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(54) **DAMPER SYSTEM AND A TURBINE**

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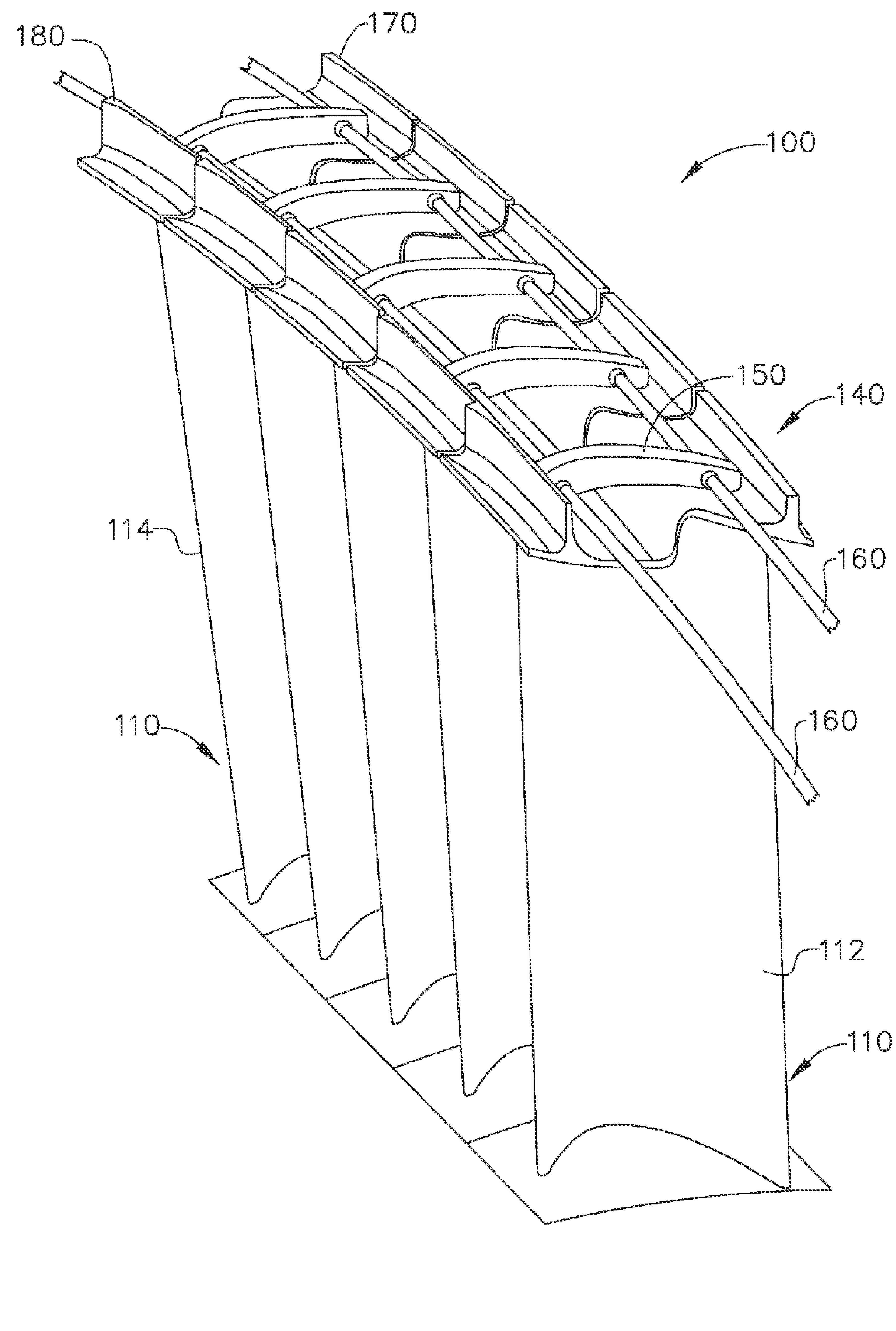
(52) **U.S. Cl.**

USPC **416/191**

(57) **ABSTRACT**

A damper system and a turbine are provided. The damper system includes a plurality of CMC blades. Each CMC blade has a first member of a tip shroud, the first member opposite a second member of the tip shroud, a radial flange extending between the first member and the second member of the tip shroud, and at least one aperture in the radial flange for receiving a damping member, the dampening member joining and dampening adjacent CMC blades. The turbine includes a plurality of turbine blade tip shroud segments, each tip shroud segment having a first surface that cooperates with the first surface in an adjacent tip shroud segment to form a first opening, each tip shroud segment having a first receiving surface. The turbine includes a damper member that abuts the first receiving surface of each tip shroud segment.



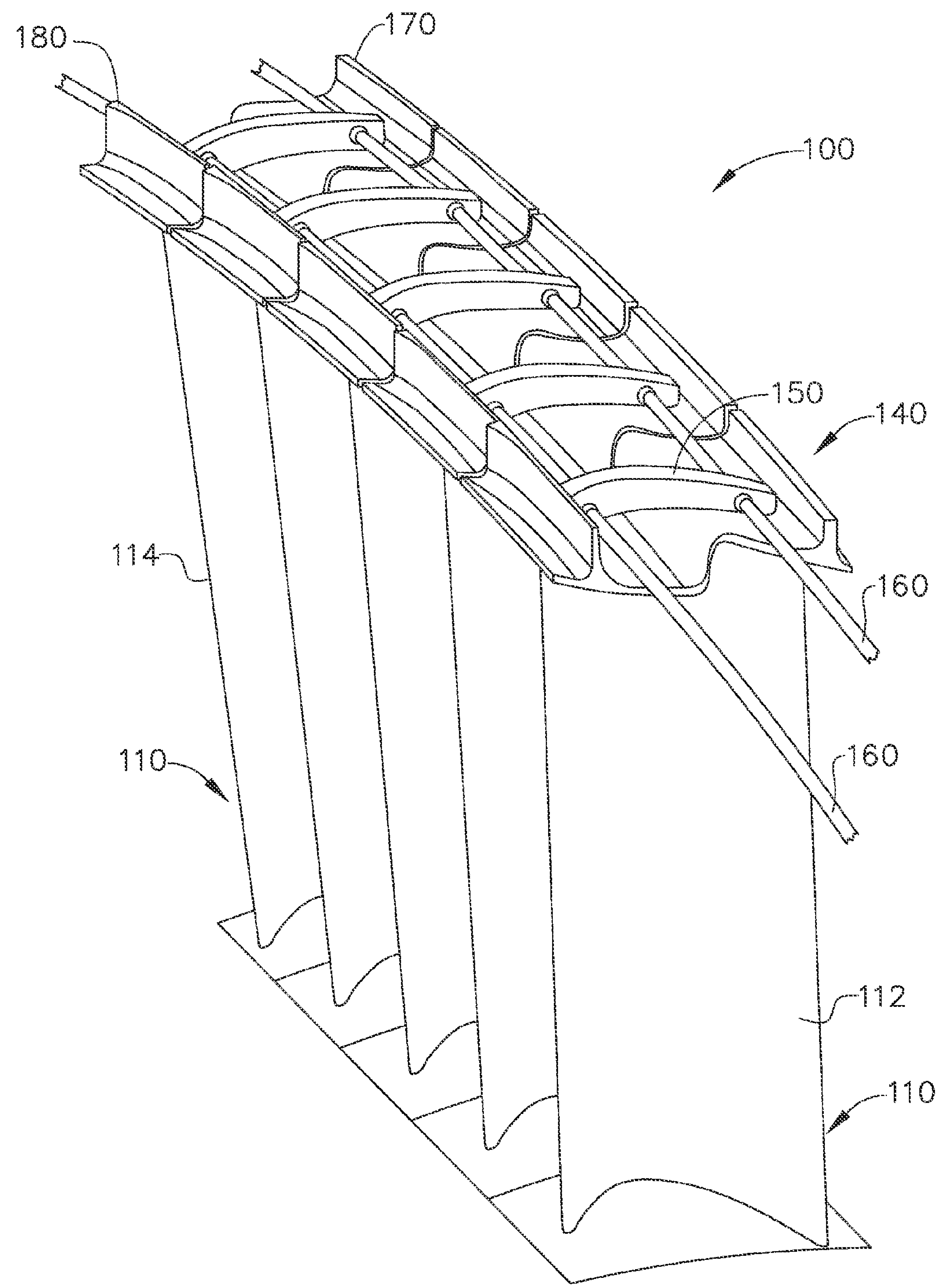


FIG. 1

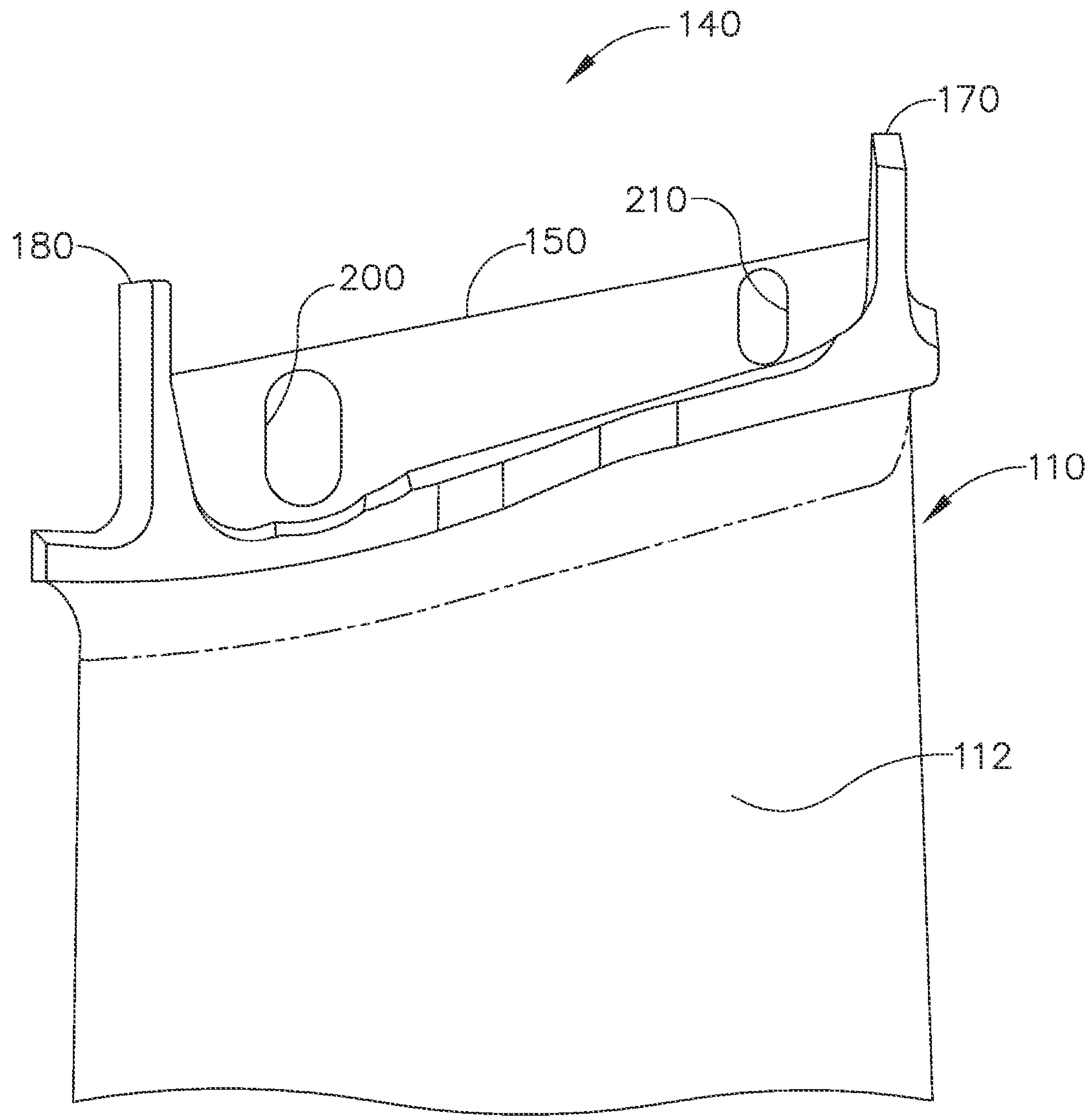


FIG. 2

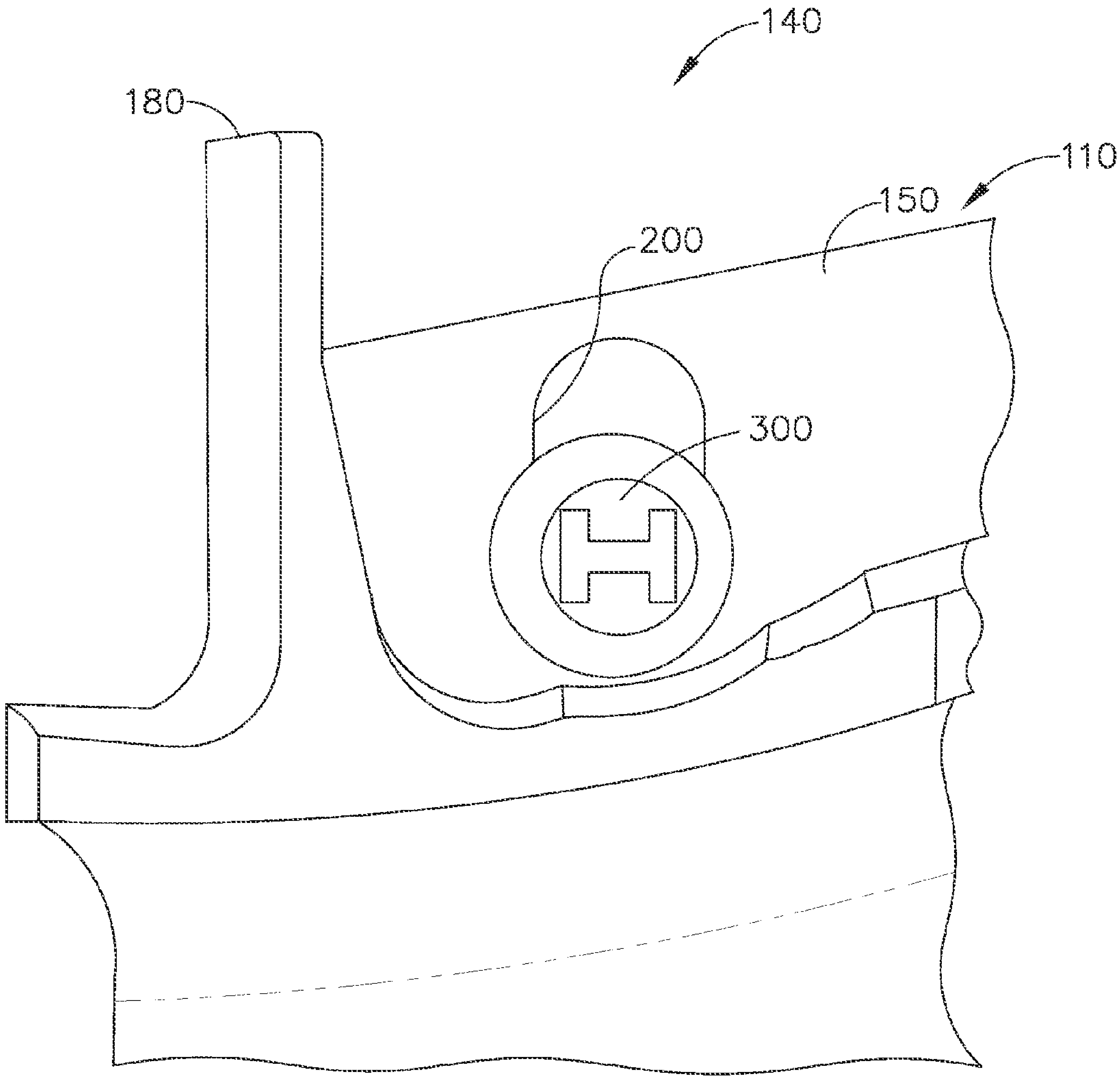


FIG. 3

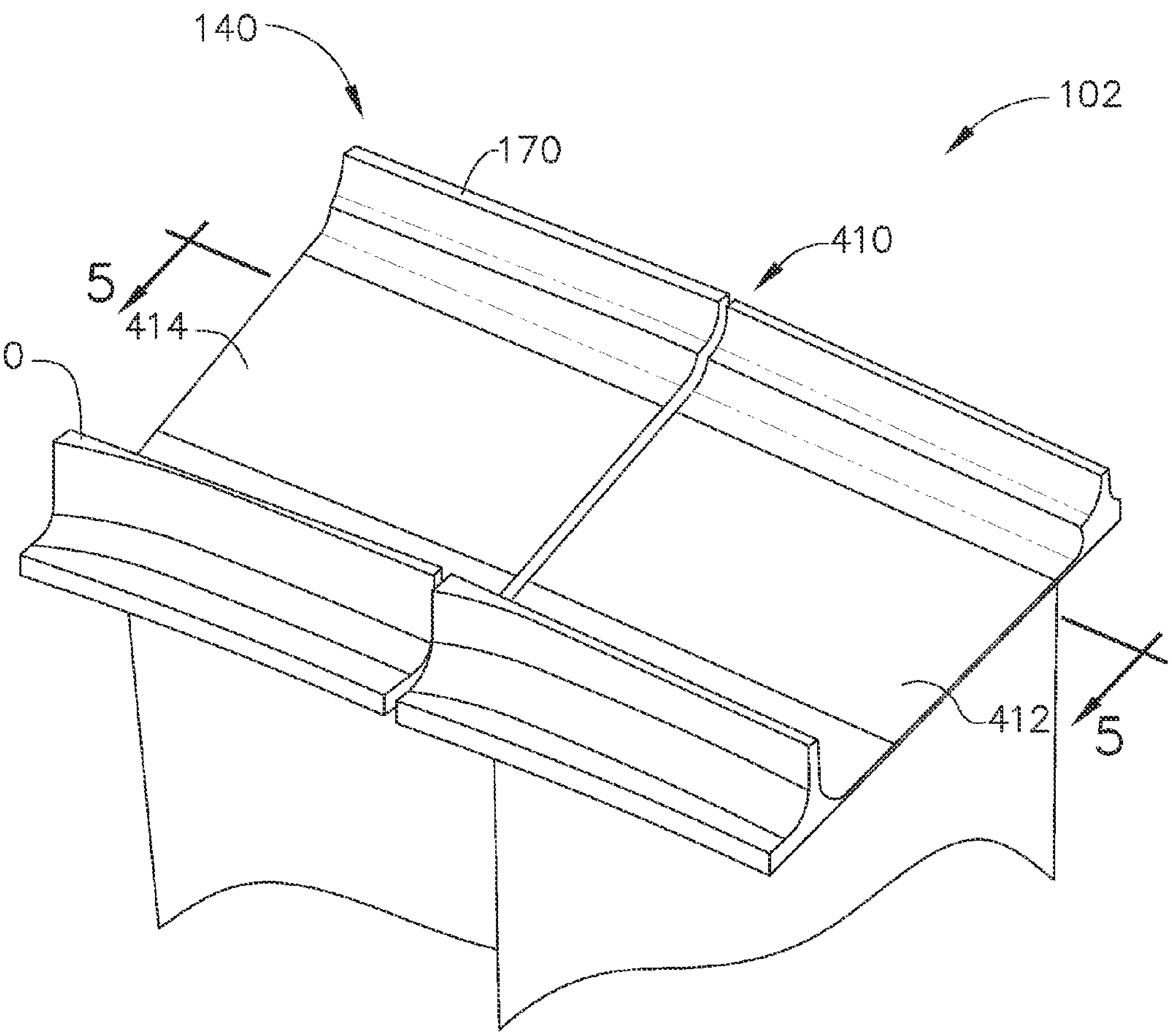
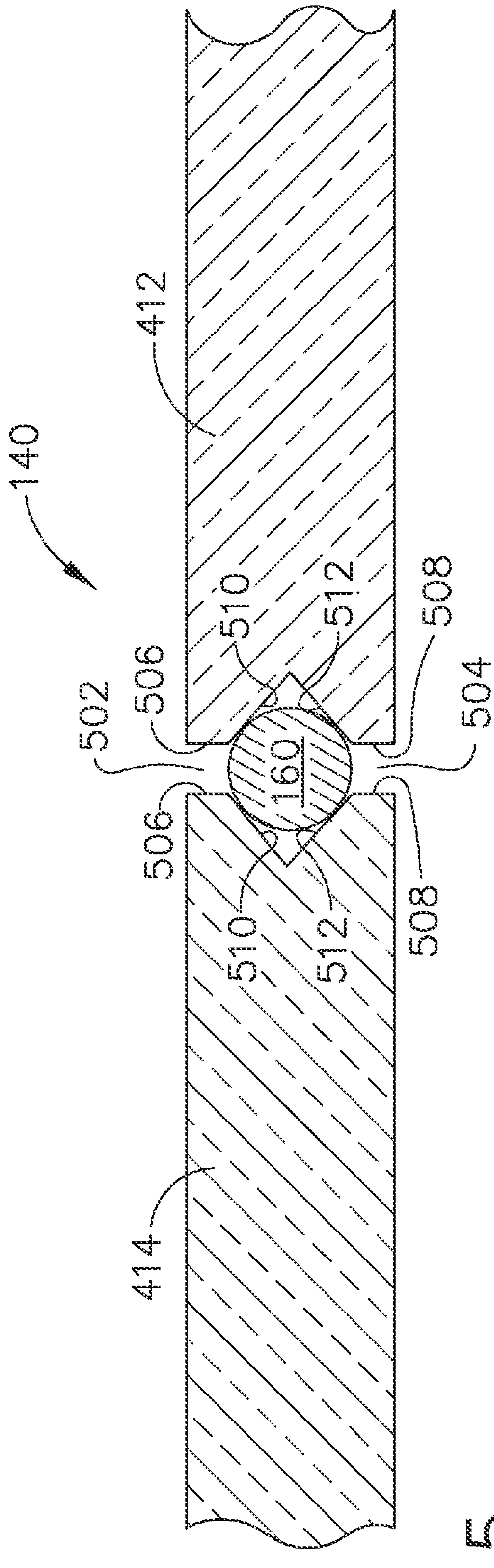


FIG. 4


140
412
502
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510
512
508
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160
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414

FIG. 5

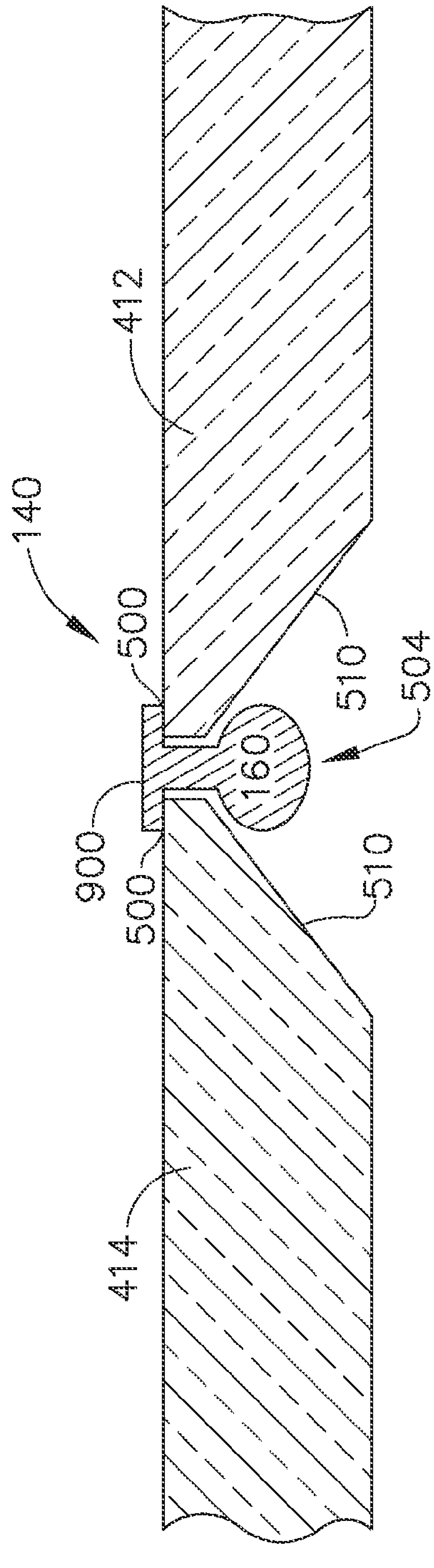
140
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FIG. 6

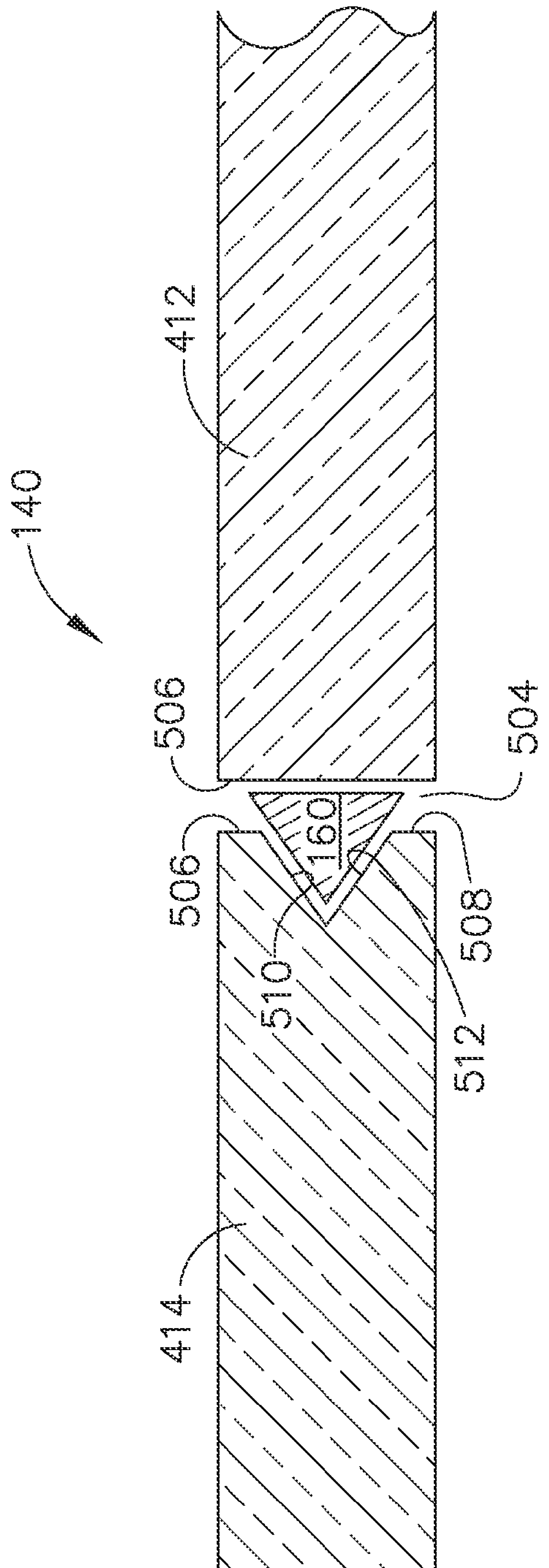
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FIG. 7

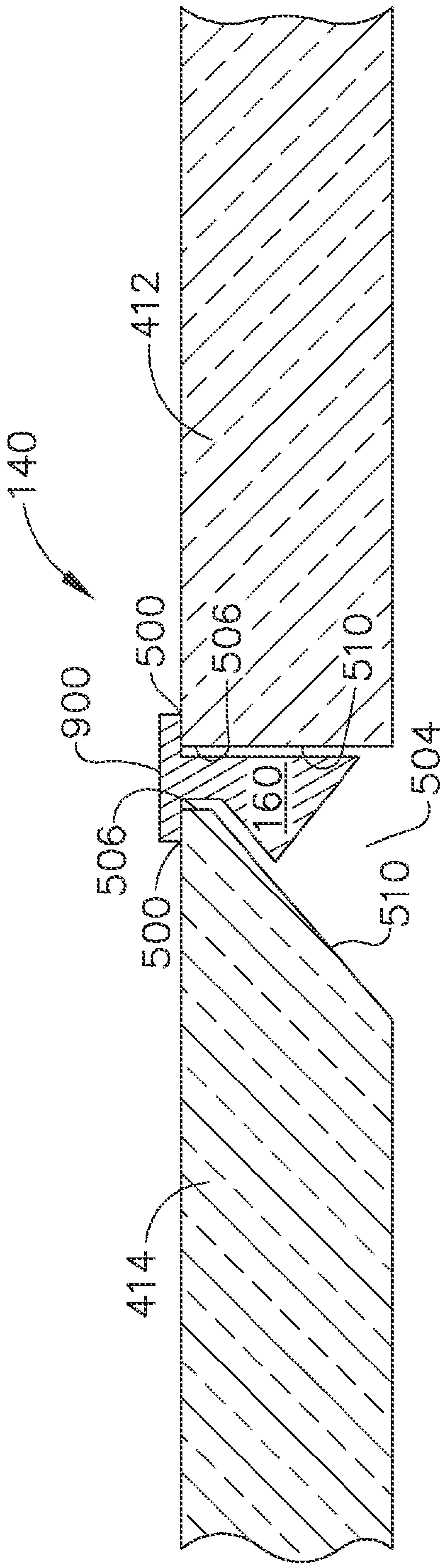
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FIG. 8

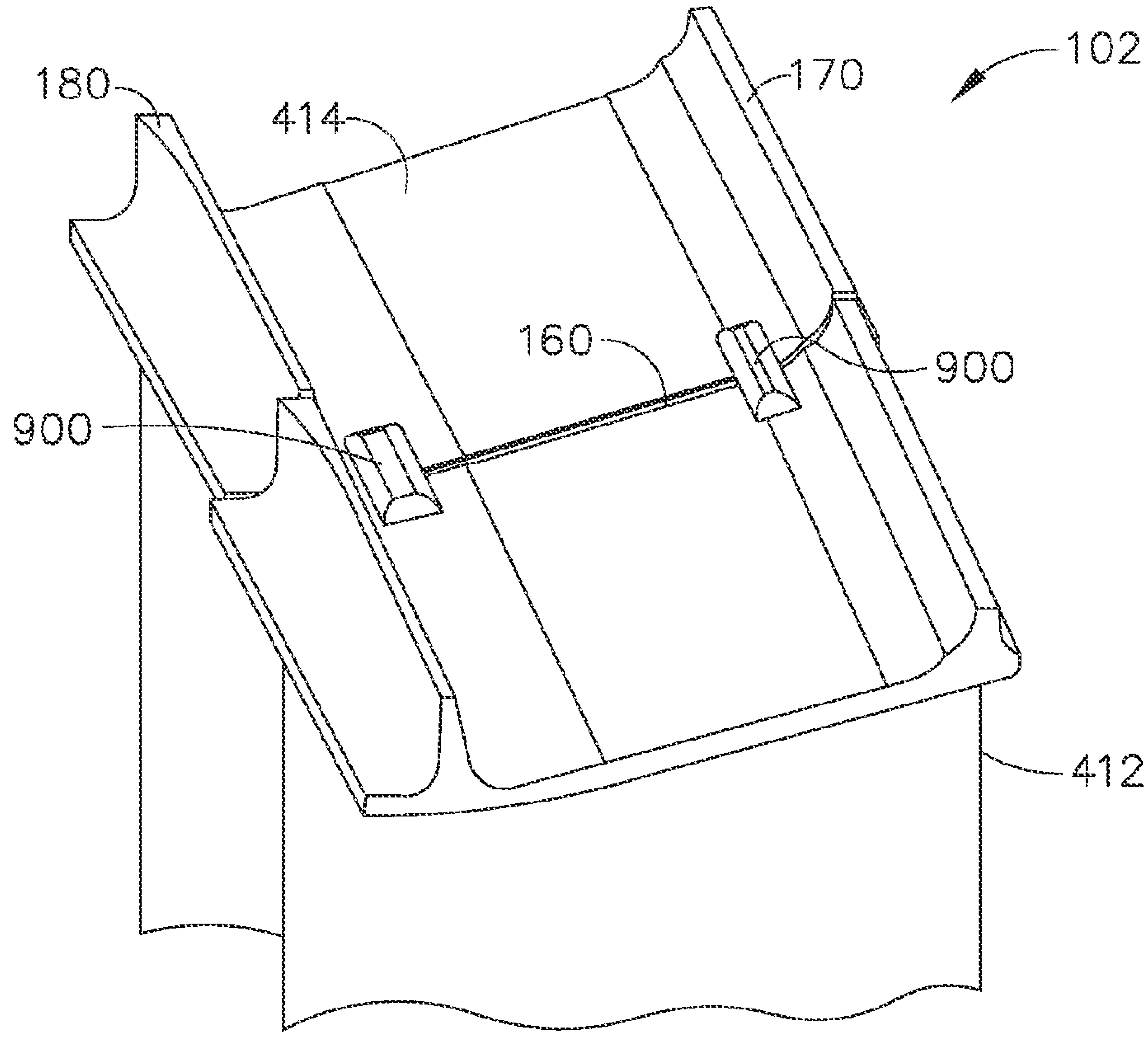

FIG. 9

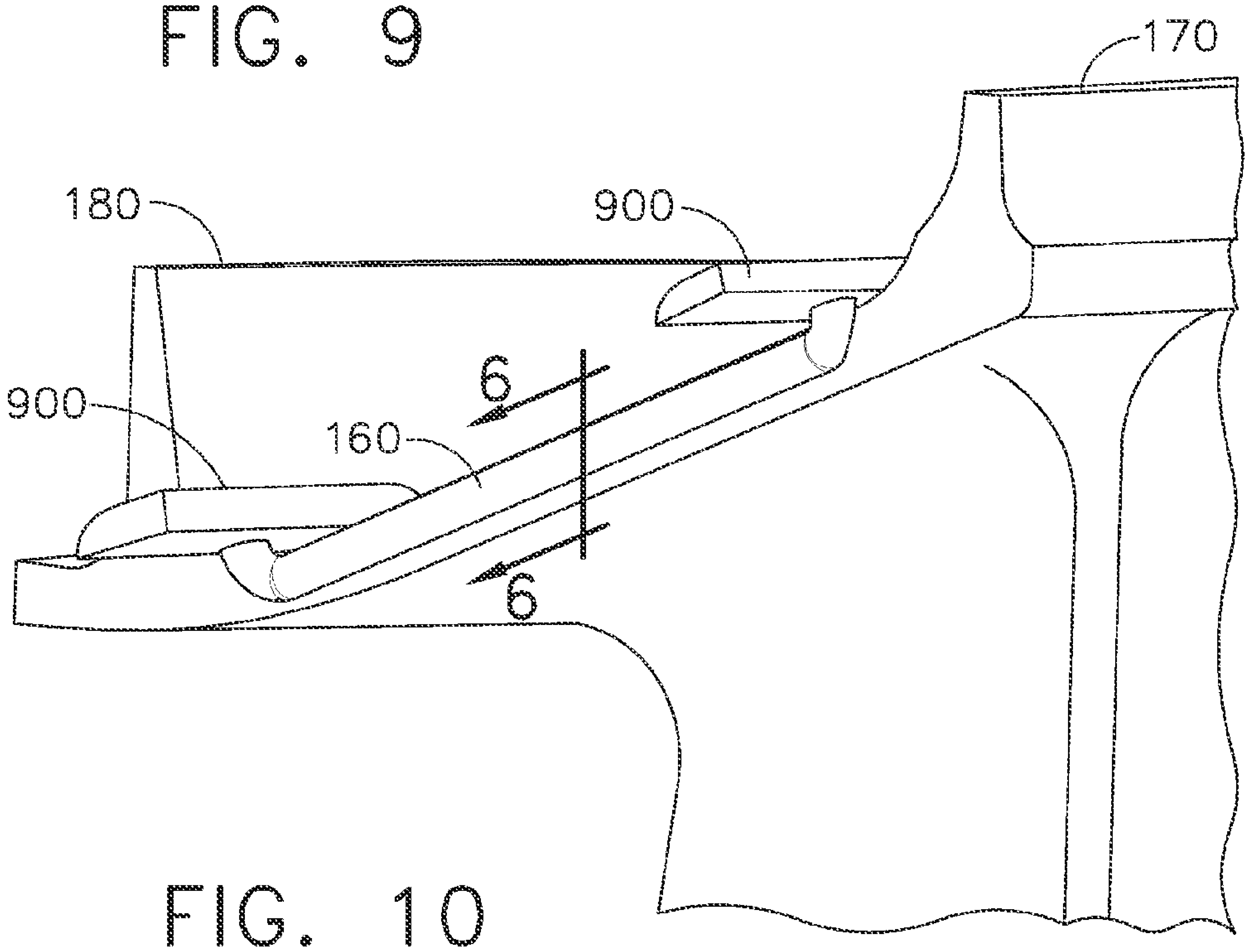

FIG. 10

DAMPER SYSTEM AND A TURBINE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This patent application claims the benefit of U.S. Provisional Patent Application Ser. No. 61/674,086 filed on Jul. 20, 2012 and entitled "DAMPER SYSTEM AND A TURBINE," the disclosure of which is incorporated by reference as if fully rewritten herein.

FIELD OF THE INVENTION

[0002] The present invention relates generally to turbines. More specifically, to a damper system and a turbine.

BACKGROUND OF THE INVENTION

[0003] A turbine assembly typically generates rotating shaft power by expanding hot compressed gas produced by combustion of a fuel. Gas turbine buckets or blades generally have an airfoil shape designed to convert the thermal and kinetic energy of the flow path gases into mechanical rotation of the rotor.

[0004] Turbine performance and efficiency may be enhanced by providing a seal at the tip of the blade to block the flow of air over or around the top of the blade that would otherwise bypass the blade. For example, a tip shroud may be positioned on the end of the blade opposite the end attached to the rotating shaft.

[0005] CMC blades pose special design challenges. CMC's have inherent low strain-to-failure and therefore lack the load carrying capability required by high centrifugal forces and assembly pretwist. Therefore, CMC material systems have difficulty withstanding high contact and torsional stresses induced by interlocked tip shrouds through an assembled inference fit.

[0006] Additionally, there are issues of durability between the CMC to CMC adjacent tip shrouds. Lack of damage tolerance, high wear rates, and vulnerability to impact damage makes CMC tip shroud contact far from ideal.

[0007] Therefore, a damper system and a turbine that do not suffer from the above drawbacks is desirable in the art.

SUMMARY OF THE INVENTION

[0008] According to an exemplary embodiment of the present disclosure, a damper system is provided. The damper system includes a plurality of CMC blades. Each CMC blades has a first member of a tip shroud, the first member opposite a second member of the tip shroud, a radial flange extending between the first member and the second member of the tip shroud, and at least one aperture in the radial flange for receiving a damper member, the damper member joining and dampening adjacent CMC blades.

[0009] According to another exemplary embodiment of the present disclosure, a turbine is provided. The turbine includes a plurality of turbine blade tip shroud segments. Each tip shroud segment has a first surface that cooperates with the first surface in an adjacent tip shroud segment to form a first opening. Each tip shroud segment has a first receiving surface. The turbine includes a damper member that abuts the first receiving surface of each tip shroud segment. The damper member joins and dampens adjacent CMC blades.

[0010] Other features and advantages of the present invention will be apparent from the following more detailed description of the preferred embodiment, taken in conjunction with the accompanying drawings which illustrate, by way of example, the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. **1** is a perspective schematic view of a damper system of the present disclosure.

[0012] FIG. **2** is a schematic side view of a tip shroud segment of the present disclosure.

[0013] FIG. **3** is a schematic side view of a tip shroud segment including metal collet the present disclosure.

[0014] FIG. **4** is a partial perspective view of a tip shroud segment of the present disclosure.

[0015] FIG. **5** is a schematic section view taken along line **5-5** of FIG. **4** of a damper of the present disclosure.

[0016] FIG. **6** is an alternative embodiment of the damper of the present disclosure.

[0017] FIG. **7** is an alternative embodiment of the damper of the present disclosure.

[0018] FIG. **8** is an alternative embodiment of the damper of the present disclosure.

[0019] FIG. **9** is a top view of a turbine including a damper of the present disclosure.

[0020] FIG. **10** is a side view of a damper of FIG. **9** of the present disclosure.

[0021] Wherever possible, the same reference numbers will be used throughout the drawings to represent the same parts.

DETAILED DESCRIPTION OF THE INVENTION

[0022] Provided is a damper system and a turbine.

[0023] One advantage of an embodiment of the present disclosure includes higher turbine inlet temperature capability. Another advantage is improved turbine efficiency. Yet another advantage is a reduction in engine weight.

[0024] According to one embodiment, a damper system including a plurality of ceramic matrix composite (CMC) blades is provided. FIG. 1 is a perspective schematic view of a damper system **100** of the present disclosure. Damper system **100** may include a plurality of blades including CMCs. CMC blades **110** may include a platform and dovetail for attaching to the turbine (not shown). CMC blades **110** may include a pressure side **112** and a suction side **114**. Each CMC blade **110** may include a first member **170** of a tip shroud **140**, first member being opposite a second member **180** of tip shroud **140**. Each CMC blade **110** may include a radial flange **150** extending between first member **170** and second member **180** tip shroud **140**. Each CMC blade **110** may include at least one aperture **200**, **210** in radial flange **150** for receiving damper member **160** (see FIG. **2**). Damper member **160** may join and dampen adjacent CMC blades **110**. As shown in FIG. **1**, damper member **160** may be a metal wire running through adjacent apertures **200**, **210** in each CMC blade **110**. Damper member **160** may be selected from metals, such as, but not limited to, metals, metal alloys, and combinations thereof, for example the alloys may include, but are not limited to, nickel-based superalloys or cobalt-based alloys. Damper member **160** may join any number of CMC blades **110**. In one embodiment, not shown in the figures, damper member **160** circumferentially joins **360** degrees of CMC blades **110**.

[0025] According to one embodiment, CMC blades may have a configuration for receiving damper member. For example, FIG. **2** illustrates the first aperture **200** and second aperture **210** on radial flange **150** for receiving damper member **160**. The radial flange **150** may be located between the first member **170** and second member **180** of tip shroud **140** of CMC blade **110**.

[0026] According to one embodiment, CMC blades may have a configuration and additional hardware for receiving damper member. For example, FIG. **3** illustrates a metal collet **300** in first aperture **200** for securing damper member **160**. Metal collet **300** may be made from any suitable metal material, such as, but not limited to, metals, metal alloys, and combinations thereof, for example, the alloys may include nickel-based superalloys or cobalt-based alloys.

[0027] According to one embodiment, turbines may include CMC blades having tip shroud segments. For example, FIG. **4** is a partial perspective view of tip shroud segments of a turbine **102**. Turbine **102** may include plurality of turbine blade tip shroud segments **140**.

[0028] According to one embodiment, tip shroud segments of adjacent CMC blades in damper system may include a number of surfaces that may cooperate to form openings for receiving and surrounding damper member. For example, as shown in FIGS. **5-8** each tip shroud segment **140** of first CMC blade **412** and second CMC blade **414** may include a first surface **506** that may cooperate with first surface **506** in an adjacent tip shroud segment **140** to form a first opening **502**. Each tip shroud segment **140** may include a first receiving surface **510**. Damper member **160** may abut first receiving surface **510** of each tip shroud segment **140**. In one embodiment, first surfaces **506** of adjacent tip shroud segments **140** may be complementary. For example, as illustrated in FIG. **5**, turbine blade tip shroud segments **140** may include a second surface **508** that cooperates with second surface **508** and adjacent tip shroud segment **140** to form a second opening **504**. First and second receiving surfaces **510** and **512** of adjacent tip shroud segments **140** may surround damper member **160**. In one embodiment, as depicted in FIG. **5** second receiving surface **512** may abut damper member **160**. Damper member **160**, as shown in FIG. **5**, may be a rounded metallic insert; however, any geometry for damper member **160** may be possible. Suitable materials for damper member **160**, include, but are not limited to metals, metal alloys, and combinations thereof, for example, the alloys may include nickel-based superalloys, cobalt-based alloys.

[0029] According to one embodiment, tip shroud segments of adjacent CMC blades in damper system may include a number of surfaces that may cooperate to form openings for receiving, but not holding damper member. For example, as shown in FIG. **6**, damper member **160** includes a holding member **900** attached to at least one end of damper member **160**. Holding member **900** may cooperate with surface **500** of adjacent tip shroud segments **140** to hold damper member **160** in place. As shown in FIG. **7**, damper member **160** may have a triangular geometry. In one embodiment first CMC blade **412** has a first surface **506** that may cooperate with first surface **506** of second CMC blade **414**. Second surface **508** of first CMC blade may cooperate with first surface **506** of second CMC blade **414**. In the embodiment shown in FIG. **7**, first receiving surface **510** and second receiving surface **512** may surround damper member **160** holding the damper member **160** in place between adjacent tip shroud segments **140**. In contrast, as shown in FIG. **8**, an embodiment does not include a second receiving surface **512**. Instead, in FIG. **8**, damper member **160** may include a holding member **900** that may cooperate with surface of adjacent tip shroud segments to hold damper member **160** in place. In one embodiment, holding member **900** may circumferentially secure damper member **160** to tip shroud segments **140**.

[0030] According to one embodiment, damper member may include a holding member. For example, as illustrated in FIGS. **9** and **10**, holding member **900** of damper member **160** may be near first member **170** and second member **180** of tip shroud segment **140**. In an alternative embodiment, holding member **900** may not span the entire length of damper member **160**.

[0031] While the invention has been described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.

What is claimed is:

1. A damper system comprising:
a plurality of CMC blades, each blade having
a first member of a tip shroud, the first member opposite a second member of the tip shroud;
a radial flange extending between the first member and the second member of the tip shroud; and
at least one aperture in the radial flange for receiving a dampening member, the dampening member joining and dampening adjacent CMC blades.

2. The damper system of claim **1**, wherein dampening member circumferentially joins 360 degrees of CMC blades.

3. The damper system of claim **1**, wherein the dampening member is metal.

4. The damper system of claim **1**, wherein the dampening member is a metal wire.

5. The damper system of claim **1**, wherein the damper system further includes a metal collet adjacent the aperture.

6. A turbine, comprising:
a plurality of turbine blade tip shroud segments, each tip shroud segment having a first surface that cooperates with the first surface in an adjacent tip shroud segment to form a first opening, each tip shroud segment having a first receiving surface; and
a damper member that abuts the first receiving surface of each tip shroud segment.

7. The turbine of claim **6**, wherein the turbine blade tip shroud segments include a second surface that cooperates with the second surface in an adjacent tip shroud segment to form a second opening.

8. The turbine of claim **6**, wherein the turbine blade tip shroud segments include a second receiving surface that abuts the damper member.

9. The turbine of claim **6**, wherein the damper includes at least one holding member attached to at least one end of the damper member.

10. The turbine of claim **9**, wherein the holding member is integrally formed with the damper member.

11. The turbine of claim **9**, wherein the holding member circumferentially secures the damper member to the tip shroud segments.

12. The turbine of claim **6**, wherein the damper member is a metal.

13. The turbine of claim **6**, wherein the plurality of turbine blade tip shroud segments are ceramic matrix composites.

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