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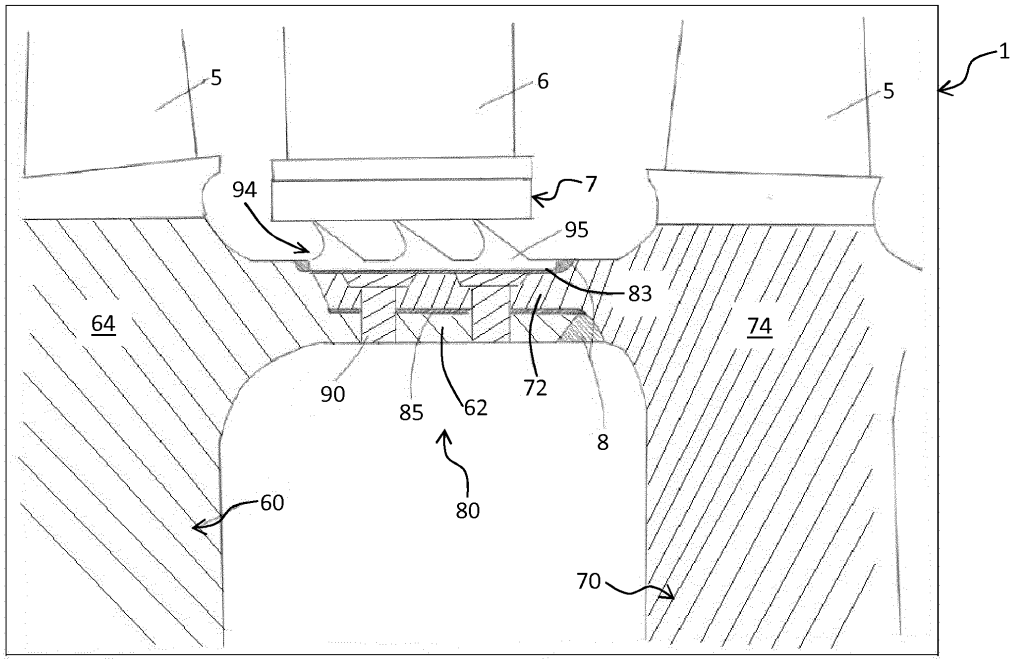
(54) TURBINE ROTOR ASSEMBLY WITH LAP JOINTS BETWEEN THE ROTOR DISCS FOR TORQUE TRANSMISSION

(57) A rotor assembly for a turbine section of a gas turbine is presented. The rotor assembly includes a first and a second rotor discs coaxially aligned and axially adjacent to each other, and configured to rotate about a rotational axis of the rotor disc assembly. The first and the second rotor discs include a first and a second annular projection, respectively, with respect to the rotational axis. The annular projections extend axially towards each other, and at least partially overlap with each other forming a lap joint. In the lap joint so formed the annular projections are adhered to each other by using an adhesive material sandwiched thereinbetween. One or more fasteners or rivets rivet the annular projections to each other in the lap joint. The lap joint of the present technique functions to keep the rotor discs packed in close proximity and to transmit torque between the rotor discs.

FIG 3



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Description

[0001] The present invention relates to gas turbine engines, and more particularly to assemblies of rotor discs of gas turbine engines.

[0002] Turbine blades in turbine sections of various modern gas turbine engines are arranged on rotor discs. A plurality of the blades is arranged circumferentially on each of the rotor disc. The rotor disc has a central hole, i.e. a central bore, or several holes through which one or several tension bolts, also known as clamping bolts or tie bolts, pass when the rotor disc along with the circumferentially assembled turbine blades is positioned within the gas turbine engine. The tie bolt may be one or multiple in number and functions to keep the rotor discs clamped to each other within the turbine section of the gas turbine. A shaft, also referred to as a drive shaft is connected to the rotor disc by generally using a bolted joint or a Hirth joint or Hirth coupling. The rotor discs within the turbine sections are also connected to each other by a torque transmission mechanism such as torque driving bolts or pins, dowels, Curvics, Hirth teeths, Splines, etc. When the gas turbine engine is operated, the torque is transmitted between the adjacently arranged rotor discs through the torque transmission mechanism and from the rotor discs to the drive shaft.

[0003] The conventional torque transmission mechanisms used in the gas turbines rotors have several disadvantages. The use of torque transmission mechanisms or features in addition to the one or more clamping bolts can make the rotors over-restrained and may lead to 'locking' mechanisms. Furthermore, the use of the torque transmission mechanisms in addition to the one or more clamping bolts makes assembly/disassembly of the rotor complicated and results into large downtimes. The mechanical features for torque transmission require very small tolerances in manufacturing. This precision manufacturing is expensive and design intensive. Moreover, a rotor assembly with tie bolts, bolted joints and torque transmission mechanisms, is not compact and is prone to suffer from high windage losses impacting the overall performance of the gas turbine. Finally, due to the complex assembly requiring arrangement of tie bolts, bolted joints and torque transmission mechanisms, tunability of the secondary air system around the rotor discs is limited. Therefore, a technique is desired to reduce complex rotor designs i.e. a rotor assembly is desired which does not require tie bolts, standard bolted joints and torque transmission mechanisms for achieving clamping of the rotor discs and for transmission of torque between the rotor discs.

[0004] Thus the object of the present invention is to provide a rotor assembly for a turbine section of a gas turbine which does not require tie bolts, standard bolted joints and torque transmission mechanisms for achieving clamping of the rotor discs and for transmission of torque between the rotor discs in the turbine section of the gas turbine.

[0005] The above objects are achieved by a rotor assembly for a turbine section of a gas turbine according to claim 1 of the present technique, a turbine section for a gas turbine according to claim 9 of the present technique and a gas turbine according to claim 14 of the present technique. Advantageous embodiments of the present technique are provided in dependent claims.

[0006] In a first aspect of the present technique a rotor assembly for a turbine section of a gas turbine is presented. The rotor assembly includes a first rotor disc and a second rotor disc, i.e. blade carrying discs in the turbine section of a gas turbine. The two rotor discs -i.e. the first rotor disc and the second rotor disc - are coaxially aligned to each other and are axially adjacent to each other. The first and the second rotor discs are configured to rotate about a rotational axis of the rotor disc assembly. The rotational axis is common for the first and the second rotor discs. The first rotor disc includes a first annular projection. The first annular projection is annular with respect to the rotational axis. The second rotor disc includes a second annular projection. The second annular projection is annular with respect to the rotational axis. Optionally, the first and the second annular projections emanate from rim sections of the first and the second rotor discs, respectively. The first and the second annular projections extend axially towards each other. The first and the second annular projections at least partially overlap with each other to form a lap joint. The lap joint is formed by at least a part of the first annular projection overlapping with at least a part of the second annular projection. The part of the first annular projection and the part of the second annular projection forming the lap joint, together referred to the first and the second annular projections in the lap joint or of the lap joint, are adhered to each other by using an adhesive material, for example a metallic ceramic composite, sandwiched between the first and the second annular projections in the lap joint. One or more rivets or close-fitted fasteners, for example solid rivets, rivet the first and the second annular projections to each other in the lap joint. The lap joint may be a full lap joint or a half lap joint.

[0007] Thus, the rotor discs in the rotor assembly of the present technique are held together, in close proximity to each other, by the intermediate lap joints thereby achieving the clamping function of the conventional tie bolts, and therefore in the rotor assembly of the present technique requirement for having a single or multiple tie bolts, i.e. the clamping bolts, is at least partially obviated. Furthermore, the lap joint by use of the adhesive and the rivets is structurally strong enough to function in torque transmission between the rotor discs and thereby requirement of having various torque transmission features in the rotor assembly of the present technique is at least partially obviated. Thus the lap joint of the present technique functions to keep the rotor discs packed in close proximity and to transmit torque between the rotor discs. This makes the design of the rotor disc assembly, of the turbine section having such rotor disc assembly and of the gas turbine having such rotor disc assembly, simple. Consequently, the rotor assembly is therefore easy to assemble and disassemble. Since the rotor assembly of the present technique has fewer components, i.e. resulting from absence of the one or more tie bolts and separate torque transmission mechanisms, the rotor assembly is compact.

[0008] In an embodiment of the rotor assembly, heads of the one or more rivets are flush with a radially outer surface of the lap joint. Thus the heads of the rivets do not protrude from or indent the radially outer surface of the lap joint. This ensures that the rivet heads do not disturb the aerodynamics of the rotor disc assembly by jutting out of the surface of the lap joint or by forming depressions on the surface of the lap joint where the rivet heads are located.

[0009] In another embodiment of the rotor assembly, the lap joint further comprises at least one push screw positioned in one of the first and the second annular projections. The one of the first and the second annular projections in which the push screw is positioned is radially outwards from other of the first and the second annular projections. After removing the rivets, the push screws can be used to separate the first and the second annular projections from each other, i.e. to separate the adhered first and the second annular projections. The separation of the first and the second annular projections from each other may be required for servicing or repairing the rotor discs, or other components of the turbine sections in vicinity of the rotor discs.

[0010] In a second aspect of the present technique a turbine section for a gas turbine is presented. The turbine section includes a housing or a casing, i.e. a part of stator of the turbine section, within which a rotor assembly is positioned or housed. The rotor assembly is same as the rotor assembly described hereinabove according to the first aspect of the present technique. A first and a second plurality of turbine blades are circumferentially arranged on the first and the second rotor discs, respectively, of the rotor assembly. The turbine section also includes a plurality of turbine vanes. The turbine vanes extend radially inwards from the housing and are positioned axially between the first and the second pluralities of turbine blades. The lap joint of the rotor assembly is positioned radially inwards of vane tips of the turbine vanes. Thus in the turbine sections of the present technique the rotor discs are held together, in close proximity to each other, thereby achieving the clamping function of the conventional tie bolts, and therefore in the turbine section of the present technique requirement for having a single or multiple tie bolts is at least partially obviated. In other words the turbine section of the present technique does not have the tie bolts. Furthermore, the lap joint functions in torque transmission between the rotor discs of the turbine section of the present technique and therefore in the turbine section of the present technique requirement of having various torque transmission features is at least partially obviated. In other words the turbine section of the present technique does not have the conventionally known torque transmission features besides not having the tie bolts. This makes the design of the turbine section of the present technique simple.

[0011] In an embodiment of the turbine section, the turbine section further includes a plurality of seal fins. The seal fins are positioned on a radially outer surface of the lap joint. The seal fins extend towards the vane tips of the turbine vanes. This provides an arrangement of the seal fins in the turbine section of the present technique. The seal fins are required for the turbine section of the present technique to reduce or obviate leakage of hot gas from a mainstream flow of the hot gas or the working gas out of the desired or designated hot gas path in the turbine section of the gas turbine.

[0012] In another embodiment of the turbine section, the seal fins are formed as a seal fins strip. The seal fins strip is adhered using an adhesive to the radially outer surface of the lap joint. In a related embodiment the adhesive is a metallic ceramic composite. Optionally, the adhesive to adhere the seal fins strip is the same as the adhesive material of the lap joint. Thus the seal fins can be manufactured separate from the rotor discs and then placed in the turbine section of the present technique.

[0013] In a third aspect of the present technique a gas turbine is presented. The gas turbine includes a rotor assembly. The rotor assembly is according to the aforementioned first aspect of the present technique.

[0014] The above mentioned attributes and other features and advantages of the present technique and the manner of attaining them will become more apparent and the present technique itself will be better understood by reference to the following description of embodiments of the present technique taken in conjunction with the accompanying drawings, wherein:

FIG 1 shows part of a conventionally known gas turbine engine in a sectional view;

FIG 2 schematically illustrates a conventionally known rotor assembly;

FIG 3 schematically illustrates an exemplary embodiment of a rotor assembly of the present technique;

FIG 4 schematically illustrates an exemplary embodiment of a turbine section of a gas turbine of the present technique;

FIG 5 schematically illustrates an exemplary embodiment of a first or a second rotor disc of the rotor assembly; and

FIG 6 schematically represents an exemplary embodiment of a lap joint; in accordance with aspects of the present technique.

[0015] Hereinafter, above-mentioned and other features of the present technique are described in details. Various embodiments are described with reference to the drawing, wherein like reference numerals are used to refer to like elements throughout. In the following description, for the purpose of explanation, numerous specific details are set forth in order to provide a thorough understanding of one or more embodiments. It may be noted that the illustrated embodiments are intended to explain, and not to limit the invention. It may be evident that such embodiments may be practiced without these specific details.

[0016] It may be noted that in the present disclosure, the terms "first", "second", etc. are used herein only to facilitate discussion, and carry no particular temporal or chronological significance unless otherwise indicated.

[0017] The basic idea of the present technique is to use lap joints between two adjacent rotor discs in a rotor assembly of a turbine section of a gas turbine, instead of having one or more tie bolts and one or more torque transmission mechanisms or featured between the rotor discs. The lap joint of the present technique is formed such that the clamping or packing of the rotor discs in the turbine section of the gas turbine is achieved by the lap joints placed between the rotor discs, therefore obviating, partially or completely, the requirement of clamping achieved by the tie bolts in conventionally known gas turbine rotor sections. Furthermore, the lap joint of the present technique function to transmit torque between adjacently positioned rotor discs and therefore obviating, partially or completely, the requirement of torque transmission by the torque transmission mechanisms, such as Curvics, Hirth couplings, Splines, between the rotor discs as is present in the conventionally known gas turbine rotor sections. Before explaining the present technique in further details FIGs 1 and 2 are used herein to explain a conventionally known rotor assembly in a conventionally known turbine section of a conventionally known gas turbine. Thereafter the present technique is explained in reference to FIGs 3, 4, 5 and 6 in combination with FIG 1.

[0018] FIG. 1 shows an example of a conventionally known gas turbine engine 10 in a sectional view. The conventionally known gas turbine engine 10, hereinafter referred to as the engine 10, comprises, in flow series, an inlet 12, a compressor or compressor section 14, a combustor section 16 and a turbine section 18 which are generally arranged in flow series and generally about and in the direction of a longitudinal or rotational axis 20.

[0019] In operation of the engine 10, air 24, which is taken in through the air inlet 12 is compressed by the compressor section 14 and delivered to the combustion section or burner section 16. The burner section 16 comprises a longitudinal axis 35 of the burner, a burner plenum 26, one or more combustion chambers 28 and at least one burner 30 fixed to each combustion chamber 28. The combustion chambers 28 and the burners 30 are located inside the burner plenum 26. The compressed air passing through the compressor 14 enters a diffuser 32 and is discharged from the diffuser 32 into the burner plenum 26 from where a portion of the air enters the burner 30 and is mixed with a gaseous or liquid fuel. The air/fuel mixture is then burned and the combustion gas 34 or working gas from the combustion is channelled through the combustion chamber 28 to the turbine section 18 via a transition duct 17.

[0020] This exemplary gas turbine engine 10 has a cannular combustor section arrangement 16, which is constituted by an annular array of combustor cans 19 each having the burner 30 and the combustion chamber 28, the transition duct 17 has a generally circular inlet that interfaces with the combustor chamber 28 and an outlet in the form of an annular segment. An annular array of transition duct outlets form an annulus for channelling the combustion gases to the turbine section 18.

[0021] The conventionally known turbine section 18 comprises a number of blade carrying discs 36 arranged around a tie bolt 22. The tie bolt 22 clamps the discs 36 to pack the discs 36 in the turbine section 18. In the present example, two discs 36 each carry an annular array of turbine blades 38 are depicted. However, the number of blade carrying discs 36 could be different. In addition, guiding vanes 40, which are fixed to a stator 42 of the engine 10, are disposed between the stages of annular arrays of turbine blades 38. Between the exit of the combustion chamber 28 and the leading turbine blades 38 inlet guiding vanes 44 are provided and turn the flow of working gas onto the turbine blades 38.

[0022] The combustion gas from the combustion chamber 28 enters the turbine section 18 and drives the turbine blades 38 which in turn drive the compressor section 14. The guiding vanes 40, 44 serve to optimise the angle of the combustion or working gas on the turbine blades 38.

[0023] The compressor section 14 comprises an axial series of vane stages 46 and rotor blade stages 48. The rotor blade stages 48 comprise a rotor disc supporting an annular array of blades. The compressor section 14 also comprises a casing 50 that surrounds the rotor stages and supports the vane stages 48. The guide vane stages include an annular array of radially extending vanes that are mounted to the casing 50. The vanes are provided to present gas flow at an optimal angle for the blades at a given engine operational point. Some of the guide vane stages have variable vanes, where the angle of the vanes, about their own longitudinal axis, can be adjusted for angle according to air flow characteristics that can occur at different engine operational conditions.

[0024] The casing 50 defines a radially outer surface 52 of the passage 56 of the compressor 14. A radially inner surface 54 of the passage 56 is at least partly defined by a rotor drum 53 of the rotor which is partly defined by the annular array of blades 48.

[0025] The present technique is described with reference to the above exemplary turbine engine having a single shaft or spool connecting a single, multi-stage compressor and a single, one or more stage turbine. However, it should be appreciated that the present technique is equally applicable to two or three shaft engines and which can be used for industrial, aero or marine applications.

[0026] FIG 2 schematically depicts a part of the conventionally known turbine section 18 in further details, when positioned within the engine 10. The conventionally known rotor discs 36, i.e. the blade carry discs, has a hub region 111, a web 109 and a rim section 108 that includes a blade retention arrangement for example fir tree grooves or slots for accepting and retaining roots of turbine blades (not shown). The hub region 111 is region or part of the rotor disc 36 that surrounds a central hole 11 or central bore 11. The central bore 11 is arranged around a rotational axis 15 of the rotor disc 36. The rotational axis 15 coincides with the rotational axis 20 as explained in FIG 1. From the hub region 111 extends radially outwards the web 109 which is section of the rotor disc 36 that connects the hub 111 to the rim section 108. The turbine blades are circumferentially arranged on the rotor discs 36 and extend radially outwards from the rotor discs 36.

[0027] As shown in FIG 2, the tension bolt 22, also referred to as the tie bolt 22 or the clamping bolt 22, passes through the central bore 11 and is physically contacted on an axial side at one of the rotor discs 36 at a chamfer recess 13 formed in the rotor disc 36. The arrow marked with reference numeral 101 represents an axial direction with respect to the turbine section 18 and the rotor discs 36 arranged in the turbine section 18. The tension bolt 22 bears the load of the rotor discs 36 along with the turbine blades (not shown in FIG 2) arranged on the rotor discs 36. On another axial side, as shown in FIG 2, another rotor disc 36 is contacted or coupled with a drive shaft 105 via generally Hirth coupling 106. The drive shaft 105 rotationally couples the turbine section 18 to the compressor section 14 of FIG 1. The rotor discs 36 of the conventionally known turbine section 18 are coupled to each other via one or more of torque transmission mechanisms 107, or in other words mechanical features 107 that function to transmit torque between the adjacent rotor discs 36, for example torque driving bolts or pins, dowels, Curvics, Hirth teeths, Splines, etc. Thus the conventionally known turbine section 18 includes the tie bolt 22, which may be one or more in number, and the torque transmission mechanisms 107.

[0028] FIG 3, FIG 4, FIG 5 and FIG 6 are hereinafter used to explain the present technique, and more particularly to explain a rotor assembly 1, a turbine section 2 and a gas turbine 100, in accordance with aspects of the present technique. FIG 1 has been used to explain features of the gas turbine 100 that are same for the conventionally known engine 10 and the gas turbine 100 of the present technique.

[0029] The rotor assembly 1 of the present technique includes a plurality of rotor discs, and namely at least a first rotor disc 60 and a second rotor disc 70, as shown in FIG 3 or further rotor discs such as a third rotor disc 70a as shown in FIG 4 besides the rotor discs 60, 70. The rotor discs 60,70,70a are blade carrying discs i.e. the rotor discs 60,70,70a have slots or grooves (not shown) formed in rim sections 64, 74 for supporting turbine blades 5. FIG 5 schematically represents an exemplary embodiment of the first rotor disc 60. FIG 5 also schematically represents an exemplary embodiment of the second rotor disc 70. As shown in FIG 5, a first plurality 65 of the turbine blades 5 are circumferentially arranged on the first rotor disc 60, and a second plurality 75 of the turbine blades 5 are circumferentially arranged on the second rotor disc 70, when the turbine section 2 is assembled. Although twenty turbine blades 5 are depicted to be present in each of the first and the second plurality 65,75 in FIG 5, it may be noted that number of turbine blades 5 in each of the plurality 65,75 may differ, for example less than twenty such as one or sixteen, or more than twenty such as twenty four. Moreover, a number of turbine blades 5 present in the first plurality 65 may differ from a number of turbine blades 5 present in the second plurality 75. Similarly turbine blades 5 are also circumferentially arranged on any further rotor discs 70a that may be present in the turbine section 2 of the gas turbine 100.

[0030] As shown in FIG 4, the rotor assembly 1, hereinafter also referred to as the assembly 1, has a rotational axis 99. The terms axial, radial, circumferential, and likes as used herein in the present disclosure, especially in reference to FIGs 3 and 4, are in respect with the rotational axis 99 of the assembly 1. FIG 5 shows an axial direction 101 and a radial direction 102 with respect to the rotational axis 99. The two rotor discs i.e. the first rotor disc 60, hereinafter also referred to as the first disc 60, and the second rotor disc 70, hereinafter also referred to as the second disc 70, are coaxially, i.e. with respect to the rotational axis 99, aligned to each other 60,70 and are axially, i.e. with respect to the rotational axis 99, adjacent to each other 60,70. The first and the second rotor discs 60,70 are configured to rotate about the rotational axis 99 of the rotor disc assembly 1, i.e. in other words the rotational axis 99, hereinafter also referred to as the axis 99, is common for the first and the second rotor discs 60,70 and also to any further rotor discs for example the third rotor disc 70a.

[0031] As depicted in FIGs 3, 4 and 5, the first rotor disc 60 includes a first annular projection 62. The first annular projection 62 is annular with respect to the rotational axis 99. The first annular projection 62 runs annularly and completely about the axis 99, as depicted in FIG 5. The second rotor disc 70 includes a second annular projection 72. The second annular projection 72 is annular with respect to the rotational axis 99. The second annular projection 72 runs annularly and completely about the axis 99, as depicted in FIG 5.

[0032] The annular projections 62,72 emanate from axial sides of the rotor discs 60,70. Optionally, as shown in FIG 3, the first and the second annular projections

62,72 emanate from rim sections 64,74 of the first and the second rotor discs 60,70, respectively. The rim sections 64,74 from where the annular projections 62,72 emanate are sections or parts of the rotor discs 60,70, respectively that lie immediately radially below or beneath the slots or grooves (not shown) that are formed on the rotor discs 60,70 to receive and support the turbine blades 5.

[0033] The first and the second annular projections 62,72 extend axially, with respect to the rotational axis 99, towards each other 62,72 as depicted in FIG 4. As shown in FIGs 3 and 4, the first and the second annular projections 62,72 at least partially overlap with each other 62,72 to form a lap joint 80, also known as an overlap joint 80.

[0034] The lap joint 80 or the overlap joint 80 is a mechanical joint in which the members, i.e. the first annular projection 62 or a part thereof and the second annular projection 72 or a part thereof, overlap. The lap joint 80 may be a full lap joint 80 as shown in FIG 4, or a half lap joint 80 as shown in FIG 3. In the full lap joint 80 as shown in FIG 4, no material is removed from either of the members, i.e. from the first annular projection 62 or from the second annular projection 72, joined, resulting in the lap joint 80 which has combined thickness of the two members, i.e. of the overlapping parts of the first and the second annular projections 62,72. In the half lap joint 80 or halving joint 80, also referred to as a stepped joint 80, material is removed from both of the members, i.e. from the first annular projection 62 and from the second annular projection 72, joined.

[0035] As aforementioned and as shown in FIGs 3 and 4, the lap joint 80 is formed by at least a part of the first annular projection 62 overlapping with at least a part of the second annular projection 72. The part of the first annular projection 62 forming the lap joint 80 is hereinafter also referred to as the first annular projection 62 in the lap joint 80. Similarly, the part of the second annular projection 72 forming the lap joint 80 is hereinafter also referred to as the second annular projection 72 in the lap joint 80.

[0036] As shown in FIGs 3 and 4, the first annular projection 62 in the lap joint 80 and the second annular projection 72 in the lap joint 80 are adhered to each other by using an adhesive material 85, for example a metallic ceramic composite, sandwiched between the first and the second annular projections 62, 72 in the lap joint 80. Such metallic ceramic composite adhesive materials 85 have a high thermal stability i.e. such adhesive materials 85 do not melt or liquefy at high temperatures that exist within the gas turbine 100, especially in the turbine section 2 of the gas turbine 100. The metallic ceramic composite adhesive material 85 is thermally stable between 400°C (degrees Celsius) and 1200°C, and more particularly between 900°C and 1100°C. Furthermore, the adhesive material 85 is such that it adheres or sticks to surfaces of the first and the second annular projections 62,72 i.e. to the alloy material of the rotor discs 60,70.

[0037] As shown in FIGs 3 and 4, in the assembly 1, one or more rivets 90 or close-fitted fasteners 90, for example solid rivets, rivet the first and the second annular projections 62,72 to each other in the lap joint 80. The rivets 90 when inserted in the lap joint 80 are structurally continuous with the first and the second annular projections 62,72, meaning thereby that no air gap exists between a body of the rivet 90 and between the material of the first and the second annular projections 62,72, in other words the rivets 90 are close-fitted or tight fitted.

[0038] Thus as shown in FIG 4, the rotor discs 60,70 are held together by the lap joint 80 in-between, in close proximity to each other, thereby achieving the clamping function of the conventional tie bolt 22 as shown in FIG 2, and therefore in an embodiment of the assembly 1 of the present technique, as shown in FIG 4, tie bolts 22 are not present. As a result, as shown in FIG 5, the rotor discs 60,70 may be bore-less or without the central bore 11 as was present in the rotor discs 36 of FIG 2. FIG 5 shows the position of the central bore 11 through a dotted line circle. Furthermore, compared to FIG 2, the assembly 1 does not include a separate torque transmission mechanism 107. Thus in the assembly 1 of the present technique the lap joint 80 functions in clamping the rotor discs 60,70 together and in transmitting the torque between the rotor discs 60,70. As shown in FIG 4, similarly another lap joint 80 may be formed between the second rotor disc 70 and the third rotor disc 70a. The lap joint 80 between the second and the third rotor disc 70,70a is structurally and functionally similar to the lap joint 80 formed between the first and the second rotor discs 60,70, and thus has not been explained herein in further details for sake of brevity.

[0039] As shown in FIG 6, in an embodiment of the rotor assembly 1, heads 92 of the one or more rivets 90 are flush with a radially outer surface 81 of the lap joint 80. Thus the heads 92 of the rivets 90 do not protrude from or indent the radially outer surface 81 of the lap joint 80.

[0040] As shown in FIG 4, in another embodiment of the rotor assembly 1, the lap joint 80 includes at least one push screw 84 positioned in one of the first and the second annular projections 62,72 in the lap joint 80. The one of the first and the second annular projections 62,72 in which the push screw 84 is positioned is radially outwards from other of the first and the second annular projections 62,72.

[0041] The present technique also presents the turbine section 2 for the gas turbine 100 as shown in FIG 4, explained herein in combination with FIG 3. The turbine section 2 includes a housing 3 or a casing 3, which may be a part of a stator (not shown) within which the rotor assembly 1 is positioned or housed. The stator 42 shown in FIG 1 may be same as the stator or housing 3 of FIG 4. The gas turbine 100 of FIG 4 has other components, for example the compressor 14, the combustor section 16, etc as described in reference to FIG 1 except for the turbine section 18. The gas turbine 100 may also include a generator 4. Instead of the conventional turbine section 18 having the tie rod 22 and the torque transmission mechanism 107 (shown in FIG 2), the turbine section 2 as explained with reference to FIG 4 is present in the gas turbine 100 of the present technique.

[0042] As aforementioned, the first and the second plurality 65,75 of the turbine blades 5 are circumferentially arranged on the first and the second rotor discs 60,70, respectively, of the rotor assembly 1 of the turbine section 2. The turbine section 2 also includes a plurality of turbine vanes 6, also depicted in FIG 3. The turbine vanes 6 extend radially inwards, with respect to the rotational axis 99, from the housing 3 and are positioned axially, with respect to the rotational axis 99, between the first and the second pluralities 65, 75 of the turbine blades 5. The lap joint 80 is positioned radially, with respect to the rotational axis 99, inwards of vane tips 7 of the turbine vanes 6.

[0043] As shown in FIGs 3 and 4, in an embodiment of the turbine section 2, the turbine section 2 further includes a plurality of seal fins 95. The seal fins 95 are positioned on a radially, with respect to the rotational axis 99, outer surface 81 of the lap joint 80. The seal fins 95 extend towards the vane tips 7 of the turbine vanes 6. The seal fins 95 reduce or obviate leakage of hot gas from a mainstream flow of the hot gas or the working gas out of the desired or designated hot gas path in the turbine section 2 of the gas turbine 100. Structure and function of seal fins are known in the art of gas turbines so is not explained herein in further details for sake of brevity.

[0044] In another embodiment of the turbine section 2 as schematically depicted in FIGs 3 and 4, the seal fins 95 are formed as a seal fins strip 94. The seal fins strip 94 is a long narrow piece of material such as alloy material like a sheet or ribbon on which the seal fins 95 are formed. The seal fins strip 94 when positioned on the surface 81 also forms an annular structure about the rotational axis 99. The seal fins strip 94 is adhered using an adhesive 83, as shown in FIG 3, to the radially outer surface 81 of the lap joint 80. The adhesive 83 may be, but not limited to a metallic ceramic composite. The metallic ceramic composite adhesive 83 is thermally stable between 400°C (degrees Celsius) and 1200°C, and more particularly between 900°C and 1100°C. Furthermore, the adhesive 83 is such that it adheres or sticks to the radially outer surface 81 of the lap joint 80 and to the material from which a base of the seal fins strip 94 is formed. The seal fins 95 emanate from the base of the seal fins strip 94. The adhesive 83 may have a composition same as or different from the adhesive material 85.

[0045] Furthermore, as shown in FIG 3, a filler material 8 may be used if any cavities or gaps are formed in forming the lap joint 80 and/or in adhering the seal fins strip 94 to the surface 81 of the lap joint.

[0046] Surfaces (not shown) of the first and the second annular projections 62, 72 that are adhered together to form the lap joint 80 may be subjected to various surface preparation treatments such as cleaning or sandblasting, etc that enhance the adherence of the adhesive material 85 on to the surfaces of the first and the second annular projections 62, 72 that are adhered together to form the lap joint 80.

[0047] As depicted in FIG 4, the turbine section 2 may be coupled to the compressor 14 via a part 69 of the first rotor disc 60, and may be coupled to the generator 4 via a part 79a of the third rotor disc 70a. The couplings may be made via conventionally known couplings as are known in the art of gas turbines for such structures.

[0048] While the present technique has been described in detail with reference to certain embodiments, it should be appreciated that the present technique is not limited to those precise embodiments. Rather, in view of the present disclosure which describes exemplary modes for practicing the invention, many modifications and variations would present themselves, to those skilled in the art without departing from the scope and spirit of this invention. The scope of the invention is, therefore, indicated by the following claims rather than by the foregoing description. All changes, modifications, and variations coming within the meaning and range of equivalency of the claims are to be considered within their scope.

Claims

1. A rotor assembly (1) for a turbine section (2) of a gas turbine (100), the rotor assembly (1) comprising:

   - a first rotor disc (60) and a second rotor disc (70) coaxially aligned and axially adjacent to each other (60,70) and configured to rotate about a rotational axis (99) of the rotor disc assembly (1), wherein the first rotor disc (60) comprises a first annular projection (62) about the rotational axis (99) and the second rotor disc (70) comprises a second annular projection (72) about the rotational axis (99), wherein the first and the second annular projections (62,72) extend towards each other (62,72) axially and at least partially overlap with each other (62,72) to form a lap joint (80), and
   - wherein the lap joint (80) comprises the first and the second annular projections (62,72) adhered to each other (62,72) with an adhesive material (85) thereinbetween, and
   - one or more fasteners or rivets (90) riveting the first and the second annular projections (62,72) in the lap joint (80).

2. The rotor assembly (1) according to claim 1, wherein the lap joint (80) is a full lap joint.

3. The rotor assembly (1) according to claim 1, wherein the lap joint (80) is a half lap joint.

4. The rotor assembly (1) according to any of claims 1

to 3, wherein the one or more fasteners or rivets (90) are solid rivets.

5. The rotor assembly (1) according to any of claims 1 to 4, wherein heads (92) of the one or more fasteners or rivets (90) are flush with a radially outer surface (81) of the lap joint (80).

6. The rotor assembly (1) according to any of claims 1 to 5, wherein the first and the second annular projections (62,72) emanate from rim sections (64,74) of the first and the second rotor discs (60,70), respectively.

7. The rotor assembly (1) according to any of claims 1 to 6, wherein the adhesive material (85) is a metallic ceramic composite.

8. The rotor assembly (1) according to any of claims 1 to 7, wherein the lap joint (80) further comprises at least one push screw (86) positioned in one of the first and the second annular projections (62,72), and wherein the one of the first and the second annular projections (62,72) in which the push screw (86) is positioned is radially outwards from other of the first and the second annular projections (62,72).

9. A turbine section (2) of a gas turbine (100), the turbine section (2) comprising:

- housing (3);
- a rotor assembly (1) according to any of claims 1 to 8 and positioned inside the housing (3), wherein a first plurality (65) of turbine blades (5) are circumferentially arranged on the first rotor disc (60) and a second plurality (75) of turbine blades (5) are circumferentially arranged on the second rotor disc (70); and
- a plurality of turbine vanes (6) extending radially inwards from the housing (3) and positioned axially between the first and the second pluralities (65,75) of the turbine blades (5), wherein the lap joint (80) of the rotor assembly (1) is positioned radially inwards of vane tips (7) of the turbine vanes (6).

10. The turbine section (2) according to claim 9, further comprising a plurality of seal fins (95) positioned on a radially outer surface (81) of the lap joint (80) and wherein the seal fins (95) extend towards the vane tips (7) of the turbine vanes (6).

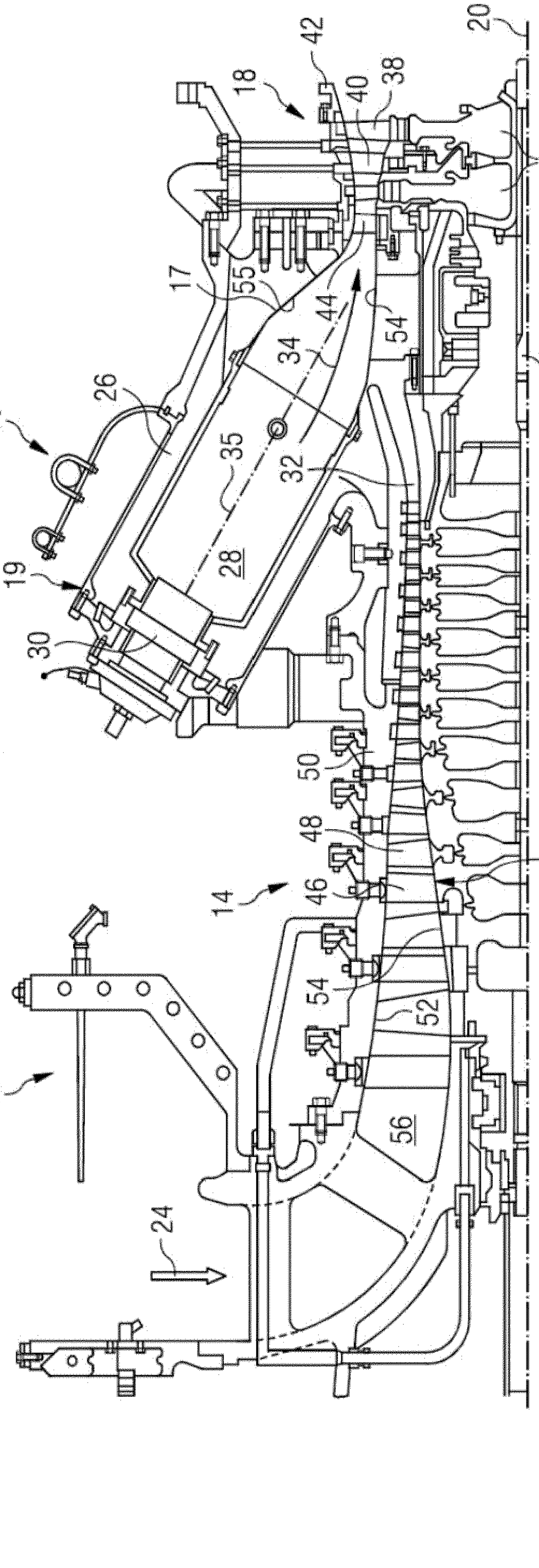
11. The turbine rotor section (2) according to claim 10, wherein the seal fins (95) are formed as a seal fins strip (94), and wherein the seal fins strip (94) is adhered using an adhesive (93) to the radially outer surface (81) of the lap joint (80).

12. The turbine rotor section (2) according to claim 11, wherein the adhesive (93) is a metallic ceramic composite.

13. The turbine rotor section (2) according to claim 11 or 12, wherein the adhesive (93) is same as the adhesive material (85) of the lap joint (80).

14. A gas turbine (100) comprising a rotor assembly (1), wherein the rotor assembly (1) is according to any of claims 1 to 8.

FIG 1 (PRIOR ART)



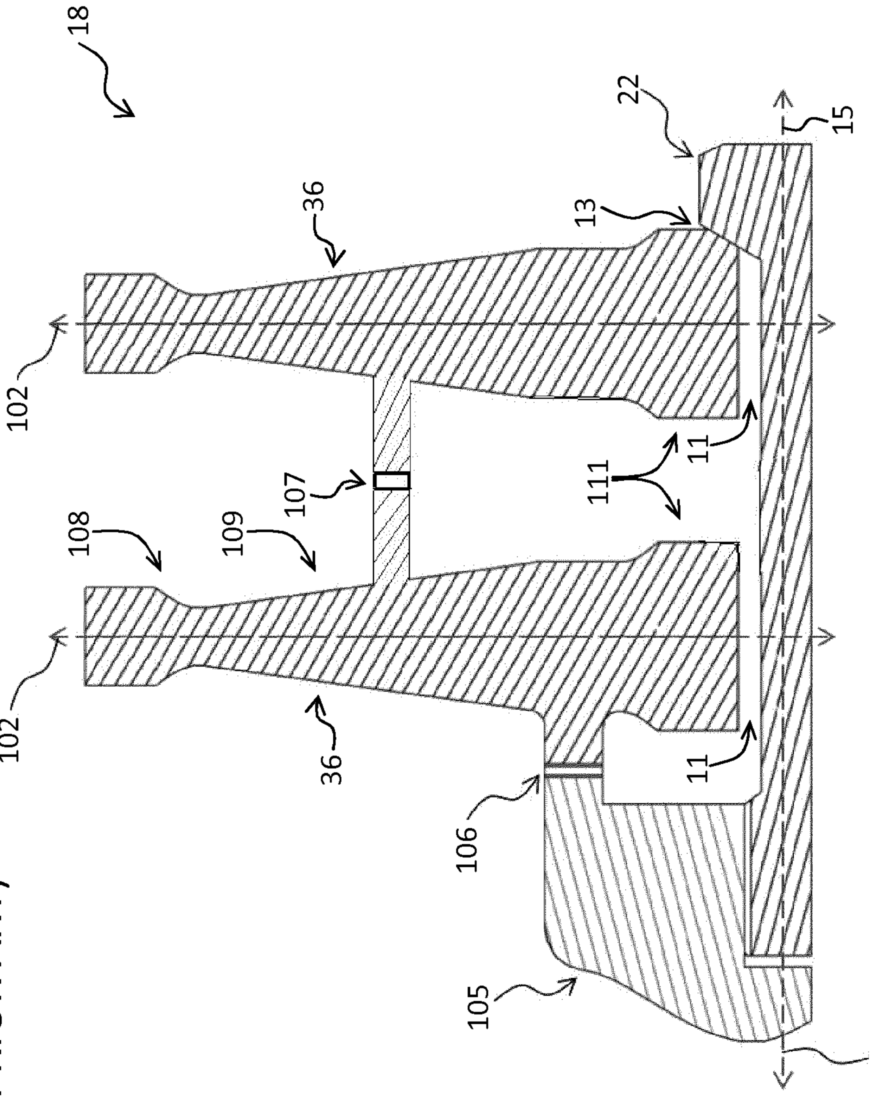


FIG 2 (PRIOR ART)

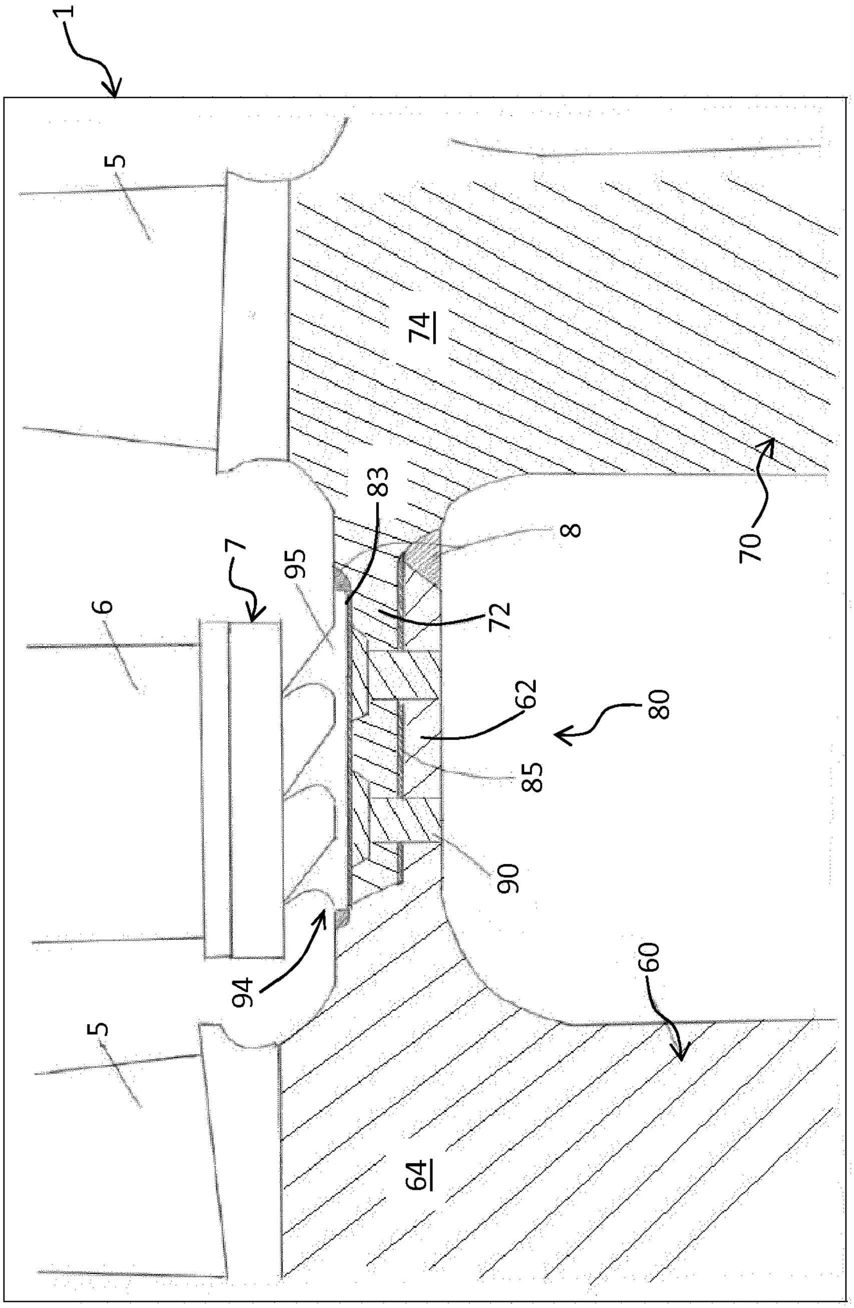
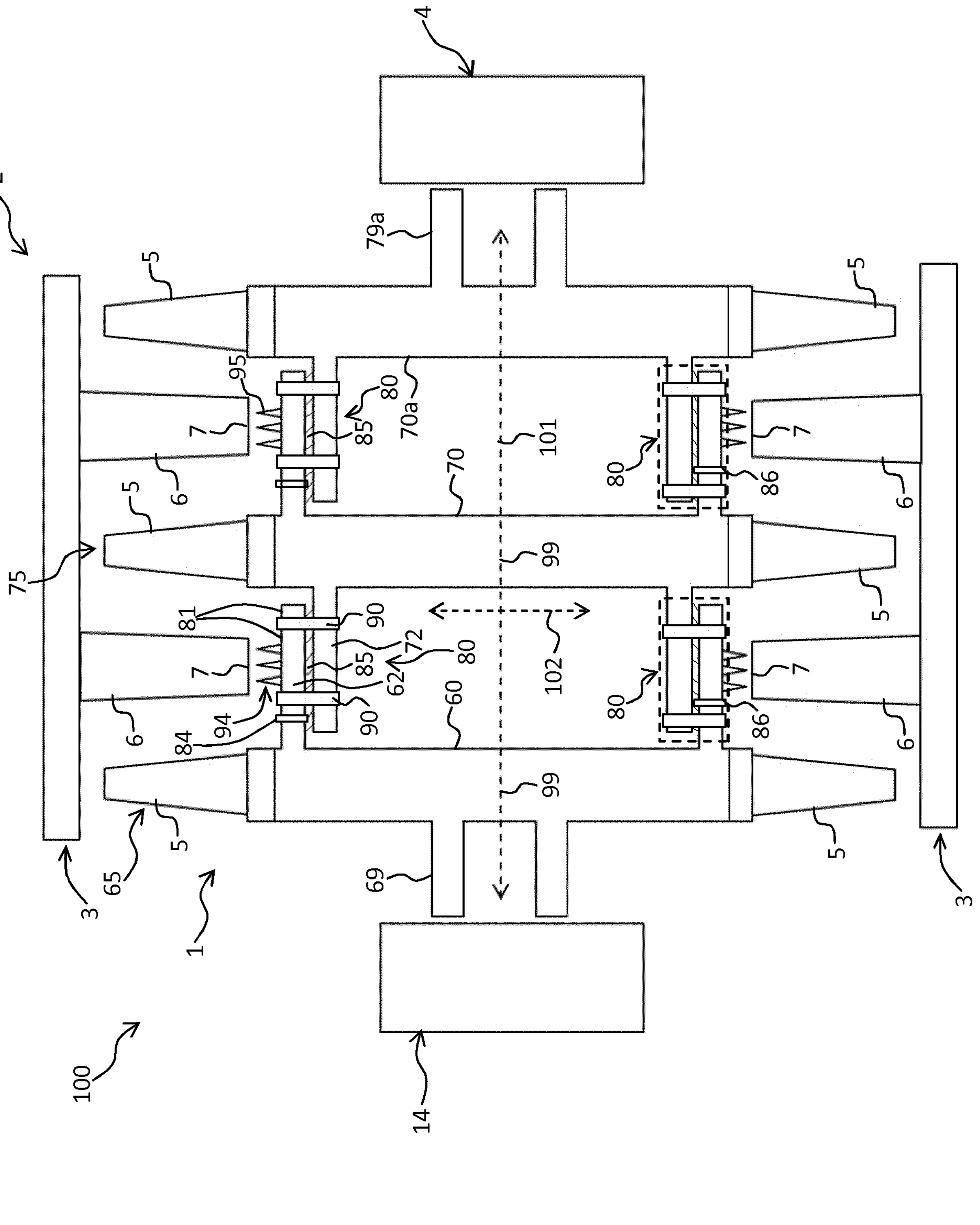


FIG 3


4
2
79a
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102
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65
69
3
1
100
14
3

FIG 4

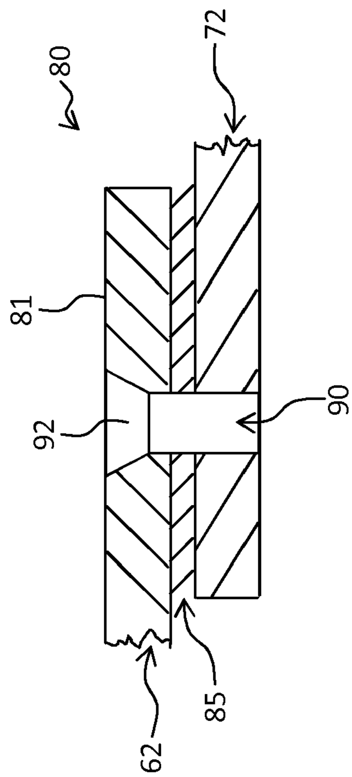

FIG 6

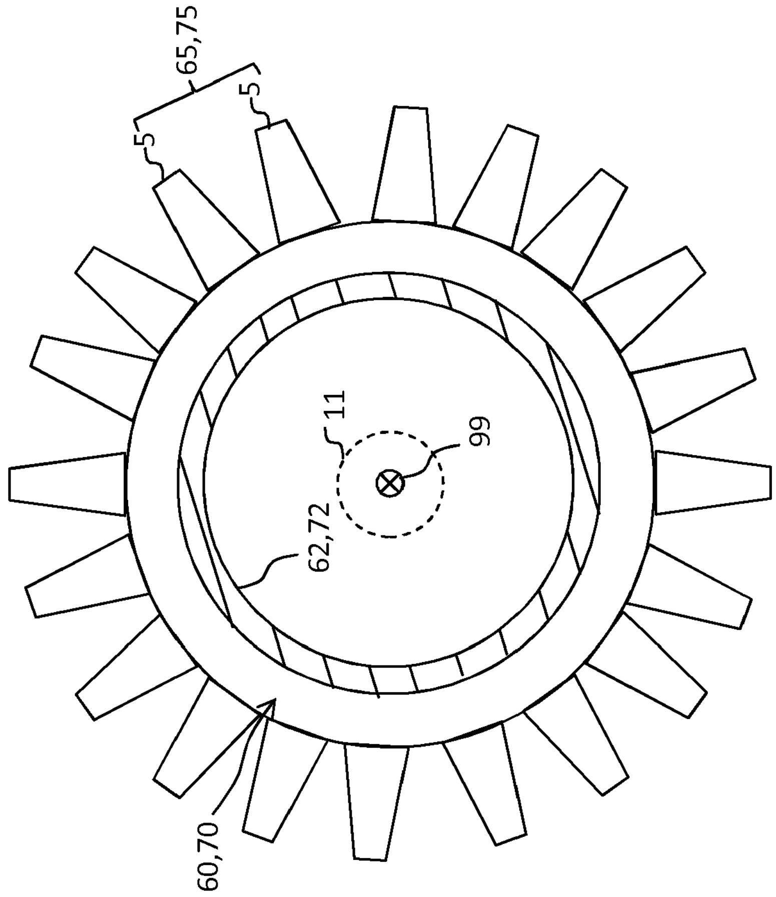

FIG 5

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EUROPEAN SEARCH REPORT

Application Number
EP 17 18 7531

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Y A	US 2 656 147 A (DENISON BROWNHILL FRANK ET AL) 20 October 1953 (1953-10-20) * figures 3,5 *	1-6,9 7,8, 10-14	INV. F01D5/02 F01D5/06
Y A	US 2011/164982 A1 (WILSON IAN DAVID [US]) 7 July 2011 (2011-07-07) * paragraphs [0021] - [0031]; figures 1-3 *	1-6,9 7,8, 10-14	
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The present search report has been drawn up for all claims

3

Place of search	Date of completion of the search	Examiner
Munich	21 February 2018	Chatziapostolou, A

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