029]

A diffusion part 5 is provided between the first member 41 and the second member 42. The diffusion part 5 uniformly  
15 diffuses the fire-extinguishing agent gas that has flowed into the first member 41 after passing through the orifice 31, toward the second member 42.

The diffusion part 5 is in the shape of a cylinder having a large number of passage holes (orifices) in the peripheral  
20 surface thereof. In this example, the diffusion part 5 may be monolithically formed together with the upper structural body 2A of the discharge head body 2 as a single piece. Alternatively, the diffusion part 5 and the discharge head body 2 may be separate members.

25 [0030]

The porous material for the silencing member 4 may

preferably be a porous structural body whose framework has a three-dimensional reticular structure and that is made of an inorganic material having high shape retention properties (metal, metal oxide, metal hydroxide, or the like).

5 [0031]

The porous material for the silencing member 4 may have voids having substantially equal pore diameters throughout the material. Alternatively, the pore diameters of the voids may be changed in the direction in which the gas flows. More specifically, the pore diameters of the voids may become smaller in the direction in which the gas flows. For example, in the present example, the pore diameters of the voids of the third member 43 may be smaller than that of the first member 41 and the second member 42.

15 If the pore diameters of the voids of the porous material for the silencing member 4 thus become smaller in the direction in which the gas flows, the noise reduction factor can be further increased.

[0032]

20 No matter whether the silencing member 4 has a monolithic structure or a composite structure, the silencing member 4 is disposed with one end surface of the silencing member 4 in contact with the discharge head body 2 (in this example, the orifice plate 3 may be included), and the outer peripheral surface of the silencing member 4, specifically, the outer peripheral surface of the third member 43 and the outer

peripheral surface of a lower portion of the second member 42, is open to the atmosphere.

The outer peripheral surface of the third member 43 forms the exposed section 4A, the circumferential end surface of which is open to the atmosphere.

In addition, a part of the outer peripheral surface of the lower portion of the second member 42 is in contact with the passage holes 21 formed at a plurality of portions of the peripheral surface of the lower structural body 2B of the discharge head body 2 (in this example, four portions spaced from each other by  $90^\circ$ ), thereby forming the high-speed discharge section 4B, which is configured to discharge the fire-extinguishing agent gas in particular directions at a discharge speed higher than that of the exposed section 4A.

Specifically, the fire-extinguishing agent gas passes through the orifice 31 to flow into the first member 41, then passes through the diffusion part 5 to flow into the second member 42, and the third member 43 covering the outer peripheral portion of the upper portion of the second member 42, and then is discharged, at a sufficiently reduced speed, from the exposed section 4A formed by the outer peripheral surface of the third member 43. Therefore, the silencing performance of the discharge head 1A is ensured.

Meanwhile, the fire-extinguishing agent gas also passes through the orifice 31 to flow into the first member 41, then passes through the diffusion part 5 to flow into the lower

portion of the second member 42, and then is discharged, with a required flow rate maintained, from the high-speed discharge section 4B formed by the outer peripheral surface of the lower portion of the second member 42 that is in contact with the passage holes 21 of the discharge head body 2. Therefore, the performance of diffusing the fire-extinguishing agent gas can be improved.

Here, the passage hole 21 may, for example, be a circular hole having a diameter of at least about 10mm, or alternatively, an elliptical or slit-shaped hole having a similar cross-sectional area (at least about 80 mm<sup>2</sup>).

The balance between the performance of diffusing the fire-extinguishing agent gas and the effect of reducing sound pressure can be regulated by changing the exposed area ratio of the exposed section 4A formed by the outer peripheral surface of the third member 43, and the high-speed discharge section 4B formed by the outer peripheral surface of the lower portion of the second member 42 that is in contact with the passage holes 21 of the discharge head body 2. For example, in the case of a discharge head having a great diameter and therefore having a high flow rate, sound pressure can be efficiently reduced by enlarging the exposed section 4A (increasing the axial dimension thereof).

Although in this example, the outer peripheral surface of the lower portion of the second member 42 is in contact with the passage holes 21 to form the high-speed discharge section 4B, a

silencing member (not illustrated) having a thickness smaller than that of the third member 43 and covers the outer peripheral portion of the lower portion of the second member 42 may, for example, be provided between the second member 42 and the lower  
5 structural body 2B of the discharge head body 2 in order to improve silencing performance, as long as a required flow rate is maintained.

Although in this example, four passage holes 21 forming the high-speed discharge section 4B are separated from each other  
10 by 90° (at equal angular intervals) in order to diffuse the fire-extinguishing agent gas into a fire suppression target space having a quadrangular shape as viewed from above, eight passage holes 21 forming the high-speed discharge section 4B may be formed and separated from each other by 45°; six passage holes  
15 21, by 60°; three passage holes 21, by 120°; or two passage holes 21, by 180°, depending on the shape of the fire suppression target space or the installation form of the discharge head.

Alternatively, passage holes 21 forming the high-speed discharge section 4B may be unevenly arranged so as to diffuse  
20 the fire-extinguishing agent gas only in particular directions.  
[0033]

As a result, the performance of diffusing the fire-extinguishing agent gas can be improved without a reduction in silencing performance. Therefore, the discharge head according  
25 to the present invention can be effectively used for fire-extinguishing equipment that discharges the fire-extinguishing

agent gas for a longer period of time and therefore has a low flow rate, a fire suppression target space having a large floor area for its volume, and the like.

[0034]

5           FIG. 3 illustrates a second example of the discharge head having a silencing means for gaseous fire-extinguishing equipment according to the present invention.

          This discharge head 1B having a silencing means for gaseous fire-extinguishing equipment excludes the orifice plate  
10   3 and the first member 41 of the silencing member 4 of the discharge head 1A of the first example illustrated in FIGS. 1 and 2. In addition, in the discharge head 1B, the passage hole 21 provided in the lower structural body 2B of the discharge head body 2 is formed such that the direction in which the fire-  
15   extinguishing agent gas is discharged from the passage hole 21 is tilted slightly (about 5 to 30°; in this example, about 10°) downward from the horizontal direction compared to the horizontal direction of the discharge head 1A of the first example.

20           In this case, a large number of passage holes formed in the peripheral surface of the diffusion part 5 serve as orifices.

          Here, the angle of the direction in which the fire-extinguishing agent gas is discharged from the passage hole 21 formed in the lower structural body 2B of the discharge head  
25   body 2 is not limited to the above angle, and may be set, depending on the place where the discharge head is installed, or

the like, such that the direction in which the fire-extinguishing agent gas is discharged from the exposed section 4A and the direction in which the fire-extinguishing agent gas is discharged from the high-speed discharge section 4B form a predetermined angle that is any angle of 0 to 90° (acute angle).

In addition, the passage hole 21 provided in the lower structural body 2B of the discharge head body 2 may be formed such that the direction in which the fire-extinguishing agent gas is discharged from the passage hole 21 is an upward direction from the horizontal direction (e.g., an upward direction having an angle of about 5 to 30°) in addition to the horizontal direction and a downward direction, depending on the shape of the fire suppression target space, the place where the discharge head is installed, or the like.

[0035]

It should be noted that the other features and effects of the discharge head 1B of this example are similar to those of the discharge head 1A of the first example.

[0036]

FIGS. 4 and 5 illustrate a third example of the discharge head having a silencing means for gaseous fire-extinguishing equipment according to the present invention.

This discharge head 1C having a silencing means for gaseous fire-extinguishing equipment includes a silencing member 40 in which the first member 41 and the second member 42 of the silencing member 4 of the discharge head 1A of the first example

illustrated in FIGS. 1 and 2 are monolithically formed together as a single piece. The discharge head 1C excludes the diffusion part 5. In the discharge head 1C, the passage hole 21 provided in the lower structural body 2B of the discharge head body 2 is formed such that the direction in which the fire-extinguishing agent gas is discharged from the passage hole 21 is tilted slightly (about 5 to 30°; in this example, about 10°) downward from the horizontal direction compared to the horizontal direction of the discharge head 1A of the first example.

10 [0037]

The discharge head body 2 includes an upper structural body 2A that has a circular transverse cross-sectional shape, and forms a coupling portion to a pipe, and a lower structural body 2B that is attached to the upper structural body 2A by a screw member.

15 [0038]

It should be noted that the other features and effects of the discharge head 1C of this example are similar to those of the discharge head 1A of the first example.

20 [0039]

FIG. 6 illustrates a fourth example of the discharge head having a silencing means for gaseous fire-extinguishing equipment according to the present invention.

In this discharge head 1D having a silencing means for gaseous fire-extinguishing equipment, passage holes 22 having a diameter smaller than that of the passage holes 21 (a diameter

that is about 1/3 to 1/5 of the diameter of the passage hole 21) are formed at a plurality of portions (in this example, four portions separated from each other by 90°) of the peripheral surface of the lower structural body 2B of the discharge head body 2 of the discharge head 1C of the third example illustrated in FIGS. 3 to 5 such that the passage holes 22 and the passage holes 21 are alternately arranged.

A part of the outer peripheral surface of a lower portion of the silencing member 40 of the silencing member 4 forms a second exposed section that is in contact with the passage hole 22 having a diameter smaller than that of the passage hole 21. Therefore, the fire-extinguishing agent gas is discharged from the passage hole 22 at a sufficiently reduced speed, so that the silencing performance of the discharge head 1D is ensured.

[0040]

It should be noted that the other features and effects of the discharge head 1D of this example are similar to those of the discharge head 1C of the third example.

[0041]

FIGS. 7 to 9 illustrate a fifth example of the discharge head having a silencing means for gaseous fire-extinguishing equipment according to the present invention.

In this discharge head 1E having a silencing means for gaseous fire-extinguishing equipment, the first member 41 and the second member 42 of the silencing member 4 of the discharge head 1A of the first example illustrated in FIGS. 1 and 2 are

monolithically formed together as a single piece, and the silencing member 4 is then divided into silencing members 40a and 40b, which are vertically separated from each other, and the third member 43 is sandwiched between the silencing members 40a and 40b, and the diffusion part 5 is removed.

[0042]

The discharge head body 2 includes an upper structural body 2A that has a regular polygonal (regular octagonal) transverse cross-sectional shape, and forms a coupling portion to a pipe, and a lower structural body 2B that, together with the upper structural body 2A, sandwiches the third member 43, and is attached to the upper structural body 2A by a screw member.

[0043]

The orifice plate 3, in which the orifice 31 is formed, is removably disposed in the discharge head body 2. Therefore, the orifice plate 3 can be selected from those having a plurality of types of orifices 31, depending on a condition such as an installation place.

[0044]

The porous material for the silencing member 4 may have voids having substantially equal pore diameters throughout the material. Alternatively, in this example, the pore diameters of the voids of the third member 43 may be smaller than that of the silencing members 40a and 40b.

Thus, the voids of the third member 43 have smaller pore

diameters, resulting in a further increase in the noise reduction factor.

[0045]

No matter whether the silencing member 4 has a monolithic  
5 structure or a composite structure, the silencing member 4 is  
disposed with one end surface of the silencing member 4 in  
contact with the discharge head body 2 (in this example, the  
orifice plate 3 may be included), and the outer peripheral  
surface of the silencing member 4, specifically, the outer  
10 peripheral surface of the third member 43 and a part of the outer  
peripheral surface of the silencing member 40b, is open to the  
atmosphere.

The outer peripheral surface of the third member 43 forms  
an exposed section 4A, the circumferential end surface of which  
15 is open to the atmosphere.

In addition, a part of the outer peripheral surface of  
the silencing member 40b is in contact with the passage holes 21  
formed at a plurality of portions of the peripheral surface of  
the lower structural body 2B of the discharge head body 2 (in  
20 this example, four portions spaced from each other by 90°),  
thereby forming a high-speed discharge section 4B that is  
configured to discharge the fire-extinguishing agent gas in  
particular directions at a discharge speed higher than that of  
the exposed section 4A.

25 Specifically, the fire-extinguishing agent gas passes  
through the orifice 31 to flow into the silencing member 40a,

then flows into the third member 43, and then is discharged, at a sufficiently reduced speed, from the exposed section 4A formed by the outer peripheral surface of the third member 43. Therefore, the silencing performance of the discharge head 1E is  
5 ensured.

Meanwhile, the fire-extinguishing agent gas also passes through the orifice 31 to flow into the silencing member 40a, then passes through the third member 43 to flow into the silencing member 40b, and then is discharged, with a required  
10 flow rate maintained, from the high-speed discharge section 4B formed by the outer peripheral surface of the silencing member 40b that is in contact with the passage holes 21 of the discharge head body 2. Therefore, the performance of diffusing the fire-extinguishing agent gas can be improved.

15 Here, four passage holes 21 may be provided at one portion. The total of the cross-sectional areas of the four passage holes 21 may be at least about 80 mm<sup>2</sup>.

[0046]

It should be noted that the other features and effects of  
20 the discharge head 1E of this example are similar to those of the discharge head 1A of the first example.

[0047]

FIGS. 10 and 11 illustrate a sixth example of the discharge head having a silencing means for gaseous fire-  
25 extinguishing equipment according to the present invention.

This discharge head 1F having a silencing means for

gaseous fire-extinguishing equipment is installed in gaseous fire-extinguishing equipment that uses a fire-extinguishing agent gas in order to discharge the fire-extinguishing agent gas into a fire suppression target space. The silencing means  
5 includes a silencing member 4 that is made of a porous material that allows gas to pass therethrough and is disposed at an exit portion of an orifice 31. The silencing member 4 has an exposed section 4A, the circumferential end surface of which is open to the atmosphere, and a high-speed discharge section 4B from which  
10 the fire-extinguishing agent gas is discharged in particular directions at a discharge speed higher than that of the exposed section 4A. The exposed section 4A and the high-speed discharge section 4B are separate sections.

[0048]

15 The block-shaped silencing member 4 made of a porous material may have a monolithic structure, or alternatively, as described in this example, may have a composite structure including a first member 41, a second member 42, and a third member 43 that covers the outer peripheral portion of an upper  
20 portion of the second member 42.

Here, the first member 41 may be formed in the shape of a cylinder, or as described in this example, in a shape whose cross-sectional area becomes larger in the direction in which the gas flows (truncated cone).

25 [0049]

A diffusion part 5 is provided between the first member

41 and the second member 42. The diffusion part 5 uniformly diffuses the fire-extinguishing agent gas that has flowed into the first member 41 after passing through the orifice 31, toward the second member 42.

5           The diffusion part 5 is in the shape of a disc having a plurality of passage holes (orifices). In this example, the diffusion part 5 is disposed and screwed to the upper structural body 2A of the discharge head body 2.

[0050]

10           No matter whether the silencing member 4 has a monolithic structure or a composite structure, the silencing member 4 is disposed with one end surface of the silencing member 4 in contact with the discharge head body 2 (in this example, the orifice plate 3 may be included), and the outer peripheral  
15 surface of the silencing member 4, specifically, the outer peripheral surface of the third member 43 and a part of the outer peripheral surface of a lower portion of the second member 42, is open to the atmosphere.

          The outer peripheral surface of the third member 43 forms  
20 the exposed section 4A, the circumferential end surface of which is open to the atmosphere.

          In addition, a part of the outer peripheral surface of the lower portion of the second member 42 is in contact with the passage holes 21 formed at a plurality of portions of the  
25 peripheral surface of the lower structural body 2B of the discharge head body 2 (in this example, four portions spaced

from each other by  $90^\circ$ ), thereby forming the high-speed discharge section 4B, which is configured to discharge the fire-extinguishing agent gas in particular directions at a discharge speed higher than that of the exposed section 4A.

5           Specifically, the fire-extinguishing agent gas passes through the orifice 31 to flow into the first member 41, then passes through the diffusion part 5 to flow into the second member 42, and the third member 43 covering the outer peripheral portion of the upper portion of the second member 42, and then  
10 is discharged, at a sufficiently reduced speed, from the exposed section 4A formed by the outer peripheral surface of the third member 43. Therefore, the silencing performance of the discharge head 1A is ensured.

          Meanwhile, the fire-extinguishing agent gas also passes  
15 through the orifice 31 to flow into the first member 41, then passes through the diffusion part 5 to flow into the lower portion of the second member 42, and then is discharged, with a required flow rate maintained, from the high-speed discharge section 4B formed by the outer peripheral surface of the lower  
20 portion of the second member 42 that is in contact with the passage holes 21 of the discharge head body 2. Therefore, the performance of diffusing the fire-extinguishing agent gas can be improved.

          Furthermore, the distance between the center of the  
25 discharge head 1F and the surface of the exposed section 4A from which the fire-extinguishing agent gas is discharged may be

greater than the distance between the center of the discharge head 1F and the surface of the high-speed discharge section 4B from which the fire-extinguishing agent gas is discharged, resulting in a further improvement in silencing performance.

5 [0051]

Incidentally, all of the discharge heads 1A to 1F are, for example, attached to the top surface of an underfloor space of a server room (the lower surface of a floor F) in use, as illustrated in FIG. 14. The direction in which the fire-extinguishing agent gas is discharged from the exposed section 4A, and the direction in which the fire-extinguishing agent gas is discharged from the high-speed discharge section 4B, may be generally parallel to each other, or may form a predetermined angle that is an acute angle. A seventh example of the discharge head having a silencing means for gaseous fire-extinguishing equipment according to the present invention that is, for example, attached to a wall W of an underfloor space of a server room in use as illustrated in FIG. 14, is illustrated in FIG. 12.

20 [0052]

This discharge head 1G having a silencing means for gaseous fire-extinguishing equipment has a silencing member 40 in which the first member 41 and the second member 42 of the silencing member 4 of the discharge head 1A of the first example illustrated in FIGS. 1 and 2 are monolithically formed together as a single piece. The discharge head 1G excludes the diffusion

part 5. Whereas the direction in which the fire-extinguishing agent gas is discharged from the passage hole 21 formed in the lower structural body 2B of the discharge head body 2 and the horizontal direction of the discharge head 1A of the first example are generally parallel to each other (the direction in which the fire-extinguishing agent gas is discharged from the exposed section 4A and the direction in which the fire-extinguishing agent gas is discharged from the high-speed discharge section 4B are generally parallel to each other), the direction in which the fire-extinguishing agent gas is discharged from the exposed section 4A and the direction in which the fire-extinguishing agent gas is discharged from the high-speed discharge section 4B form an angle of generally 90° in the discharge head 1G.

[0053]

No matter whether the silencing member 4 has a monolithic structure or a composite structure, the silencing member 4 is disposed with one end surface of the silencing member 4 in contact with the discharge head body 2 (in this example, the orifice plate 3 may be included), and the outer peripheral surface of the silencing member 4, specifically, the outer peripheral surface of the third member 43 and a part of the other end surface of the silencing member 40, is open to the atmosphere.

The outer peripheral surface of the third member 43 forms the exposed section 4A, the circumferential end surface of which

is open to the atmosphere.

In addition, a part of the other end surface of the silencing member 40 is in contact with the passage holes 21 formed at a plurality of portions (in this example, four portions  
5 separated from each other by 90°) of the lower surface of the lower structural body 2B of the discharge head body 2 (a vertical surface when the discharge head is attached to a wall W of an underfloor space of a server room). As a result, the high-speed discharge section 4B is configured to discharge the fire-  
10 extinguishing agent gas in particular directions at a discharge speed higher than that of the exposed section 4A.

Specifically, the fire-extinguishing agent gas passes through the orifice 31 to flow into the first member 41, then flows into the third member 43 covering the outer peripheral  
15 portion of the upper portion of the silencing member 40, and then is discharged, at a sufficiently reduced speed, from the exposed section 4A formed by the outer peripheral surface of the third member 43. Therefore, the silencing performance of the discharge head 1G is ensured.

20 Meanwhile, the fire-extinguishing agent gas also passes through the orifice 31 to flow into the silencing member 40, and then is discharged, with a required flow rate maintained, from the high-speed discharge section 4B formed by the other end surface of the silencing member 40 that is in contact with the  
25 passage holes 21 of the discharge head body 2. Therefore, the performance of diffusing the fire-extinguishing agent gas can be

improved.

[0054]

Although in the foregoing, several embodiments of the discharge head having a silencing means for gaseous fire-  
5 extinguishing equipment according to the present invention have been described, the present invention is not limited to the embodiments. The embodiments may be modified or changed by, for example, combining, as appropriate, the features described in the embodiments described above without departing from the  
10 spirit and scope according to the present invention.

#### INDUSTRIAL APPLICABILITY

[0055]

The discharge head having a silencing means for gaseous  
15 fire-extinguishing equipment according to the present invention has improved performance of diffusing the fire-extinguishing agent gas without a reduction in silencing performance, and therefore, can be effectively used for fire-extinguishing equipment having a low flow rate due to a longer period of time  
20 for which the fire-extinguishing agent gas is discharged, a fire suppression target space having a large floor area for its volume, and the like. Therefore, the discharge head having a silencing means for gaseous fire-extinguishing equipment according to the present invention is preferably usable for  
25 gaseous fire-extinguishing equipment using a fire-extinguishing agent gas, such as nitrogen, carbon dioxide, or a fluorine

compound, which is provided in a fire suppression target space having a large floor area for its volume, such as an underfloor space. In addition, the suppression range can be enlarged without an increase in the number of attached discharge heads.

5 Therefore, the discharge head having a silencing means for gaseous fire-extinguishing equipment according to the present invention can be widely used for gaseous fire-extinguishing equipment that is provided in a typical fire suppression target space. The discharge head having a silencing means for gaseous  
10 fire-extinguishing equipment according to the present invention is also applicable to not only gaseous fire-extinguishing equipment newly set up, but also existing gaseous fire-extinguishing equipment only by replacing existing discharge heads.

15

#### REFERENCE SIGNS LIST

[0056]

|          |                              |
|----------|------------------------------|
| 1A to 1G | DISCHARGE HEAD               |
| 2        | DISCHARGE HEAD BODY          |
| 20 2A    | UPPER STRUCTURAL BODY        |
| 2B       | LOWER STRUCTURAL BODY        |
| 3        | ORIFICE PLATE                |
| 31       | ORIFICE                      |
| 4        | SILENCING MEMBER             |
| 25 4A    | EXPOSED SECTION              |
| 4B       | HIGH-SPEED DISCHARGE SECTION |



## CLAIMS

1. A discharge head having a silencing means for gaseous fire-extinguishing equipment using a fire-extinguishing agent gas, for discharging the fire-extinguishing agent gas into a fire suppression target space, wherein

the silencing means includes a silencing member that is disposed at an exit portion of an orifice and that is made of a porous material that allows gas to pass therethrough,

the silencing member includes an exposed section having a circumferential end surface open to the atmosphere, and a high-speed discharge section from which the fire-extinguishing agent gas is discharged in particular directions at a discharge speed higher than that of the exposed section, and

the exposed section and the high-speed discharge section are separate sections.

2. The discharge head having a silencing means for gaseous fire-extinguishing equipment according to claim 1, wherein

a direction in which the fire-extinguishing agent gas is discharged from the exposed section and a direction in which the fire-extinguishing agent gas is discharged from the high-speed discharge section are generally parallel to each other.

3. The discharge head having a silencing means for gaseous fire-extinguishing equipment according to claim 1, wherein

a direction in which the fire-extinguishing agent gas is discharged from the exposed section and a direction in which the fire-extinguishing agent gas is discharged from the high-speed discharge section form a predetermined angle that is an acute angle.

4. The discharge head having a silencing means for gaseous fire-extinguishing equipment according to claim 1, wherein

a direction in which the fire-extinguishing agent gas is discharged from the exposed section and a direction in which the fire-extinguishing agent gas is discharged from the high-speed discharge section form an angle of generally 90°.

5. The discharge head having a silencing means for gaseous fire-extinguishing equipment according to claim 1, wherein

the silencing member forming the exposed section has a cylindrical tubular, cylindrical, or polygonal shape, or a shape expanded outward beyond other portions.

6. The discharge head having a silencing means for gaseous fire-extinguishing equipment according to claim 1,

wherein

the porous material for the silencing member has voids having a pore diameter that becomes smaller in a direction in which gas flows.

5

7. The discharge head having a silencing means for gaseous fire-extinguishing equipment according to claim 1, wherein

the high-speed discharge section is in contact with a  
10 passage hole formed in a peripheral surface of a discharge head body.

8. The discharge head having a silencing means for gaseous fire-extinguishing equipment according to claim 1,  
15 wherein

the exposed section is interposed between the high-speed discharge sections.

9. The discharge head having a silencing means for  
20 gaseous fire-extinguishing equipment according to claim 1, wherein

the exposed section is disposed on an upstream side and the high-speed discharge section is disposed on a downstream side in a direction in which the fire-extinguishing agent gas  
25 flows into the discharge head.

10. The discharge head having a silencing means for gaseous fire-extinguishing equipment according to claim 1, wherein

a distance between a center of the discharge head and a surface of the exposed section from which the fire-extinguishing agent gas is discharged is greater than a distance between the center of the discharge head and a surface of the high-speed discharge section from which the fire-extinguishing agent gas is discharged.

10

11. The discharge head having a silencing means for gaseous fire-extinguishing equipment according to claim 1, wherein

a diffusion part configured to uniformly diffuse the fire-extinguishing agent gas passed through the orifice is provided between the orifice, and the exposed section and the high-speed discharge section.

12. The discharge head having a silencing means for gaseous fire-extinguishing equipment according to claim 1, wherein

a plurality of the high-speed discharge sections are formed in a peripheral surface of a discharge head body at equal angular intervals.

25