

SUPERCHARGER MESH ASSEMBLY

Field

[001] This application relates to superchargers and mesh assemblies that can dampen noise, vibration, and harshness ("NVH") within a supercharger housing.

Background

[002] Air pulsation is a dominant noise source in automotive applications. To damp the noise, reactive acoustic elements, such as Helmholtz resonators, have been used in vehicle intake systems to damp low frequency narrow band noise. But the reactive acoustic elements have limited application in vehicle intake systems because they can be large in size, requiring substantial volume. Dissipative elements, like foam or fiberglass can be used, however, they are effective only with high frequency noise. Foam and fiberglass have also been avoided because they can contaminate the air flow, potentially damaging the supercharger or engine in addition to reducing performance.

[003] Also, existing devices that dampen NVH are only capable of damping certain ranges of frequencies. A single supercharger can produce NVH having a wide range of low and high frequencies.

SUMMARY

[004] The disclosure overcomes the above disadvantages and improves the art by way of a supercharger housing having an inlet wall cavity comprising a mesh assembly.

[005] A supercharger housing assembly comprises a housing. The housing comprises an outlet opening. The outlet opening is perpendicular to an inlet opening. The housing comprises an inlet wall with an inlet opening located in the inlet wall, at least two rotor mounts located in the inlet wall, an inlet wall cavity located in the inlet wall, and a mesh assembly located in the inlet wall cavity, wherein the mesh assembly comprises openings.

[006] A method of assembling a supercharger housing comprises the step of attaching a mesh assembly to an inlet wall cavity in an inlet wall of a supercharger housing.

[007] Additional objects and advantages will be set forth in part in the description which follows, and in part will be obvious from the description, or may be

learned by practice of the disclosure. The objects and advantages will also be realized and attained by means of the elements and combinations particularly pointed out in the appended claims.

[008] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the claimed invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[009] Figure 1 is a view of a supercharger housing assembly.

[010] Figure 2 is a view of a mesh assembly.

[011] Figure 3 is a view of a mesh assembly and a cover plate.

[012] Figure 4 is a view of a mesh assembly located in an inlet wall cavity in a supercharger housing assembly.

DETAILED DESCRIPTION

[013] Reference will now be made in detail to the examples, which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts. Directional references such as “left,” “right,” “top,” and “bottom” are for ease of reference to the figures.

[014] Figure 1 shows a supercharger housing assembly 100 comprising a housing 101, including an inlet 140 with an inlet opening 102, and an outlet 130 with an outlet opening 103. The outlet opening 103 is perpendicular to inlet opening 102.

[015] During operation of a supercharger, air flows through inlet opening 102 to outlet opening 103. Air is transferred through the inner cavity 150 by rotors (not shown) spinning at the same speed and in opposite directions, one clockwise and the other counterclockwise. The rotors extend laterally along axis X from rotor mounts 110A, 110B.

[016] The supercharger housing assembly 100 includes an inlet wall 104. First and second rotor mounts 110A, 110B are located in the inlet wall. The inlet wall 104 can be an integral part of the housing 101, formed, for example, by casting, machining, three-dimensional printing, or some combination of casting, machining, and three-dimensional printing. Inlet wall 104 can also be formed separate from the housing 101. For example, one could separately cast, machine, or print inlet wall 104, then affix inlet wall 104 to housing 101 using bolts or screws. One can also, alternatively, weld inlet

wall 104 to housing 101. One can insert the mesh assembly 200 into the inlet wall cavity 105 before or after attaching inlet wall 104 to housing 101. Also, one might print, using a three-dimensional printer, inlet wall 104 and mesh assembly 200 together.

[017] Inlet wall 101 comprises an inlet wall cavity 105. Inlet wall cavity 105 can be located between rotor mounts 110A, 110B and outlet opening 103 along the Y axis. The inlet wall cavity 105 need not be the same pyramidal shape as depicted in Figure 1. For example, it can be rectangular, circular, oval-shaped, or any other shape. Inlet wall cavity 105 can be deeper in depth along the X axis, or can be longer along any of the axes X, Y, or Z.

[018] A mesh assembly can be located in inlet wall cavity 105. Figure 2 shows an example of a mesh assembly 200 that can fit inside inlet wall cavity 105.

[019] In Figure 1, inlet wall cavity 105 includes a back face 106 and a recessed face 120. The distance of back face 106 from recessed face 120 depends on depth on inlet wall cavity 105 along the X axis. When selecting the depth of back face 106 and other dimensions of inlet wall cavity 105, one can consider, among other factors, the type and frequency of NVH to be dampened and the size of the mesh assembly. Recessed face 120 is optional. In the arrangement in Figure 1, it can serve to hold a cover plate, for example, a cover plate 300 as shown in Figure 3.

[020] Inlet wall cavity 105 can include a side slot 107 and lower slot 108. Side slot 107 can have a corresponding side slot (not shown) located a distance away along the Z axis. Lower slot 108 can be a single slot or include multiple slots.

[021] Side slot 107 and lower slot 108 help keep a mesh assembly (e.g., mesh assembly 200 in Figure 2) from moving in directions along the Y and Z axes. The housing 101 need not include a side slot 107 or lower slot 108 to hold a mesh assembly in place. For example, the mesh assembly 200 might be press fit into inlet wall cavity 105 in such a manner that it does not move during operation. Also, one can first shrink the mesh assembly 200 by cooling it, then fit it into inlet wall cavity 105, where it expands as it increases in temperature to prevent it from moving along axes X, Y, and Z during operation. The mesh assembly 200 can also be formed as an integral part of housing 101, for example, by using a three-dimensional printer to integrate housing 101 with mesh assembly 200. Such a printing step avoids need for retaining the mesh assembly 200 via cover plate 300.

[022] Figure 2 shows a mesh assembly 200. It can include an array of wires, including horizontal wire 201A and vertical wire 201B. Horizontal wire 201A need not be

perfectly horizontal or perfectly parallel to axis Z. And vertical wire 201B need not be perfectly vertical or perfectly parallel to axis Y. The wires can be arranged diagonally in a lattice-like fashion. They can also be curved or positioned in a variety of other arrangements. The cross-section shape of horizontal wire 201A and vertical wire 201B can be circular, oval-shaped, square, rectangular, or any other shape. The array of wires can conform to the shape of inlet wall cavity 105.

[023] When multiple wires cross, for example at point P, they form openings, like mesh opening 210. The mesh openings 210 in the mesh assembly 200 of Figure 2 are quadrilateral in shape, but the mesh openings 210 can be triangular, circular, oval-shaped, hexagonal, or other shapes. The mesh openings 210 need not be the same shape or size across the mesh. The array of wires can comprise multiple layers of wires, as illustrated, with uniform wire distribution among the layers. Or, the distribution of shapes for the mesh openings 210 can differ within and or among the layers. For Example, layer L1 can have the openings of differing heights, as shown. Layer L2 could have openings of different proportion than layer L1. Layer 3 could have openings of a shape different than layers L1 or L2. Or, any combination of the above variations in size, shape, proportion among the openings 210 in the layers L1, L2, L3. As a further example, the mesh can be bisected along a plane in the Y axis shown in Figure 2. The mesh can comprise a mirror image about the plane in the Y axis. This would make the openings comprise a first pair of openings of similar size and a second pair of openings of similar size, and the size of the first pair of openings is different than the size of the second pair of openings. The leftmost opening could mirror the rightmost opening in size and shape, and stepwise inwardly toward the Y axis, the openings could differ from the previous pair of openings.

[024] The mesh assembly 200 can be formed separately from inlet wall 104, for example, by weaving wires, welding wires, three-dimensional printing, casting, stamping, among other methods of forming a mesh. It can be made of almost any material, including metal, plastic, or a composite. One can spot weld, overlapping wires to form mesh assembly 200. One might form each layer of mesh separately, then connect the layers using spot welds, adhesives, or wires.

[025] The mesh assembly 200 can have multiple layers, for example, layers L1, L2, and L3. One can join these layers, for example, using an axial wire 204 running along axis X. One can also join these layers using other methods, for example, using spot welds or adhesives. The openings, e.g., opening 210, need not be aligned from

layer to layer. Nor must the layers be made of the same material or comprise the same dimensions. Different layers of different sizes allow the mesh assembly 200 to damp NVH of different frequencies. This gives the mesh assembly 200 more capability to dampen NVH of a wider range than using just one layer or similar layers. Also, the distance D2 between layers can vary. One can select the distance D2 between the layers to fit the needs of dampening NVH.

[026] The thickness TZ of the wire in the direction along the Z axis and the thickness TX of the wire in the direction along the X axis can vary, depending on the dampening needs and available space for the mesh assembly 200. For example, the wire thickness TZ in the direction along the Z axis can be thicker than the wire thickness TX of the wire in the direction along the X axis. This arrangement is shown in Figure 2. Also, the wire thickness TZ in the direction along the Z axis can be less than or equal to the wire thickness TX in the direction along the X axis. These arrangements are not shown in Figure 2.

[027] The mesh assembly 200 in Figure 2 has side projections 202A, 202B and lower projections, e.g., lower projection 203. Side projections 202A, 202B can fit into side slots (e.g., side slot 107) in housing 101 of Figure 1. Projections 202A, 202B help to prevent the mesh assembly 200 from moving along the Y axis. Lower projection 203 can fit into lower slot 108 in housing 101 of Figure 1. Lower projection 203 helps to prevent mesh assembly 200 from moving along the Z axis. Side projections 202A, 202B and lower projection 203 are optional as one can fit the mesh assembly 200 in inlet wall cavity 105 in a manner that prevents mesh assembly 200 from moving in any direction. One can achieve this, for example, by press fitting the mesh assembly 200 into inlet wall cavity 105, temporarily shrinking mesh assembly 200 before fitting it into inlet wall cavity 105, or by using a three-dimensional printer to print mesh assembly 200 as an integral part of housing 101.

[028] Figure 3 shows a mesh assembly 200 with a cover plate 300. Cover plate 300 has an opening 301 allowing fluid (e.g., air) to flow to mesh assembly 200. One can place cover plate 300 in inlet wall cavity 105 of Figure 1 with second cover face 305 abutting recessed face 120 of inlet wall cavity 105, both shown in Figure 1. The thickness D3 of cover plate 300 can be selected so that it matches the depth on recessed face 120 so that first cover face 304 does not protrude out of inlet wall cavity 105 in the direction of the X axis, thus avoiding interference with rotor action.

[029] Cover plate 300 can be made of metal, plastic, composite, or other material suitable for use in a supercharger. Cover plate 300 in Figure 3 can include screw holes 302A, 302B, and 302C. The cover plate 300 is not limited having three screw holes. It can have more, less, or none at all. Screws 303A, 303B, and 303C can secure cover plate 300 to the housing 101 of Figure 1. Instead of using screws, one can secure the cover plate using other methods, for example, using bolts, welds, or adhesives. Cover plate 300 can be omitted all together, securing the mesh assembly 200 to housing 101 without cover plate 300.

[030] Figure 4 shows a supercharger housing assembly 100 with a mesh assembly 200 installed in the housing 101. Mesh assembly 200 is located in inlet wall cavity 105. Cover plate 300 is positioned over mesh assembly 200 and inlet wall cavity 105, secured by screws 303A, 303B, and 303C.

[031] During operation, air flows through inlet opening 102 to outlet opening 103. Rotors (not shown) are positioned in rotor mounts 110A, 110B. The rotors (not shown) rotate along axis X drawing and compressing air.

[032] In Roots style pumps, back flow compression processes at an outlet port cause high-level air pulsation. Air pulsation can create unwanted noise, vibration, and harshness. This not only creates undesired noise for persons near the supercharger, but it reduces the lifespan of the supercharger. Adding an inlet wall cavity and mesh assembly to the inlet side of a supercharger can reduce air pulsation. A mesh assembly is advantageous over other reactive or dissipative acoustic elements in the vehicle air intake system because this arrangement treats the noise problem at its source.

[033] The mesh assembly 200 helps to reduce eddies of turbulence. For example, turbulence is reduced when eddies pass through the openings, e.g., opening 210, in the mesh assembly 200.

[034] The inlet wall cavity 105, without the mesh assembly 200, can also reduce NVH. One can tune inlet wall cavity 105 to reduce a certain frequency by adjusting the depth of the inlet wall cavity 105 along the X axis.

[035] The mesh assembly 200 complements the inlet wall cavity 105 by damping different frequencies. A mesh assembly 200 with multiple layers further complements the arrangement by reducing other frequencies. As such, one can tune the supercharger housing assembly to tune many frequencies. For example, the inlet wall cavity can tune low frequencies and layer L1 can tune high frequencies. One can

design layer L2 so that it tunes frequencies between the ranges damped by inlet wall cavity 105 and layer L1.

[036] Layer L1 can be made of a wire mesh with openings smaller than the opening in layer L2. Layer L1 can be made of a metal wire while layer L2 is made from a different material. The opening size and material selection affects the mesh assembly's ability to dampen certain frequencies.

[037] Other implementations will be apparent to those skilled in the art from consideration of the specification and practice of the examples disclosed herein. It is intended that the specification and examples be considered as exemplary only, with the true scope of the invention being indicated by the following claims.

WHAT IS CLAIMED IS:

1. A supercharger housing assembly comprising:
 - a housing comprising:
 - an outlet opening, wherein the outlet opening is perpendicular to an inlet opening;
 - an inlet wall comprising:
 - the inlet opening located in the inlet wall;
 - at least two rotor mounts located in the inlet wall;
 - an inlet wall cavity located in the inlet wall; and
 - a mesh assembly located in the inlet wall cavity, wherein the mesh assembly comprises openings.
2. The supercharger housing assembly of claim 1, wherein the mesh assembly comprises more than one layer of mesh.
3. The supercharger housing assembly of claim 1, wherein the mesh assembly comprises wire.
4. The supercharger housing assembly of claim 1, wherein the mesh assembly comprises welds.
5. The supercharger housing assembly of claim 1, wherein the mesh assembly is made by three-dimensional printing.
6. The supercharger housing assembly of claim 1, wherein the mesh assembly is made by casting.
7. The supercharger housing assembly of claim 1, wherein the mesh assembly is metal.
8. The supercharger housing assembly of claim 1, wherein the mesh assembly is plastic.
9. The supercharger housing assembly of claim 1, wherein the mesh assembly is a composite.
10. The supercharger housing assembly of claim 1, wherein the mesh assembly comprises a wire thickness in the direction along the Z axis that is different from a wire thickness in the direction along the X axis.
11. The supercharger housing assembly of claim 1, wherein the openings of the mesh assembly comprise circular shapes.

12. The supercharger housing assembly of claim 1, wherein the openings of the mesh assembly comprise quadrilateral shapes.
13. The supercharger housing assembly of claim 1, wherein the inlet wall cavity comprises a back face and wherein the mesh assembly is located between the back face of the inlet wall cavity and a cover plate.
14. The supercharger housing assembly of claim 13, wherein the cover plate has an opening.
15. The supercharger housing assembly of claim 1, wherein the openings comprise a first pair of openings of similar size and a second pair of openings of similar size, and wherein the size of the first pair of openings is different than the size of the second pair of openings.
16. The supercharger housing assembly of claim 1, wherein the mesh assembly generally comprises a pyramidal shape.
17. The supercharger housing assembly of claim 1, wherein the mesh assembly comprises one of a quadrilateral, triangular, pyramidal, spherical, circular, oval, or hexagonal shape.
18. The supercharger housing assembly of claim 1, wherein the openings comprise one or more of quadrilateral, triangular, circular, oval, or hexagonal shapes.
19. The supercharger housing assembly of claim 1, wherein the mesh assembly comprises a lattice array.
20. The supercharger housing assembly of claim 1, wherein the mesh assembly comprises multiple layers of wires, and wherein the wires are uniformly distributed among the multiple layers.
21. The supercharger housing assembly of claim 1, wherein the mesh assembly comprises multiple layers of wires, and wherein the wires are distributed non-uniformly among the multiple layers to form openings of different sizes among the multiple layers.
22. The supercharger housing assembly of claim 1, wherein the mesh assembly comprises multiple layers of wires, and wherein the wires are distributed non-uniformly among the multiple layers to space the layers non-uniformly apart.
23. The supercharger housing assembly of claim 1, wherein the mesh assembly comprises multiple layers of wires, and wherein the wires are distributed non-uniformly among the multiple layers to form openings differing in one or more of height, size, shape, or proportion among the layers

24. A method of assembling a supercharger housing, comprising the step of attaching a mesh assembly to an inlet wall cavity in an inlet wall of a supercharger housing.
25. The method of claim 24, wherein the mesh assembly comprises more than one layer of mesh.
26. The method of claim 24, wherein the step of attaching the mesh assembly to the inlet wall cavity comprises press fitting the mesh assembly in the inlet wall cavity.
27. The method of claim 24, wherein the step of attaching the mesh assembly to the inlet wall cavity comprises shrink-fitting the mesh assembly.
28. The method of claim 24, comprising placing a portion of the mesh assembly in slots located in the inlet wall cavity.
29. The method of claim 24, comprising the step of printing the mesh assembly with a three-dimensional printer.
30. The method of claim 24, comprising the step of casting the mesh assembly.
31. The method of claim 24, comprising the step of weaving wire to form the mesh assembly.
32. The method of claim 24, comprising the step of welding wire to form the mesh assembly.
33. The method of claim 24, comprising attaching a cover plate over the mesh assembly.
34. The method of claim 33, comprising securing the cover plate with screws or bolts.

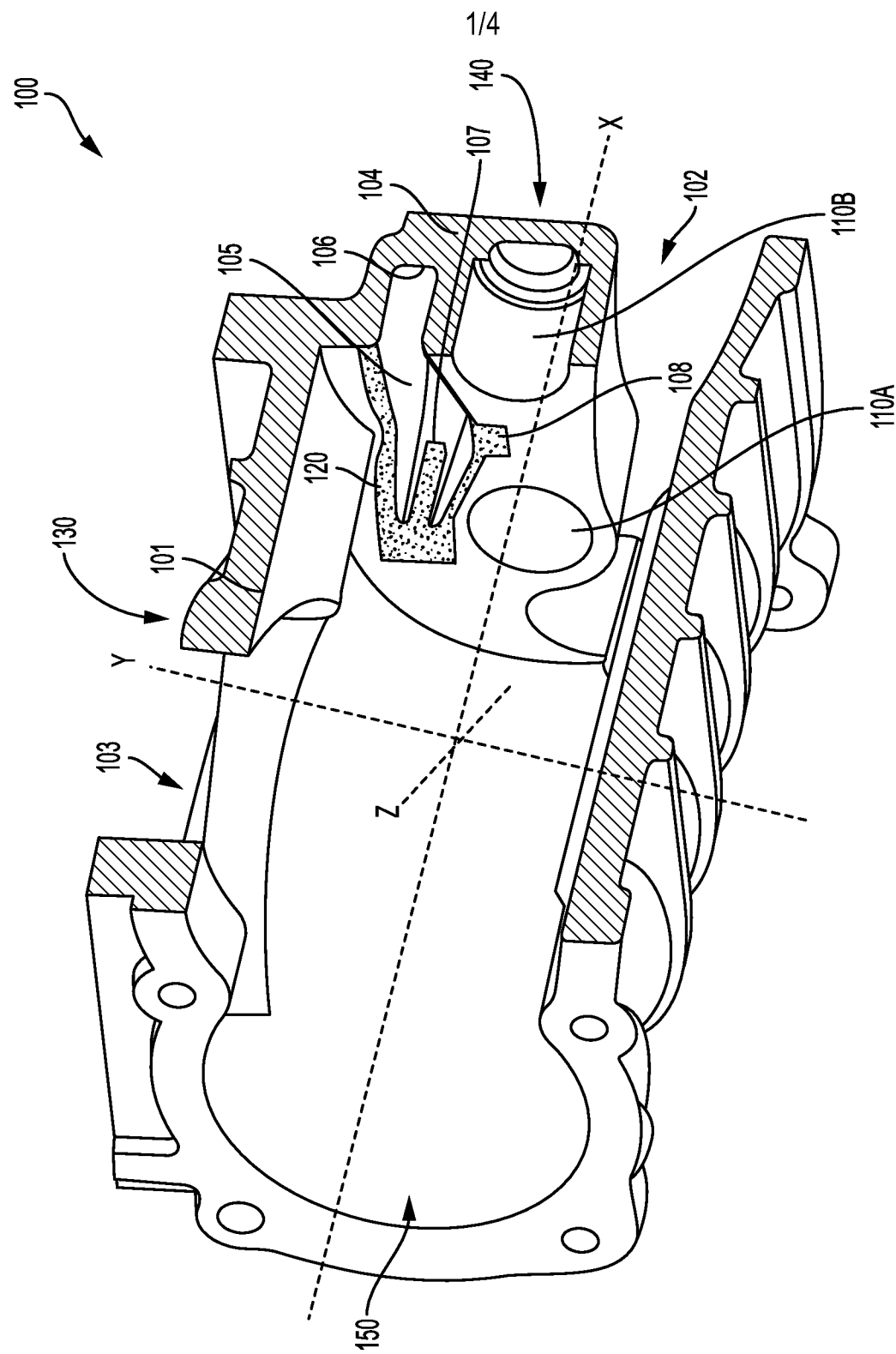


FIG. 1

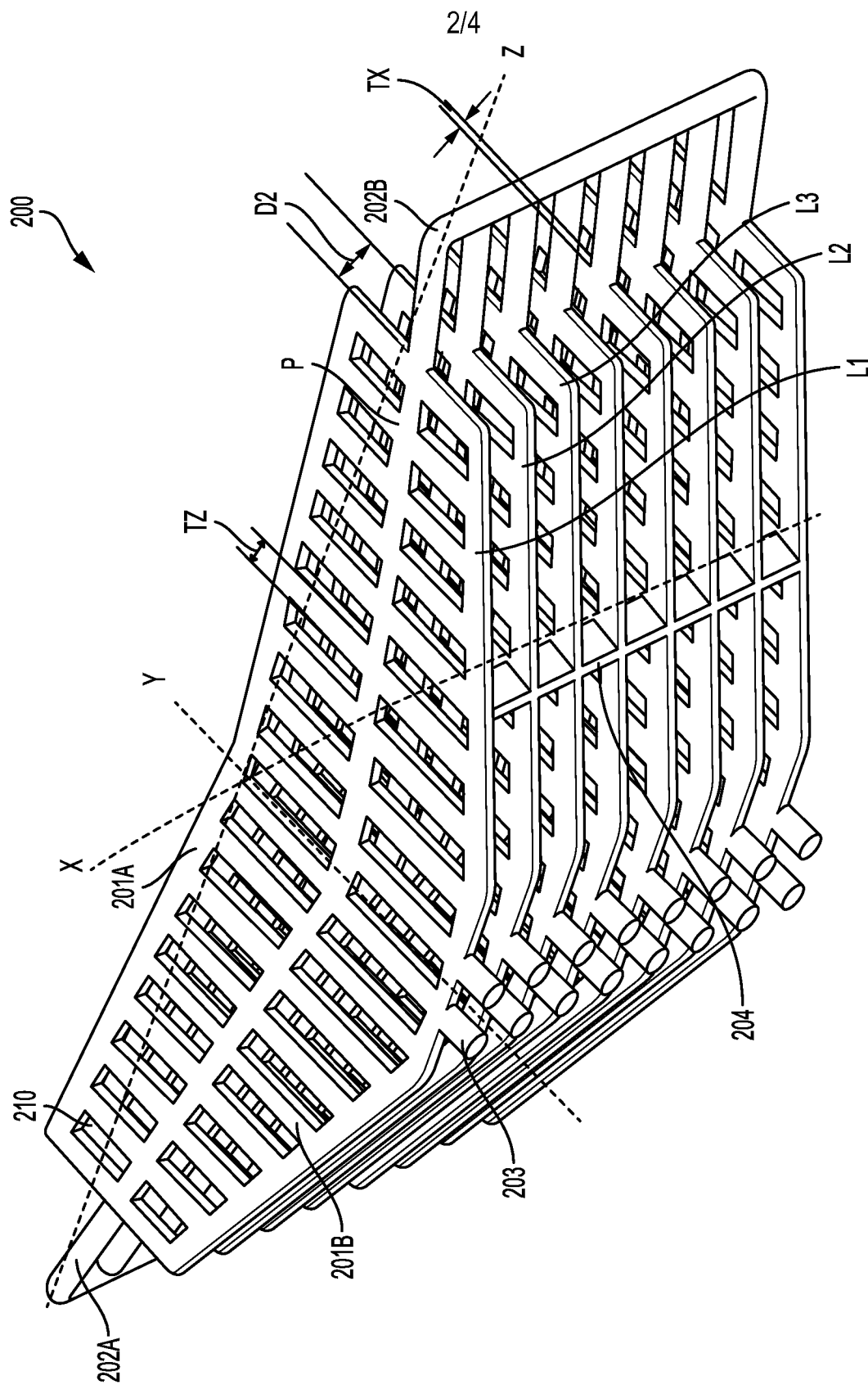


FIG. 2

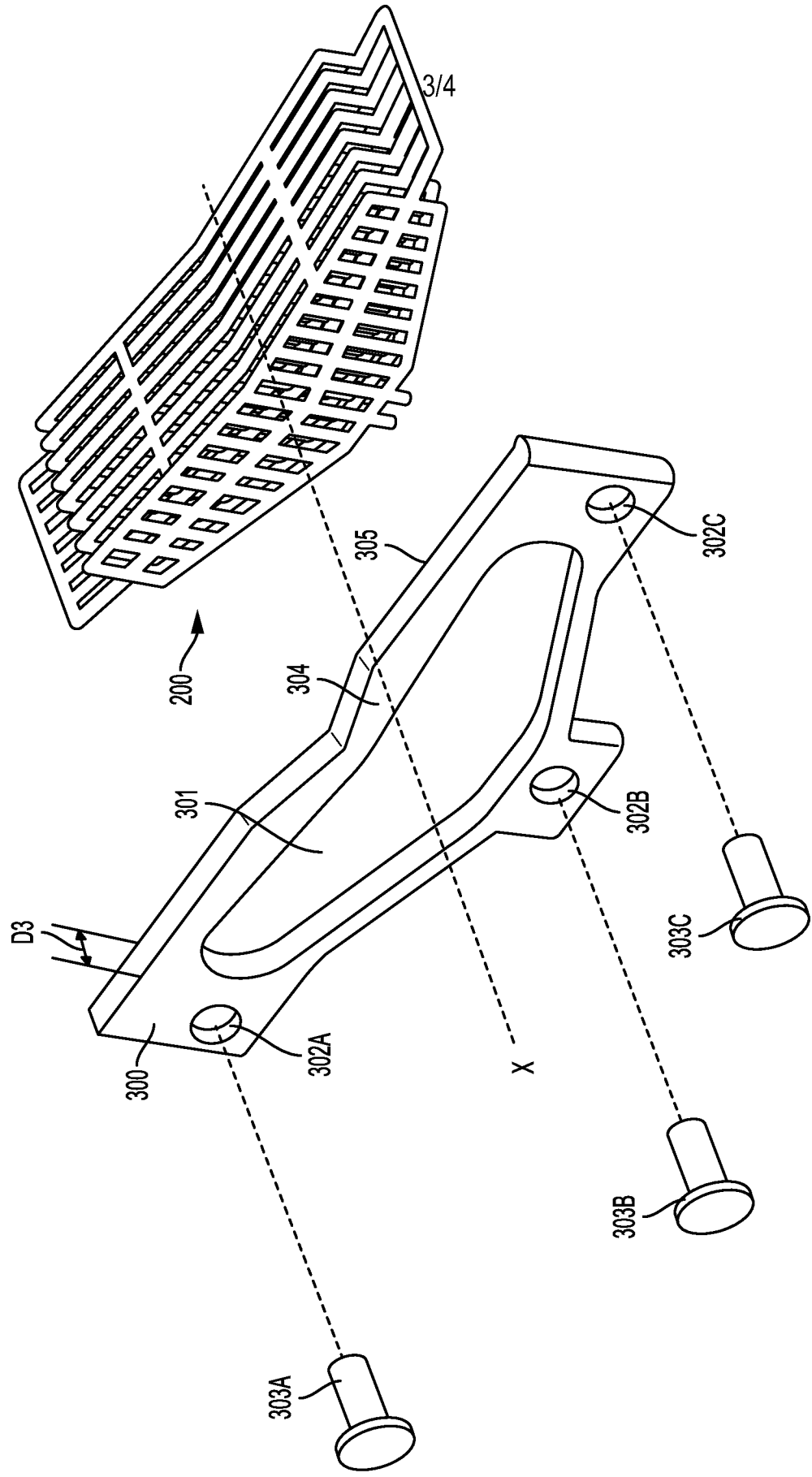


FIG. 3

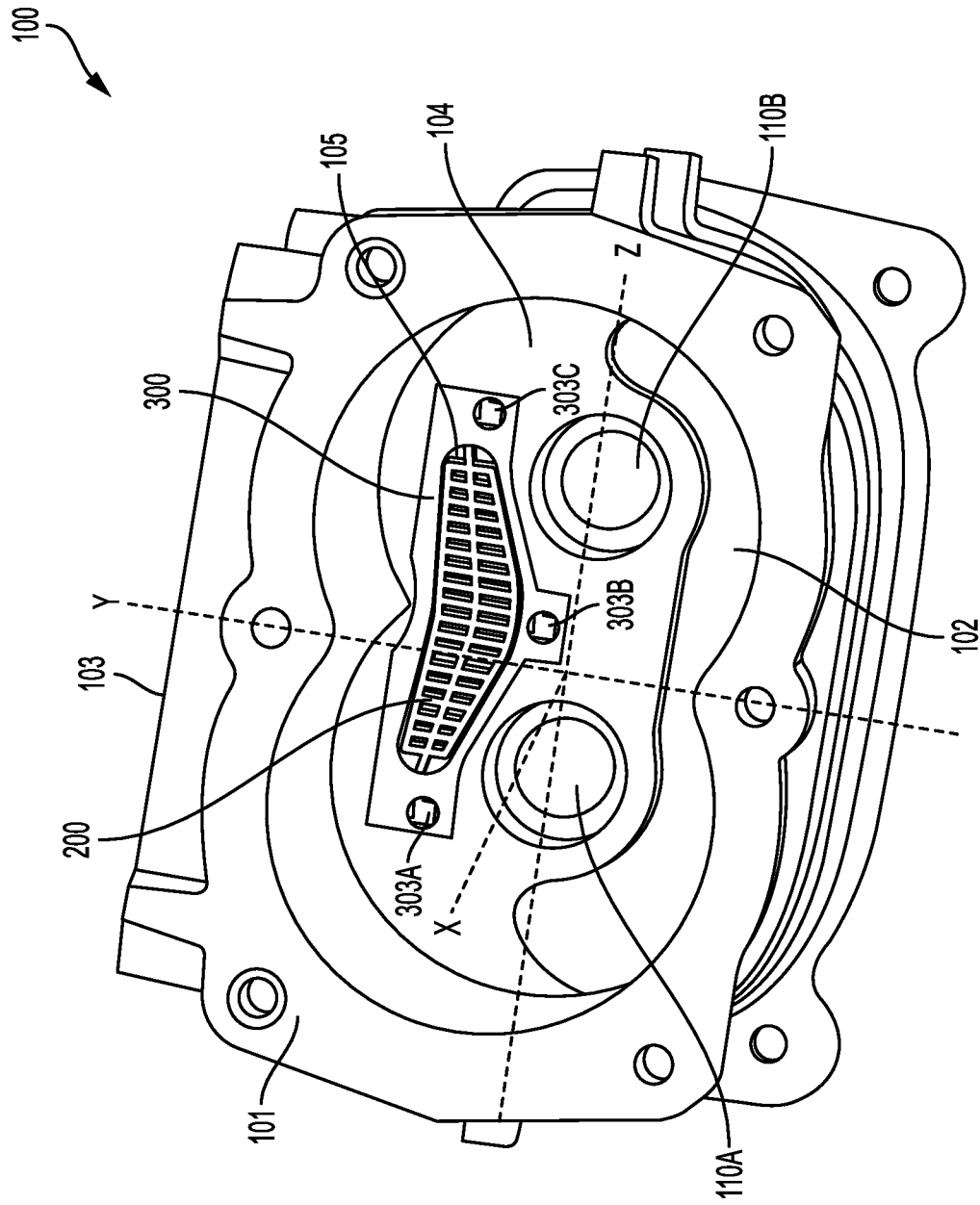


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/059301**A. CLASSIFICATION OF SUBJECT MATTER****F02B 39/16(2006.01)i, F02B 33/38(2006.01)i, F04C 29/06(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)

F02B 39/16; F01C 21/00; F02M 35/12; F02B 33/00; F02B 33/44; F01C 1/08; F02B 33/38; F02B 37/00; F04C 18/16; F04C 29/06

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: supercharger, engine, housing, inlet, outlet, cavity, opening, rotor, mesh and NVH

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012-0020824 A1 (HUANG et al.) 26 January 2012 See paragraphs [0019]-[0023], [0047]; claims 1, 4 and figures 4a-4b.	1-9, 11-12, 15-27 , 29-34
A		10, 13-14, 28
A	US 2010-0269798 A1 (PRIOR, GREGORY P.) 28 October 2010 See abstract; paragraphs [0005]-[0008]; claim 1 and figure 1.	1-34
A	JP 2001-164943 A (TOCHIGI FUJI IND. CO., LTD.) 19 June 2001 See paragraphs [0008]-[0019] and claim 1.	1-34
A	EP 2818683 A1 (MITSUBISHI HEAVY INDUSTRIES, LTD. et al.) 31 December 2014 See paragraphs [0008]-[0019].	1-34
A	US 4768934 A (SOETERS, JR., RAYMOND A.) 06 September 1988 See abstract and column 3, line 26 - column 4, line 40.	1-34



Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/059301

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