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(54) **ACOUSTICALLY TREATED THRUST REVERSER BULLNOSE FAIRING AND TORQUE BOX**

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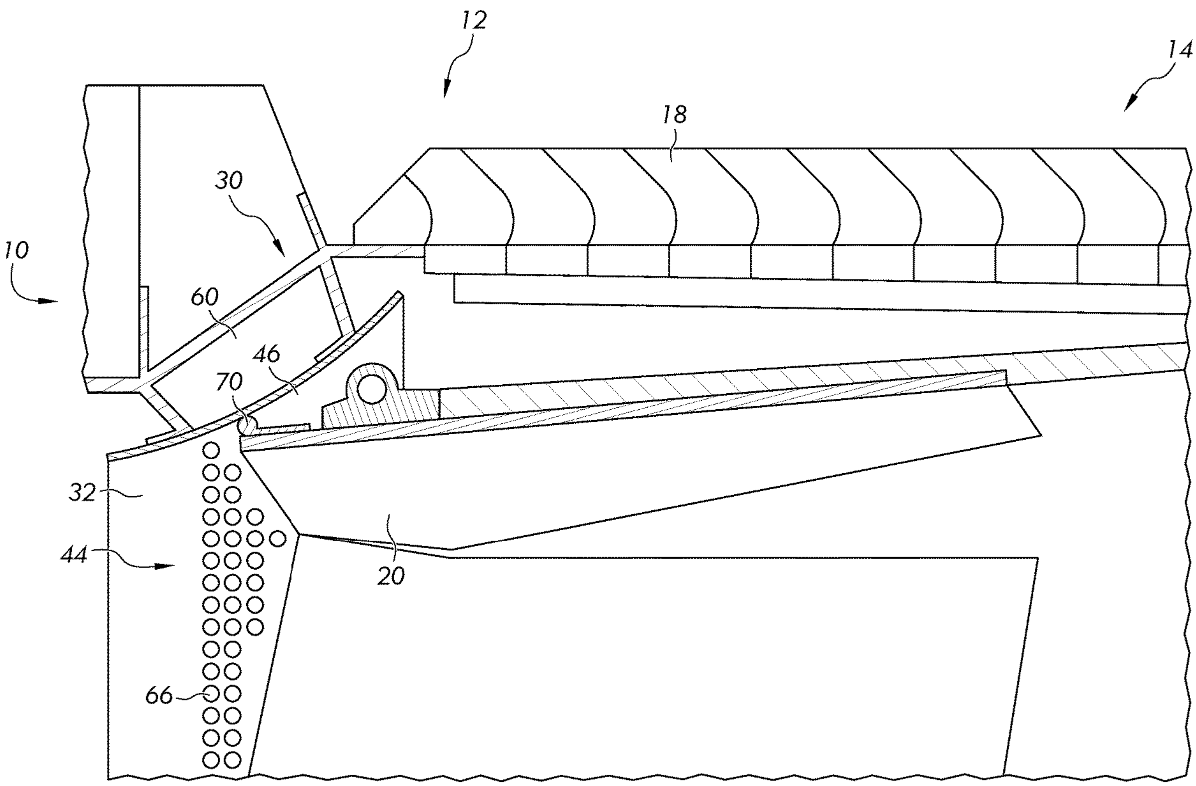
CPC ***B64D 29/00*** (2013.01); ***F02K 1/72*** (2013.01); ***G10K 11/161*** (2013.01)

(57) **ABSTRACT**

An acoustically treated fairing assembly for a thrust reverser of an aircraft having a torque box fixed to the thrust reverser, a bullnose fairing attached to the torque box to form a cavity therebetween, and a plurality of spaced apart frame members extending axially within the cavity to divide the cavity into a plurality of circumferentially extending cavity sections configured to attenuate engine fan tones.



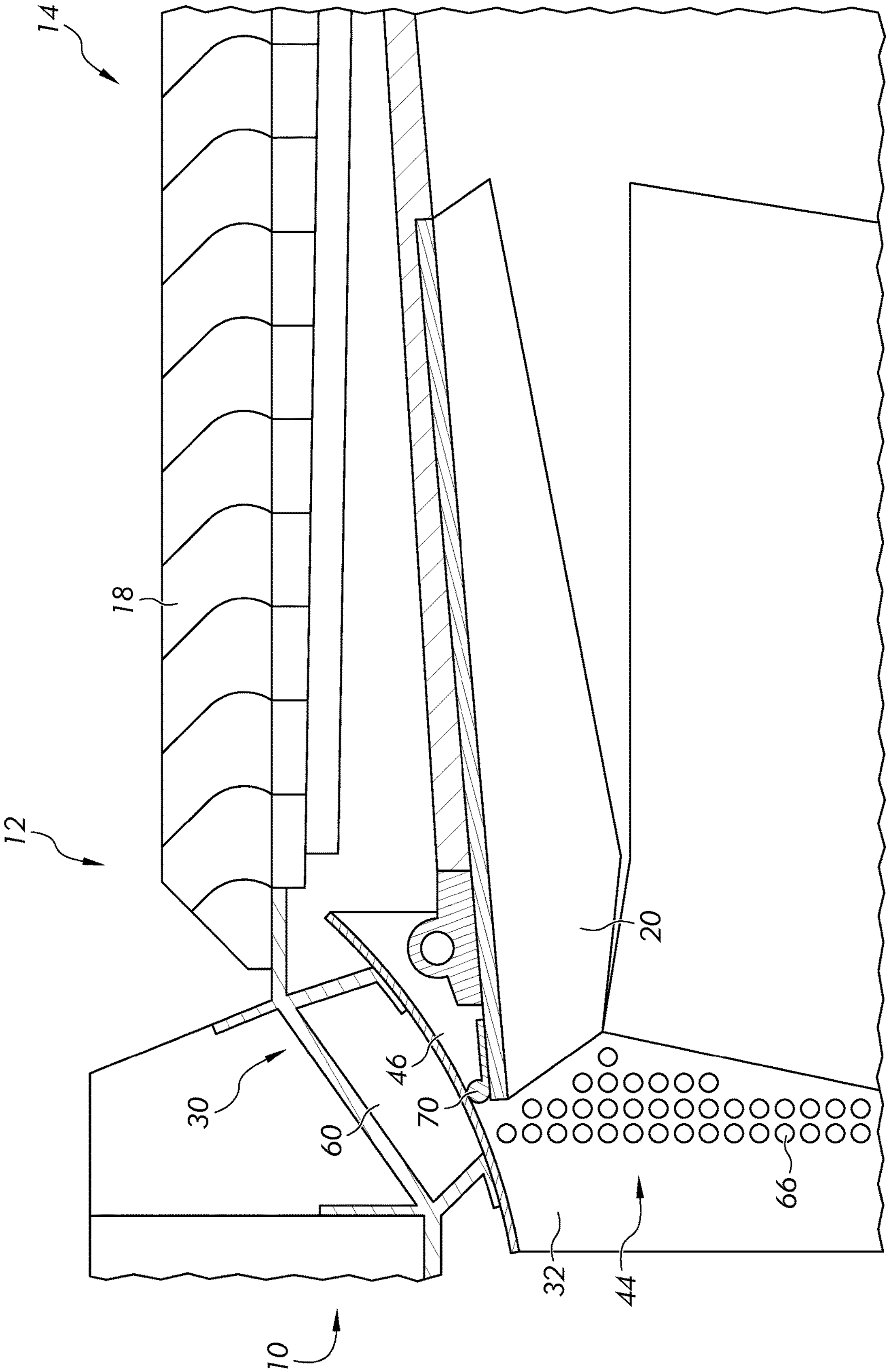


FIG. 1

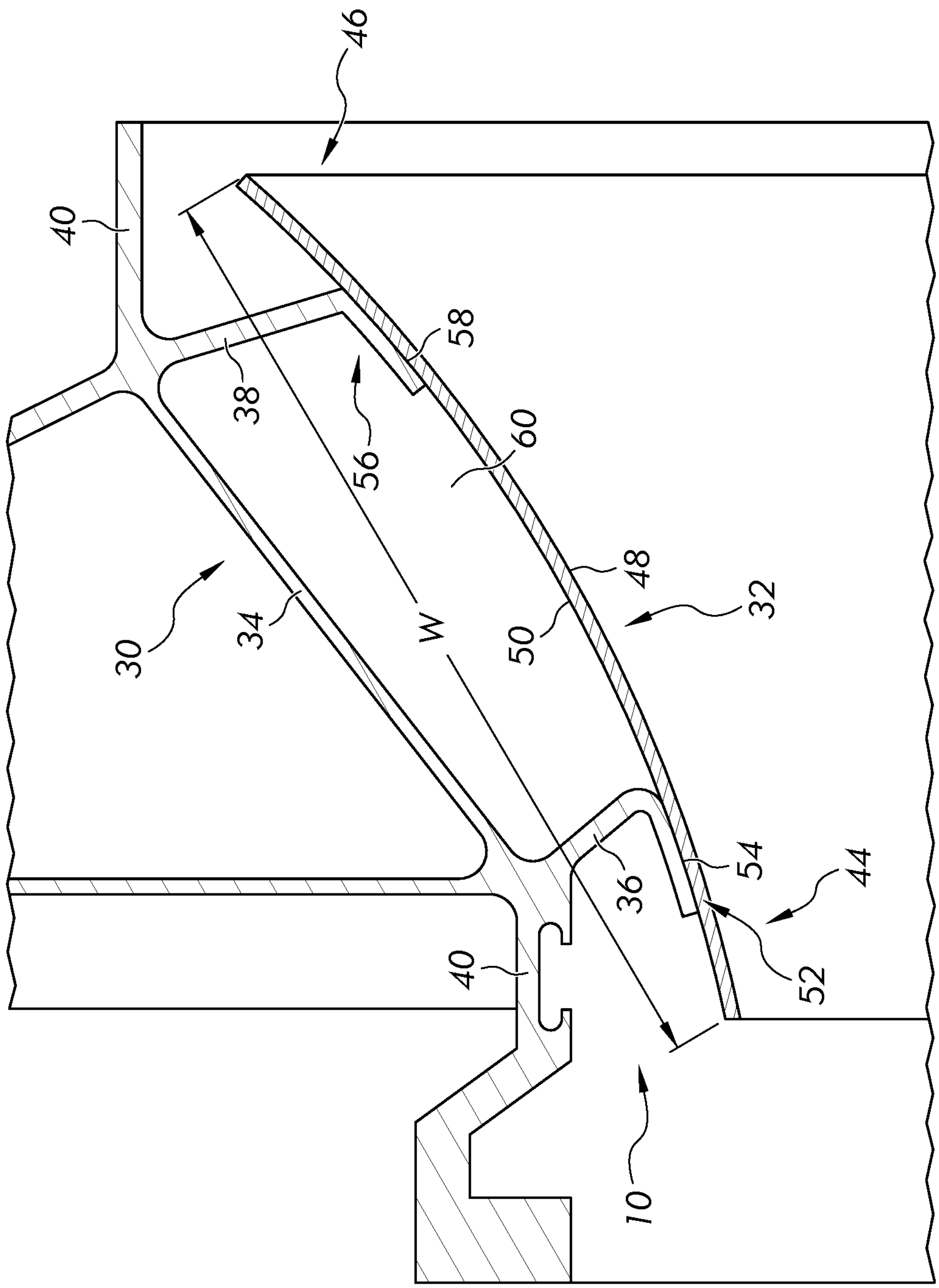


FIG. 2

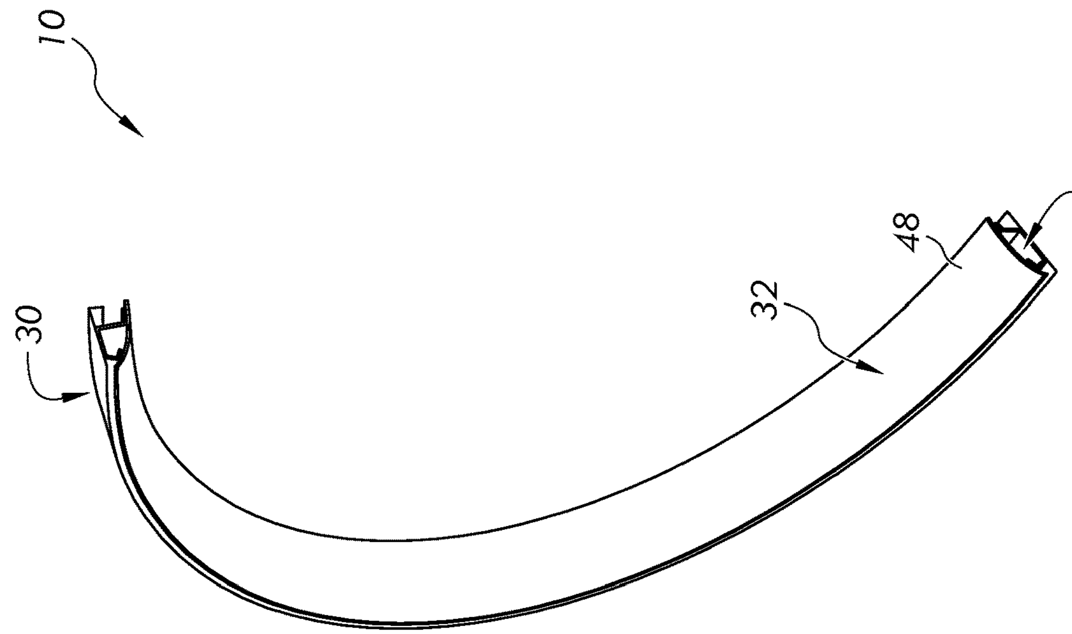


FIG. 4

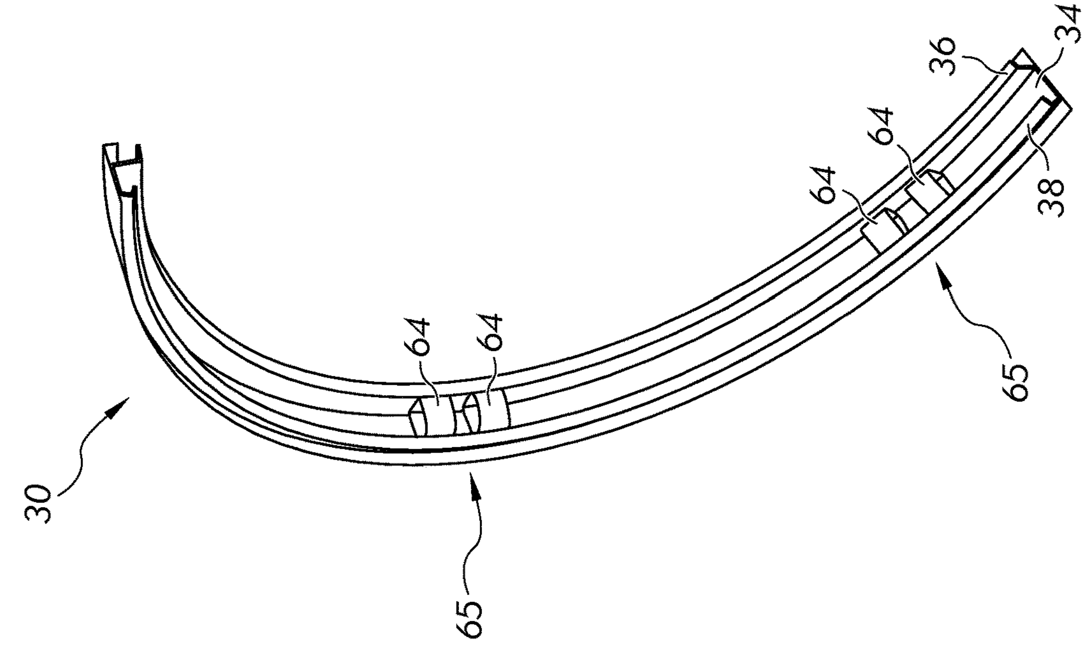


FIG. 3

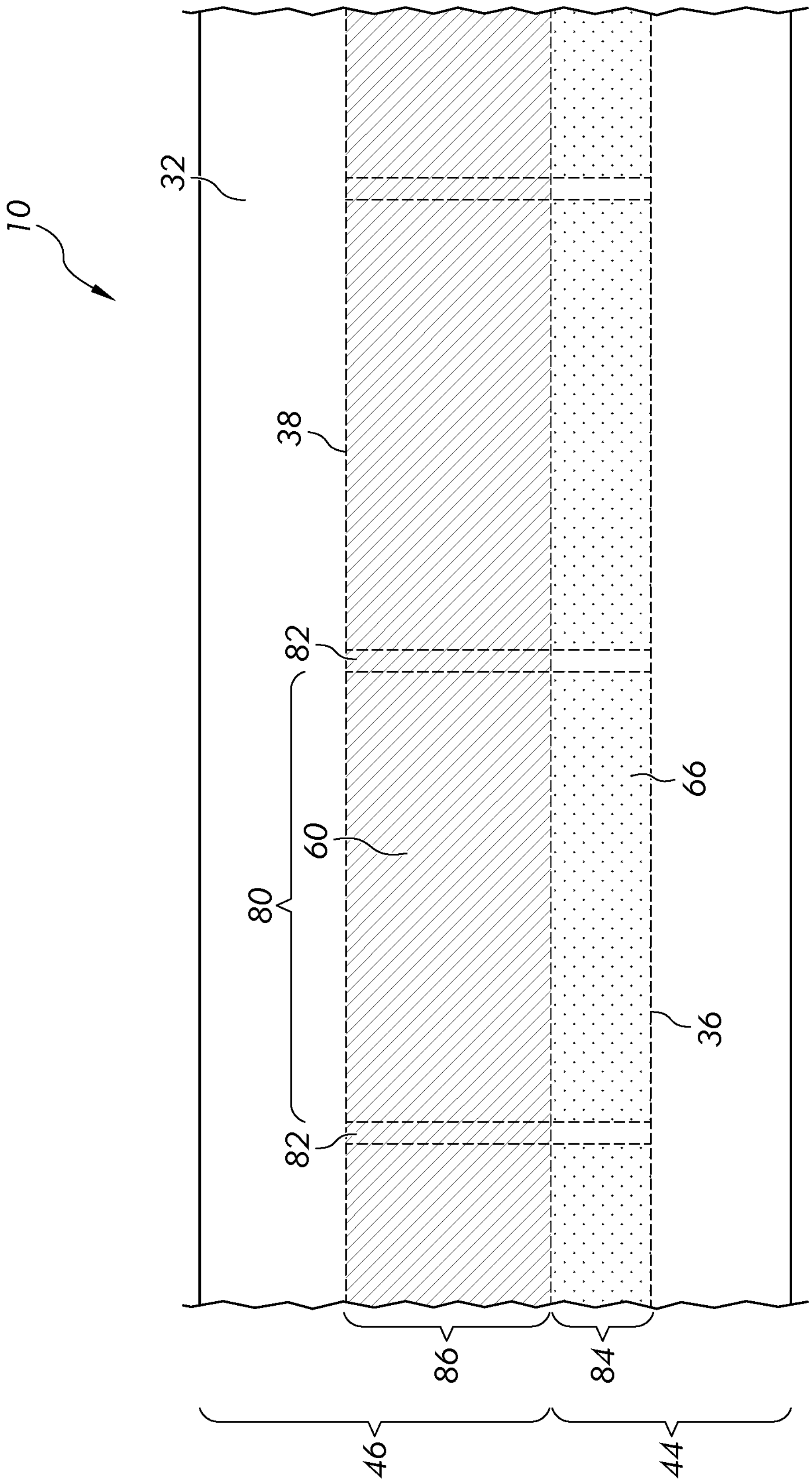


FIG. 5

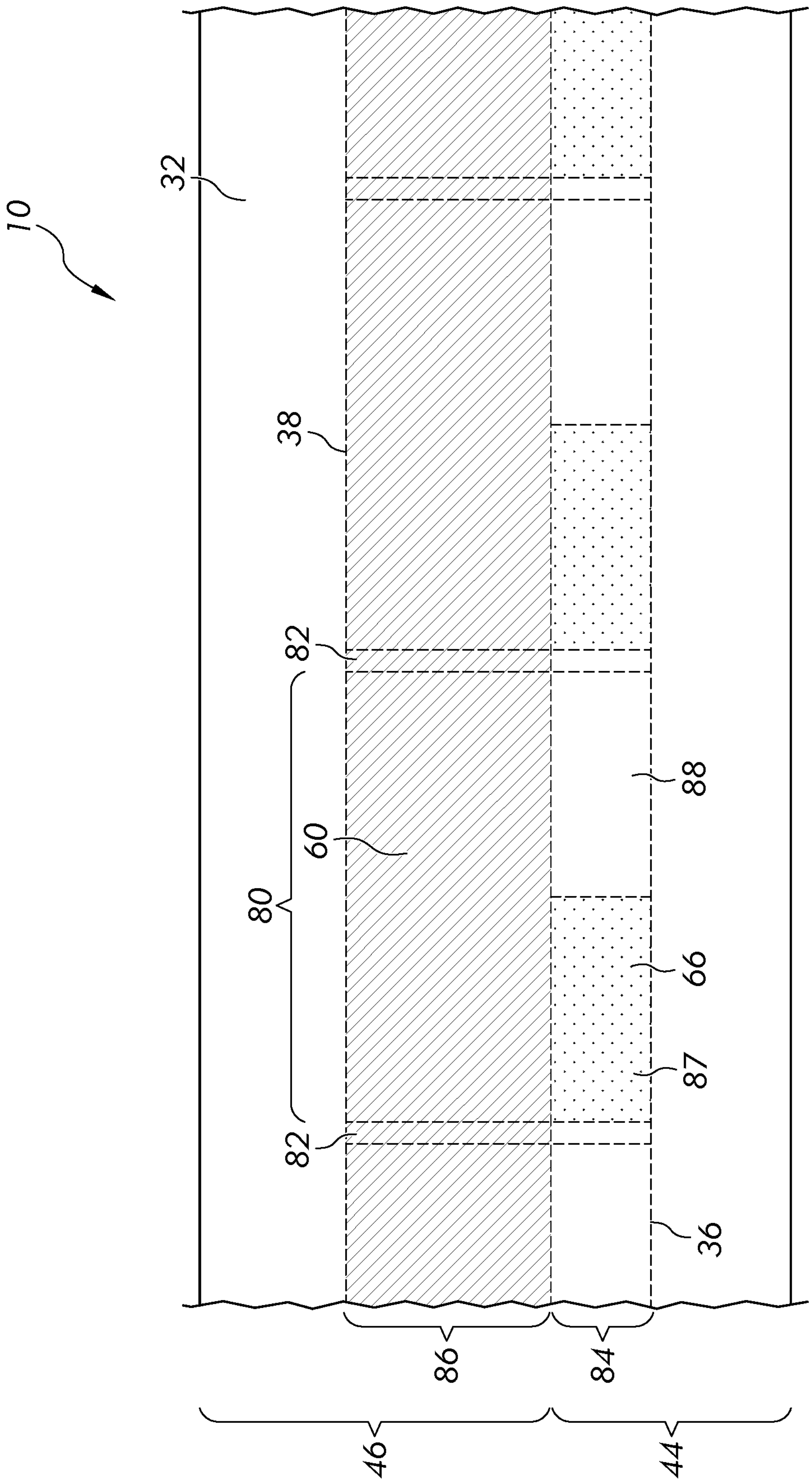


FIG. 6

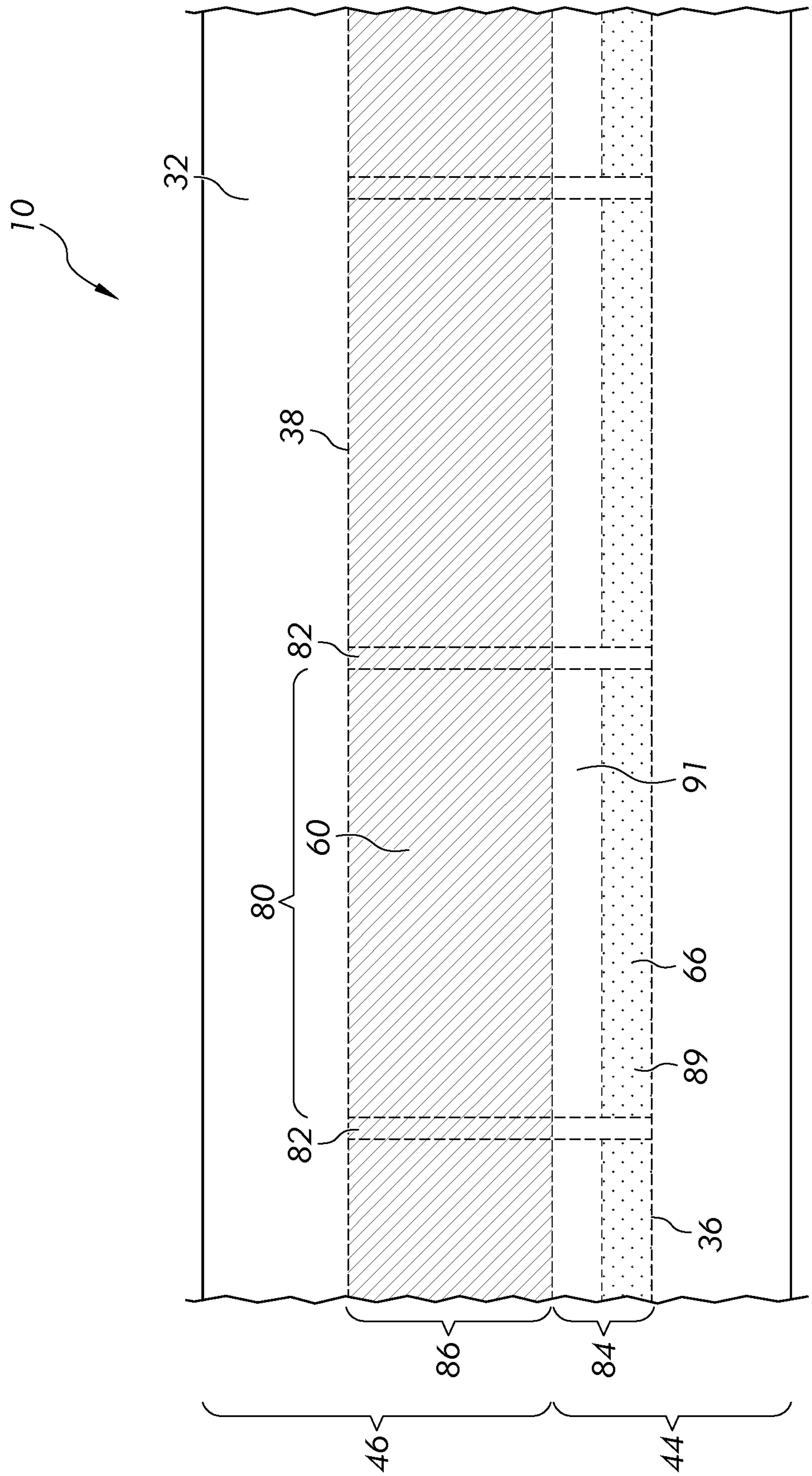


FIG. 7

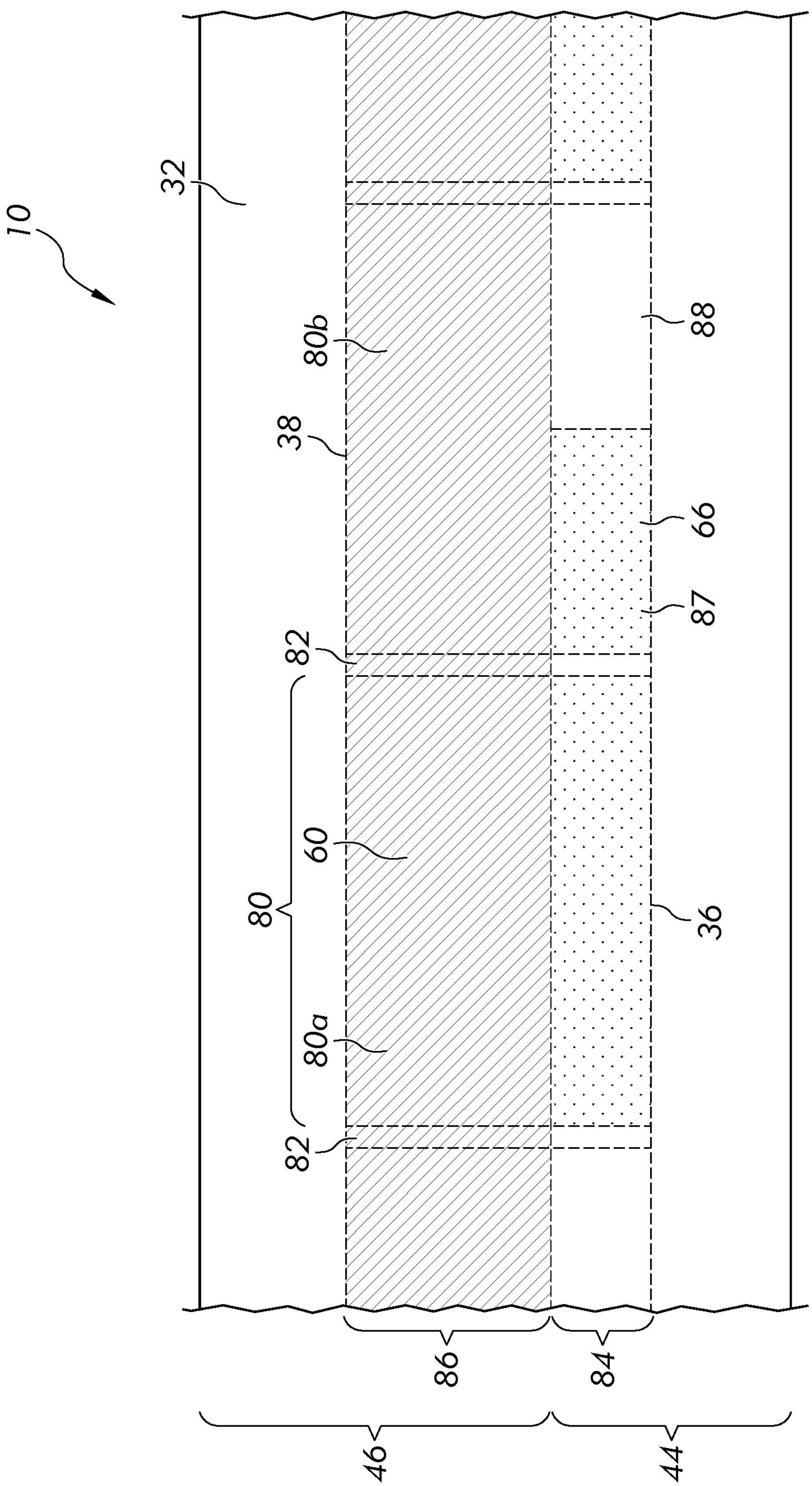


FIG. 8

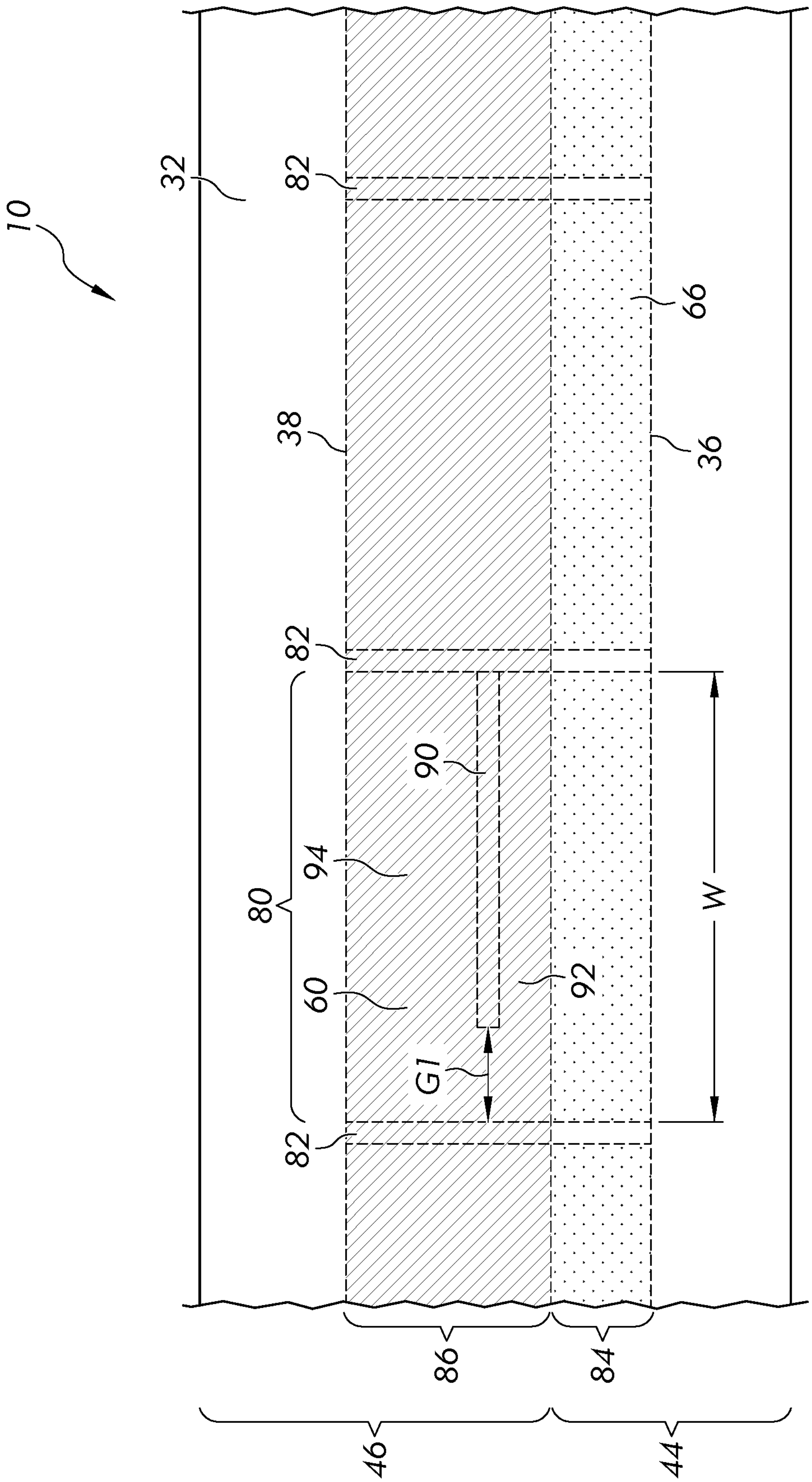


FIG. 9

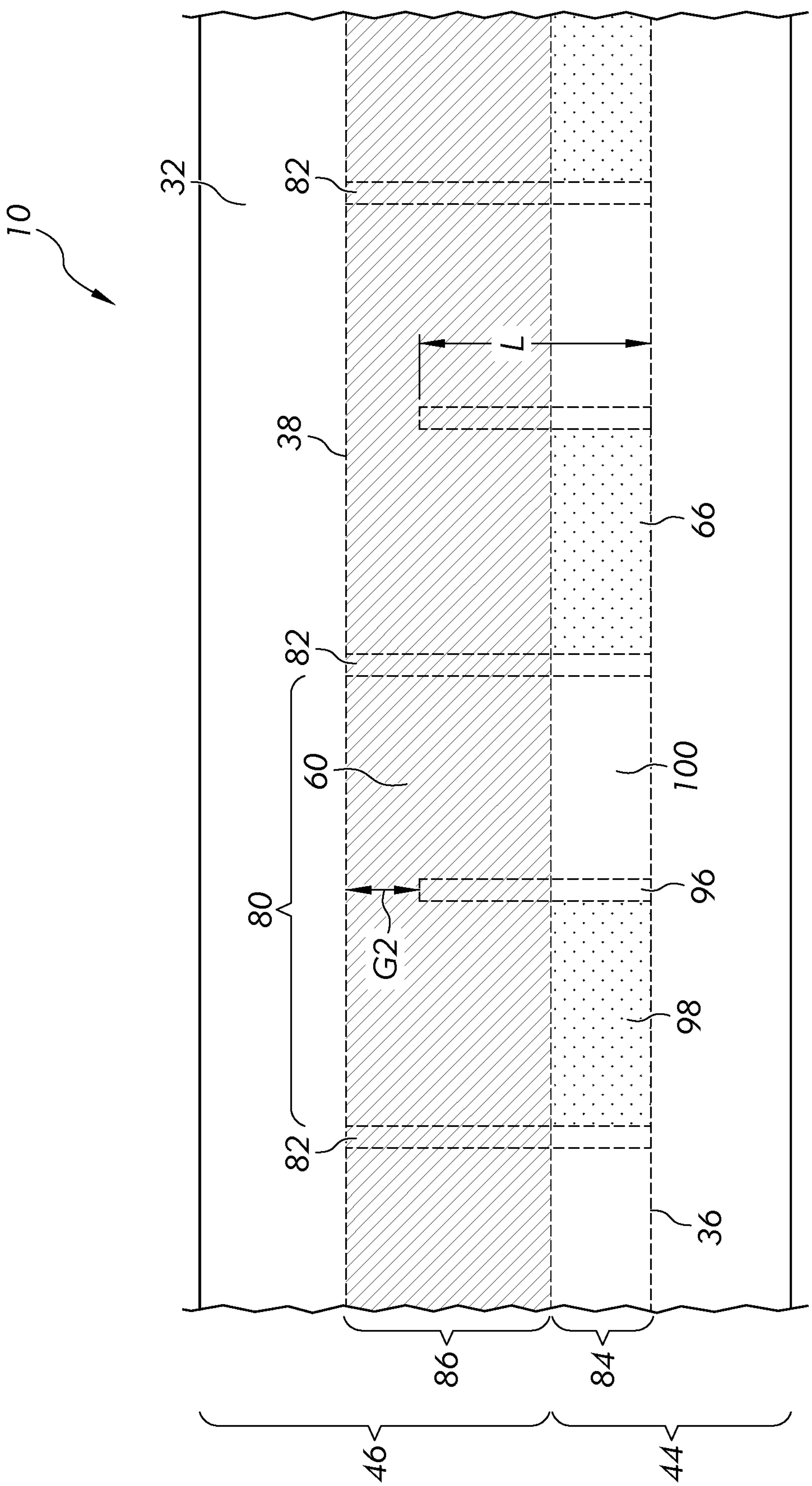


FIG. 10

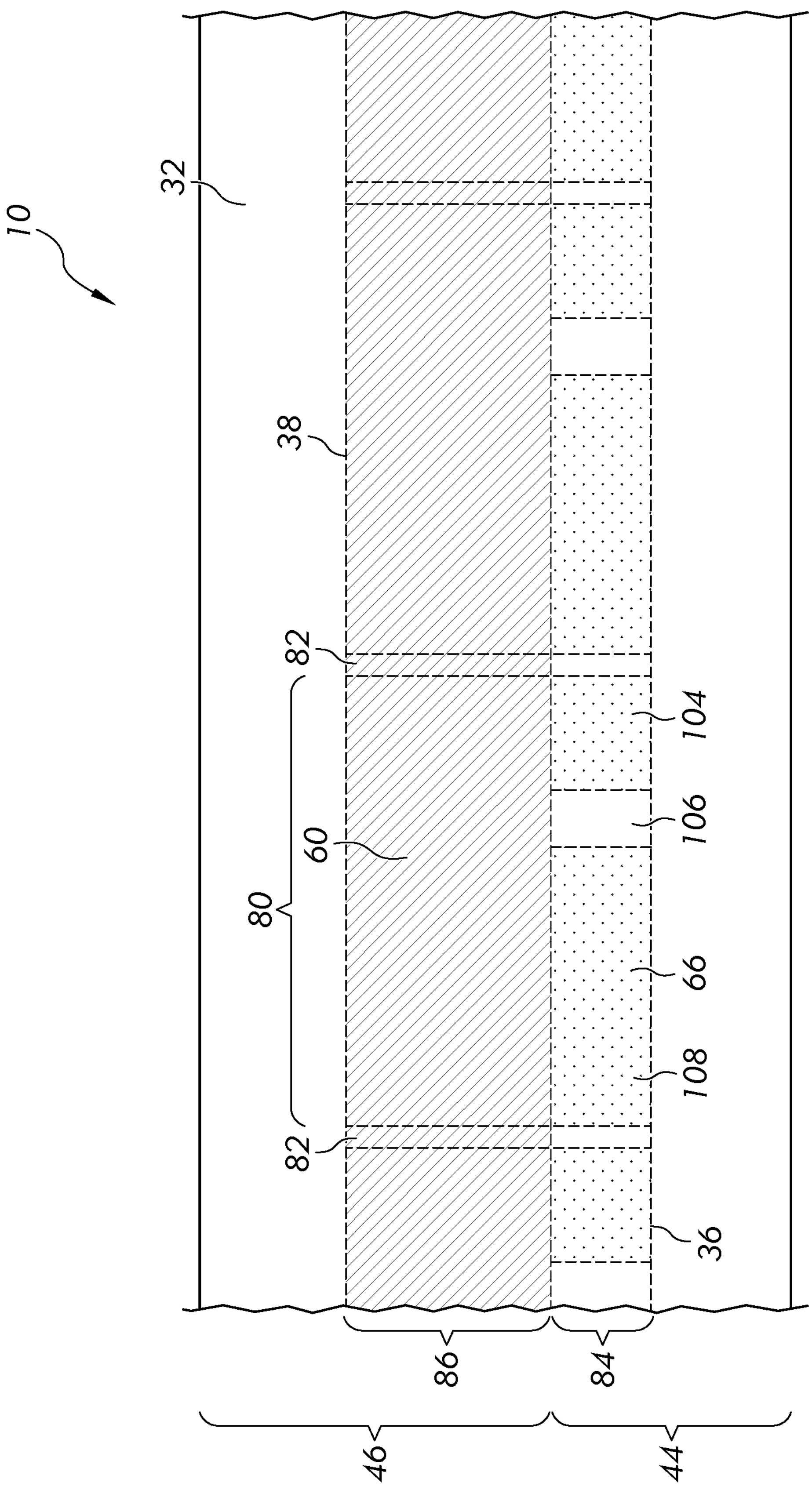


FIG. 11

ACOUSTICALLY TREATED THRUST REVERSER BULLNOSE FAIRING AND TORQUE BOX

FIELD

[0001] This disclosure relates to the attenuation of aircraft jet engine sound frequencies and, more particularly, to a bullnose fairing assembly for installation in an aircraft thrust reverser.

BACKGROUND

[0002] Aircraft engine noise pollution is a significant concern, especially in high population areas and other noise-controlled environments. One source of aircraft engine noise pollution is engine fan tones which propagate through the thrust reverser. Attenuating these engine fan tones is desirable. Engine fan tone frequencies depend on the number of fan blades and rotation speed of the engine. The first few fan tone harmonics often have high amplitudes but are difficult to attenuate due to their low frequencies. Existing efforts to mitigate aircraft engine noise pollution do not satisfactorily address the concern, especially regarding fan tones with low frequencies.

[0003] It is desirable to provide a solution to mitigating engine fan tones that can be tuned to attenuate a desired frequency, including fan tone harmonics with low frequency.

SUMMARY

[0004] According to various implementations, an acoustically treated bullnose fairing assembly for a thrust reverser of an aircraft is presented. The acoustically treated bullnose fairing assembly may include a torque box fixed to the thrust reverser of the aircraft, a bullnose fairing attached to the torque box to form a cavity therebetween, and a plurality of spaced apart frame members extending axially within the cavity to divide the cavity into a plurality of circumferentially extending cavity sections. In some implementations, each circumferentially extending cavity section may have a forward portion of the bullnose fairing and a rearward portion of the bullnose fairing associated therewith, with the rearward portion being aft of a forward edge of a blocker door of the thrust reverser when the blocker door is in a stowed position. In some implementations, the bullnose fairing associated with at least two of the circumferentially extending cavity sections have a perforated forward portion.

[0005] In some implementations, the perforated forward portion has an open area ratio in the range of 4 to 8 percent. In some implementations, the perforated forward portion has an open area ratio in the range of 10 to 20 percent.

[0006] In some implementations, the plurality of spaced apart frame members are spaced apart from each other in the range of 6 to 10 inches.

[0007] In some implementations, the acoustically treated bullnose fairing assembly includes a plurality of dividing members, each of the plurality of dividing members being configured to divide a corresponding one of the circumferentially extending cavity sections into a first and a second circumferentially extending cavity subsection.

[0008] In some implementations, each of the plurality of dividing members extends circumferentially across a portion of a corresponding one of the circumferentially extending cavity sections leaving an undivided portion between the first subsection and the second subsection of the corresponding one of the circumferentially extending cavity.

[0009] In some implementations, each of the plurality of dividing members extends axially across a portion of a corresponding one of the circumferentially extending cavity sections leaving an undivided portion between the first subsection and the second subsection of the corresponding one of the circumferentially extending cavity.

[0010] In some implementations, the first subsection has a first volume and the second subsection has a second volume that is different than the first volume.

[0011] In some implementations, the bullnose fairing associated with a first plurality of the circumferentially extending cavity sections includes perforated forward portions with a first percent open area and the bullnose fairing associated with a second plurality of the circumferentially extending cavity sections includes perforated forward portions with a second open area ratio greater than the first open area ratio. In some implementations, the first open area ratio is in the range of 4 to 8 percent and the second open area ratio is in the range of 10 to 20 percent.

[0012] In some implementations, the first plurality of the circumferentially extending cavity sections are circumferentially arranged in an alternating sequence with the second plurality of the circumferentially extending cavity sections.

[0013] In some implementations, the perforated forward portion includes a forward perforated section and a rearward unperforated section.

[0014] In some implementations, the perforated forward portion includes a lateral perforated section and a lateral unperforated section.

[0015] According to various implementations, a method of acoustically treating a bullnose fairing assembly for a thrust reverser of an aircraft is presented. In some implementations, the bullnose fairing assembly includes a bullnose fairing attached to a torque box to form a cavity therebetween. In some implementations, the method includes dividing the cavity into a plurality of circumferentially extending cavity sections and perforating the bullnose fairing associated with at least two of the plurality of circumferentially extending cavity sections in a forward portion of the front sheet that is forward of a forward edge a blocker door of the thrust reverser when the blocker door is in a stowed position.

[0016] In some implementation, perforating the front sheet includes creating an open area ratio in the forward portion in the range of 4 to 8%. In some implementation, perforating the front sheet further comprising creating an open area ratio in the forward portion in the range of 10 to 20%.

[0017] In some implementation, the method includes dividing at least one of the plurality of circumferentially extending cavity sections into a first subsection and a second subsection and leaving an undivided section between the first subsection and the second subsection.

[0018] In some implementation, dividing at least one of the plurality of circumferentially extending cavity sections into the forward subsection and the aft subsection includes perforating a dividing member that divides at least one of the plurality of circumferentially extending cavity sections.

[0019] In some implementation, perforating the forward portion associated with at least two of the plurality of circumferentially extending cavity sections includes creating a first open area ratio in the forward portion of a first of the plurality of circumferentially extending cavity sections and creating a second open area ratio in the forward portion of a second of the plurality of circumferentially extending cavity sections that is different than the first open area ratio.

[0020] In some implementation, the first of the plurality of circumferentially extending cavity sections is adjacent to the second of the plurality of circumferentially extending cavity sections.

[0021] In some implementations, one or more of the circumferentially extending cavity sections can be filled (fully or partially) with a noise attenuating materials (e.g., a honeycomb structure).

[0022] Combinations, (including multiple dependent combinations) of the above-described elements and those within the specification have been contemplated by the inventors and may be made, except where otherwise indicated or where contradictory.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] Various features of the examples can be more fully appreciated, as the same become better understood with reference to the following detailed description of the examples when considered in connection with the accompanying figures, in which:

[0024] FIG. **1** is a side view illustrating a portion of an aircraft jet engine showing an example bullnose fairing assembly.

[0025] FIG. **2** is an enlarged side view illustrating the example bullnose fairing assembly of FIG. **1**.

[0026] FIG. **3** is a perspective view of the example torque box of FIG. **1**.

[0027] FIG. **4** is a perspective view of the example bullnose fairing attached to the torque box of FIG. **1**.

[0028] FIG. **5** is a schematic representation of a portion an example implementation of the bullnose fairing assembly.

[0029] FIG. **6** is a schematic representation of a portion an example implementation of the bullnose fairing assembly.

[0030] FIG. **7** is a schematic representation of a portion an example implementation of the bullnose fairing assembly.

[0031] FIG. **8** is a schematic representation of a portion an example implementation of the bullnose fairing assembly.

[0032] FIG. **9** is a schematic representation of a portion an example implementation of the bullnose fairing assembly.

[0033] FIG. **10** is a schematic representation of a portion an example implementation of the bullnose fairing assembly.

[0034] FIG. **11** is a schematic representation of a portion an example implementation of the bullnose fairing assembly.

DESCRIPTION OF THE EXAMPLES

[0035] Reference will now be made in detail to example implementations, illustrated in the accompanying drawings. Wherever convenient, the same reference numbers will be used throughout the drawings to refer to the same or like parts. In the following description, reference is made to the accompanying drawings that form a part thereof, and in which is shown by way of illustration specific exemplary examples in which the invention may be practiced. These examples are described in sufficient detail to enable those skilled in the art to practice the invention and it is to be understood that other examples may be utilized and that changes may be made without departing from the scope of the invention. The following description is, therefore, merely exemplary.

[0036] These and other features and advantages are shown and described herein in reference to the figures.

[0037] FIGS. **1-2** illustrate an example acoustically treated bullnose fairing assembly **10**, according to the present disclosure. The bullnose fairing assembly **10** may be fixably attached to a thrust reverser **12** of an aircraft **14**. The bullnose fairing assembly **10** may be fixably attached to the thrust reverser **12** by any suitable means (e.g., as is known in the art).

[0038] In the illustrated example, the thrust reverser **12** is positioned aft of a jet engine (not shown) on the aircraft and is fitted within the engine nacelle **16**. The thrust reverser **12** includes thrust reverser cascades **18** circumferentially spaced around the interior of the engine nacelle **16**. The thrust reverser cascades **18** are positioned aft and radially outward of the bullnose fairing assembly **10**. The thrust reverser **12** also includes thrust reverser blocker doors **20** movable between a stowed position and a deployed or closed position. In other configurations, the thrust reverser cascades **18** may be stowed forward and radially out from the bullnose fairing assembly **10** and the thrust reverser cascades **18** translate aft with the rest of the thrust reverser **12** when the thrust reverser **12** is deployed.

[0039] During normal flying operations the thrust reverser cascades **18** are covered and the thrust reverser blocker doors **20** are in a stowed position (as shown in FIG. **1**). For landing the aircraft, the thrust reverser cascades **18** are uncovered and the thrust reverser blocker doors **20** are moved to the deployed or closed position. This positioning routes engine high by-pass fan air along the bullnose fairing assembly **10** to flow through the thrust reverser cascades **18** to slow down the aircraft on the ground.

[0040] Referring to FIGS. **2-4**, the acoustically treated bullnose fairing assembly **10** may be configured in a variety of ways. The bullnose fairing assembly **10** may extend circumferentially around the interior of the engine nacelle **16**. In some implementations, the bullnose fairing assembly **10** includes a torque box **30** and a bullnose fairing **32**. The torque box **30** may be configured in a variety of ways.

[0041] Referring to FIG. **2**, in some implementations, the torque box **30** includes an outer wall **34**, a forward side wall **36** extending radially inward from the outer wall **34**, a rearward side wall **38** spaced apart from the forward side wall **36** and extending radially inward from the outer wall **34**. The torque box **30** may include a plurality of attachment portions **40** configured to attach the torque box **30** to the thrust reverser cascades **18** (FIG. **1**).

[0042] The bullnose fairing **32** is structurally configured to attach to the torque box **30**. The bullnose fairing **32** may be configured in a variety of ways. In some implementations, the bullnose fairing **32** is formed as a sheet or plate having a width W, a forward portion **44**, and a rearward portion **46**. The bullnose fairing **32** may include first face **48** facing radially inward and a second face **50** facing radially outward opposite the first face **48**. In some implementations, the first face **48** may be curved or convex. The bullnose fairing **32** can be made from a variety of materials. For example, in some implementations, the bullnose fairing **32** is made from extruded aluminum, sheet metal, composites, or the like.

[0043] As shown in FIG. **2**, the bullnose fairing **32** may be attached to the forward side wall **36** and the rearward side wall **38** of the torque box **30**. For example, in some implementations, the forward side wall **36** may include a first distal portion **52** having a first mounting portion **54** (e.g., flange, shoulder, collar, edge, etc.) structurally configured to attach to the second face **50** of the bullnose fairing **32**. Likewise, the rearward side wall **38** may include a second distal portion **56** having a second mounting portion **58** (e.g., flange, shoulder, collar, edge, etc.) structurally configured to attach to the second face **50** of the bullnose fairing **32**.

[0044] When connected to the torque box **30**, the bullnose fairing **32**, the outer wall **34**, the forward side wall **36**, and the rearward side wall **38** define a cavity or interior space **60** that extends circumferentially within the bullnose fairing assembly **10**. The cavity **60** may be configured in a variety of ways, including different shapes (e.g., cross sectional shape) and sizes. As shown in FIG. **3**, in some implementations, the bullnose fairing assembly **10** may include a plurality of spaced apart fittings **64** configured to provide structurally support for the bullnose fairing assembly **10**. The fittings **64** may be configured in a variety of ways, including the shape, the size, the arrangement (e.g., the spacing between fittings), the number of fittings, etc. In the illustrated example, each fitting **64** is configured as a strip of material formed in a closed shape that generally follows the perimeter of the cavity shape (i.e., along or attached to the inner surface of the walls defining the cavity). In some implementations, the fittings **64** are arranged in pairs with each pair of fittings **65** spaced apart from each other circumferentially within the bullnose fairing assembly **10**. In some implementations, the pairs of fittings **65** may be evenly spaced apart within the bullnose fairing assembly **10**. In other implementations, however, the pairs of fittings **65** may be unevenly spaced apart within the bullnose fairing assembly **10**.

[0045] The bullnose fairing assembly **10** can be configured to use the cavity **60** to attenuate engine fan tones from the engine which propagate through the thrust reverser **12**. For example, the bullnose fairing **32** may include a plurality of perforations **66** that extend from the first face **48** through the bullnose fairing **32** and into the cavity **60**, thereby forming open paths from the air flow through the thrust reverser **12** to the cavity **60**. In this way, the cavity **60** can function as a Helmoltz resonator that can be configured to attenuate the engine fan tones.

[0046] For example, the number, the size, the location, and arrangement of the perforations **66** and the size and shape of the cavity **60** or sections of the cavity **60** can be selectively configured to attenuate specific engine fan tones. As shown in FIG. **1**, when the thrust reverser blocker doors **20** are in the stowed position, the blocker doors **20** cover the rearward portion **46** of the bullnose fairing **32** (i.e., a portion of the bullnose fairing **32** that is aft of a forward edge **70** of the blocker doors **20** in the stowed position). The forward portion **44** of the bullnose fairing **32** (i.e., a portion forward of the forward edge **70** of the blocker doors **20**) is not covered and is exposed to the airflow from the jet engine (not shown). In some implementations, the perforations **66** are formed in the forward portion **44**. In some implementations, no perforations **66** are formed in the rearward portion **46**.

[0047] The plurality of perforations **66** may be sized, shaped, and numbered as required to attenuate engine fan tones at desired frequencies. In particular, the plurality of perforations **66** may be configured to create a desired open area ratio (e.g., 10-20%, 4-8%, etc.) in the bullnose fairing **32**. The plurality of perforations **66** can be configured to create any suitable open area ratio. Open area ratio is defined as the percentage open area relative to a base area. For example, the base area may be the area of the bullnose fairing **32** associated with (i.e., overlaps or covers) the cavity **60** and the open area ratio may be area of open space in the bullnose fairing **32** caused by the perforations **66** in the bullnose fairing **32**, in the base area, divided by the base area. The individual size and shape of each perforation **66** may be selected as desired. In some implementations, each perforation **66** is generally a circular shape having a diameter in 0.02-0.08 inches, or approximately 0.05 inches. In other implementations, however, that diameter of each perforation **66** may be less than 0.02 inches or greater than 0.08 inches. Further, in some implementations, the perforations **66** may be shaped other than circular (e.g., oval, triangular, rectangular, or any other suitable shape).

[0048] In some implementations, the bullnose fairing assembly **10** may be configured to attenuate engine fan tones in different ways. For example, in some implementations, the bullnose fairing assembly **10** may be configured to act as a reactive acoustic structure (i.e., reflects acoustic energy). In other implementations, the bullnose fairing assembly **10** may be configured to act as a resistive acoustic structure (i.e., absorb acoustic energy). Further, in some implementations, some portions of bullnose fairing assembly **10** can be configured to act as a reflective acoustic structure while other portions of the bullnose fairing assembly **10** can be configured to act as a reactive acoustic structure. For example, configuring the bullnose fairing assembly **10** (or a portion thereof) to have a relatively low open area ratio (e.g., 4-8%) can cause the bullnose fairing assembly **10** to function as a resistive acoustic structure while configuring the bullnose fairing assembly **10** (or a portion thereof) to have a relatively high open area ratio (e.g., 10-20%) can cause the bullnose fairing assembly **10** to function as a reactive acoustic structure.

[0049] Referring to FIGS. **5-11**, in some implementations, the circumferentially extending cavity **60** can be divided into a plurality of circumferentially extending cavity sections **80**. For example, in some implementations, the bullnose fairing assembly **10** can include a plurality of spaced apart frame members **82**. Each of the frame members **82** can be configured to extend axially within the cavity **60** to divide the cavity **60** into cavity sections **80**. In some implementations, each cavity section **80** can individually attenuate engine fan tones and can be tuned to attenuate specific frequencies.

[0050] The frame members **82** may be configured in a variety of ways, including material, thickness, orientation, shape, spacing between frame members, etc. In some implementations, each frame member **82** forms a solid wall, or a wall with low porosity, that divides the cavity **60** into two adjacent circumferentially extending cavity sections **80**. In some implementations, each frame member **82** extends axially across the entire cross-sectional shape of the cavity (i.e., extends from the bullnose fairing to the back wall and extends from the first wall to the second wall).

[0051] In some implementations, the cavity sections **80** may be equally sized to each other (e.g., the frame members **82** defining the cavity sections **80** may be evenly spaced apart). In other implementations, however, one or more cavity sections **80** may vary in size relative to one or more other cavity sections **80**. The spacing of the frame members **82** may depend on the size of the engine and the desired frequencies for noise attenuation. In some implementations, the frame members **82** are spaced in the range of 6-10 inches apart.

[0052] In some implementations, each cavity section **80** may include a drainage path (not shown) to allow fluid to drain from each cavity sections **80** if fluid accumulates. In some implementations, the drainage path (not shown) may include one or more openings (e.g., perforations) formed in one or more of the frame members **82**.

[0053] FIG. **5** is a partial schematic representation of an example implementation of the bullnose fairing assembly **10**. The bullnose fairing assembly of FIG. **5** includes the frame members **82** (showed in dashed lines) that divide the cavity **60** (shown in dashed lines) into cavity sections **80**. The bullnose fairing **32** may include a forward cavity portion **84** and a rearward cavity portion **86** (shown in crosshatch in FIG. **5**). The forward cavity portion **84** is the portion of the forward portion **44** of the bullnose fairing **32** (i.e., the portion forward of the forward edge **70** of the blocker doors **20** when in the stowed position) that is positioned over the cavity **60**. The rearward cavity portion **86** is the portion of the rearward portion **46** of the bullnose fairing **32** (i.e., the portion aft of the forward edge **70** of the blocker doors **20** when in the stowed position) that is positioned over the cavity **60**.

[0054] As shown in FIG. **5**, in some implementations, the bullnose fairing **32** includes the perforations **66** in the forward cavity portion **84**. In the example of FIG. **5**, the perforations **66** are shown evenly spaced across the entire forward cavity portion **84**. In other implementations, however, the perforations **66** may be positioned only in a section of the forward cavity portion **84** and/or may be unevenly spaced or arranged in a pattern.

[0055] In some implementations, the bullnose fairing assembly **10** can be configured to perform as a reactive acoustic liner (i.e., reflects acoustic energy). For example, the number, size, and distribution of the perforations **66** are configured to create an open area ratio in the range 10-20%. An open area ratio in the range of 10-20% allows the bullnose fairing assembly **10** to reflect acoustic energy. For example, in some implementations, the bullnose fairing assembly **10** can reflect acoustic energy back toward the jet engine or toward other acoustic treatments.

[0056] FIG. **6** is a partial schematic representation of an example implementation of the bullnose fairing assembly **10**. The bullnose fairing assembly of FIG. **6** includes the frame members **82** (showed in dashed lines) that divide the cavity **60** (shown in dashed lines) into cavity sections **80**. In some implementations, the bullnose fairing **32** includes the perforations **66** in the forward cavity portion **84**. In the example of FIG. **6**, the perforations **66** are shown evenly spaced across a portion (e.g., a circumferential half) of the forward cavity portion **84** such that forward cavity portion **84** includes a perforated lateral portion **87** and an unperforated lateral portion **88**. In other implementations, however, the perforations **66** may be spread arranged in another portion of the forward cavity portion **84** or across the entire the forward cavity portion **84** and/or may be unevenly spaced or arranged in a pattern.

[0057] In some implementations, the bullnose fairing assembly **10** can be configured to perform as a resistive acoustic liner (i.e., absorbs acoustic energy). For example, the number, size, and distribution of the perforations **66** may be configured to create an open area ratio in the range 4-8%. An open area ratio in the range of 4-8% allows the bullnose fairing assembly **10** absorb acoustic energy. As compared to the example of FIG. **5**, the bullnose fairing assembly of FIG. **6** may include less perforations.

[0058] FIG. **7** is a partial schematic representation of an example implementation of the bullnose fairing assembly **10**. The bullnose fairing assembly of FIG. **7** includes the frame members **82** (showed in dashed lines) that divide the cavity **60** (shown in dashed lines) into cavity sections **80**. In some implementations, the bullnose fairing **32** includes the perforations **66** in the forward cavity portion **84**. In the example of FIG. **7**, the perforations **66** are shown evenly spaced across a forward portion (e.g., axial forward half) of the forward cavity portion **84** to form a forward perforated portion **89** and a rearward unperforated portion **91**. In other implementations, however, the perforations **66** may be spread arranged in another portion of the forward cavity portion **84** or across the entire the forward cavity portion **84** and/or may be unevenly spaced or arranged in a pattern.

[0059] In some implementations, the bullnose fairing assembly **10** can be configured to perform as a resistive acoustic liner (i.e., absorbs acoustic energy). For example, the number, size, and distribution of the perforations **66** may be configured to create an open area ratio in the range 4-8%. An open area ratio in the range of 4-8% allows the bullnose fairing assembly **10** absorb acoustic energy. As compared to the example of FIG. **5**, the bullnose fairing assembly of FIG. **7** may include less perforations.

[0060] FIG. **8** is a partial schematic representation of an example implementation of the bullnose fairing assembly **10**. The bullnose fairing assembly of FIG. **8** includes the frame members **82** (showed in dashed lines) that divide the cavity **60** (shown in dashed lines) into cavity sections **80**. In some implementations, the bullnose fairing **32** includes the perforations **66** in the forward cavity portion **84**. In some implementations, the amount and/or location of perforations **66** may vary in different cavity sections **80**.

[0061] As shown in FIG. **8**, in some implementations, the amount and/or location of perforations **66** in a first cavity section **80*a*** may differ from the amount and location of perforations **66** in a second cavity section **80*b***. In the example of FIG. **8**, the perforations **66** are shown evenly spaced across the entire forward cavity portion **84** of the first cavity section **80*a*** while the perforations **66** are shown evenly spaced across a portion (e.g., a circumferential half) of the forward cavity portion **84** of the second cavity section **80*b*** such that forward cavity portion **84** includes a perforated lateral portion **87** and an unperforated lateral portion **88**.

[0062] In some implementations, the first cavity section **80*a*** can be configured to perform as a reactive acoustic liner section (i.e., reflects acoustic energy). For example, the number, size, and distribution of the perforations **66** in the first cavity section **80*a*** can be configured to create an open area ratio in the range 10-20%. An open area ratio in the range of 10-20% allows the first cavity section **80*a*** of the bullnose fairing assembly **10** to reflect acoustic energy. In some implementations, the second cavity section **80*b*** of the bullnose fairing assembly **10** can be configured to perform as a resistive acoustic liner (i.e., absorbs acoustic energy). For example, the number, size, and distribution of the perforations **66** in the section cavity section **80*b*** may be configured to create an open area ratio in the range 4-8%. An open area ratio in the range of 4-8% allows the section cavity section **80***b* of the bullnose fairing assembly **10** to absorb acoustic energy.

[0063] FIG. **9** is a partial schematic representation of an example implementation of the bullnose fairing assembly **10**. The bullnose fairing assembly of FIG. **9** includes the frame members **82** (showed in dashed lines) that divide the cavity **60** (shown in dashed lines) into cavity sections **80**. In some implementations, the bullnose fairing **32** includes the perforations **66** in the forward cavity portion **84**. In the example of FIG. **9**, the perforations **66** are shown evenly spaced across the entire forward cavity portion **84**. In other implementations, however, the perforations **66** may be positioned only in a section of the forward cavity portion **84** and/or may be unevenly spaced or arranged in a pattern.

[0064] In some implementations, the bullnose fairing assembly **10** can include a plurality of dividing members **90**. Each of the plurality of dividing members **90** can be configured to extend circumferentially in one of the cavity sections **80** to divide the cavity sections **80** into a forward subsection **92** and an aft subsection **94**. The dividing members **90** may be configured in a variety of ways, including material, thickness, orientation, shape, etc. In some implementations, each dividing member **90** extends partially across a width W of the cavity (e.g., extends between first and second frame members but leaves a gap G**1** therebetween). In some implementations, the gap G**1** is less than 10%, less than 20%, less than 30%, or less than 40% of the width W. Thus, the forward subsection **92** is open to the aft subsection **94**.

[0065] The size of the forward subsection **92** relative to the aft subsection **94** may be vary in different implementations to tune the cavity section **80** as desired. In some implementations, the forward subsection **92** has the same volume as the aft subsection **94**. In other implementations, the forward subsection **92** may be larger or smaller than the aft subsection **94**.

[0066] In some implementations, the dividing member **90** may extend radially to connect the bullnose fairing **32** to the outer wall **34** (see FIG. **2**). In other implementations, the dividing member **90** may only partially extend radially between the bullnose fairing **32** to the outer wall **34** such that a radially undivided portion (e.g., a gap) may be between the dividing member **90** and bullnose fairing **32** or may be between the dividing member **90** and outer wall **34**. In some implementations, the dividing member **90** may extend fully between adjacent frame members **82** such that there is no gap G**1**. Instead, the dividing member **90** may have a radially undivided portion (e.g., a gap) between the dividing member **90** and bullnose fairing **32** or may have a radially undivided portion between the dividing member **90** and outer wall **34**.

[0067] FIG. **10** is a partial schematic representation of an example implementation of the bullnose fairing assembly **10**. The bullnose fairing assembly of FIG. **10** includes the frame members **82** (showed in dashed lines) that divide the cavity **60** (shown in dashed lines) into cavity sections **80**. In some implementations, the bullnose fairing **32** includes the perforations **66** in the forward cavity portion **84**. In the example of FIG. **10**, the perforations **66** are shown evenly spaced across a portion (e.g., a circumferential half) of the forward cavity portion **84**. In other implementations, however, the perforations **66** may be positioned only in a section of the forward cavity portion **84** and/or may be unevenly spaced or arranged in a pattern.

[0068] In some implementations, the bullnose fairing assembly **10** can include a plurality of dividing members **96**. Each of the plurality of dividing members **96** can be configured to extend axially in one of the cavity sections **80** to divide the cavity sections **80** into a first lateral subsection **98** and a second lateral subsection **100**. The dividing members **96** may be configured in a variety of ways, including material, thickness, orientation, shape, etc. In some implementations, each dividing member **96** extends partially across a length L of the cavity section **80** (e.g., extends between the forward side wall **36** and the rearward side wall **38** but leaves a gap G**2** therebetween). In some implementations, the gap G**2** is less than 10%, less than 20%, less than 30%, or less than 40% of the length L. Thus, the first lateral subsection **98** is open to the second lateral subsection **100**.

[0069] The size of the first lateral subsection **98** relative to the second lateral subsection **100** may be vary in different implementations to tune the cavity section **80** as desired. In some implementations, the first lateral subsection **98** has the same volume as the second lateral subsection **100**. In other implementations, the first lateral subsection **98** may be larger or smaller than the second lateral subsection **100**.

[0070] In some implementations, the dividing member **96** may extend radially to connect the bullnose fairing **32** to the outer wall **34** (see FIG. **2**). In other implementations, the dividing member **96** may only partially extend radially between the bullnose fairing **32** to the outer wall **34** such that a radially undivided portion (e.g., a gap) may be between the dividing member **96** and bullnose fairing **32** or may be between the dividing member **96** and outer wall **34**. In some implementations, the dividing member **96** may extend fully between the forward side wall **36** and the rearward side wall **38** such that there is no gap G**2**. Instead, the dividing member **96** may have a radially undivided portion (e.g., a gap) between the dividing member **90** and bullnose fairing **32** or may have a radially undivided portion between the dividing member **90** and outer wall **34**.

[0071] FIG. **11** is a partial schematic representation of an example implementation of the bullnose fairing assembly **10**. The bullnose fairing assembly of FIG. **11** includes the frame members **82** (showed in dashed lines) that divide the cavity **60** (shown in dashed lines) into cavity sections **80**. In some implementations, the bullnose fairing **32** includes the perforations **66** in the forward cavity portion **84**. In some implementations, the forward cavity portion **84** may include two or more groups of perforations **66** separated by one or more unperforated portions. For example, in the illustrated implementation of FIG. **11**, the perforations **66** are shown evenly spaced across a portion of the forward cavity portion **84** such that forward cavity portion **84** includes a first perforated portion **102**, a second perforated portion **104**, and an unperforated portion **106** dividing the first perforated portion **102** and the second perforated portion **104**. In other implementations, however, the perforations **66** in the first perforated portion **102** and the second perforated portion **104** may be unevenly spaced or arranged in a pattern. Further, in other implementations, there may be more than two perforated portions separated by an unperforated portion (s).

[0072] In some implementations, the two or more perforated portions **102**, **104** can be configured to create a desired open area ratio for a cavity section **80** and the bullnose fairing assembly **10** overall.

[0073] In some implementations, any of the circumferentially extending cavity sections, cavity subsections, or cavity portions, can be filled (fully or partially) with a noise attenuating materials. A variety of noise attenuating materials may be used. In some implementations, the noise attenuating material may be a honeycomb structure (not shown). For example, in some implementations, the honeycomb structure may have any commonly used honeycomb core designs such as flexcore, hexcore, or the like. In some implementations, the honeycomb structure may have cell sizes in the range % of an inch to % of an inch, or approximately % of an inch.

[0074] As used herein, the terms “A or B” and “A and/or B” are intended to encompass A, B, or {A and B}. Further, the terms “A, B, or C” and “A, B, and/or C” are intended to encompass single items, pairs of items, or all items, that is, all of: A, B, C, {A and B}, {A and C}, {B and C}, and {A and B and C}. The term “or” as used herein means “and/or.”

[0075] As used herein, language such as “at least one of X, Y, and Z,” “at least one of X, Y, or Z,” “at least one or more of X, Y, and Z,” “at least one or more of X, Y, or Z,” “at least one or more of X, Y, and/or Z,” or “at least one of X, Y, and/or Z,” is intended to be inclusive of both a single item (e.g., just X, or just Y, or just Z) and multiple items (e.g., {X and Y}, {X and Z}, {Y and Z}, or {X, Y, and Z}). The phrase “at least one of” and similar phrases are not intended to convey a requirement that each possible item must be present, although each possible item may be present.

[0076] The techniques presented and claimed herein are referenced and applied to material objects and concrete examples of a practical nature that demonstrably improve the present technical field and, as such, are not abstract, intangible or purely theoretical. Further, if any claims appended to the end of this specification contain one or more elements designated as “means for [perform]ing [a function] . . . ” or “step for [perform]ing [a function] . . . ”, it is intended that such elements are to be interpreted under 35 U.S.C. § 112(f). However, for any claims containing elements designated in any other manner, it is intended that such elements are not to be interpreted under 35 U.S.C. § 112(f).

[0077] While the invention has been described with reference to the exemplary examples thereof, those skilled in the art will be able to make various modifications to the described examples without departing from the true spirit and scope. The terms and descriptions used herein are set forth by way of illustration only and are not meant as limitations. Although the method has been described by examples, the steps of the method can be performed in a different order than illustrated or simultaneously. Those skilled in the art will recognize that these and other variations are possible within the spirit and scope as defined in the following claims and their equivalents.

What is claimed is:

1. An acoustically treated fairing assembly for a thrust reverser of an aircraft, the thrust reverser having a stowable blocker door, the acoustically treated fairing assembly comprising:

a torque box fixed to the thrust reverser;

a bullnose fairing attached to the torque box to form a cavity therebetween; and

a plurality of spaced apart frame members extending axially within the cavity to divide the cavity into a plurality of circumferentially extending cavity sections, each circumferentially extending cavity section having a forward portion of the bullnose fairing and a rearward portion of the bullnose fairing associated therewith, the rearward portion being aft of a forward edge of the stowable blocker door when the stowable blocker door is in a stowed position,

wherein the bullnose fairing associated with at least two of the circumferentially extending cavity sections has a perforated forward cavity portion.

2. The acoustically treated fairing assembly according to claim **1**, wherein the perforated forward cavity portion has an open area ratio in a range of 4 to 8 percent.

3. The acoustically treated fairing assembly according to claim **1**, wherein the perforated forward cavity portion has an open area ratio in a range of 10 to 20 percent.

4. The acoustically treated fairing assembly according to claim **1**, wherein the plurality of spaced apart frame members are spaced apart from each other in a range of 6-10 inches.

5. The acoustically treated fairing assembly according to claim **1**, further comprising a plurality of dividing members, each of the plurality of dividing members being configured to divide a corresponding one of the circumferentially extending cavity sections into a first subsection and a second subsection.

6. The acoustically treated fairing assembly according to claim **5**, wherein each of the plurality of dividing members partially extends circumferentially across a corresponding one of the circumferentially extending cavity sections leaving an undivided portion between the first subsection and the second subsection.

7. The acoustically treated fairing assembly according to claim **5**, wherein each of the plurality of dividing members partially extends axially across a corresponding one of the circumferentially extending cavity sections leaving an undivided portion between the first subsection and the second subsection.

8. The acoustically treated fairing assembly according to claim **5**, wherein the first subsection has a first volume and the second subsection has a second volume that is different than the first volume.

9. The acoustically treated fairing assembly according to claim **1**, wherein the bullnose fairing associated with a first plurality of the circumferentially extending cavity sections includes perforated forward portions with a first open area ratio and the bullnose fairing associated with a second plurality of the circumferentially extending cavity sections includes perforated forward cavity portions with a second open area ratio greater than the first open area ratio.

10. The acoustically treated fairing assembly according to claim **9**, wherein the first open area ratio is in a range of 4 to 8 percent and the second open area ratio is in a range of 10 to 20 percent.

11. The acoustically treated fairing assembly according to claim **9**, wherein the first plurality of the circumferentially extending cavity sections are circumferentially arranged in an alternating sequence with the second plurality of the circumferentially extending cavity sections.

12. The acoustically treated fairing assembly according to claim **1**, wherein the perforated forward portion includes a forward perforated section and a rearward unperforated section.

13. The acoustically treated fairing assembly according to claim **1**, wherein the perforated forward portion includes a lateral perforated section and a lateral unperforated section.

14. A method of acoustically treating a fairing assembly for a thrust reverser of an aircraft, the thrust reverser having a stowable blocker door, the fairing assembly having a bullnose fairing attached to a torque box to form a cavity therebetween, the method comprising:

dividing the cavity into a plurality of circumferentially extending cavity sections; and

perforating the bullnose fairing associated with at least two of the plurality of circumferentially extending cavity sections in a forward cavity portion of the bullnose fairing that is forward of a forward edge of the stowable blocker door when the stowable blocker door is in a stowed position.

15. The method according to claim **14**, wherein perforating the bullnose fairing further comprising creating an open area ratio in the forward cavity portion in a range of 4 to 8%.

16. The method according to claim **14**, wherein perforating the bullnose fairing further comprising creating an open area ratio in the forward cavity portion in a range of 10 to 20%.

17. The method according to claim **14**, further comprising dividing at least one of the plurality of circumferentially extending cavity sections into a first subsection and a second subsection and leaving an undivided section between the first subsection and the second subsection.

18. The method according to claim **17**, wherein dividing at least one of the plurality of circumferentially extending cavity sections into the first subsection and the second subsection further comprises perforating a dividing member that divides the at least one of the plurality of circumferentially extending cavity sections.

19. The method according to claim **14**, wherein perforating the forward cavity portion associated with at least two of the plurality of circumferentially extending cavity sections further comprising creating a first open area ratio in the forward cavity portion associated with a first of the plurality of circumferentially extending cavity sections and creating a second open area ratio in the forward cavity portion associated with a second of the plurality of circumferentially extending cavity sections that is different than the first open area ratio.

20. The method according to claim **19**, wherein the first of the plurality of circumferentially extending cavity sections is adjacent the second of the plurality of circumferentially extending cavity sections.

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