An article of manufacture is provided having a first component configured for use with a stator of a turbomachine. The first component is configured for attachment to a second component. The second component is also configured for use with the stator of the turbomachine. The first component is configured to substantially reduce the possibility of installation in an undesired stage of the stator by modification of at least one characteristic of the first component. The second component is configured to substantially reduce the possibility of installation in an undesired stage of the stator by modification of at least one characteristic of the second component.
FIG. 1
(PRIOR ART)
FIG. 2
(PRIOR ART)
FIG. 3
(PRIOR ART)
ARTICLE OF MANUFACTURE FOR TURBOMACHINE

BACKGROUND OF THE INVENTION

[0001] The present invention relates generally to turbomachinery, and more particularly relates to an article of manufacture configured for use with turbomachines.

[0002] A conventional gas turbine generally operates on the principle of compressing air within a compressor, and then delivering the compressed air to a combustion chamber where fuel is added to the air and ignited. Afterwards, the resulting combustion mixture is delivered to the turbine section of the engine, where a portion of the energy generated by the combustion process is extracted by a turbine to drive the compressor via a shaft.

[0003] In multi-stage compressor sections, stator vanes are placed at the entrance and exit of the compressor section, as well as between each compressor stage, for purposes of properly directing the airflow to each successive compressor stage. As a result, stator vanes are able to enhance engine performance by appropriately influencing air flow and pressure within the compressor section.

[0004] Each stator stage generally consists of an annular array of airfoils, or vanes. A stator stage is typically formed in segments as stator vane units consisting of one or more airfoils supported by the base. These stator vane units are then individually mounted to the compressor casing to form an annular array, so that the airfoils project radially between an adjacent pair of rotor stages.

[0005] Stator vanes in an industrial gas turbine compressor are loaded and unloaded during start-stop cycles. In addition, the vanes are subject to small pressure fluctuations during operation. These result in relative motion between the vane base and the casing in which the vanes are assembled. The relative motion results in wear of both the vane base and casing, which, in turn, results in loose vanes. The loose vanes become more susceptible to relative motion and begin to chatter. Repair or replacement of the vanes may be required. Similar problems exist between stator ring segments, which hold a plurality of stator vanes, the stator ring segments being mounted in slots of the compressor casing.

[0006] FIG. 1 illustrates a known compressor section having a portion of an open casing showing five exemplary stages of stator vanes. In the embodiment shown, the casing section is semi-circular. The casing has a mounting surface that may be secured to a corresponding mounting surface on another casing section with fasteners extending through a plurality of holes. For a complete compressor, two of the semi-circular casing sections would be fitted together around a rotor.

[0007] Each stator vane has an airfoil that extends upwards from a base and radially inward towards the shroud of the compressor rotor (not shown). The airfoil, and stator vanes, are interposed between the rotor blades (not shown). Certain stator stages of a compressor may mount stator vanes directly in a slot in the casing. Other stator stages mount stator vanes in ring segments, which are then mounted in slots of the casing.

[0008] FIG. 2 illustrates individual stator vanes. Airfoil extends vertically from a base or platform. The basic shape has two opposing retaining faces. The basic shape has a pair of projections, one on each of the retaining faces. The projections are to be received by a correspondingly shaped groove in a slot of the casing. The grooves retain the stator vane in place in the slot of the casing. The other two opposing faces of the base are the engaging faces. The engaging faces of the base butt against the bases of adjacent stator vane units when the units are installed in a casing slot. The retaining faces and projections are the same shape and size on both sides of the stator vane. In this arrangement, the stator vanes can be rotated 180 degrees and inserted within a casing slot (or ring segment).

[0009] FIG. 3 illustrates an enlarged side view of the casing showing a stage in which individual stator vanes are assembled in a slot of the compressor casing. For this type of installation, a plurality of the stator vanes are assembled in the casing to form the stator vane stage. The casing 15 has a plurality of slots for receiving the stator vane units. The casing 15 has a pair of side edges, each of which has a groove or dovetail-shaped recess. The square base dovetail holds the vane units in place. The side edges and dovetails are mirror images of each other on each side of the slot. As mentioned previously, this allows the stator vanes to be rotated 180 degrees and inserted within a casing slot (or ring segment), with the potential for inserting a stator vane backwards. The term “backwards” is defined as the airfoil being oriented 180 degrees from a desired orientation. Each vane unit is allowed to slide into place with the base received in the slot and the projections received in the grooves. The casing 15 in the particular example shown has an air extraction cavity that underlies the stage and is formed by the slot and the stator vanes.

[0010] The stator vanes for an individual stage are sequentially placed in the slot of the casing until the full circumferential run of the slot has been filled with a designated number of stator vanes.

[0011] Other stages of stator vanes may be attached to the casing using ring segment assemblies. The ring segment assembly includes a ring segment and one or more stator vanes. Ring segments typically hold a plurality of stator vanes. After the ring segments have been loaded with stator vanes, the ring segments are slid into circumferential slots in the turbine/compressor casing and are butted against each other to sequentially fill the circumferential slots. Blades that are larger and have more forces placed on them may be assembled using this vane and ring segment assembly to provide a stiffer base mounting.

[0012] FIG. 4 illustrates a ring segment assembly that is slid out and away from the casing 15. The ring segment 90 receives a plurality of stator vanes 25. A base 45 of the stator vane 25 slides (in a generally axial direction with respect to the compressor) into the ring segment 90. The base 45 of the stator vane 25 includes a dovetail 95 fitting into the being retained by a corresponding dovetail-shaped slot 100 in the ring segment 90.

[0013] The ring segment slides into the circumferential slot of the casing. The sidewalls are supported axially by the sidewalls of the slot when the ring segment is within the slot. The square dovetail fits into the grooves of the circumferential slot 70, thereby retaining the ring segments in the circumferential slot 70. Ring segments are sequentially placed in the slot 70 of casing until the slot is filled with the design number of ring segment assemblies.

[0014] During initial assembly of turbomachine components, or subsequent repair and replacement of turbomachine
components, a large number of components must be installed in specific locations of the turbomachine. For example, a stage one stator vane must be installed in the correct position in a stage one stator case. A typical turbomachine may have many stages with many corresponding components, so a high probability exists that a component for a specific stage may get installed in an incorrect stage (e.g., a stage five stator vane might get installed in a stage six stator slot). The negative implications of this event lead to machine malfunction or inefficiency and increase outage or construction time due to the need to remove and correctly install the specific components. Accordingly, need still exists for an improved system for installing turbomachine components that reduces the probability for errors during installation.

BRIEF DESCRIPTION OF THE INVENTION

[0015] According to one aspect of the present invention, an article of manufacture is provided having a first component configured for use with a stator of a turbomachine. The first component is configured for attachment to a second component. The second component is also configured for use with the stator of the turbomachine. The first component is configured to substantially reduce the possibility of installation in an undesired stage of the stator by modification of at least one characteristic of the first component. The second component is configured to substantially reduce the possibility of installation in an undesired stage of the stator by modification of at least one characteristic of the second component.

[0016] According to another aspect of the present invention, an article of manufacture is provided having a first component configured for use with a stator of a turbomachine. The first component is configured for attachment to a second component, and the second component is configured for use with the stator of the turbomachine. A third component is configured for use with the stator of the turbomachine, and the third component is configured for attachment to the second component. The first component is configured to substantially reduce the possibility of installation in an undesired stage of the stator by modification of at least one characteristic of the first component. The second component is configured to substantially reduce the possibility of installation in an undesired stage of the stator by modification of at least one characteristic of the second component. The third component is configured to substantially reduce the possibility of installation in an undesired stage of the stator by modification of at least one characteristic of the third component.

[0017] According to yet another aspect of the present invention, an article of manufacture configured for use with a turbomachine is provided. The article of manufacture includes a stator having an upper half and a lower half. The upper half has one or more upper half locker segments and a plurality of upper half pack segments. The plurality of upper half pack segments are located circumferentially between the one or more upper half locker segments. The lower half has one or more lower half locker segments and a plurality of lower half pack segments. The plurality of lower half pack segments are located circumferentially between the one or more lower half locker segments. At least one characteristic of the upper half is different than at least one characteristic of the lower half.

[0018] These and other features and improvements of the present invention should become apparent to one of ordinary skill in the art upon review of the following detailed description when taken in conjunction with the several drawings and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] FIG. 1 illustrates a compressor section including a portion of an open compressor casing showing five exemplary stages of stator vanes;
[0020] FIG. 2 illustrates individual stator vanes;
[0021] FIG. 3 illustrates a stator vane assembled in a slot of a turbine casing;
[0022] FIG. 4 illustrates a ring segment assembly slid out from the turbine casing slot;
[0023] FIG. 5 illustrates an axial segment assembly slid out from the turbine casing slot;
[0024] FIG. 6 illustrates an axial compressor flow path, according to an aspect of the invention;
[0025] FIG. 7 illustrates a partial, cross-sectional view of a stator casing, according to an aspect of the invention;
[0026] FIG. 8 illustrates a perspective view of a plurality of stator vanes inserted in a ring segment, according to an aspect of the invention;
[0027] FIG. 9 illustrates a cross-sectional view of a stator vane, according to an aspect of the invention; and

DETAILED DESCRIPTION OF THE INVENTION

[0028] One or more specific aspects/embodiments of the present invention will be described below. In an effort to provide a concise description of these aspects/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 machine-related, 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.

[0029] 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. Any examples of operating parameters and/or environmental conditions are not exclusive of other parameters/conditions of the disclosed embodiments. Additionally, it should be understood that references to “one embodiment”, “one aspect” or “an embodiment” or “an aspect” of the present invention are not intended to be interpreted as excluding the existence of additional embodiments or aspects that also incorporate the recited features. A turbomachine is defined as a machine that transfers energy between a rotor and a fluid or vice-versa, including but not limited to gas turbines, steam turbines and compressors.

[0030] Referring now to the drawings, FIG. 5 illustrates an axial compressor flow path 500 of a compressor 501 that includes a plurality of compressor stages. The compressor 501 may be used in conjunction with, or as part of, a gas turbine. As one non-limiting example only, the compressor
flow path 500 may comprise about eighteen rotor/stator stages. However, the exact number of rotor and stator stages is a choice of engineering design, and may be more or less than the illustrated eighteen stages. It is to be understood that any number of rotor and stator stages can be provided in the compressor, as embodied by the invention. The eighteen stages are merely exemplary of one turbine/compressor design, and are not intended to limit the invention in any manner.

[0031] The compressor rotor blades 502 impart kinetic energy to the airflow and therefore bring about a desired pressure rise. Directly following the rotor blades 502 is a stage of stator vanes 504. However, in some designs the stator vanes 504 may precede the rotor blades 502. Both the rotor blades 502 and stator vanes 504 turn the airflow, slow the airflow velocity (in the respective airfoil frame of reference), and yield a rise in the static pressure of the airflow. Typically, multiple rows of rotor/stator stages are arranged in axial flow compressors to achieve a desired discharge to inlet pressure ratio. Each rotor blade and stator vane includes an airfoil, and these airfoils can be secured to rotor wheels or a stator case by an appropriate attachment configuration, often known as a "root," "base" or "dovetail." In addition, compressors may also include inlet guide vanes (IGVs), variable stator vanes (VSVs), exit or exhaust guide vanes (EGVs) and stator vanes. All of these blades and vanes have airfoils that act on the medium (e.g., air) passing through the compressor flow path 500.

[0032] Exemplary stages of the compressor 501 are illustrated in FIG. 5. One stage of the compressor 501 comprises a plurality of circumferentially spaced rotor blades 502 mounted on a rotor wheel 512 and a plurality of circumferentially spaced stator vanes 504 attached to a static compressor case 514. Each of the rotor wheels 512 may be attached to an aft drive shaft 516, which may be connected to the turbine section of the engine. The rotor blades and stator vanes lie in the flow path 500 of the compressor 501. The direction of airflow through the compressor flow path 500, as embodied by the invention, is indicated by the arrow 518 (FIG. 5), and flows generally from left to right in the illustration.

[0033] The rotor blades 502 and stator vanes 504 herein of the compressor 501 are merely exemplary of the stages of the compressor 502 within the scope of the invention. In addition, each inlet guide vane 506, rotor blade 502, stator vane 504, and exit guide vane 510 may be considered an article of manufacture. Further, the article of manufacture may comprise a stator vane and/or a stator casing and/or a ring segment configured for use with a compressor.

[0034] Aspects of the present invention provide a collection of strategically defined geometric features incorporated on the stator vanes, ring segments (also referred to as stator vane attachments), and casing slots for a unique configuration of the stator vane assembly. This unique configuration prevents mis-assembly due to assembly errors. Assembly errors occur when a stator vane or ring segment is installed in the wrong stage or the wrong half of the casing. For example, a stator vane or ring segment may be designed for an upper half of the compressor, but assembly error leads to installation in the lower half of the compressor. Further, this unique configuration provides a physical method of mis-assembly proofing where the wrong method of installation may not be visually apparent. For example, it would be difficult to place a stage five stator vane in a stage thirteen stator slot, however, it would be very easy to interchange (and install incorrectly) a stage eleven stator vane with a stage twelve stator vane. Adjacent stages may have very similarly sized components, and even though these sizes may look visually insignificant (or hard to detect), the improper installation of components can lead to severe machine damage and loss of efficiency.

[0035] FIG. 6 illustrates a partial, cross sectional view of a stator casing 600, according to an aspect of the present invention. In this example, a ring segment 602, shown in phantom, is positioned within the stator casing slot 604. The stator casing slot has an axial length 605 which may be the distance between the forward sidewall 606 and the aft sidewall 607. Alternatively, the axial length 610 may be measured from the forward and aft surfaces of the forward groove 612 and aft groove 613. The stator casing slot also has two radial heights. The radial height 620 of the forward sidewall 606 may be measured from the bottom of slot 604 to the top of forward sidewall 606. The radial height 630 of the aft sidewall 607 may be measured from the bottom of slot 604 to the top of aft sidewall 607. According to an aspect of the present invention, the forward radial height 620 may be configured to be different from the aft radial height 630, and in the example shown the forward radial height 620 is smaller than the aft radial height 630. Further, the radial height of the forward groove 612 may be different than the radial height of the aft groove 613. The radial positioning of the forward and aft grooves may also be different.

[0036] It is to be understood that the invention is not to be limited to only the examples shown, and that the invention also includes embodiments where the aft groove has a smaller radial height than the forward radial groove, the forward and aft radial grooves have different axial depths, the forward and aft radial grooves have different geometrical cross-sectional shapes and/or the forward and aft radial grooves have different radial heights or are located at different radial heights. It is also to be understood that the invention also includes embodiments where the forward sidewall has a larger radial height than the aft sidewall.

[0037] FIG. 7 illustrates a perspective view of a plurality of stator vanes 710 inserted in a ring segment 720, according to an aspect of the present invention. The ring segment 720 fits into the stator slot (e.g., slot 604 in FIG. 6). The ring segment 720 has an axial length 730, which may be measured from the forward sidewall or forward surface 732 to the aft sidewall or aft surface 734, or the axial length 730 may be measured from the end of the forward projection 736 to the end of the aft projection 738. According to an aspect of the present invention, this axial length 730 may be configured so that it is different for each stage of the stator, for adjacent stages of the stator, or for nearby stages of the stator. This configuration provides the advantage of eliminating the possibility of a ring segment designed for a specific stage from being installed in an adjacent or nearby stage of the stator. For example, the axial length 730 for a stage five ring segment may be 3 inches, and the axial length for a stage six ring segment may be 2.75 inches, so it would be impossible to install the stage five ring segment into a stage six stator casing slot, because the stage six stator casing slot would be too small.

[0038] Ring segments may also be installed backwards when the cross-sectional profile of the ring segment is symmetrical. When this happens, machine efficiency is reduced and damage may occur. According to another aspect of the present invention, the ring segment 720 has a generally trapezoidal or quadrilateral cross-sectional profile. The radial
height \(740\) of the forward sidewall/surface \(732\) is configured to be different than the radial height \(742\) of the aft sidewall/surface \(734\), and these heights may be measured from the base of the respective sidewalls or from the bottom surface of the ring segment. The radial height \(740\) is shown to be smaller than radial height \(742\), but it is to be understood that the radial height \(740\) could also be configured to be larger than radial height \(742\).

[0039] In addition, the radial height \(744\) of the forward projection \(736\) may be configured to be smaller than the radial height \(746\) of the aft projection \(738\). As one example only, the radial height \(744\) of the forward projection \(736\) may be about 0.25 inches while the radial height \(746\) of the aft projection \(738\) may range between about 0.30 inches and about 0.50 inches. The purpose of the difference in radial heights (between forward and aft projections) is to ensure that the ring segment \(720\) is not installed backwards in the stator casing slot. Further, adjacent or nearby stages may have different radial heights for the aft projection (and/or different radial heights for the forward projection) to further error-proof installation.

[0040] FIG. 8 illustrates a cross-sectional view of a stator vane \(800\), according to an aspect of the present invention. The stator vane \(800\) may be configured to fit directly into a stator casing slot or into a ring segment, where the ring segment is configured to engage a stator casing slot. The stator vane \(800\) has an angled platform \(810\) that tapers up from a forward side \(801\) to an aft side \(802\). However, the platform could also be configured to taper downward from the forward side to the aft side of the stator vane. This taper ensures that the stator vane \(800\) can only be inserted in the designed direction on the ring segment or stator casing slot, and that backwards installation is impossible. In order to properly match the complementary surfaces of the ring segment or stator casing slot, the forward surface or forward sidewall \(811\) is configured to have a smaller radial height \(821\) than the radial height \(822\) of the aft surface or aft sidewall \(812\). The lower dovetail or tang portion \(830\) is configured to fit within the lower portion of the ring segment slot. The upper dovetail \(840\) is tapered to follow the contours of the platform \(810\) and to allow insertion into the ring segment or stator casing slot. The axial length \(850\) of the stator vane \(800\) may also be configured to be different for each stage or for adjacent or nearby stages to reduce or eliminate the possibility of installation in an undesired stage ring segment or stator casing slot.

[0041] FIG. 9 illustrates a schematic representation of a stator, according to an aspect of the present invention. The stator \(900\) may be divided into many arcuate sections or segments. An upper half \(901\) may include an upper half left half locker segment \(911\), an upper half right half locker segment \(912\), and a plurality of n-pack segments \(913-916\). However, it is to be understood that more or less n-pack segments could be used as desired in the specific application. Each of the n-pack segments span an angle of \(\theta_n\) and have a circumferential length or arc length of ARC\(m\). \(\theta_m\) may be referred to as the span angle. The lower half m-segments may be referred to collectively as the m-Pack.

[0043] According to an aspect of the present invention, and to aid in fool proofing installation of stator components, the stator has a different number of n-pack segments than m-pack segments. As shown, there are fewer n-pack segments than m-pack, but this could be reversed to have more m-pack segments than n-pack segments as desired in the specific application. The angle of \(\theta_n\) is also configured to be different than the angle \(\theta_m\), and in the example shown \(\theta_n\) is greater than \(\theta_m\). However, it is to be understood that in some applications it may be desirable to have \(\theta_n\) be greater than \(\theta_m\). The difference in angles also leads to a difference in segment length, as the arc length ARC\(n\) is greater than the arc length ARC\(m\). However, it is to be understood that in some applications it may be desirable to have ARC\(m\) be greater than ARC\(n\).

[0044] According to an aspect of the present invention, an article of manufacture configured for use with a turbomachine has a stator \(900\) having an upper half \(901\) and a lower half \(902\). The upper half \(901\) has one or more upper half locker segments \(911, 912\) and a plurality of upper half pack segments \(913-916\). The upper half pack segments \(913-916\) are located circumferentially between the one or more upper half locker segments \(911, 912\). The lower half \(902\) has one or more lower half locker segments \(921, 922\) and a plurality of lower half pack segments \(923-929\). The lower half pack segments \(923-929\) are located circumferentially between the lower half locker segments \(921, 922\). At least one characteristic of the upper half \(901\) is different than at least one characteristic of the lower half \(902\). The characteristics of both the upper half \(901\) and lower half \(902\) are chosen from one, all or a portion of, the number of pack segments, the pack segment span angle \(\theta_n\) or \(\theta_m\), and pack segment arc length ARC\(n\) or ARC\(m\).

[0045] The various features of the stator, according to an aspect of the present invention, are used to fool proof installation of stator components. It can be seen that by physically changing the stator segments so that the number of n-pack segments are different from the number of m-pack segments, configuring the angle \(\theta_n\) to be different from the angle \(\theta_m\) and by configuring the arc length ARC\(n\) to be different than the arc length ARC\(m\), that it is now extremely difficult, if not impossible, to improperly install the stator components.

[0046] Aspects of the present invention provide, an article of manufacture comprising a first component (e.g., stator vane \(800\)) configured for use with a stator of a turbomachine. The first component (e.g., stator vane \(800\)) is configured for attachment to a second component (e.g., ring segment \(720\)) also configured for use with the stator of the turbomachine. The first component (e.g., stator vane \(800\)) is configured to substantially reduce the possibility of installation in an undesired stage of the stator by modification of at least one characteristic of the first component. The second component (e.g., ring segment \(720\)) is configured to substantially reduce the possibility of installation in an undesired stage of the stator by modification of at least one characteristic of the second component.

[0047] The characteristic of the stator vane \(800\) may be chosen from one, all, or a portion of, the radial height \(821\) of a forward sidewall \(811\), the radial height \(822\) of an aft sidewall \(812\), and an axial length \(850\). The characteristic of the ring segment \(720\) may be chosen from one, all, or a portion of, the radial height \(740\) of a forward surface \(732\), the radial height
742 of an aft surface 734, the radial height 744 of a forward projection 736, the radial height 746 of an aft projection 738, and an axial length 730.

[0048] The article of manufacture may also include a third component (e.g., stator casing slot 604) configured for use with the stator of the turbomachine. The third component is also configured for attachment to the second component (e.g., ring segment 720). The third component (e.g., stator casing slot 604) is configured to substantially reduce the possibility of installation in an undesired stage of the stator by modification of at least one characteristic of the third component. The characteristic of the stator casing slot 604 may be chosen from one, all, or a portion of, the radial height 620 of a forward sidewall 606, a radial height 630 of an aft sidewall 607, a radial height of a forward groove 612, a radial height of an aft groove 613, and an axial length 605 or 610.

[0049] 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 languages of the claims.

1. An article of manufacture comprising:
a first component configured for use with a stator of a turbomachine, the first component configured for attachment to a second component, the second component configured for use with the stator of the turbomachine:

wherein, the first component is configured to substantially reduce the possibility of installation in an undesired stage of the stator by modification of at least one characteristic of the first component, and the second component is configured to substantially reduce the possibility of installation in an undesired stage of the stator by modification of at least one characteristic of the second component.

2. The article of manufacture of claim 1, wherein the first component is a stator vane and the second component is a ring segment.

3. The article of manufacture of claim 2, the at least one characteristic of the stator vane comprising at least one of:
a radial height of a forward sidewall, a radial height of an aft sidewall, and an axial length.

4. The article of manufacture of claim 2, the at least one characteristic of the ring segment comprising at least one of:
a radial height of a forward surface, a radial height of an aft surface, a radial height of a forward projection, a radial height of an aft projection, and an axial length.

5. The article of manufacture of claim 1, further comprising:
a third component configured for use with the stator of the turbomachine, the third component configured for attachment to the second component:

wherein, the third component is configured to substantially reduce the possibility of installation in an undesired stage of the stator by modification of at least one characteristic of the third component.

6. The article of manufacture of claim 5, wherein the third component is a stator casing slot; and

wherein the at least one characteristic of the stator casing slot is at least one of, a radial height of a forward sidewall, a radial height of an aft sidewall, a radial height of a forward groove, a radial height of an aft groove, and an axial length.

7. An article of manufacture comprising:
a first component configured for use with a stator of a turbomachine, the first component configured for attachment to a second component, the second component configured for use with the stator of the turbomachine;

a third component configured for use with the stator of the turbomachine, the third component configured for attachment to the second component;

wherein, the first component is configured to substantially reduce the possibility of installation in an undesired stage of the stator by modification of at least one characteristic of the first component, and the third component is configured to substantially reduce the possibility of installation in an undesired stage of the stator by modification of at least one characteristic of the second component.

8. The article of manufacture of claim 7, wherein the first component is a stator vane, the second component is a ring segment and the third component is a stator casing slot.

9. The article of manufacture of claim 8, the at least one characteristic of the stator vane comprising at least one of:
a radial height of a forward sidewall, a radial height of an aft sidewall, and an axial length.

10. The article of manufacture of claim 8, the at least one characteristic of the ring segment comprising at least one of:
a radial height of a forward surface, a radial height of an aft surface, a radial height of a forward projection, a radial height of an aft projection, and an axial length.

11. The article of manufacture of claim 8, the at least one characteristic of the stator casing slot comprising at least one of:
a radial height of a forward sidewall, a radial height of an aft sidewall, a radial height of a forward groove, a radial height of an aft groove, and an axial length.

12. The article of manufacture of claim 8, wherein the turbomachine is a compressor.

13. The article of manufacture of claim 1, further comprising:
the stator having an upper half and a lower half;
the upper half having one or more upper half locker segments and a plurality of upper half pack segments, the plurality of upper half pack segments located circumferentially between the one or more upper half locker segments;
the lower half having one or more lower half locker segments and a plurality of lower half pack segments, the plurality of lower half pack segments located circumferentially between the one or more lower half locker segments;

wherein at least one characteristic of the upper half is different than at least one characteristic of the lower half.
14. The article of manufacture of claim 13, wherein the at least one characteristic of both the upper half and the lower half are chosen from at least one of:
   a number of pack segments, pack segment span angle, and pack segment arc length.

15. An article of manufacture configured for use with a turbomachine, the article of manufacture comprising:
   a stator having an upper half and a lower half;
   the upper half having one or more upper half locker segments and a plurality of upper half pack segments, the plurality of upper half pack segments located circumferentially between the one or more upper half locker segments;
   the lower half having one or more lower half locker segments and a plurality of lower half pack segments, the plurality of lower half pack segments located circumferentially between the one or more lower half locker segments;
   wherein at least one characteristic of the upper half is different than at least one characteristic of the lower half.

16. The article of manufacture of claim 15, wherein the at least one characteristic of both the upper half and the lower half are chosen from at least one of:
   a number of pack segments, pack segment span angle, and pack segment arc length.

17. The article of manufacture of claim 15 further comprising:
   a first component configured for use with a stator of a turbomachine, the first component configured for attachment to a second component, the second component configured for use with the stator of the turbomachine;
   wherein, the first component is configured to substantially reduce the possibility of installation in an undesired stage of the stator by modification of at least one characteristic of the first component, and the second component is configured to substantially reduce the possibility of installation in an undesired stage of the stator by modification of at least one characteristic of the second component.

18. The article of manufacture of claim 17, wherein the first component is a stator vane and the second component is a ring segment; and
   the at least one characteristic of the stator vane is chosen from at least one of, a radial height of a forward sidewall, a radial height of an aft sidewall, and an axial length; and
   the at least one characteristic of the ring segment is chosen from at least one of, a radial height of a forward surface, a radial height of an aft surface, a radial height of a forward projection, a radial height of an aft projection, and an axial length.

19. The article of manufacture of claim 17, further comprising:
   a third component configured for use with the stator of the turbomachine, the third component configured for attachment to the second component;
   wherein, the third component is configured to substantially reduce the possibility of installation in an undesired stage of the stator by modification of at least one characteristic of the third component.

20. The article of manufacture of claim 19, wherein the third component is a stator casing slot; and
   wherein the at least one characteristic of the stator casing slot is at least one of, a radial height of a forward sidewall, a radial height of an aft sidewall, a radial height of a forward groove, a radial height of an aft groove, and an axial length.

* * * * *