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

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(57) **ABSTRACT**

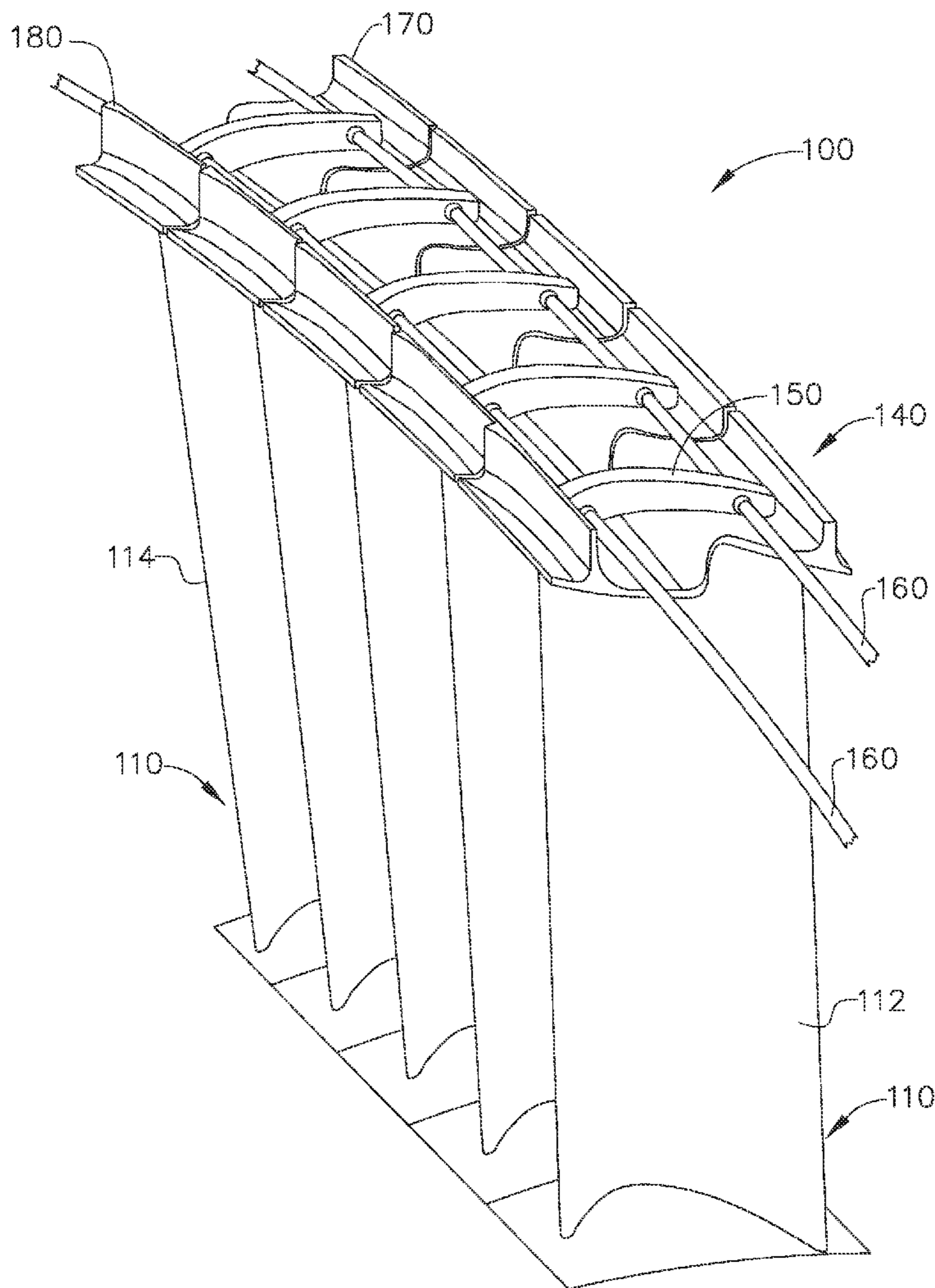
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A damper system and a turbine are provided. The damper system includes a plurality of CMC blades. Each CMC blade has a first member of a tip shroud, the first member opposite a second member of the tip shroud, a radial flange extending between the 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.

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**Related U.S. Application Data**

(60) Provisional application No. 61/674,086, filed on Jul. 20, 2012.



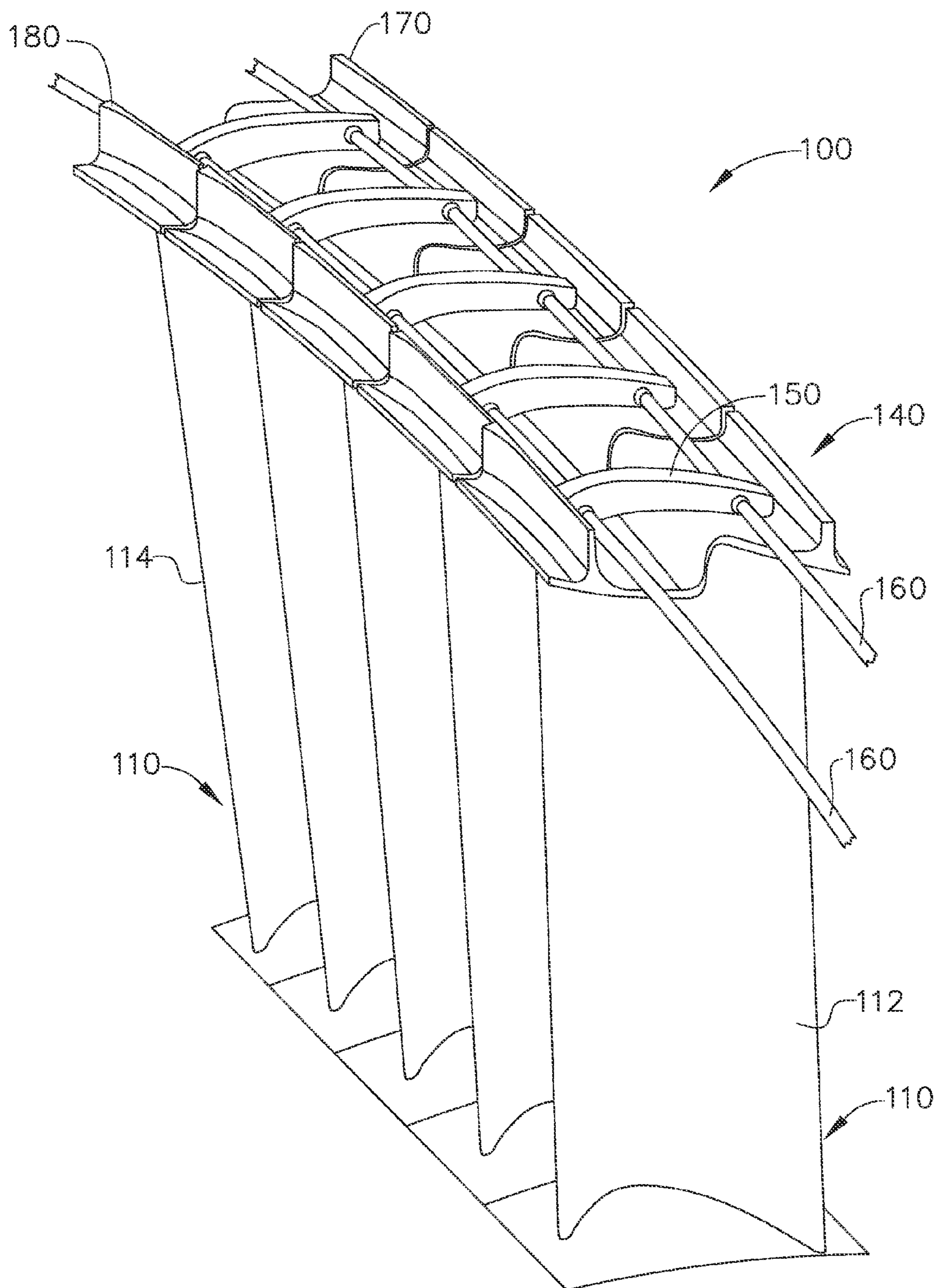


FIG. 1

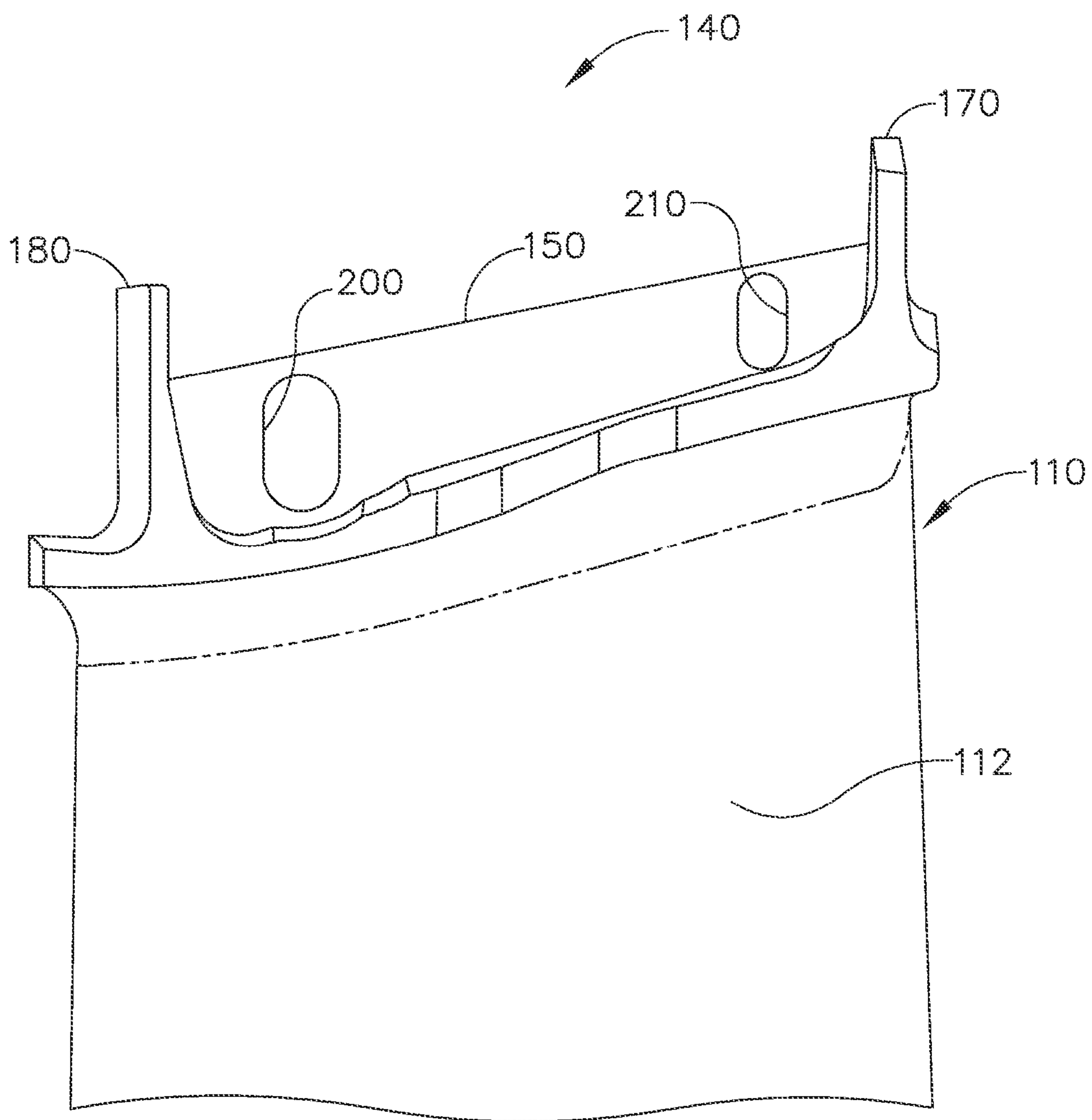


FIG. 2

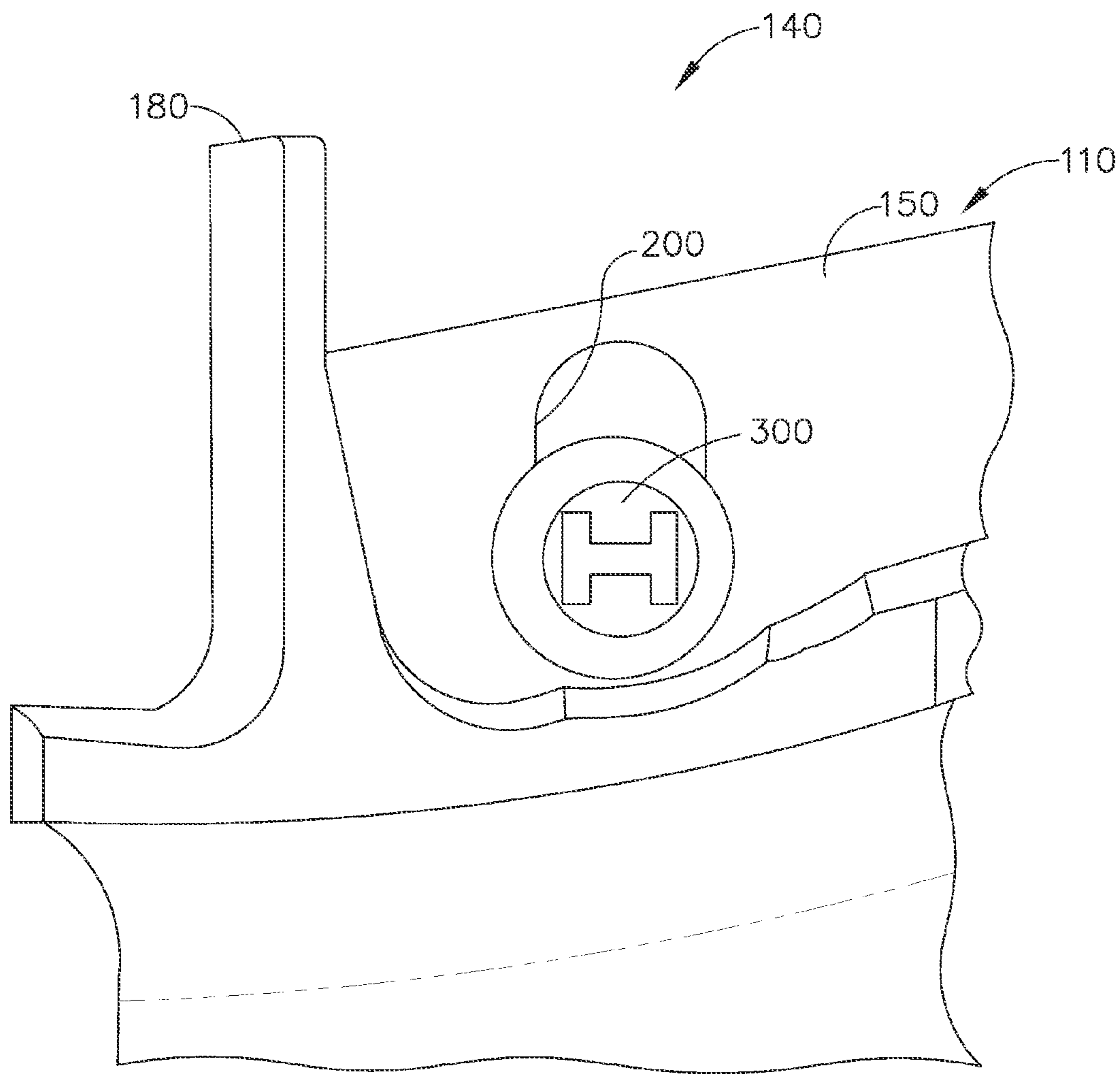


FIG. 3

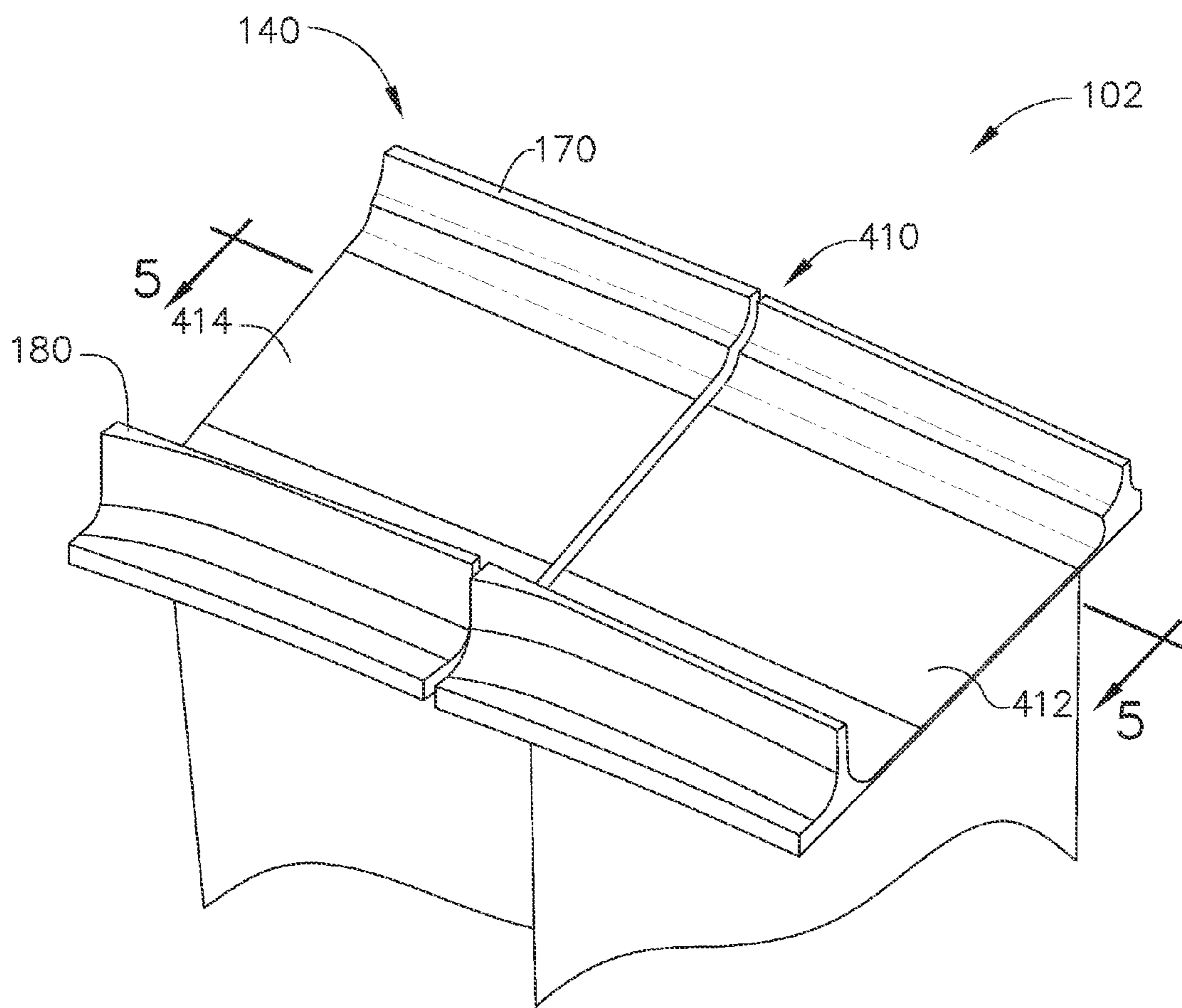


FIG. 4

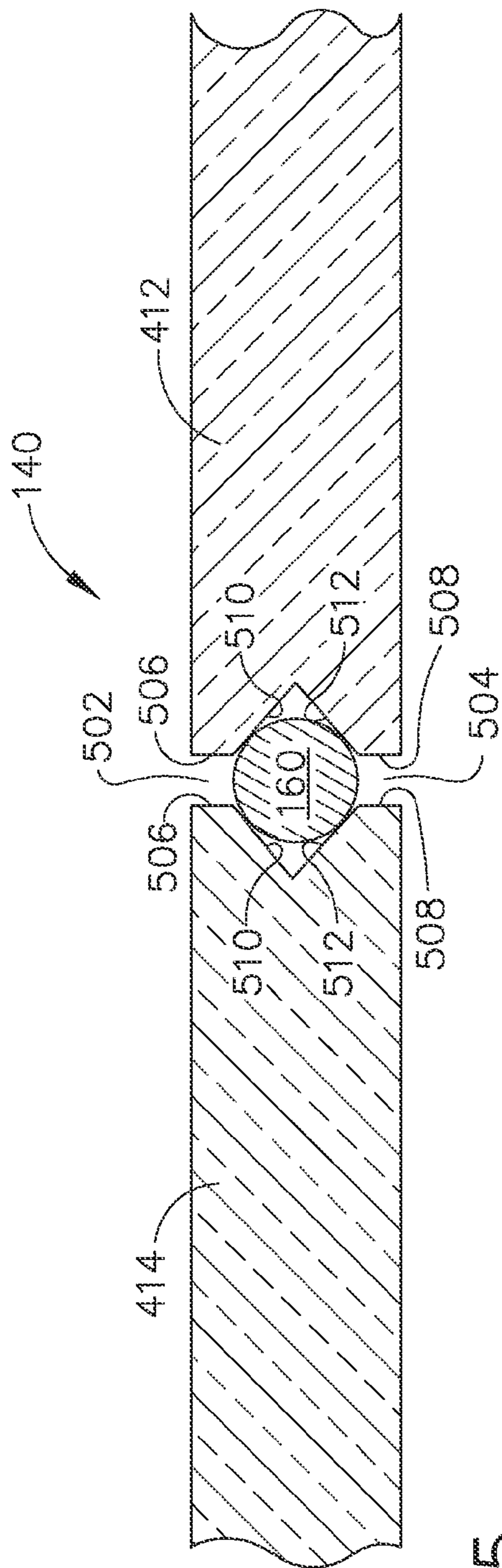


FIG. 5

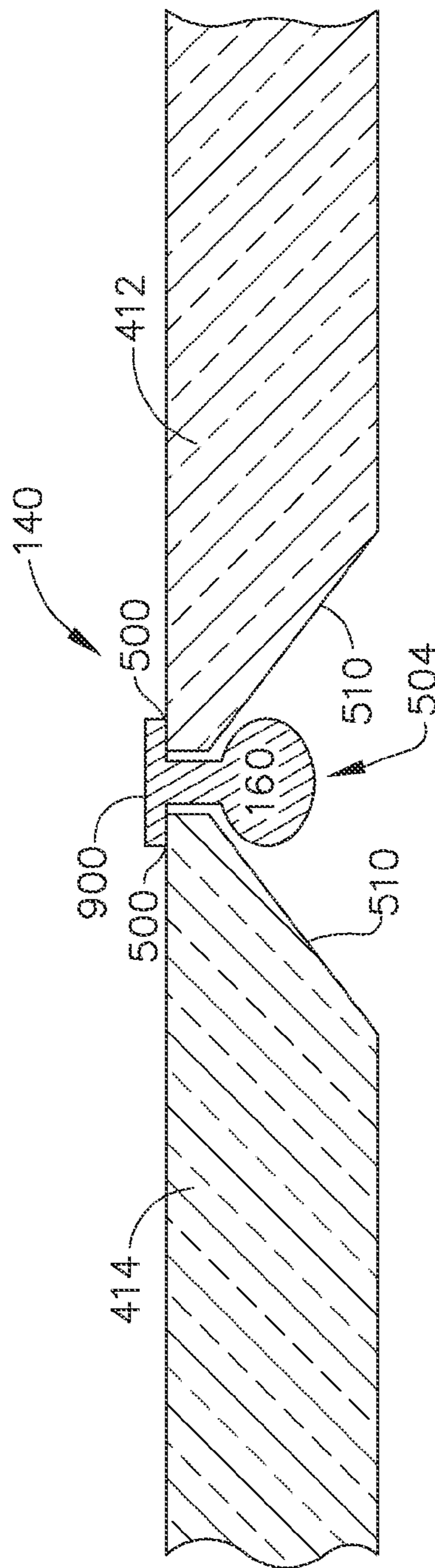


FIG. 6

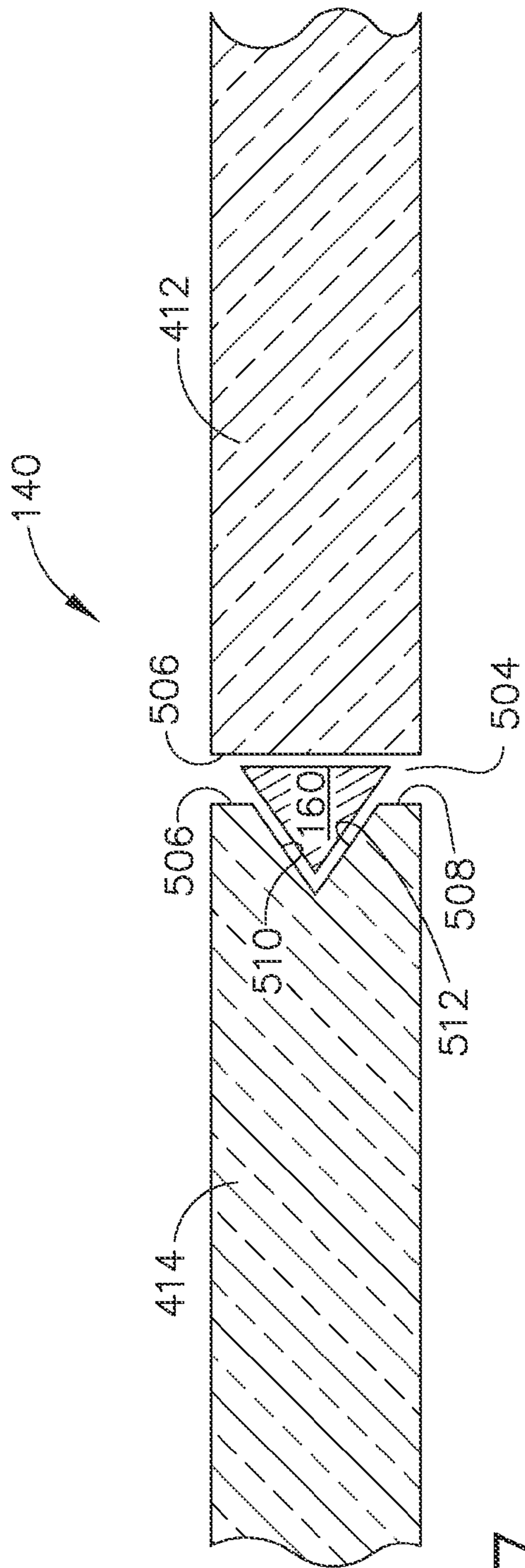


FIG. 7

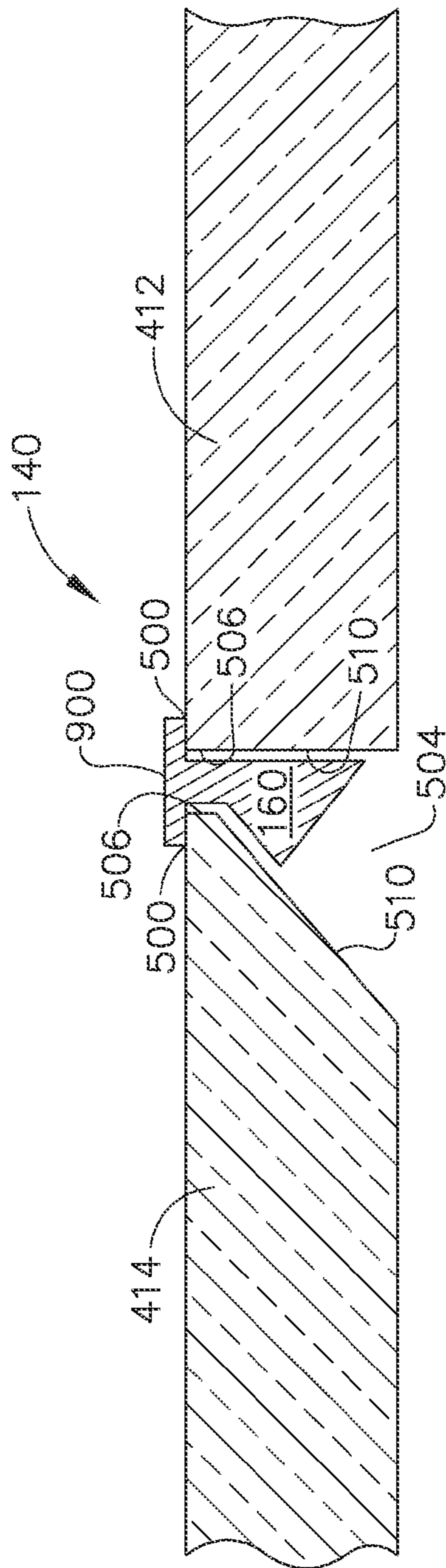


FIG. 8

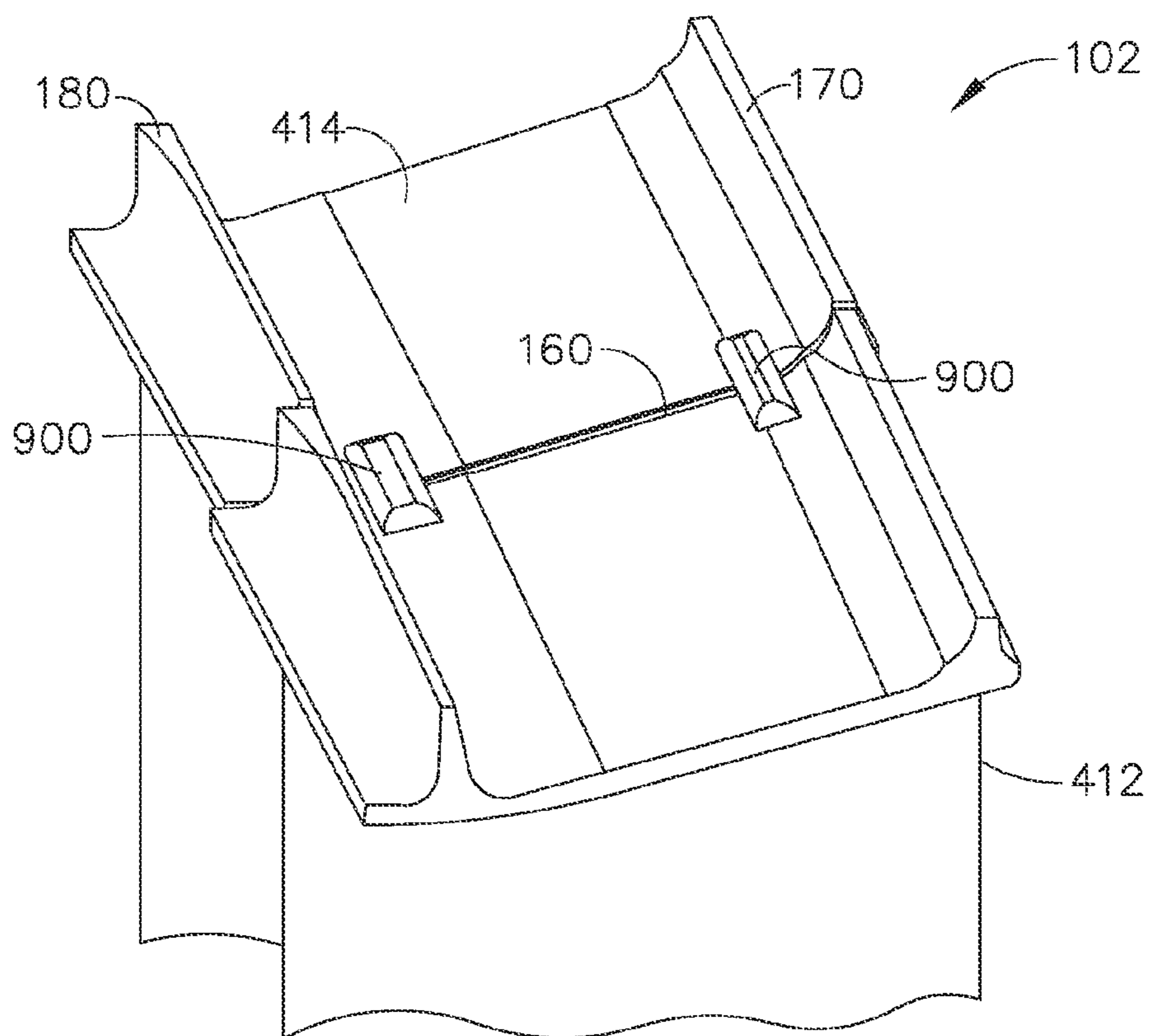


FIG. 9

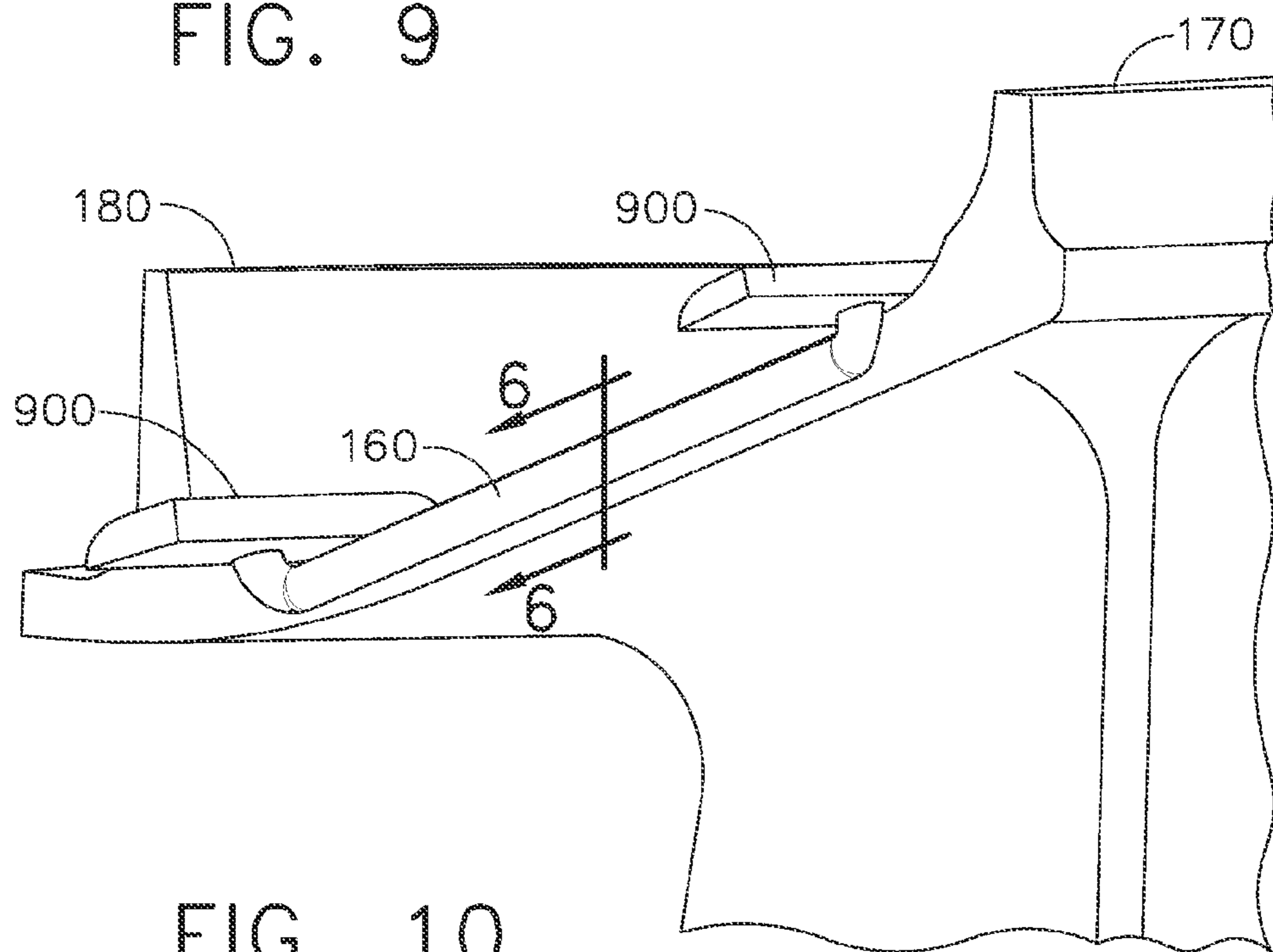


FIG. 10



## 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 conjunc-

tion 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 mem-

ber 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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