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(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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(54) Title: MIXER AND DOSER CONE ASSEMBLY

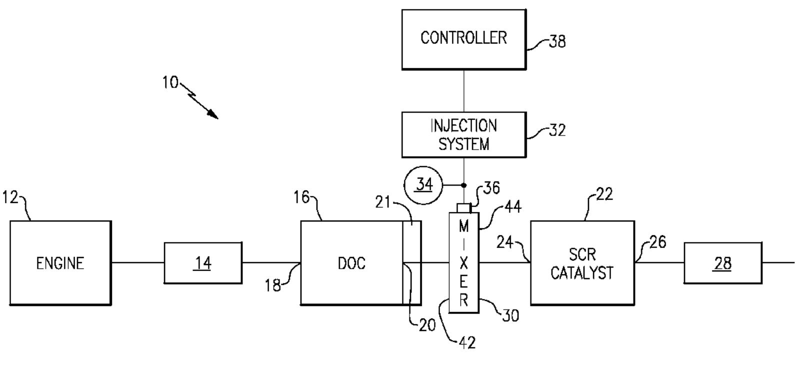


FIG.1

(57) Abstract: A vehicle exhaust system includes an exhaust component defining an engine exhaust gas passageway and which includes an opening. A doser defines a doser axis and extends to a doser tip that is configured to spray a reducing agent into the engine exhaust gas passageway through the opening. A cone has a base end positioned adjacent the opening such that an annular gap is formed within the exhaust component around the doser tip. Exhaust gas is directed into the base end of the cone through the annular gap in a direction transverse to the doser axis. This configuration reduces deposit formation while still allowing the reducing agent to be thoroughly mixed with engine exhaust gases prior to introduction of the mixture into a downstream exhaust component.

WO 2015/187128 A1

13FECT104; 67,341-3011 PCT

MIXER AND DOSER CONE ASSEMBLY

BACKGROUND OF THE INVENTION

[0001] An exhaust system conducts hot exhaust gases generated by an engine through various exhaust components to reduce emissions and control noise. The exhaust system includes an injection system that injects a diesel exhaust fluid (DEF), or a reducing agent such as a solution of urea and water for example, upstream of a selective catalytic reduction (SCR) catalyst. A mixer is positioned upstream of the SCR catalyst and mixes engine exhaust gases and products of urea transformation. The injection system includes a doser that sprays the urea into the exhaust stream. The urea should be transformed as much as possible into ammonia (NH_3) before reaching the SCR catalyst. Thus, the droplet spray size plays an important role in reaching this goal.

[0002] The industry is moving towards providing more compact exhaust systems, which results in reduced volume of the system. Systems that spray larger size droplets may not be able to provide adequate transformation of urea when used in more compact system configurations. As such, smaller droplet size dosers are required for these more compact configurations.

[0003] The smaller the droplet size, the more effective the transformation into ammonia is, due to the increased surface contact area. However, the spray generated by small droplet dosers is very sensitive to recirculation flow. Typically, an area located at a tip of the doser has a vortex of recirculating flow. This vortex pushes the spray droplets towards the walls of the mixer and onto the tip of the doser, which creates deposit initiation sites. The deposits build up over time and can adversely affect system operation. For example, there may be a lower ammonia uniformity index, there may be an increased pressure drop across the mixer, or higher ammonia emissions during active diesel particulate filter (DPF) regeneration.

SUMMARY OF THE INVENTION

[0004] In one exemplary embodiment, a vehicle exhaust system includes an exhaust component defining an engine exhaust gas passageway, which includes an opening. A doser defines a doser axis and extends to a doser tip that is configured to spray a reducing agent into the engine exhaust gas passageway through the opening. A cone has a base end positioned adjacent the opening such that an annular gap is formed within the exhaust component around the doser tip. Exhaust gas is directed into the base end of the cone through the annular gap in a direction transverse to the doser axis.

[0005] In a further embodiment of the above, the exhaust gas is directed into the base end of the cone in an evenly distributed manner about the annular gap in a direction that is perpendicular to the doser axis.

[0006] In a further embodiment of any of the above, the exhaust component comprises a mixer.

[0007] In another exemplary embodiment, a method for injecting a reducing agent into an exhaust component includes the steps of; providing an exhaust component defining an engine exhaust gas passageway, the exhaust component including an opening; mounting a doser to the exhaust component, the doser extending to a doser tip that is configured to inject a reducing agent along a doser spray axis and into the engine exhaust gas passageway through the opening; and positioning a base end of a cone adjacent the opening such that an annular gap is formed within the exhaust component around the doser tip, and wherein exhaust gas is directed into the base end of the cone through the annular gap in a direction transverse to the doser spray axis.

[0008] These and other features of this application will be best understood from the following specification and drawings, the following of which is a brief description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Figure 1 schematically illustrates one example of an exhaust system with a mixer according to the subject invention.

[0010] Figure 2 is a schematic side cross-sectional view of a cone as used in a doser sub-assembly.

[0011] Figure 3 is an end view of a portion of an inlet baffle of the mixer.

[0012] Figure 4 is end view of the cone showing entry and exit points of exhaust gas flow.

[0013] Figure 5 shows an example flow pattern which directs the spray away from walls of the cone.

[0014] Figure 6 shows a perspective view of the doser sub-assembly.

[0015] Figure 7 shows a side cross-sectional view of the doser sub-assembly.

[0016] Figure 8 is an end view of the doser sub-assembly as installed within a mixer.

[0017] Figure 9 is an end perspective view of the doser sub-assembly as located between inlet and outlet baffles of the mixer.

DETAILED DESCRIPTION

[0018] Figure 1 shows a vehicle exhaust system 10 that conducts hot exhaust gases generated by an engine 12 through various upstream exhaust components 14 to reduce emission and control noise as known. The various upstream exhaust components 14 can include one or more of the following: pipes, filters, valves, catalysts, mufflers etc.

[0019] In one example configuration, the upstream exhaust components 14 direct engine exhaust gases into a diesel oxidation catalyst (DOC) 16 having an inlet 18 and an outlet 20. Downstream of the DOC 16 there may be a diesel particulate filter (DPF) 21 that is used to remove contaminants from the exhaust gas as known. Downstream of the DOC 16 and optional DPF 21 is a selective catalytic reduction (SCR) catalyst 22 having an inlet 24 and an outlet 26. The outlet 26 communicates exhaust gases to downstream exhaust components 28. Optionally, component 22 can comprise a catalyst that is configured to perform a selective catalytic reduction function and a particulate filter function. The various downstream exhaust components 28 can include one or more of the following: pipes, filters, valves, catalysts, mufflers etc. These upstream 14 and downstream 28 components can be mounted in various different configurations and combinations dependent upon vehicle application and available packaging space.

[0020] A mixer 30 is positioned downstream from the outlet 20 of the DOC 16 or DPF 21 and upstream of the inlet 24 of the SCR catalyst 22. The upstream catalyst and downstream catalyst can be in-line or in parallel. The mixer 30 is used to generate a swirling or rotary motion of the exhaust gas.

[0021] An injection system 32 is used to inject a reducing agent, such as a solution of urea and water for example, into the exhaust gas stream upstream from the SCR catalyst 22 such that the mixer 30 can mix the urea and exhaust gas thoroughly together. The injection system 32 includes a fluid supply 34, a doser 36, and a controller 38 that controls injection of the urea as known.

[0022] The mixer 30 comprises a mixer body having an inlet end 42 configured to receive the engine exhaust gases and an outlet end 44 to direct a mixture of swirling engine exhaust gas and products transformed from urea to the SCR catalyst 22. Examples of a mixer 30 that can be used in the exhaust system 10 can be found in US 2012/0216513 and co-pending US application numbers 12/57693, 12/57886, and 12/57768 which are also assigned to the assignee of the present application and are hereby incorporated by reference.

[0023] As shown in Figure 6, a doser sub-assembly 100 includes a top plate 50 with an opening 52. A doser mount structure 51 abuts against the top plate 50 and holds the doser 36. The doser sub-assembly 100 includes a cylindrical housing 70 with at least one opening 71.

[0024] As shown in Figure 2, the doser 36 defines a doser axis A. The doser tip 54 is configured to spray the reducing agent into the mixer 30 through the opening 52. A base end 56 of a cone 58 is positioned adjacent the opening 52 such that an annular gap 60 is formed within the doser sub-assembly 100 around the doser tip 54. Exhaust gas is directed to enter the base end 56 of the cone 58 through the annular gap 60 in a direction transverse to the doser axis A.

[0025] The cone 58 extends to a distal end 62 that is defined by a diameter that is greater than a diameter of the base end 56. The cone 58 has an outer surface 64 and an inner surface 66. The base end 56 comprises a tubular section 68 of a generally constant diameter D1 and the distal end 62 is defined by a diameter D2 that is greater than D1. The inner 66 and outer 64 surfaces of the cone 58 taper outwardly from the tubular section 68 to the distal end 62. In one example, the cone 58 is concentric with the doser axis A. In one example, the cone 58 may have a tulip shape.

[0026] As shown in Figure 2, the exhaust gas is directed to enter the base end 56 of the cone 58 in an evenly distributed manner about the annular gap 60 in a direction that is perpendicular to the doser axis A. The cylindrical housing 70 is fixed to the top plate 50 and surrounds at least a portion of the cone 58. The opening 52 is formed in the top plate of the doser-subassembly 100. The housing 70 includes at least one opening 71 to direct exhaust gas in a first flow direction F1 against the outer surface 64 of the cone 58. The exhaust gas then flows in a second flow direction F2 along the outer surface 64 of the cone 58 toward the base end 56. The exhaust gas then flows in a third flow direction F3 to enter the annular gap 60 extending circumferentially around the base end 56. After flowing through the annular gap 60, the exhaust gas flows in a fourth flow direction F4 where it mixes with the reducing agent and to exits the cone 58 at the distal end 62. In one example, the fourth flow direction F4 extends generally along the doser axis A and is opposite of the second flow direction F2. Further, the third flow direction F3 is perpendicular to the fourth flow direction F4.

[0027] As shown in Figure 8, the doser sub-assembly 100 is positioned between an inlet baffle 80 and an outlet baffle 81 of the mixer 30. The inlet baffle 80 is at the upstream end 42 of the mixer 30. The inlet baffle 80 is configured to initiate swirling of the primary exhaust gas flow through the mixer 30.

[0028] In one example, the inlet baffle 80 includes a large inlet opening 82 (Figure 3) that receives the majority of the exhaust gas, and which is configured to initiate the swirling motion. The inlet baffle 80 also includes a plurality of perforations, slots, or additional inlet openings 84 that ensure optimal homogenization of exhaust gases and reduces back pressure.

[0029] The inlet baffle 80 includes one or more openings 90 that direct a small portion of exhaust gas away from the primary flow path and toward the outer surface 64 of the cone 58 due to the openings 71 located in the housing 70. In one example, three openings 90a, 90b, 90c are used to direct exhaust gas toward the outer surface 64 of the cone 58. The openings 90 and 71 facilitate an even distribution of the gas around the base of the cone 58 (Figure 4) such that an evenly distributed flow enters the annular gap 60. In one example, the openings 90a, 90b, 90c are spaced apart from each other about an outer peripheral edge of the inlet baffle 80.

[0030] The housing 70 doser sub-assembly 100 is shown in greater detail in Figure 6. In one example, the housing 70 comprises a cylindrical body that completely surrounds the cone 58. The housing 70 includes a plurality of slots 71 that are spaced circumferentially about the cylindrical body. In one example, the number of slots 71 corresponds in number to the number of openings 90a, 90b, and 90c that are in the inlet baffle 80.

[0031] Figure 7 shows flow in the first direction F1 entering through the slots 71 of the housing 70 and impacting against the outer surface of the cone 58, which forces the flow in the second direction F2 toward a base of the cone 58. Flow then enters the interior of the cone evenly distributed through the gap 60 in the third direction F3. Flow exits the distal end of the cone 58 in the fourth direction F4. Figure 8 shows the flow exiting from the cone 58 at a position between the inlet 80 and outlet 81 baffles.

[0032] As shown in Figure 9, the mixer 30 includes one or more deflectors 83. The deflectors 83 assist in guiding the flow through the annular gap 60. In one example, at least one deflector 83 is associated with each of the openings 90a, 90b, and 90c in the inlet baffle 80 to direct the flow toward the cone 58 as desired.

[0033] The subject invention deviates a small portion of the main exhaust gas stream and reintroduces this exhaust flow in a direction that is perpendicular to a spray direction along the doser axis A. The reintroduction of the exhaust gas is evenly distributed about the annular gap 60 that surrounds the doser tip 54. This generates a trumpet-shaped flow pattern (Figure 5) that pushes spray droplets away from the tip 54 and away from the inner surface 66 of the cone 58. Further, this flow configuration removes the recirculation zone near the doser tip found in prior designs. The core of the trumpet shape also protects the doser tip 54 to avoid any disruption of the spray. Further, it is important to control the amount of exhaust flow introduced into the annular gap 60 to avoid disrupting the spray. This type of flow configuration is especially effective for dosers that produce small droplet sized spray.

[0034] Although an embodiment of this invention has been disclosed, a worker of ordinary skill in this art would recognize that certain modifications would come within the scope of this invention. For that reason, the following claims should be studied to determine the true scope and content of this invention.

13FECT104; 67,341-3011 PCT

CLAIMS

1. A vehicle exhaust system comprising:

an exhaust component defining an engine exhaust gas passageway, the exhaust component including an opening;

a doser defining a doser axis and extending to a doser tip that is configured to spray a reducing agent into the engine exhaust gas passageway through the opening;

a cone having a base end positioned adjacent the opening such that an annular gap is formed within the exhaust component around the doser tip, and wherein exhaust gas is directed into the base end of the cone through the annular gap in a direction transverse to the doser axis.

2. The vehicle exhaust system according to claim 1 wherein the exhaust gas is directed into the base end of the cone in an evenly distributed manner about the annular gap in a direction that is perpendicular to the doser axis.

3. The vehicle exhaust system according to claim 1 wherein the base end extends to a distal end, the distal end having a greater diameter than the base end.

4. The vehicle exhaust system according to claim 1 including a housing fixed to the exhaust component and surrounding at least a portion of the cone, the housing including at least one slot to direct exhaust gas in a first direction against an outer surface of the cone, the exhaust gas then flowing in a second direction along the outer surface of the cone toward the base end, and then to flow in a third direction to enter the annular gap.

5. The vehicle exhaust system according to claim 4 wherein, after flowing through the annular gap, the exhaust gas flows in a fourth direction to exit the cone.

6. The vehicle exhaust system according to claim 5 wherein the fourth direction extends generally along the doser axis.

7. The vehicle exhaust system according to claim 5 wherein the third direction is perpendicular to the fourth direction.

8. The vehicle exhaust system according to claim 1 wherein the cone is concentric with the doser axis.

9. The vehicle exhaust system according to claim 1 wherein the exhaust component comprises a mixer.

10. The vehicle exhaust system according to claim 9 wherein the opening is positioned downstream of an inlet baffle of the mixer.

11. The vehicle exhaust system according to claim 10 including a housing that surrounds the cone, the housing including a plurality of circumferentially spaced slots, and wherein the inlet baffle includes a primary opening that directs a majority of an exhaust gas stream through the mixer and a plurality of openings to deviate a small portion of the exhaust gas stream toward the housing and through the slots against an outer surface of the cone.

12. The vehicle exhaust system according to claim 11 wherein the plurality of openings comprises at least three openings that are spaced apart from each other about an outer peripheral edge of the inlet baffle.

13. The vehicle exhaust system according to claim 12 wherein the base end extends to a distal end, the distal end having a greater diameter than the base end, and wherein inlet flow is directed into the annular gap only via the three openings and slots and wherein the cone has a single exit via the distal end.

14. A method for injecting a reducing agent into an exhaust component comprising the steps of:

providing an exhaust component defining an engine exhaust gas passageway, the exhaust component including an opening;

mounting a doser to the exhaust component, the doser extending to a doser tip that is configured to inject a reducing agent along a doser spray axis and into the engine exhaust gas passageway through the opening; and

positioning a base end of a cone adjacent the opening such that an annular gap is formed within the exhaust component around the doser tip, and wherein exhaust gas is directed into the base end of the cone through the annular gap in a direction transverse to the doser spray axis.

15. The method according to claim 14 wherein exhaust gas enters the annular gap in an evenly distributed manner about the doser spray axis.

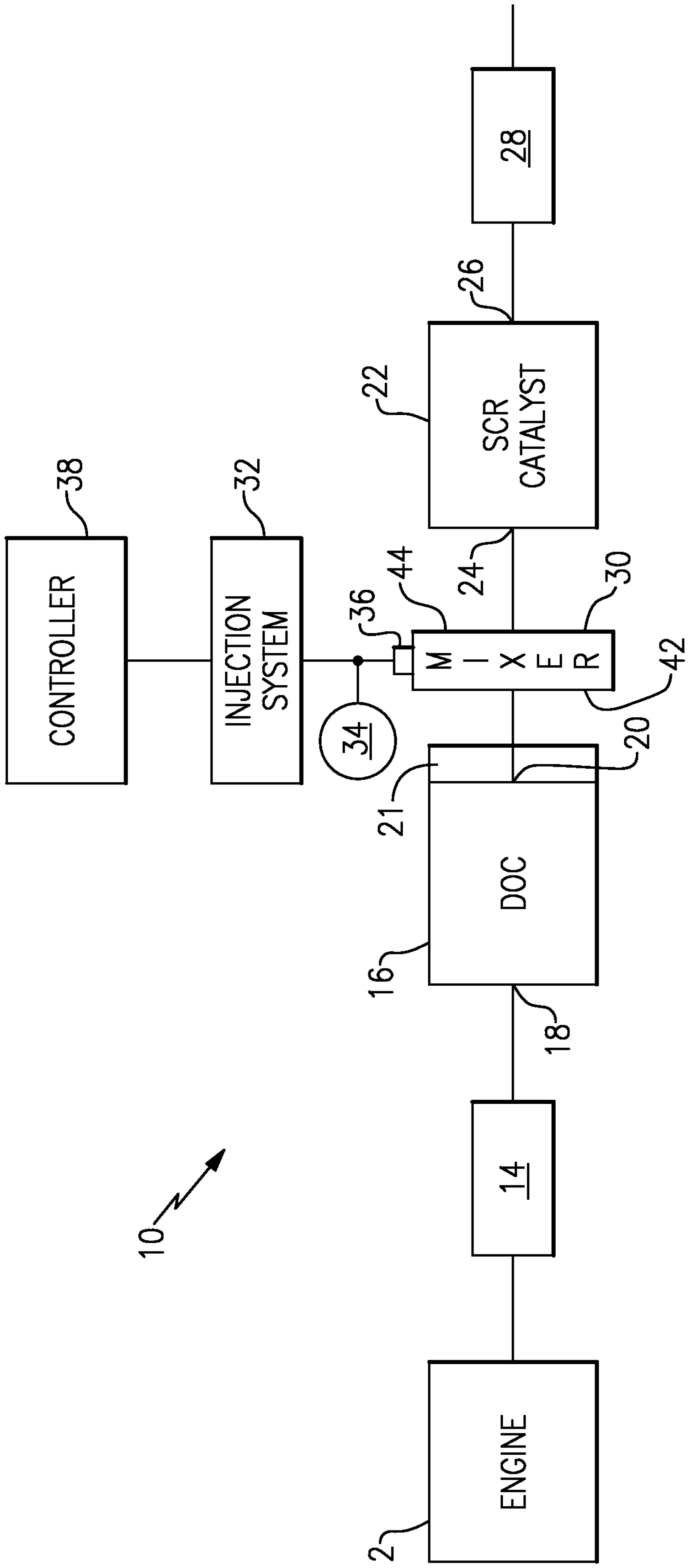
16. The method according to claim 15 including fixing a housing to the exhaust component to surround at least a portion of the cone, the housing including at least one slot to direct exhaust gas in a first direction against an outer surface of the cone, the exhaust gas then flowing in a second direction along the outer surface of the cone toward the base end, and then the exhaust gas flowing in a third direction to enter the annular gap.

17. The method according to claim 16 wherein, after flowing through the annular gap, the exhaust gas flows in a fourth direction to exit the cone.

18. The method according to claim 17 wherein the fourth direction extends generally along the doser spray axis.

19. The method according to claim 17 wherein the third direction is perpendicular to the fourth direction.

20. The method according to claim 14 including surrounding the cone with a housing that includes a plurality of circumferentially spaced slots, and wherein the exhaust component comprises a mixer including an inlet baffle, and including forming the inlet baffle to include a primary opening that directs a majority of an exhaust gas stream through the mixer and a plurality of openings to deviate a small portion of the exhaust gas stream toward the housing and through the slots against an outer surface of the cone.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ENGINE
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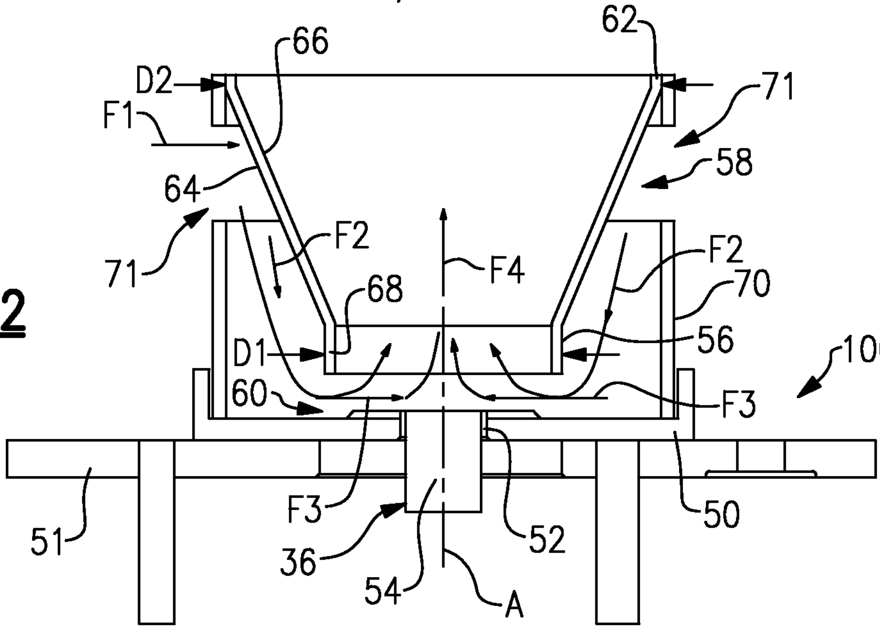
FIG.1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F2
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D1
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36
54
A

FIG.2

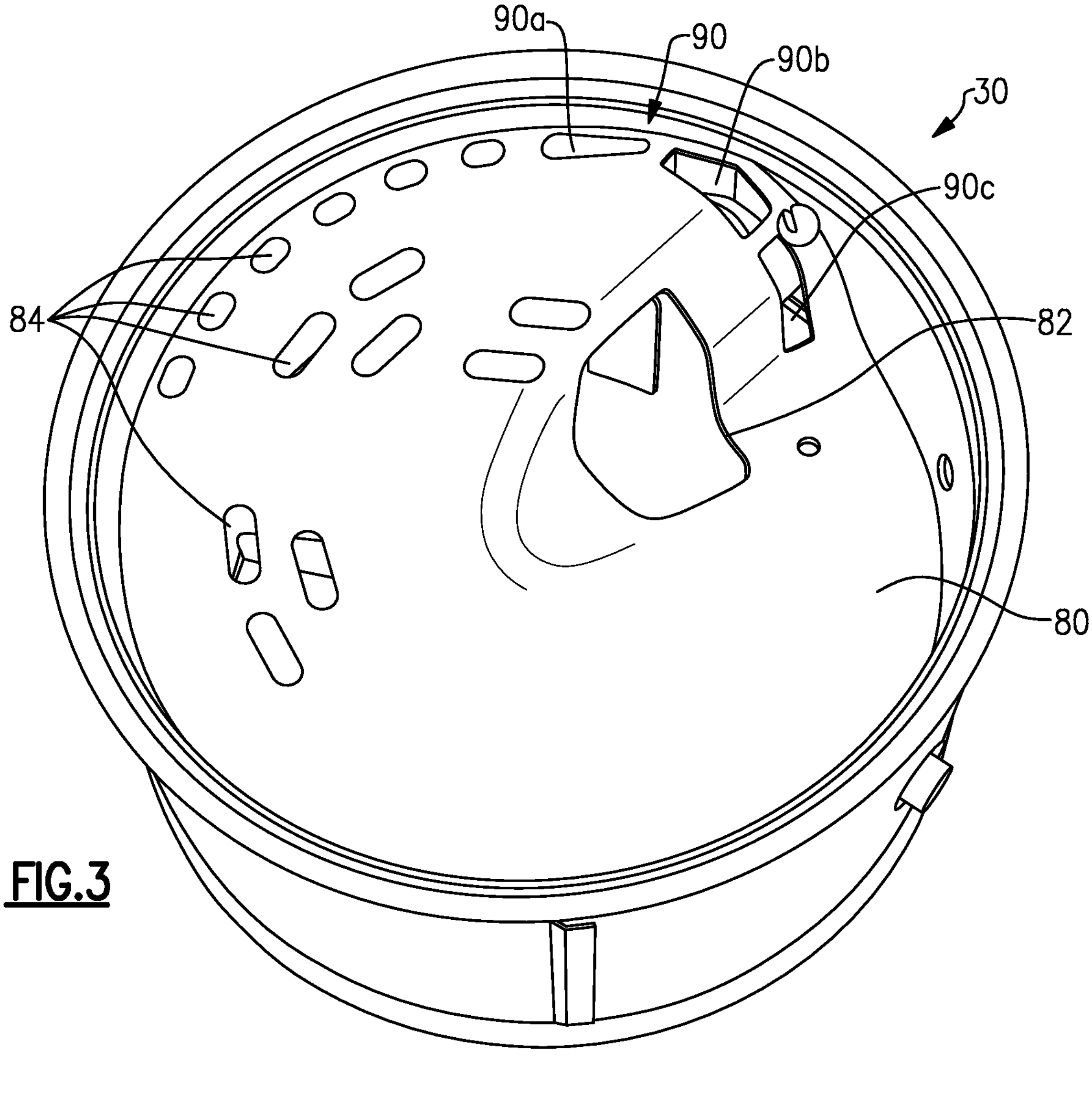
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FIG.3

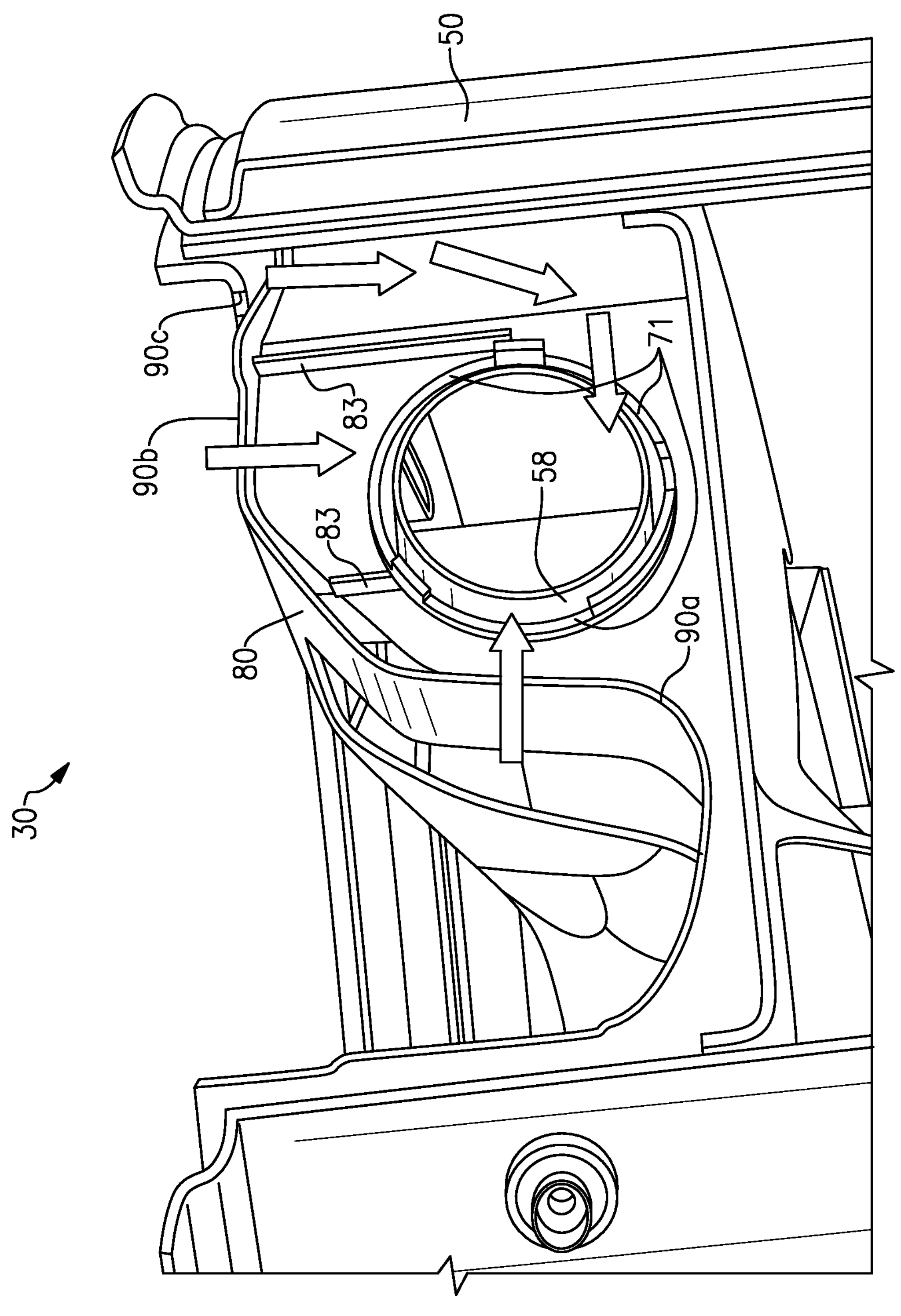


FIG.4

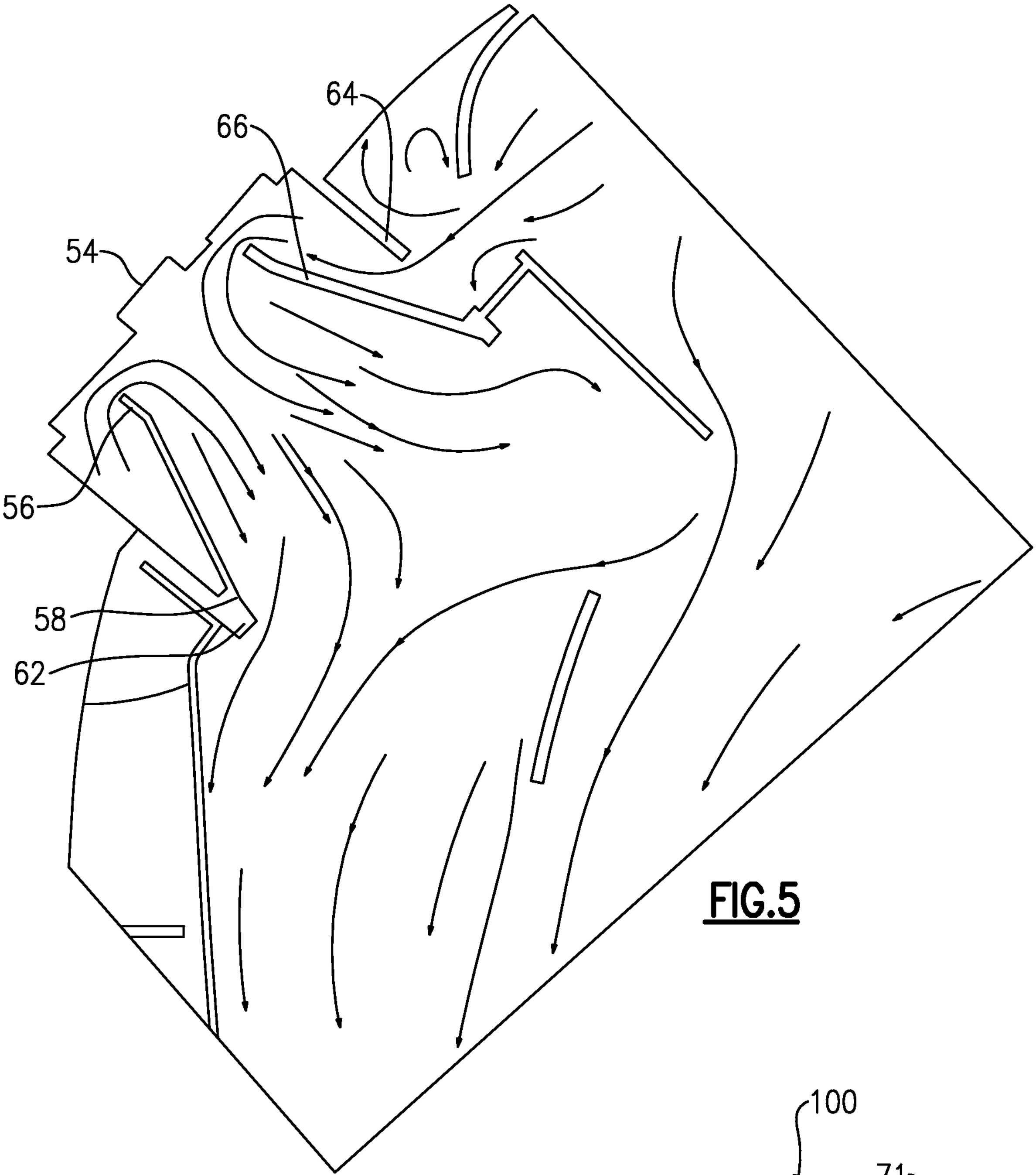


FIG.5

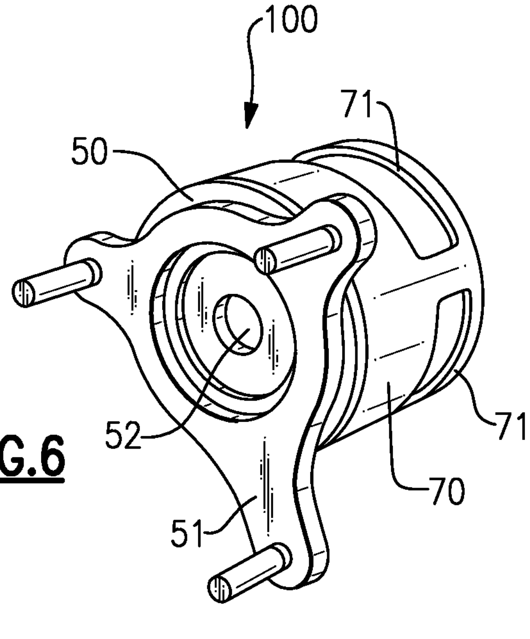
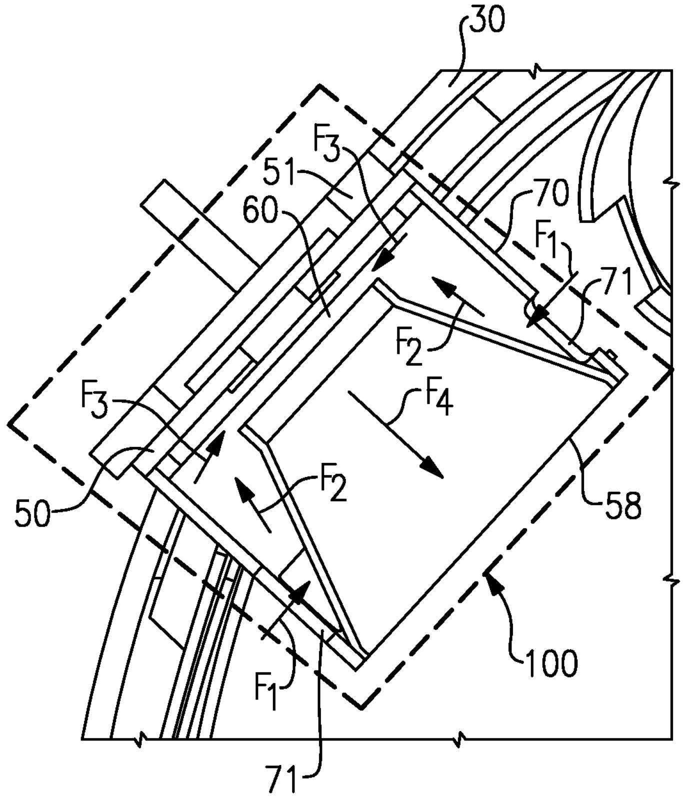


FIG.6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F1
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FIG.7

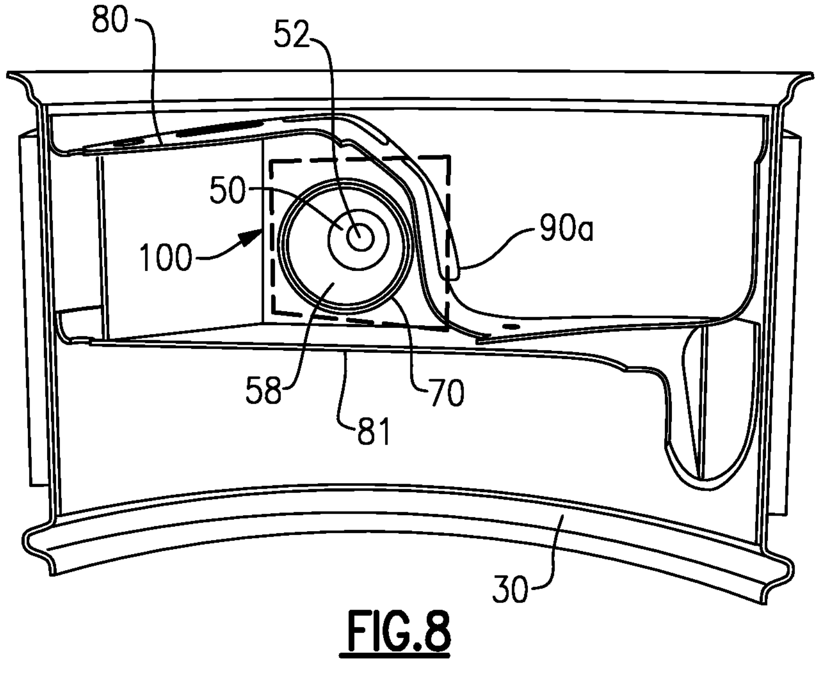
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FIG.8

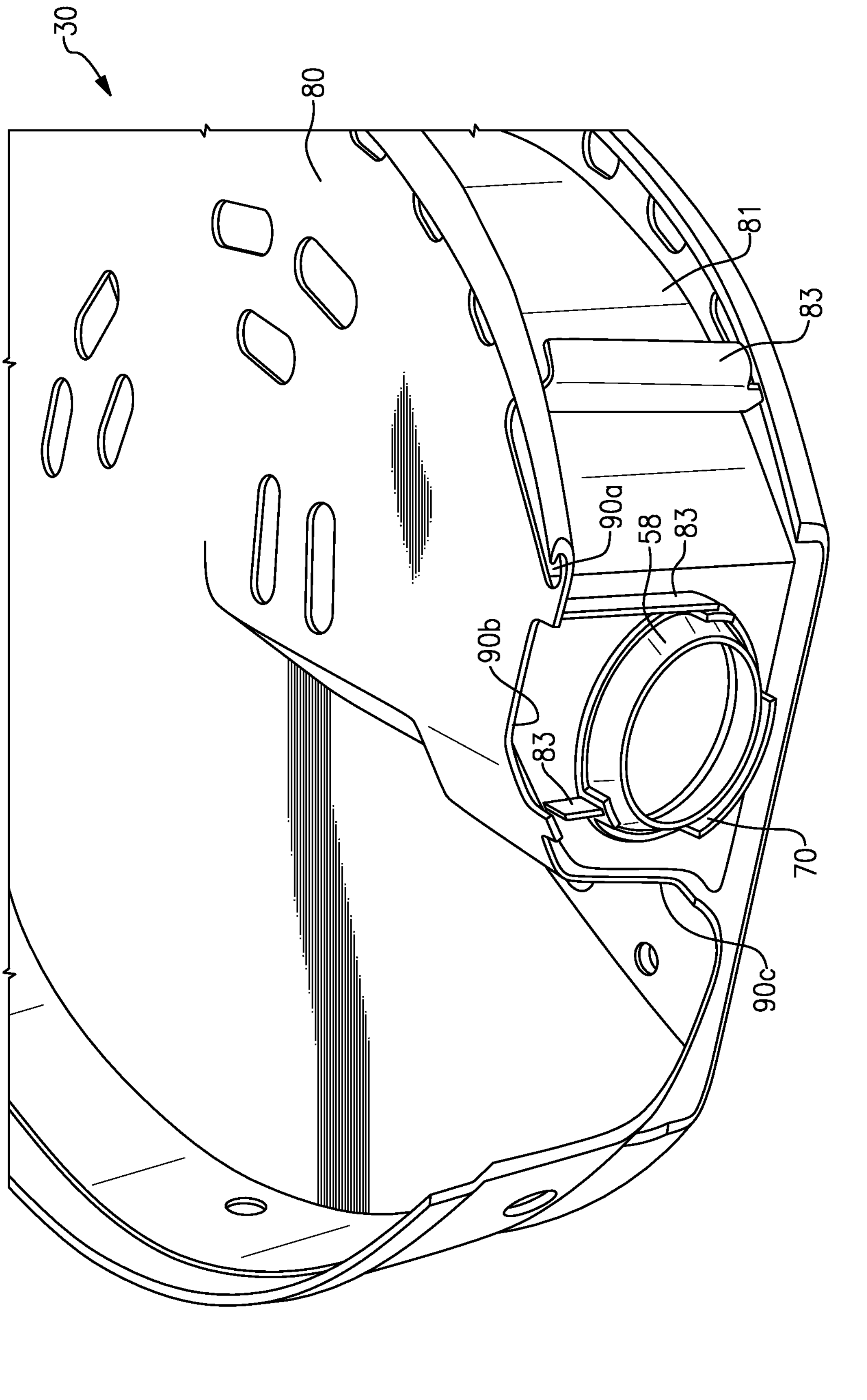

FIG.9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/040588

A. CLASSIFICATION OF SUBJECT MATTER

F01N 3/20(2006.01)i, F01N 3/36(2006.01)i, F01N 13/08(2010.01)i, B01D 53/94(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F01N 3/20; F01N 3/00; F01N 3/10; B01F 3/04; F01N 1/00; F01N 3/025; F02B 33/40; F01N 9/00; F01N 3/36; F01N 13/08; B01D 53/94

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: mixer, doser, cone, gap

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2010-0212301 A1 (DE RUDDER et al.) 26 August 2010 See paragraphs [0030]-[0044]; and figures 1-2.	1-20
A	US 2009-0064668 A1 (HERRICK et al.) 12 March 2009 See paragraphs [0035]-[0040]; and figure 2A.	1-20
A	US 2013-0291519 A1 (PATEL et al.) 07 November 2013 See paragraphs [0018]-[0022]; and figure 1.	1-20
A	US 6,382,600 B1 (MAHR, BERND) 07 May 2002 See column 2, line 58 - column 3, line 38; and figure 1.	1-20
A	US 7,980,063 B2 (COOKE, MICHAEL P.) 19 July 2011 See column 6, line 54 - column 8, line 43; and figures 1-2.	1-20

☐ Further documents are listed in the continuation of Box C.   ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
05 February 2015 (05.02.2015)	**06 February 2015 (06.02.2015)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea
Facsimile No. ++82 42 472 3473

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HAN, Joong Sub
Telephone No. +82-42-481-5606

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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