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(54) FLEXIBLE SEAL FOR TURBINE ENGINE

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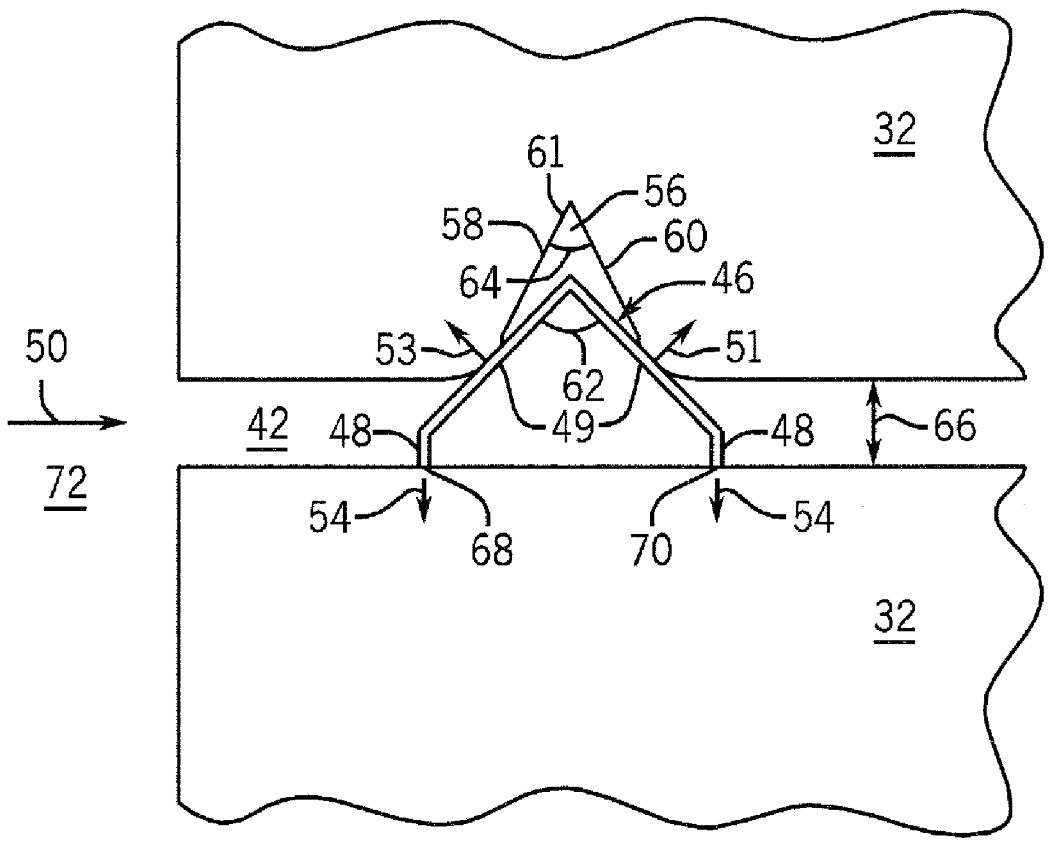
(57) **ABSTRACT**

A turbine includes a turbine seal. The turbine seal includes a first straight portion extending along a first axis. The turbine seal also includes a second straight portion extending along the first axis. The first and second straight portions of the turbine seal intersect to form a V-shaped cross section with an opening extending along the first axis. The first and second straight portions of the turbine seal are also configured to resiliantly move towards and away from each other and the first and second straight portions of the turbine seal are configured to pre-load the turbine seal along a gap between first and second bucket segments of the turbine.



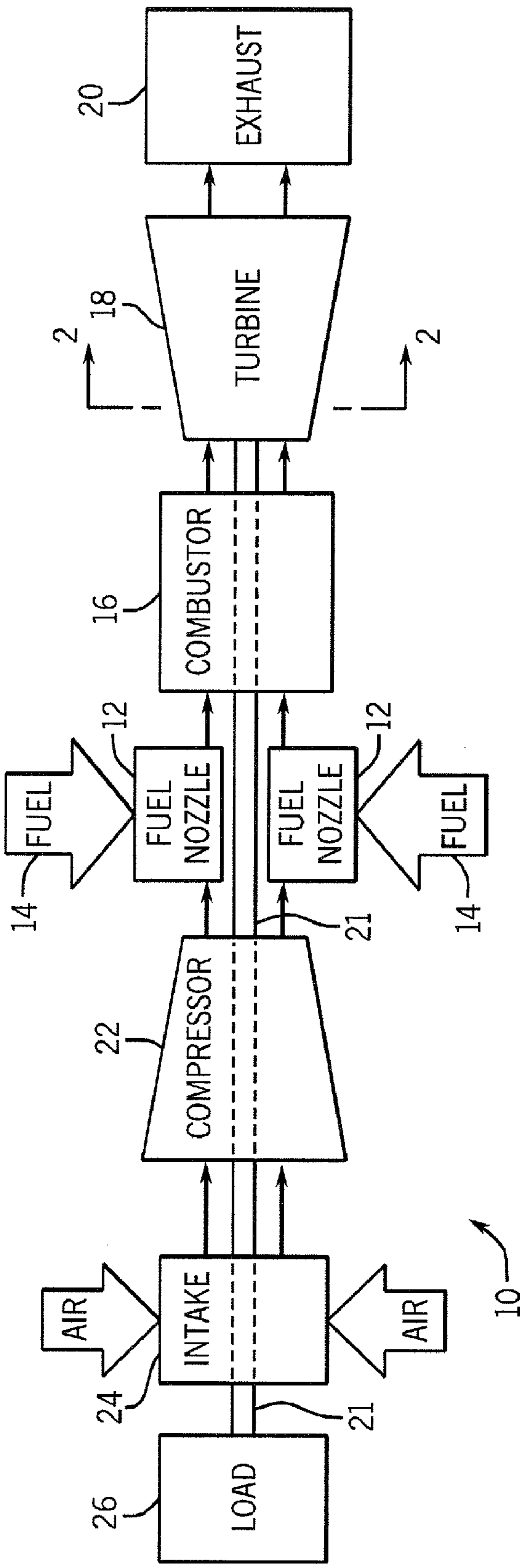


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FIG. 1

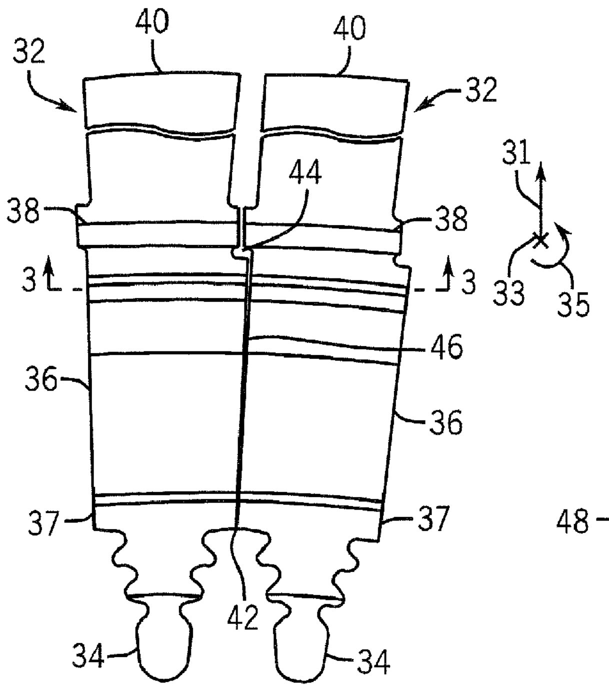

FIG. 2

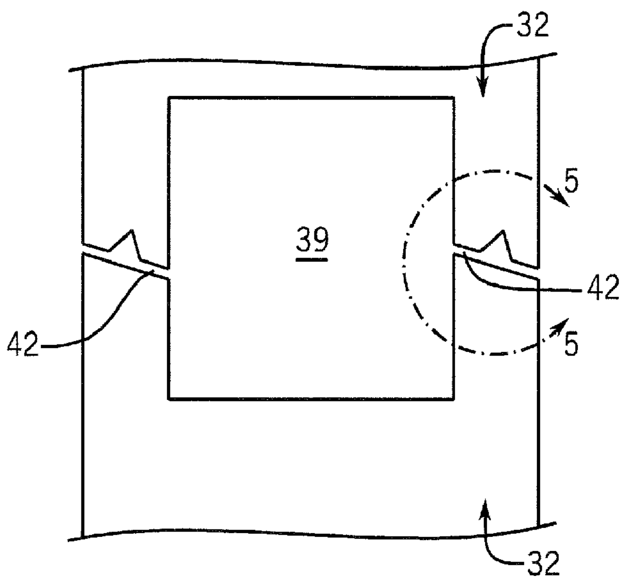

FIG. 3

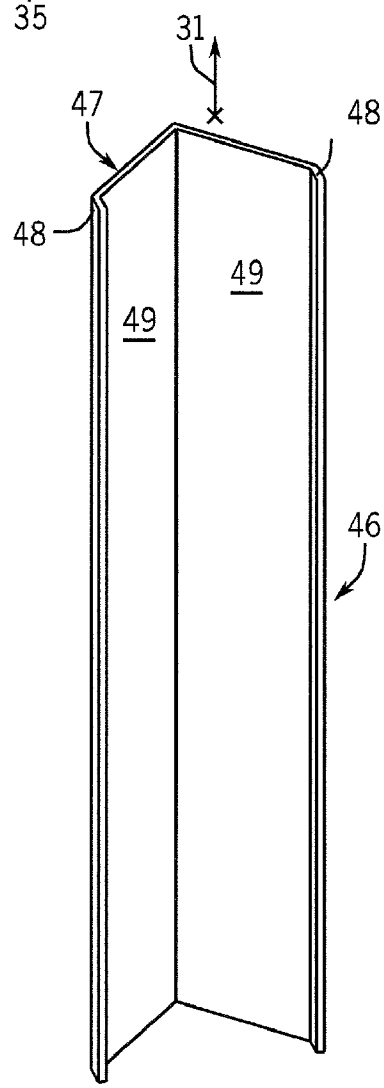

FIG. 4

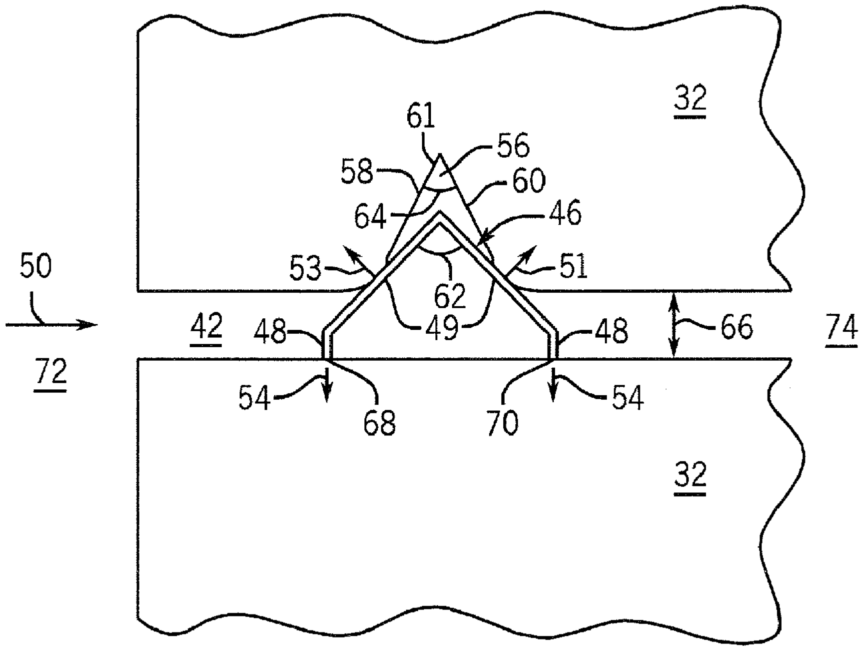
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FIG. 5

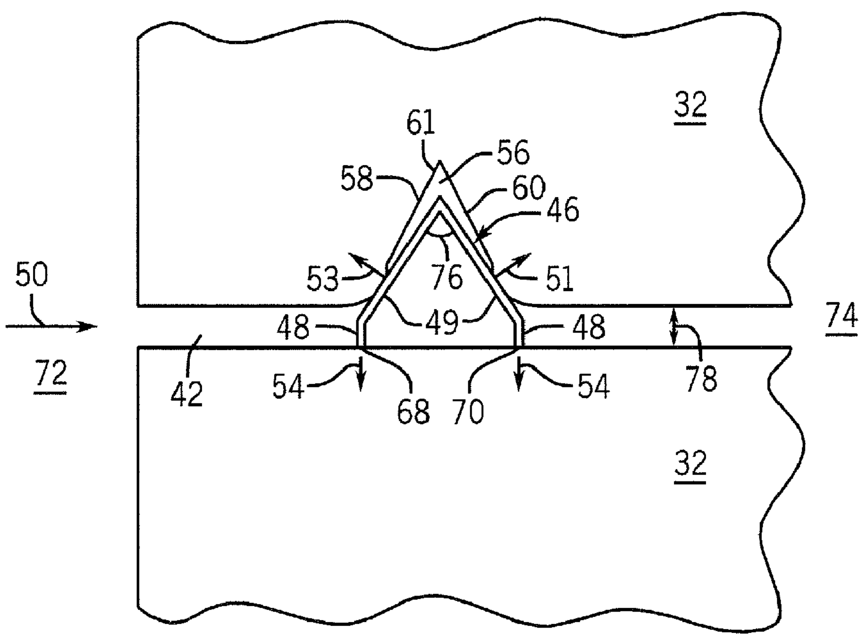
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FIG. 6

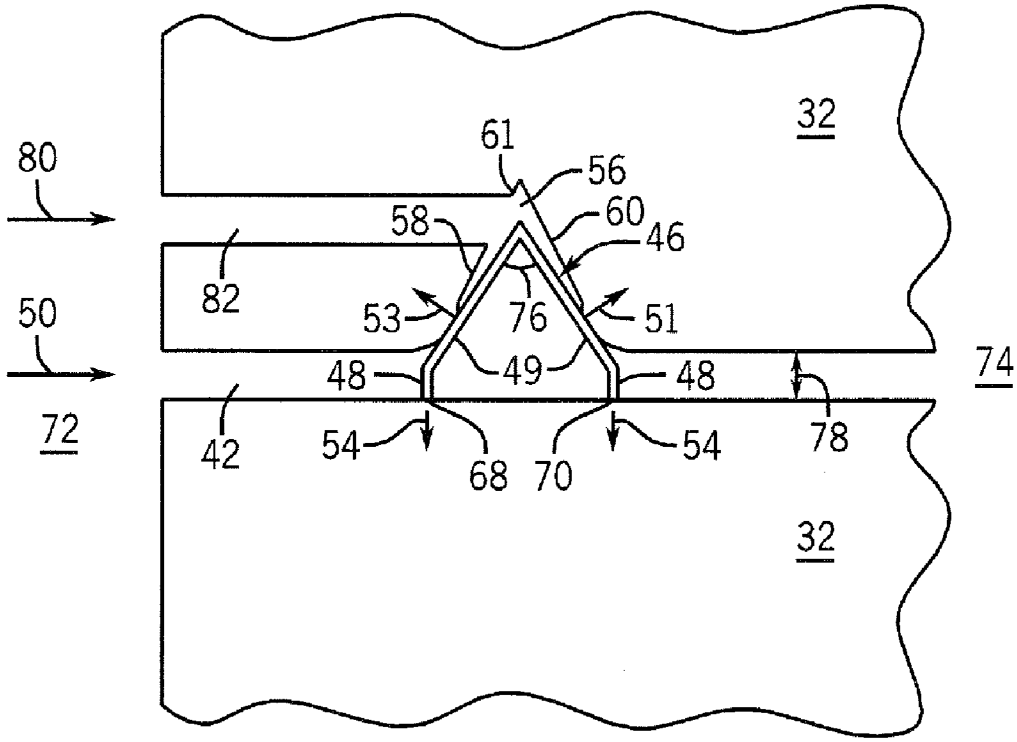

FIG. 7

FLEXIBLE SEAL FOR TURBINE ENGINE

BACKGROUND OF THE INVENTION

[0001] The subject matter disclosed herein relates to a flexible seal for use in turbomachinery, such as a turbine engine.

[0002] A gas turbine engine combusts a mixture of fuel and air to generate hot combustion gases, which in turn drive one or more turbines. In particular, the hot combustion gases force turbine bucket segments to rotate, thereby driving a shaft to rotate one or more loads, e.g., electrical generator. These turbine bucket segments may include shanks that allow for adjacent placement in a turbine stage of the gas turbine engine. At the same time, highly compressed air is often extracted from a compressor for utilization in pressurizing a cavity formed between two adjacent bucket shanks. This positive pressure difference may aid in preventing hot combustion gases from entering into the shank cavity, thus avoiding increases in thermal stresses that adversely affect bucket life. However, as these bucket segments and their shanks may be individually produced and then combined into a single turbine stage, gaps may be present between the individual turbine bucket shanks. These gaps may provide a leakage path for the pressurized shank cavity air, thus reducing overall turbine efficiency and output. Accordingly, it is desirable to minimize the leakage of this pressurizing gas through gaps located between turbine bucket shanks in a turbine stage of a gas turbine engine.

BRIEF DESCRIPTION OF THE INVENTION

[0003] Certain embodiments commensurate in scope with the originally claimed invention are summarized below. These embodiments are not intended to limit the scope of the claimed invention, but rather these embodiments are intended only to provide a brief summary of possible forms of the invention. Indeed, the invention may encompass a variety of forms that may be similar to or different from the embodiments set forth below.

[0004] In a first embodiment, a turbine includes a turbine seal including a first straight portion extending along a first axis and a second straight portion extending along the first axis, wherein the first and second straight portions intersect to form a V-shaped cross section with an opening extending along the first axis, wherein the first and second straight portions are configured to resiliantly move towards and away from each other, wherein the first and second straight portions are configured to pre-load the turbine seal along a gap between first and second bucket segments of the turbine

[0005] In a second embodiment, a system includes a first turbine segment comprising a first blade coupled to a first shank, a second turbine segment comprising a second blade coupled to a second shank, and a flexible seal disposed in a gap between the first and second shanks, wherein the flexible seal comprises an opening formed by a first straight portion and a second straight portion, the first and second straight portions diverge at an angle away from a vortex, the first and second straight portions are configured to resiliantly move towards and away from each other to vary the width of the opening, and the flexible seal is configured to maintain contact with the first and second turbine segments as a width of the opening varies.

[0006] In a third embodiment, a turbine seal includes a first straight portion extending along a first axis, a second straight portion extending along the first axis, wherein the first and second straight portions intersect to form a V-shaped cross section with an opening extending along the first axis, wherein the first and second straight portions are configured to pre-load the turbine seal along a gap between first and second bucket segments of a turbine, a third straight portion coupled to the first straight portion and disposed on a first side of the opening, wherein the third straight portion extends along the first axis, and a fourth straight portion coupled to the second straight portion and disposed on a second side of the opening, wherein the fourth straight portion extends along the first axis, wherein the third straight portion and the fourth straight portion extend in parallel planes along the first axis.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] These and other features, aspects, and advantages of the present invention will become better understood when the following detailed description is read with reference to the accompanying drawings in which like characters represent like parts throughout the drawings, wherein:

[0008] FIG. **1** is a schematic flow diagram of an embodiment of a gas turbine engine having turbine bucket platforms with seals;

[0009] FIG. **2** is a side view of an embodiment of two turbine bucket segments of the gas turbine engine of FIG. **1** taken along line **2-2**;

[0010] FIG. **3** is a partial cross-sectional view of two turbine bucket segments of FIG. **2** taken along line **3-3**;

[0011] FIG. **4** is perspective side view of an embodiment of a flexible seal of FIG. **2**;

[0012] FIG. **5** is a partial cross-sectional view of an embodiment of two turbine bucket segments of FIG. **3** taken within line **5-5**, illustrating an embodiment of the flexible seal;

[0013] FIG. **6** is a partial cross-sectional view of an embodiment of two turbine bucket segments of FIG. **3** taken within line **5-5**, illustrating an embodiment of the flexible seal; and

[0014] FIG. **7** is a partial cross-sectional view of an embodiment of two turbine bucket segments of FIG. **3** taken within line **5-5**, illustrating an embodiment of the flexible seal.

DETAILED DESCRIPTION OF THE INVENTION

[0015] One or more specific embodiments of the present invention will be described below. In an effort to provide a concise description of these embodiments, all features of an actual implementation may not be described in the specification. It should be appreciated that in the development of any such actual implementation, as in any engineering or design project, numerous implementation-specific decisions must be made to achieve the developers' specific goals, such as compliance with system-related and business-related constraints, which may vary from one implementation to another. Moreover, it should be appreciated that such a development effort might be complex and time consuming, but would nevertheless be a routine undertaking of design, fabrication, and manufacture for those of ordinary skill having the benefit of this disclosure.

[0016] When introducing elements of various embodiments of the present invention, the articles "a," "an," "the," and "said" are intended to mean that there are one or more of the elements. The terms "comprising," "including," and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements.

[0017] The present disclosure is directed to a system and a method for sealing a gap between adjacent segments in a turbomachine, such as turbine bucket shanks in a turbine stage of a gas turbine engine, a steam turbine engine, a hydro turbine engine, or another turbine. The system and method may include inserting a flexible seal, such as a flexible seal pin, between adjacent turbine bucket shanks. The preload value (e.g., spring force) of the flexible seal and pressure differentials between the turbine bucket shanks provides a positive seal between any two adjacent bucket shanks. For example, the preload value of the flexible seal provides a positive force by the flexible seal against the adjacent bucket shanks prior to and during operation of the turbomachine (e.g., turbine). The pressure differentials also supplement the positive force of the flexible seal against the adjacent bucket shanks, thereby increasing the effectiveness of the flexible seal. This flexible seal may be, for example, V-shaped or formed in other shapes and may maintain a positive seal despite variations in the gap between adjacent bucket shanks.

[0018] FIG. **1** is a block diagram of an exemplary turbine system including a gas turbine engine **10** that may employ turbine rotor buckets (i.e., blades). As discussed below, the buckets may include plunger seals, such as V-shaped plunger seals. In certain embodiments, the engine **10** may be utilized to power an aircraft, a watercraft, a locomotive, a power generation system, or combinations thereof. The illustrated gas turbine engine **10** includes fuel nozzles **12**, which may intake a fuel supply **14** and mix the fuel with air, as well as distribute the air-fuel mixture into a combustor **16**. The air-fuel mixture may combust in, for example, a chamber within combustor **16**, thereby creating hot pressurized exhaust gases. The combustor **16** may direct the exhaust gases through a turbine **18** toward an exhaust outlet **20**. As the exhaust gases pass through the turbine **18**, the gases force turbine blades to rotate a shaft **21** along an axis of system **10**. As illustrated, shaft **21** is connected to various components of the turbine engine **10**, including compressor **22**. Compressor **22** also includes blades coupled to shaft **21**. Thus, blades within compressor **22** rotate as shaft **21** rotates, compressing air from air intake **24** through compressor **22** into fuel nozzles **12** and/or combustor **16**. Shaft **21** may also be connected to load **26**, which may be a vehicle or a stationary load, such as an electrical generator in a power plant or a propeller on an aircraft. Load **26** may be any suitable device that is powered by the rotational output of the turbine engine **10**.

[0019] FIG. **2** illustrates a side view of an embodiment of two turbine bucket segments **32** of the turbine **18** portion of the gas turbine engine **12** taken along line **2-2** of FIG. **1**, as well as a legend that illustrates the orientation of the bucket segments **32** in a radial direction **31**, an axial direction **33**, and a circumferential direction **35**. The turbine bucket segments **32** may, for example, be coupled to the shaft **21** via rotor wheels, and may be partially disposed within the path of the hot combustion gases as part of a single stage gas turbine, a dual-stage turbine system that includes a low-pressure turbine and a high-pressure turbine, or in a multi-stage turbine system with three or more turbine stages. Alternatively, the turbine bucket segments **32** may be disposed in a steam turbine or a hydro turbine. For illustrative purposes, only two turbine bucket segments **32** are illustrated in FIG. **2**; however, it should be noted that multiple turbine bucket segments **32** may be arranged, for example, to form a circular structure in the turbine **18**.

[0020] The bucket segments **32** may be constructed of a metal, metal alloy, ceramic matrix composite (CMC), or other suitable material. Each bucket segment **32** includes a wheel mount **34**, a shank **36**, a platform **37**, a platform **38**, and a bucket or blade **40**. When aligned as illustrated in FIG. **2**, the bucket segments **32** may also form a gap **42** which may allow for gas to leak between the bucket segments (thus reducing the efficiency of the turbine engine **10**) if not properly sealed. Additionally, in the illustrated embodiment, each wheel mount **34** includes a dovetail to couple the bucket segment **32** with a corresponding groove (e.g., axial **33** groove) of a rotor wheel in the turbine **18**. Thus, the dovetail of the wheel mount **34** extends into the wheel and the platform **37** rests on the wheel to support the shank **36**. The shank **36** extends radially **31** outward from the dovetail of the wheel mount **34** to the platform **38**, which may be a ledge or base that supports the bucket or blade **40**. For example, the bucket **40** may be an airfoil extending radially **31** outward from the platform **38**. The buckets **40** (e.g. airfoils) are disposed within the path of the hot combustion gases. In operation, the hot combustion gases exert motive forces on the buckets (e.g., airfoils) **40** to drive the turbine **18**.

[0021] Additionally, as discussed above, the bucket segments **32** may form a gap **42**. This gap **42** may extend radially **31** along the shank **36** from the dovetail of the wheel mount **34** to radially **31** beneath a damper opening **44**, which may be located between the adjacent shanks **36** and radially **31** below the airfoil **40** of each of the bucket segments **32**. This gap **42** may allow for leakage of hot combustion from an upstream side to a downstream side of the bucket segments **32**. Unfortunately, this leakage may reduce the overall efficiency of the turbine engine **10** during use. Accordingly, it may be desirable to block this leakage from occurring through the use of, for example, one or more flexible seals **46** in the gap **42**.

[0022] FIG. **3** illustrates a partial cross-sectional view of the bucket segments **32** taken along line **3-3** of FIG. **2**. As illustrated, the bucket segments **32** are positioned in an annular arrangement circumferentially **35** adjacent one another, with a cavity **39** formed therebetween. This cavity **39** may, for example, be a pressurized cavity that receives compressed air from the compressor **22** cool the bucket segments **32** and block entry of the hot combustion gases into the shank cavity **39**, thus reducing leakage between bucket segments **32** to increase work of the hot combustion gases on the buckets **40**. However, in this configuration, the shape of the bucket segments **32** may cause the gap **42** (e.g., a leakage path from the cavity **39**) to be present between the adjacent bucket segments **32**. That is, the gap **42** also allow for leakage of the air in the pressurized shank cavity **39** between the bucket segments **32** if not properly sealed, for example, by a one or more flexible seals **46** in the gap **42**. As discussed in detail below, the flexible seal **46** may provide a spring-force or pre-load between the one or more seals **46** and the segments **32** to ensure a positive seal despite variations in the gap **42**.

[0023] FIG. **4** illustrates a perspective side view of an embodiment of flexible seal **46** (e.g. a V-type seal) that may be utilized for sealing the gap **42** between bucket segments **32**. The flexible seal **46** may, for example, include an elongated structure having a V-shaped cross-section **47** as well as support legs **48** to define the shape of the flexible seal **46**, wherein the V-shaped cross-section **47** and the support legs **48** extend along a radial axis **31** of the flexible seal **46**. This flexible seal **46** may be a flexible seal pin characterized as a V-type seal, which includes two straight portions **49** (e.g., flat surfaces) that combine to form a V-shape for the flexible seal **46**. In other words, the flexible seal **46** may be defined as an elongated seal with a V-shaped cross-section **47** along its length. For example, the flexible seal **46** may be an extended V-shape with a uniform V-shaped cross-section **47** along its length. In certain embodiments, the flexible seal **46** may be extruded to form the uniform V-shaped cross-section. Moreover, the support legs **48** may extend from the uniform V-shaped cross-section along the length of the flexible seal **46**. In one embodiment, the support legs **48** may be parallel to one another.

[0024] Moreover, the V-shaped cross-section **47** of the flexible seal **46** may compress when pressure is applied. Each of the straight portions **49** of the flexible seal **46** may flex when pressure is applied, such that the straight portions **49** may move closer in proximity to one another (thus moving support legs **48** closer to one another as well). For example, due to thermal expansion and/or mechanical load, the shanks **36** may move in a tangential direction, such as direction **35**, reducing gap **42**. The inverse may also occur when a thermal load is reduced, such that gap **42** may increase. Accordingly, with a change (e.g., reduction) in gap **42**, the shank **36** or bucket **32** may apply pressure to the flexible seal **46**, causing the flexible seal **46** to move into a cavity (such as a V-shaped cavity) in the bucket **32**. Conversely, when gap **42** is increased, the flexible seal **46** may move from a cavity (such as a V-shaped cavity) in the bucket **32**. However, regardless of the change in the gap **42**, the flexible seal **46** will maintain contact with the bucket **32** adjacent the bucket **32** with the cavity therein to maintain a seal of the gap **42**.

[0025] In one embodiment, the flexible seal **46** may be made from nickel, cobalt, or iron-base superalloys, or other suitable materials, with desirable mechanical properties able to withstand turbine operating temperatures and conditions (such as 310 stainless steel). Examples of usable superalloys may include Inconel® alloy 600, Inconel® alloy 625, Inconel® alloy 718, Inconel® alloy 738, Inconel® alloy X-750, or Hastalloy® X. The material chosen for the flexible seal **46** may be based on requirements for mechanical strength, creep resistance at high temperatures, corrosion resistance, or other attributes. The flexible seal **46** may be sized such that it fits into the gap **42**. An illustration of the flexible seal **46** installed between two bucket segments **32** is illustrated in FIG. **5**.

[0026] FIG. **5** illustrates a cross-sectional view of the bucket segments **32** taken within line **5-5** of FIG. **3**, illustrating an embodiment of the flexible seal **46** (e.g. a V-type seal). FIG. **5** may represent assembly conditions (i.e., cold conditions) present for the bucket segments **32**. As illustrated, the flexible seal **46** may be a flexible seal pin inserted between the bucket segments **32**, such that the flexible seal **46** maintains a positive seal despite variations in the gap **42** to block leakage of gas along line **50**. For example, the flexible seal **46** may provide a resiliency, a flexibility, or a spring-force, which creates a pre-load in the gap **42** between the bucket segments **32**. In other words, the straight portions **49** may flex or bend toward one under upon installation in the gap **42** between the bucket segments **32**, such that the straight portions **49** impart outward forces **51** and **53** toward the adjacent bucket segments **32**. Additionally, support legs **48** may impart an outward force **54** toward the adjacent bucket segments **32**. In this manner, the flexible seal **46** may be preloaded into position in a hollow region **56** of one of the bucket segments **32**. For example, the flexible seal **46** may be loaded into a hollow region **56** of one of the bucket segments **32** that includes two flat portions **58** and **60** configured to receive the flexible seal **46**. These flat portions **58** and **60** may form a V-shape **61** or a triangular shape that is sized to hold the flexible seal **46**. In one embodiment, this V-shape **61** formed by flat portions **58** and **60** may be approximately, for example, 10 mils, 15 mils, 20 mils, 25 mils, 30 mils, or more in width at its widest opening. However, it should be noted that these dimensions are given as examples only and that any suitable dimensions may be applied.

[0027] As illustrated, the flexible seal **46** under assembly (i.e., cold) conditions may form an angle **62** separating straight portions **49** of the flexible seal. This angle **62** may be approximately, for example, 70 degrees, 75 degrees, 80 degrees, 85 degrees, 90 degrees, 95 degrees, 100 degrees, 105 degrees, 110 degrees, 115 degrees, or more. Moreover, the range of the angle **62** may be between about 60 degrees and about 120 degrees, between about 70 degrees and about 100 degrees, or between about 75 degrees and about 90 degrees. Furthermore, the hollow region **56** may include an angle **64** formed at a connection point of the flat portions **58** and **60**. This angle **64** may be approximately, for example, 45%, 50%, 55%, 60%, 56%, 70%, or 75% of the angle **62** of the flexible seal **46**.

[0028] Furthermore, as illustrated in FIG. **5**, under assembly conditions the flexible seal **46** may operate to seal gap **42**, which may be of a width **66** of approximately 20 mils, 25 mils, 30 mils, 40 mils, 45 mils, 50 mils, or more. That is, the flexible seal **46** may contact the bucket segment **32** adjacent to the bucket segment **32** in which cavity **56** is located. Two contact points **68** and **70** of the support legs **48** of the flexible seal **46** may abut the bucket segment **32**, such that the flexible seal **46** may operate to block gas from moving along line **50** from a frontside **72** (e.g., upstream side inclusive of the cavity **39**) of the bucket segments **32** and a backside **74** (e.g., downstream side) of the bucket segments **32** to prevent leakage across gap **42**. That is, pressure differentials between gases present in the frontside **72** and backside **74** of the bucket segments **32** may exist such that pressure of gases present in the frontside **78** (e.g., in the cavity **39**) of the bucket segments **32** may be greater than those present in the backside **80** of the bucket segments **32**. However, placement of the flexible seal **46** as illustrated in FIG. **5** may allow for sealing of gap **42** to block the flow of gas along line **50**. Moreover, it is envisioned that the contact points **68** and **70** may be at the tip of each of the support legs **48**. Additionally, the contact points **68** and **70** may, for example, be flat, rounded, curved, or otherwise shaped. These various shapes of the contact points **68** and **70** may be selected based on such factors as ease of manufacture, frictional resistance characteristics, or based on other criteria.

[0029] FIG. **6** illustrates a cross-sectional view of the bucket segments **32** taken within line **5-5** of FIG. **3**, illustrating an embodiment of the flexible seal **46** (e.g. a V-type seal) under operational conditions (i.e., hot conditions) present for the bucket segments **32**. As illustrated, the flexible seal **46** under operational (i.e., hot) conditions may form an angle **76** separating straight portions **49** of the flexible seal. This angle **76** may be approximately, for example, 30 degrees, 35 degrees, 40 degrees, 45 degrees, 50 degrees, 55 degrees, 60 degrees, 65 degrees, 70 degrees, 75 degrees, or more. Moreover, the range of the angle **76** may be between about 30 degrees and about 80 degrees, between about 40 degrees and about 70 degrees, or between about 50 degrees and about 60 degrees. As illustrated, angle **76** is smaller than angle **62** previously discussed above with respect to FIG. **5**. That is, angle **76** may be generated as a result of a width **78** of the gap **42** being smaller than width **66** of gap **42** in FIG. **5**. This reduction in the value of the width **78** of the gap **42** may be as a result of thermal expansion of the bucket segments **32** as the temperature increases due to operation of the engine **10**. This thermal expansion causes the bucket segments **32** to move closer to one another, thus reducing the width **78** of the gap **42**. This thermal expansion also causes the flexible seal **46** to be pushed further into the hollow region **56**, resulting in support legs **48** moving closer in proximity to one another. However, the contact points **68** and **70** of the support legs **48** remain in contact with the bucket segment **32** during the reduction in the width **78** of the gap **42** to block gas from moving along line **50** from the frontside **72** of the bucket segments **32** to the backside **74** of the bucket segments **32** (i.e., to block leakage across gap **42**.) In one embodiment, the support legs **48** may move approximately, for example, approximately 10 mils, 15 mils, 20 mils, 25 mils, 30 mils, or more from their assembly condition position as the temperature surrounding the flexible seal **46** rises (e.g., due to the operation of the engine **10**.) Additionally, the flexible seal **46** may return to its original cold assembly position when the engine **10** is not operating. In this manner, the flexible seal **46** may adjust its position in response to bucket segment **32** movement caused by, for example, thermal expansion, while maintaining a seal of the gap **42** present between the bucket segments **32**. Additionally, as the flexible seal **46** is positionally adjusted, the contact points **68** and **70** constantly maintain contact with the bucket segment **32**. That is, the contact points **68** and **70** have the same amount of contact with the bucket segment **32** regardless of whether the flexible seal **46** is exposed to assembly conditions or operational conditions.

[0030] FIG. **7** illustrates a cross-sectional view of the bucket segments **32** taken within line **5-5** of FIG. **3**, illustrating an embodiment of the flexible seal **46** (e.g. a V-type seal) under operational conditions (i.e., hot conditions) present for the bucket segments **32**. As illustrated, the flexible seal **46** under operational (i.e., hot) conditions may form an angle **76** separating straight portions **49** of the flexible seal. Additionally, to aid in increasing outward forces **51** and **53**, high pressure gas present in the frontside **72** (e.g., upstream side inclusive of the cavity **39**) of the bucket segments **32** may be channeled into hollow region **56** of one of the bucket segments **32**. That is, high pressure gas present in the frontside **72** (i.e., in the cavity **39**) may be directed along line **80** through a channel **82** of one of the bucket segments **32**. That is, the channel **82** may connect the frontside **72** with the hollow region **56** of one of the bucket segment **32**. This pressurized gas may aid in imparting additional force to the flexible seal **46** (i.e., adding to outward forces **51** and **53**, as well as outward force **54**) to aid in the sealing of the gap **42**.

[0031] This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal language of the claims.

1. A turbine, comprising:

a turbine seal, comprising:

a first straight portion extending along a first axis; and

a second straight portion extending along the first axis, wherein the first and second straight portions intersect to form a V-shaped cross section with an opening extending along the first axis, wherein the first and second straight portions are configured to resiliantly move towards and away from each other, wherein the first and second straight portions are configured to pre-load the turbine seal along a gap between first and second bucket segments of the turbine.

2. The turbine of claim **1**, comprising a third straight portion coupled to the first straight portion and disposed on a first side of the opening, wherein the third straight portion extends along the first axis.

3. The turbine of claim **2**, comprising a fourth straight portion coupled to the second straight portion and disposed on a second side of the opening, wherein the fourth straight portion extends along the first axis.

4. The turbine of claim **3**, wherein the third straight portion and the fourth straight portion extend in parallel planes along the first axis.

5. The turbine of claim **3**, wherein the third straight portion and the fourth straight portion each terminate in a flat tip.

6. The turbine of claim **3**, wherein the third straight portion and the fourth straight portion each terminate in a rounded tip.

7. The turbine of claim **1**, wherein the turbine seal is configured to mount within a triangular recess in the first bucket segment.

8. The turbine of claim **7**, comprising the first bucket segment having the turbine seal disposed in the triangular recess.

9. The turbine of claim **7**, wherein the first bucket segment comprises a channel disposed between an upstream side of the first turbine segment and the triangular recess.

10. The turbine of claim **1**, wherein the turbine seal comprises material having a first coefficient of thermal expansion that is greater than a second coefficient of thermal expansion of the first and second bucket segments.

11. A system, comprising:

a first turbine segment comprising a first blade coupled to a first shank;

a second turbine segment comprising a second blade coupled to a second shank; and

a flexible seal disposed in a gap between the first and second shanks, wherein the flexible seal comprises an opening formed by a first straight portion and a second straight portion, the first and second straight portions diverge at an angle away from a vortex, the first and second straight portions are configured to resiliantly move towards and away from each other to vary the width of the opening, and the flexible seal is configured to maintain contact with the first and second turbine segments as a width of the opening varies.

12. The system of claim **11**, wherein the first straight portion and the second straight portion intersect at the vertex to form a V-shaped cross section.

13. The system of claim **11**, wherein the angle between the first and second straight portions varies to maintain contact between the flexible seal and the first and second turbine segments as the width of the opening varies.

14. The system of claim **11**, wherein the opening extends along an axis of the flexible seal.

15. The system of claim **11**, wherein the flexible seal extends along the gap between the first and second shanks in a radial direction relative to a rotational axis of the first and second turbine segments, and the flexible seal is at least partially disposed in a recess in the first shank.

16. The system of claim **15**, wherein the recess comprises a triangular cross-section extending along an axis of the flexible seal.

17. The system of claim **11**, wherein the flexible seal comprises a third straight portion coupled to the first straight portion and a fourth straight portion coupled to the second portion.

18. The system of claim **17**, wherein the first straight portion and the second straight portion are at least partially disposed in an elongated recess in the first shank and the third straight portion and the fourth straight portion are disposed in the gap.

19. A turbine seal, comprising:

a first straight portion extending along a first axis;

a second straight portion extending along the first axis, wherein the first and second straight portions intersect to form an opening extending along the first axis, wherein the first and second straight portions are configured to pre-load the turbine seal along a gap between first and second bucket segments of a turbine;

a third straight portion coupled to the first straight portion and disposed on a first side of the opening, wherein the third straight portion extends along the first axis; and

a fourth straight portion coupled to the second straight portion and disposed on a second side of the opening, wherein the fourth straight portion extends along the first axis, wherein the third straight portion and the fourth straight portion extend in parallel planes along the first axis.

20. The turbine seal of claim **19**, wherein the opening comprises an angle of between about 70 degrees and about 100 degrees.

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