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DESCRIPTION

Description

Technical Field

[0001] The present invention relates to a nozzle and a hydrolyzing device.

Background Art

[0002] There is a conventionally-known system for cleaning emissions by decomposing nitrogen oxides contained in the emissions into nitrogen and water through a selective catalytic reduction (SCR) using, as a reducing agent, ammonia (NH_3) obtained by hydrolyzing an aqueous urea solution. What is being demanded in such a system is an improvement in the efficiency of a hydrolysis reaction of an aqueous urea solution to form ammonia by spraying the catalyst with the aqueous urea solution.

[0003] A variety of nozzles for misting a liquid over a spray target object are put into practical use. For example, Patent Literature 1 discloses a fluid spray nozzle having two orifices disposed parallel to each other in a width direction thereof and for spraying a fluid from each of the orifices.

Citation List

[Patent Literature]

[0004] [Patent Literature 1] Japanese Patent Application Publication, Tokukai, No. 2003-93926. DE 102009034072 A1 relates to an injection nozzle for supplying reducing agent. US 10473013B2 relates to a selective catalytic reduction system. US9995194B2 relates to a system for preventing the urea crystal formation. US2012/317963A1 relates to a reducing agent injection nozzle. DE 102009005528 A1 relates to a two-substance nozzle for atomizing a liquid.

Summary of Invention

Technical Problem

[0005] The inventors have found that it is important, for a method of efficiently hydrolyzing an aqueous urea solution into NH_3 , to evenly spray an aqueous urea solution on a certain cross-sectional surface of a spray target object, which is a catalyst. The inventors tried to achieve such spraying by using the nozzle as described above.

[0006] However, when three or more spraying parts are provided in the nozzle as described above, the amount of liquid adhering to a spray target surface can vary from position to position. Therefore, there still remains room for improvement in evenness of an adhesion amount of a liquid sprayed on a spray target object by using a conventional nozzle.

[0007] It is an object of an aspect of the present invention to improve evenness of an adhesion amount of a liquid sprayed on a spray target object by using a nozzle including three or more spraying parts.

Solution to Problem

[0008] In order to solve the above problem, provided is a nozzle in accordance with an aspect of the present invention including the features of claim 1.

Advantageous Effects of Invention

[0009] An aspect of the present invention enables an improvement in evenness of an adhesion amount of a liquid sprayed on a spray target object by using a nozzle including three or more spraying parts.

Brief Description of Drawings

[0010]

Fig. 1 is a view schematically illustrating a configuration of a hydrolyzing device, including a container, in accordance with Embodiment 1 of the present invention.

Fig. 2 is a view schematically illustrating a nozzle of the container.

Fig. 3 is a cross-sectional view of a section taken along line A-A' of the nozzle illustrated in Fig. 2.

Fig. 4 is a view schematically illustrating an internal structure of a spraying part of the nozzle.

Fig. 5 is a view illustrating a spray target surface on which a liquid has been sprayed by using the nozzle.

Fig. 6 is a view schematically illustrating a nozzle in accordance with Embodiment 2 of the present invention.

Fig. 7 is a cross-sectional view of a section taken along line B-B' of the nozzle illustrated in Fig. 6.

Fig. 8 is a view illustrating a spray target surface on which a liquid has been sprayed by using the nozzle.

Description of Embodiments

Embodiment 1

<Configuration of hydrolyzing device 100 >

[0011] The following description will discuss an embodiment of the present invention with reference to Figs. 1 to 5 in detail. Fig. 1 is a view schematically illustrating a configuration of a hydrolyzing device 100, including a container 1, in accordance with Embodiment 1 of the present invention. Fig. 2 is a view schematically illustrating a nozzle 2 of the container 1. Fig. 3 is a cross-sectional view of a section taken along line A-A' of the nozzle 2 illustrated in Fig. 2. Fig. 4 is a cross-sectional view illustrating an internal structure of a spraying part 13 of the nozzle 2. Fig. 5 is a view illustrating how a liquid 6 adheres to a spray target surface P on which the liquid 6 has been sprayed by using the nozzle 2.

[0012] The hydrolyzing device 100 in accordance with Embodiment 1 is a device for cleaning emissions by supplying a denitration catalyst with a gas containing ammonia (NH_3) and decomposing nitrogen oxides contained in the emissions into nitrogen and water through a selective catalytic reduction (SCR) reaction using, as a reducing agent, the ammonia. As illustrated in Fig. 1, the hydrolyzing device 100 includes the container 1, a bleed air line 101, a treatment gas line 102, and a heater (not illustrated).

[0013] The heater heats a bleed air of exhaust from an engine such as a diesel engine. The bleed air having been heated is supplied to the container 1 through the bleed air line 101.

[0014] The container 1 is a device for hydrolyzing the liquid 6 inside the container 1 to

generate ammonia. For example, the liquid 6 is an aqueous urea solution. The container 1 stores a spray target object 5, which is a catalyst for accelerating a hydrolysis reaction. The container 1 includes the nozzle 2 for spraying the spray target object 5 with the liquid 6. The container 1 further includes a pipe 4 for supporting the nozzle 2 and supplying the nozzle 2 with the liquid 6. The nozzle 2 is supplied with the liquid 6 through the pipe 4.

[0015] The nozzle 2 sprays the spray target object 5 with the liquid 6. The liquid 6 having been sprayed is hydrolyzed by a hot gas (bleed air) introduced into the container 1 to form ammonia.

[0016] The container 1 has a shape that include, as a specific example, the shape of an axially long tube, such as the shape of a rectangular tube that is substantially square in a cross section perpendicular to an extending direction thereof. However, the container 1 is not limited to the shape of a rectangular tube, but may be cylindrical. The container 1 supplies, through the treatment gas line 102, a hot treatment gas into which ammonia has been mixed.

<Configuration of nozzle 2>

[0017] The nozzle 2, which is provided in the container 1, is a liquid spray nozzle for spraying (misting) the liquid 6 in the form of mist, over a spray target surface P of the spray target object 5. As illustrated in Figs. 2 and 3, the nozzle 2 includes: a nozzle body 11 connected to the pipe 4; and at least three spraying parts 13 for spraying the liquid 6. Described as an example in Embodiment 1 is a case where the nozzle body 11 includes, as a spraying part 13, three spraying parts: a spraying part 13A; a spraying part 13B; and a spraying part 13C.

[0018] The spraying parts 13A to 13C have the same structure. Therefore, in the following description, only the structure of the spraying part 13A is described and the descriptions of the structures of the spraying part 13B and the spraying part 13C will be omitted. Fig. 4 is a cross-sectional view illustrating the structure of the spraying part 13A of the nozzle 2. As illustrated in Fig. 4, the spraying part 13A includes: a liquid spray hole 14; a gas supply portion 15; and gas ejecting parts 17 (route control part) paired together. The liquid spray hole 14 is a circular opening provided in the spraying part 13. The liquid spray hole 14 is connected to a liquid passage 141 inside the pipe 4, and sprays the liquid 6 carried by the liquid passage 141.

[0019] The gas supply portion 15 includes: gas spray holes 151 serving as spray holes; and gas passages 152. The gas spray holes 151 are a pair of openings located near the liquid spray hole 14. The gas passages 152 are connected to a gas passage inside the pipe 4. The gas passages 152 supply a gas 50 carried by the gas passage to the gas spray holes 151, which spray the gas 50 toward the liquid 6 sprayed from the spraying part 13. This makes the particle diameter of the liquid 6 sprayed from the liquid spray hole 14 smaller, so that the liquid 6 becomes misty.

[0020] The gas ejecting parts 17 are a mechanism for controlling a region (hereinafter,

referred to also as adhesion region) formed through adhesion, to the spray target surface P, of the liquid 6 sprayed from the spraying part 13. Note that the spray target surface P is a flat surface substantially perpendicular to a direction in which the nozzle body 11 is viewed in a plan view.

[0021] The gas ejecting parts 17 control a route of a liquid sprayed from the liquid spray hole 14 by blowing a gas toward the liquid sprayed from the liquid spray hole 14. The gas ejecting parts 17 include: gas spray holes 171; and gas passages 172. Each of the gas ejecting parts 17 paired together includes corresponding one of the gas spray holes 171.

[0022] The gas spray holes 171 are a pair of openings provided near the end of the spraying part 13A, on a straight line L (a straight line denoted by a sign L in Fig. 2) connecting a center point 20 (see Fig. 2) of the nozzle body 11 and the spraying part 13A. As illustrated in Fig. 2, the gas spray holes 171 paired together are disposed such that the liquid spray hole 14 is placed therebetween on the straight line L. In other words, the gas spray holes 171 paired together are provided in an outer circumferential part of the spraying part 13A and also on a straight line L passing through the center of the nozzle body 11 and the liquid spray hole 14.

[0023] The gas passages 172 are connected to another gas passage that is different from the gas passage connected to the gas passages 152 and that is provided inside the pipe 4. The gas passages 172 supply the gas spray holes 171 with a gas 60 carried by the other gas passage. It should be noted that the gas passages 172 and the gas passages 152 can be connected to the same gas passage provided inside the pipe 4. In such a case, the gas spray holes 171 and the gas spray holes 151 are supplied with the gas 50 carried by the same gas passage.

[0024] The gas spray holes 171 spray, with the gas 60 supplied by the gas passages 172, the liquid 6 that have been sprayed and have become misty. Note that the gas 50 and the gas 60 sprayed from the gas spray holes 151 and the gas passage 17, respectively are not limited to any particular types. The gas 50 and the gas 60 may be, for example, air.

[0025] The three spraying parts 13 are disposed so as not to be located in line with each other when seen from a third direction (a direction represented by an arrow 30 in Fig. 3) that is perpendicular to the spray target surface P. Specifically, the three spraying parts 13 are disposed on the circumference of the same circle having a center which is the center point 20 (a position represented by a dot 20 in Fig. 2), which is the center of the nozzle body 11, when seen from the third direction (in other words, in the plan view, from a position where the three spraying parts 13 are disposed, of the nozzle body 11).

[0026] The three spraying parts 13 are disposed so as to be spaced at regular intervals. In other words, the three spraying parts 13 are disposed so as to form a regular triangle when seen from the third direction. Further, the three spraying parts 13 are disposed so as to be inclined with respect to a plane perpendicular to the third direction, so that, when seen from the third direction, the liquid is sprayed in directions from the center point 20 of the nozzle body 11

to the spraying parts 13 (for example, the direction represented by an arrow 40 in a case of the spraying part 13B in Fig. 3).

<Effect of nozzle 2>

[0027] According to the nozzle 2 of Embodiment 1, with the pressure of the gas 60 sprayed by the gas spray holes 171 of the gas ejecting parts 17, the liquid 6 sprayed from the liquid spray hole 14 is deformed to be flattened (oval) as a whole, so as to be shorter in a direction in which the gas spray holes 171 face each other and longer in a direction perpendicular to the direction in which the gas spray holes 171 face each other. This means the gas ejecting parts 17 control a route of the liquid such that an adhesion region S is shorter in a first direction outward from a central part of a group of the plurality of adhesion regions S than in a second direction perpendicular to the first direction.

[0028] The configuration described above makes flattened (oval) the adhesion region S (a region denoted by a sign S in Fig. 5) of the liquid 6 that is sprayed from each of the spraying parts 13 and then adheres to the spray target surface P, as illustrated in Fig. 5. In other words, the adhesion region S is shorter in a first direction (a direction represented by an arrow 70 in Fig. 5) outward from the center (center point 20) of the nozzle body 11 than in a second direction (a direction represented by an arrow 80 in Fig. 5) perpendicular to the first direction.

[0029] As illustrated in Fig. 5, a region T (referred to as an adhesion region T) is a group of the adhesion regions S, in which the liquid having been sprayed from the three spraying parts 13 adheres to the spray target surface P. In the region T, an end part of one adhesion region S (a region denoted by S in Fig. 5) produced by one of the spraying parts 13 overlaps an end part of another adhesion region S produced by another one of the spraying parts 13. The gas ejecting parts 17 control the route of the liquid such that the adhesion region S is shorter in the first direction outward from the central part of the adhesion region T than in the second direction perpendicular to the first direction.

[0030] Since the spray region S generated by a single spraying part 13 is flattened, an adhesion amount of the liquid 6 is likely to be reduced, in particular, in end parts thereof in a longitudinal direction. However, according to the nozzle 2, the three spraying parts 13 generate the spray regions S each having end parts that overlap end parts of the other spray regions S. This reduces variation in the adhesion amount of the liquid 6 within the spray region T.

[0031] Each of the spraying parts 13 is inclined outward from the nozzle body 11. The spraying parts 13 therefore spray the liquid 6 in a direction outward from the nozzle body 11. This reduces the variation in the adhesion amount of the liquid 6 within the adhesion region S more than in a case where the spraying parts 13 point in the third direction.

[0032] In a case where the spraying parts 13 face, in the third direction, the spray target object 5 that has a honeycomb structure, the liquid 6 sprayed from the spraying parts 13 is mostly

sprayed substantially in the third direction. In this case, the liquid 6 mostly passes through the inside of the honeycomb structure of a catalyst, which is the spray target object 5, without touching the inner wall surface of the honeycomb structure. This could reduce the efficiency of a catalyzed reaction.

[0033] In contrast, according to the nozzle 2 in accordance with Embodiment 1, each of the spraying parts 13 is inclined outward from the nozzle body 11. This causes the liquid 6 sprayed from the spraying parts 13 to be sprayed in a direction inclined with respect to the third direction. Accordingly, the liquid 6 mostly touches the inner wall surface of the honeycomb structure of the spray target object 5. This improves the efficiency of the catalyzed reaction.

[0034] In the spraying parts 13, the flattened shape is adjusted by means of wind pressure of a gas jetted from the gas spray holes 171. This enables adaptation by changing the wind pressure without changing the structure of the spraying parts 13, even in a case where a condition such as the size of the spray target surface P is changed.

[0035] The route control part described in Embodiment 1 has the configuration that involves the gas ejecting parts 17. However, a method for controlling the shape of the adhesion region S is not limited to this. For example, the route control part may be a liquid spray hole 14 that is deformed to be flattened so that the adhesion region S is adjusted to be flattened.

Embodiment 2

<Configuration of nozzle 2A>

[0036] The following description will discuss another embodiment of the present invention with reference to Figs. 6 to 8. For the convenience of description, a member having the same function as the member already described in Embodiment 1 is assigned with the same reference sign, and the description thereof is omitted. Fig. 6 is a view schematically illustrating a nozzle 2A in accordance with Embodiment 2 of the present invention. Fig. 7 is a cross-sectional view of a section taken along line B-B' of the nozzle 2A illustrated in Fig. 6. Fig. 8 is a view illustrating a spray target surface P on which a liquid 6 has been sprayed by using the nozzle 2A.

[0037] As illustrated in Figs. 6 and 7, the nozzle 2A in accordance with Embodiment 2 of the present invention includes, as a spraying part 13, four spraying parts: spraying parts 13A, 13B, 13C, and 13D. The four spraying part 13A to 13D are disposed so as not to be located in line with each other when viewed from a third direction perpendicular to the spray target surface P. Specifically, the four spraying parts 13 are disposed on the circumference of the same circle having a center which is a center point 20 of a nozzle body 11 when seen from the third direction.

[0038] The four spraying parts 13 are disposed so as to be spaced at regular intervals. In other words, the four spraying parts 13 are disposed so as to form a regular triangle when seen from the third direction. Further, the four spraying parts 13 are disposed so as to be inclined with respect to a plane perpendicular to the third direction, so that, when seen from the third direction, the liquid is sprayed in directions from the center point 20 of the nozzle body 11 to the spraying parts 13.

<Effect of nozzle 2A>

[0039] As illustrated in Fig. 8, using the nozzle 2A generates an adhesion region U of the liquid 6 (a region denoted by a sign U in Fig. 8) that is formed by four adhesion regions S. Accordingly, the adhesion region U is larger than the adhesion region T generated by using the nozzle 2. This is because the nozzle 2A includes the four spraying parts 13A to 13D. With the above configuration, the nozzle 2A enables both a reduction in the variation in an adhesion amount of the liquid 6 within the adhesion region T, as with the case of the nozzle 2, and spray of the liquid 6 in the spray region P over a larger range.

Reference Signs List

[0040]

2, 2A: Nozzle

5: Spray target object

6: Liquid

11: Nozzle body

13, 13A, 13B, 13C, 13D: Spraying part

14: Liquid spray hole (spray hole)

17: Gas ejecting part (route control part)

P: Spray target surface

REFERENCES CITED IN THE DESCRIPTION

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This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

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- DE102009005528A1 [0004]

Patentkrav

1. Dyse, som består af:

et dyselegeme (11); og

5 mindst tre sprøjtedelege (13, 13A, 13B, 13C, 13D), der er anbragt i dyselegemet (11) og indrettet til at sprøjte en væske (6) på en sprøjtemålsoverflade (P), hvor væsken (6) er en vandig urinstofopløsning (6),

10 hvor de mindst tre sprøjtedelege (13, 13A, 13B, 13C, 13D) er anbragt således, at de ikke er på linje med hinanden i et planbillede, fra en position, hvor de mindst tre sprøjtedelege (13, 13A, 13B, 13C, 13D) er anbragt, af dyselegemet (11),

hvor de mindst tre sprøjtedelege (13, 13A, 13B, 13C, 13D) hver især omfatter: et sprøjtehul (14), gennem hvilket væsken (6) sprøjtes udad fra dyselegemet (11); og

15 en rutestyringsdel (17) til styring af en rute for væsken (6), der sprøjtes fra sprøjtehullet (14),

hvor dysen (2, 2A) som rutestyringsdel (17) omfatter gasudstødende dele (17), der er parret sammen for at blæse en gas mod væsken (6), der sprøjtes fra sprøjtehullet (14),

20 hvor væsken (6), der sprøjtes fra sprøjtehullet (14), klæber til sprøjtemålsoverfladen (P) for at danne et adhæsionsområde (S), og

rutestyringsdelen (17) styrer væskens (6) rute, således at adhæsionsområdet (S) er kortere i en første retning (70) udad fra en central del af en gruppe af en flerhed af adhæsionsområder (S) hvor flerheden af adhæsionsområder (S) hver især er adhæsionsområdet (S), end i en anden retning (80) vinkelret på den første retning (70).

2. Dyse ifølge krav 1, hvor de gasudstødende dele (17), der er parret sammen, hver især omfatter et gassprøjtehul (171) til sprøjtning af gassen, og

gassprøjtehullet (171) er tilvejebragt i en ydre periferisk del af en tilsvarende af de mindst tre sprøjtede dele (13, 13A, 13B, 13C, 13D) og på en lige linje, der går gennem midten af dyselegemet (11) og sprøjtehullet (14).

5 **3.** Dyse ifølge et hvilket som helst af kravene 1 til 2, hvor de mindst tre sprøjtede dele (13, 13A, 13B, 13C, 13D) er anbragt med jævne mellemrum på omkredsen af den samme cirkel med et centrum, der er centrum af dyselegemet (11).

4. Hydrolyseindretning, som omfatter:

10 en beholder (1) til opbevaring af en katalysator til acceleration af en hydrolyse-reaktion;

en dyse (2, 2A) ifølge et hvilket som helst af kravene 1 til 3, der er anbragt inde i beholderen og indrettet til at sprøjte katalysatoren med den vandige urinstofopløsning (6); og

15 et rør (4) til at forsyne dysen (2, 2A) med den vandige urinstofopløsning (6).

DRAWINGS

Drawing

FIG. 1

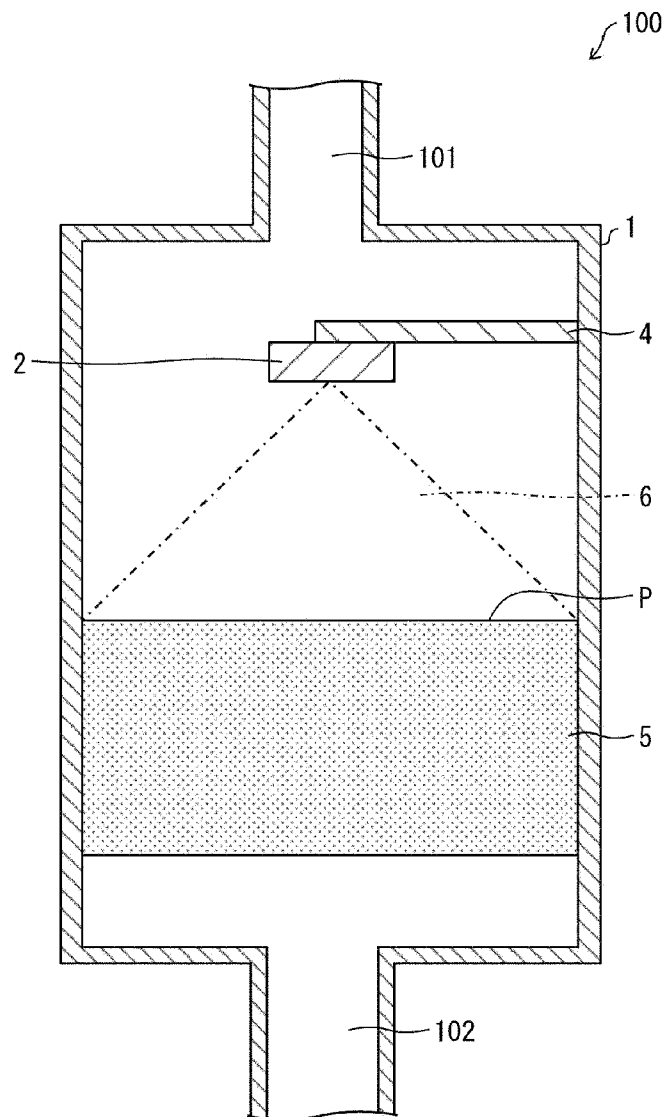


FIG. 2

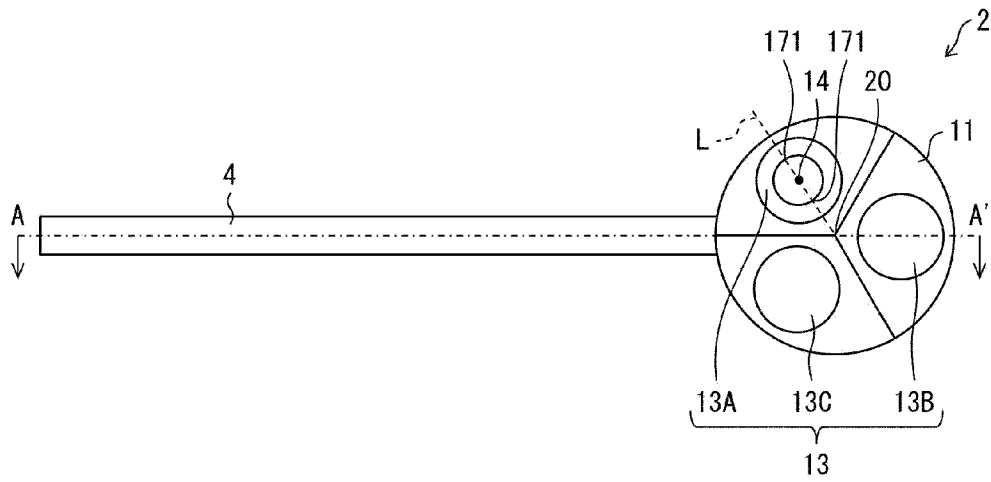


FIG. 3

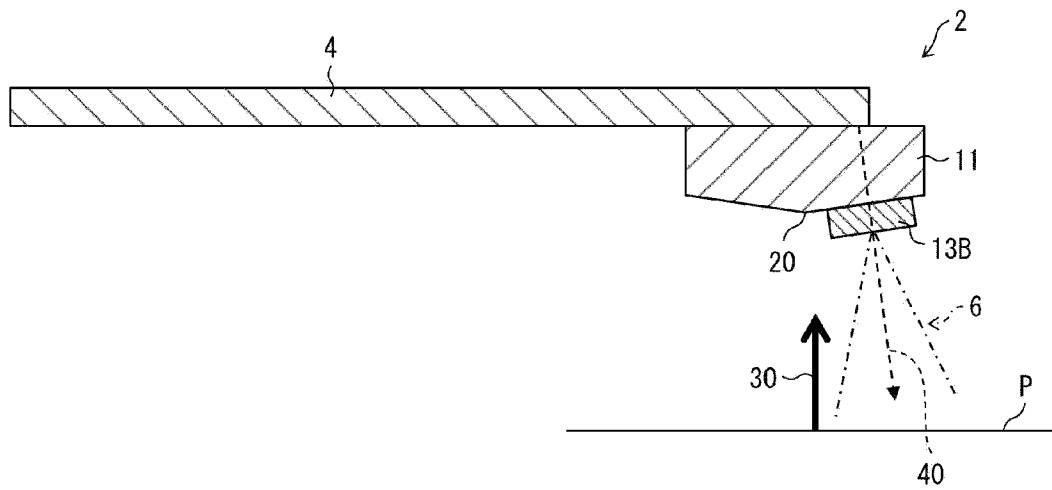


FIG. 4

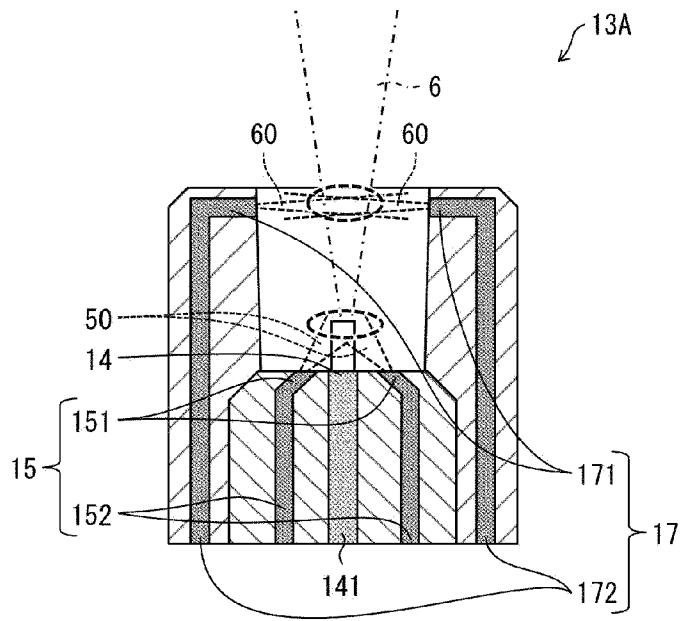


FIG. 5

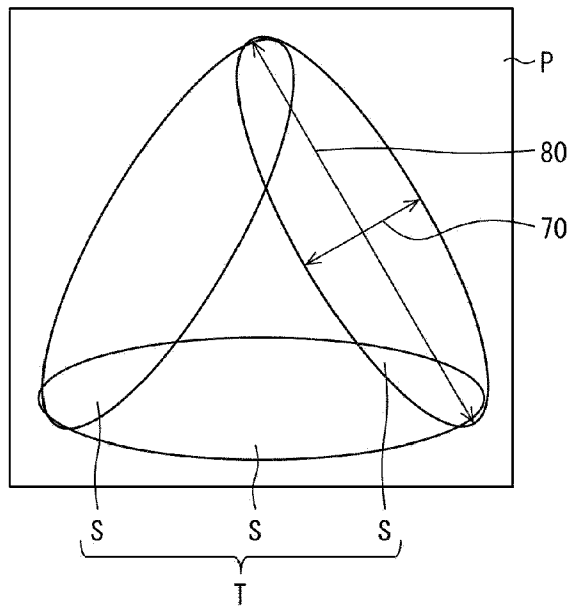


FIG. 6

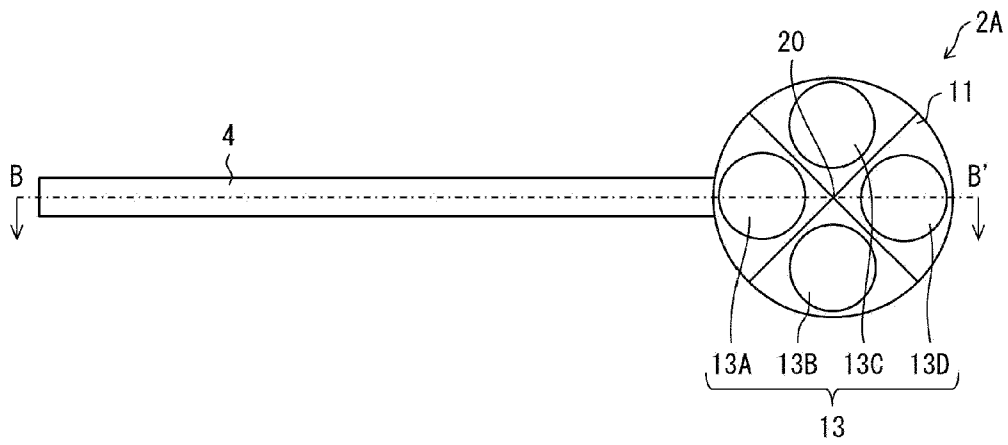


FIG. 7

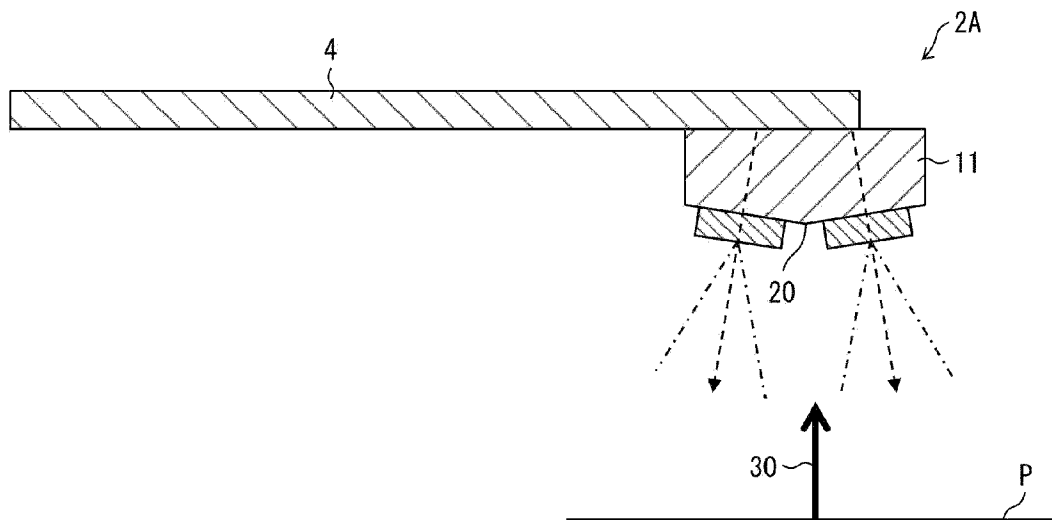


FIG. 8

