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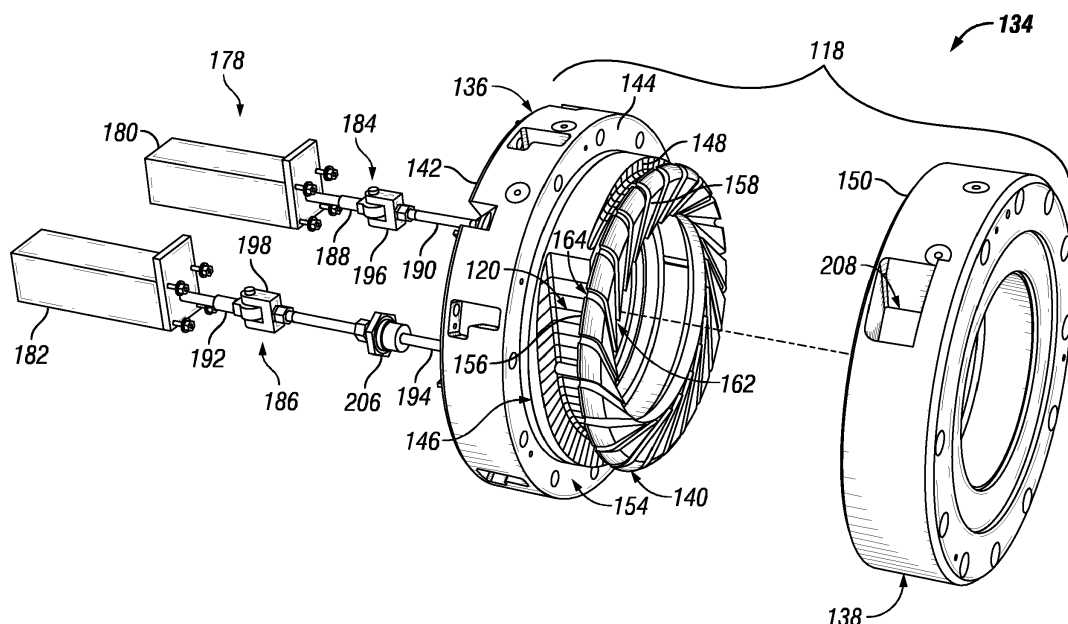
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(54) VARIABLE AREA DIFFUSER

(57) A diffuser assembly for a compressor is provided. The diffuser may include a first stationary wall and a second stationary wall coupled with one another and forming at least in part a volute configured to receive compressed process fluid from the diffuser. The second stationary wall may define a plurality of stationary wall grooves. The diffuser may also include a moveable wall defining a plurality of moveable wall grooves. The moveable wall may be disposed between the first stationary

wall and the second stationary wall such that respective stationary wall grooves and moveable wall grooves form respective flow passages configured to receive the flow of process fluid exiting an impeller of the compressor. The diffuser assembly may also include an actuator assembly configured to displace the moveable wall to alter a cross-sectional area of each of the flow passages based on a flow rate of the process fluid.

**FIG. 2**

Description

Cross-Reference to Related Applications

[0001] This application claims the benefit of U.S. Provisional Patent Application having Serial No. 62/345,171, which was filed June 3, 2016. The aforementioned patent application is hereby incorporated by reference in its entirety into the present application to the extent consistent with the present application.

Background

[0002] Reliable and efficient compressors, such as centrifugal compressors, have been developed and are often utilized in a myriad of industrial processes (e.g., petroleum refineries, offshore oil production platforms, and subsea process control systems). Centrifugal compressors may have one or more stages of compression, where each stage may generally include an impeller and a diffuser. Developments in compressor designs have resulted in improved centrifugal compressors with stages of compression capable of achieving higher compression ratios (e.g., 10:1 or greater) for a process fluid having one or more relatively high molecular weight gases. In the high-pressure ratio stages of compression, the process fluid may be discharged from the impeller to the diffuser at increased velocities (e.g., supersonic velocities). Conventional diffusers and designs thereof, however, may not be capable of effectively handling or diffusing the process fluid at the increased supersonic velocities.

[0003] In view of the foregoing, conventional centrifugal compressors may utilize a pipe diffuser or a similar diffuser to diffuse the process fluid in the high-pressure ratio stages of compression. A conventional pipe diffuser may include an array of pipe-shaped diffuser passages spaced circumferentially about the impeller. The diffuser passages may have a cross-sectional area that may generally increase from an inlet to an outlet thereof to thereby diffuse the process fluid from the impeller. The cross-sectional area of the diffuser passages may at least partially determine the efficacy and efficiency of the pipe diffuser. For example, the relative increase in the cross-sectional area along the diffuser passages may at least partially determine a diffusion rate along the diffuser passages, which may determine the efficiency of the pipe diffuser.

[0004] Conventional pipe diffusers may often be configured to operate at predetermined or designed operating conditions or operating points of the compressor. For example, the pipe diffusers may be designed to provide increased or optimum efficiency when operating at the designed operating conditions of the compressor. Conventional pipe diffusers, however, may often exhibit a significant decrease in efficiency when the operating conditions of the compressor deviate from the designed operating conditions. For example, the diffuser passages of the pipe diffusers may not be configured to provide

optimum diffusion rates when the operating conditions of the compressor deviate from the designed operating conditions. Further, conventional pipe diffuser designs may present a limited ability to control or vary the diffusion rates along the diffuser passages thereof, which may limit the ability to optimize the pipe diffusers over a broad range of operating conditions of the compressor.

[0005] What is needed, then, are improved pipe diffusers and methods for controlling diffusion rates along the diffuser passages for increased efficiency over a broad range of varying operating conditions of a compressor.

Summary

[0006] Embodiments of the disclosure may provide a diffuser assembly for a compressor. The diffuser assembly may include a diffuser disposed about an impeller of the compressor and configured to receive and compress a flow of process fluid exiting the impeller. The diffuser may include a first stationary wall and a second stationary wall coupled with one another and forming at least in part a volute configured to receive the compressed process fluid from the diffuser. The second stationary wall may define a plurality of stationary wall grooves. The diffuser may also include a moveable wall defining a plurality of moveable wall grooves. The moveable wall may be disposed between the first stationary wall and the second stationary wall such that respective stationary wall grooves and moveable wall grooves form respective flow passages configured to receive the flow of process fluid exiting the impeller. The diffuser assembly may also include an actuator assembly comprising at least one actuator and at least one linkage operatively coupling the at least one actuator and the moveable wall. The actuator assembly may be configured to displace the moveable wall to alter a cross-sectional area of each of the flow passages.

[0007] Embodiments of the disclosure may further provide a compressor. The compressor may include a casing having an inlet and defining an impeller cavity. The compressor may also include a rotary shaft configured to be driven by a driver, and an impeller fluidly coupled with the inlet and disposed in the impeller cavity. The impeller may be coupled to the rotary shaft and configured to rotate with the rotary shaft to impart energy to process fluid received via the inlet. The impeller may be further configured to discharge the process fluid in at least a partially radial direction. The compressor may further include a diffuser disposed circumferentially about the impeller and configured to receive and compress the process fluid discharged from the impeller. The diffuser may include a first stationary wall coupled with the casing, and a second stationary wall coupled with the first stationary wall and the casing and defining a plurality of stationary wall grooves. The diffuser may also include a moveable wall defining a plurality of moveable wall grooves. The moveable wall may be disposed between the first stationary wall and the second stationary wall

such that respective stationary wall grooves and moveable wall grooves form respective flow passages configured to receive the flow of process fluid discharged from the impeller. The compressor may further include a collector formed at least in part by the first stationary wall and the second stationary wall. The collector may be configured to receive the compressed process fluid from the flow passages of the diffuser. The compressor may also include an actuator assembly comprising at least one actuator and at least one linkage operatively coupling the at least one actuator and the moveable wall. The actuator assembly may be configured to displace the moveable wall to alter a cross-sectional area of each of the flow passages.

[0008] Embodiments of the disclosure may further provide a method for adjusting a cross-sectional area of a flow passage of a diffuser in a compressor. The method may include monitoring one or more operating parameters of the compressor or a process fluid flowing there-through. The method may also include detecting an operating parameter of the one or more operating parameters outside of a predetermined range. The method may further include axially displacing a moveable wall of the diffuser via at least one actuator operatively coupled with the moveable wall via at least one linkage. The axial displacement of the moveable wall may adjust the cross-sectional area of the flow passage of the diffuser.

Brief Description of the Drawings

[0009] The present disclosure is best understood from the following detailed description when read with the accompanying Figures. It is emphasized that, in accordance with the standard practice in the industry, various features are not drawn to scale. In fact, the dimensions of the various features may be arbitrarily increased or reduced for clarity of discussion.

Figure 1 illustrates an elevated cross-sectional view of a compressor including a diffuser assembly, according to one or more embodiments disclosed.

Figure 2 illustrates an exploded view of the diffuser assembly of Figure 1, according to one or more embodiments disclosed.

Figure 3 illustrates an enlarged cutaway view of a portion of the diffuser assembly including a first stationary wall and a moveable wall, according to one or more embodiments disclosed.

Figure 4 illustrates an enlarged cutaway view of a portion of the diffuser assembly including a second stationary wall, according to one or more embodiments disclosed.

Figure 5A illustrates an enlarged cross-sectional view of the diffuser arranged to provide flow passag-

es therein having a maximum cross-sectional area, according to one or more embodiments disclosed.

Figure 5B illustrates an enlarged cross-sectional view of the diffuser arranged to provide flow passages therein having a minimum cross-sectional area, according to one or more embodiments disclosed.

Figure 6 illustrates a flow chart of a method for adjusting a cross-sectional area of a flow passage of a diffuser in a compressor, according to one or more embodiments disclosed.

Detailed Description

[0010] It is to be understood that the following disclosure describes several exemplary embodiments for implementing different features, structures, or functions of the invention. Exemplary embodiments of components, arrangements, and configurations are described below to simplify the present disclosure; however, these exemplary embodiments are provided merely as examples and are not intended to limit the scope of the invention. Additionally, the present disclosure may repeat reference numerals and/or letters in the various exemplary embodiments and across the Figures provided herein. This repetition is for the purpose of simplicity and clarity and does not in itself dictate a relationship between the various exemplary embodiments and/or configurations discussed in the various Figures. Moreover, the formation of a first feature over or on a second feature in the description that follows may include embodiments in which the first and second features are formed in direct contact, and may also include embodiments in which additional features may be formed interposing the first and second features, such that the first and second features may not be in direct contact. Finally, the exemplary embodiments presented below may be combined in any combination of ways, *i.e.*, any element from one exemplary embodiment may be used in any other exemplary embodiment, without departing from the scope of the disclosure.

[0011] Additionally, certain terms are used throughout the following description and claims to refer to particular components. As one skilled in the art will appreciate, various entities may refer to the same component by different names, and as such, the naming convention for the elements described herein is not intended to limit the scope of the invention, unless otherwise specifically defined herein. Further, the naming convention used herein is not intended to distinguish between components that differ in name but not function. Additionally, in the following discussion and in the claims, the terms "including" and "comprising" are used in an open-ended fashion, and thus should be interpreted to mean "including, but not limited to." All numerical values in this disclosure may be exact or approximate values unless otherwise specifically stated. Accordingly, various embodiments of the disclosure may deviate from the numbers, values, and

ranges disclosed herein without departing from the intended scope. Furthermore, as it is used in the claims or specification, the term "or" is intended to encompass both exclusive and inclusive cases, *i.e.*, "A or B" is intended to be synonymous with "at least one of A and B," unless otherwise expressly specified herein.

[0012] Figure 1 illustrates an elevated cross-sectional view of a compressor 100 configured to pressurize a process fluid, according to one or more embodiments of the present disclosure. The compressor 100 may be a direct-inlet centrifugal compressor, such as, for example, a version of a Dresser-Rand Pipeline Direct Inlet (PDI) centrifugal compressor manufactured by the Dresser-Rand Company of Olean, New York. In other embodiments, the compressor 100 may be a back-to-back compressor. The compressor 100 may have a center-hung rotor configuration, or the compressor may have an overhung rotor configuration, as illustrated in Figure 1. The compressor 100 may operate in one or more modes or regimes including, but not limited to, a subsonic regime, a transonic regime, a supersonic regime, or any combination thereof.

[0013] The compressor 100 may be part of a compression system including, amongst other components, a driver (not shown) operatively coupled to a rotary shaft 102 of the compressor 100 via a drive shaft (not shown). The driver may be configured to provide the drive shaft with rotational energy to thereby drive the compressor 100. In an exemplary embodiment, the drive shaft may be integral with or coupled with the rotary shaft 102 of the compressor 100, such that the rotational energy of the drive shaft is imparted to the rotary shaft 102. The drive shaft may be coupled with the rotary shaft 102 via a gearbox (not shown) including a plurality of gears configured to transmit the rotational energy of the drive shaft to the rotary shaft 102 of the compressor 100, such that the drive shaft and the rotary shaft 102 may spin at the same speed, substantially similar speeds, or differing speeds and rotational directions.

[0014] The driver may be a motor and more specifically may be an electric motor, such as a permanent magnet motor, and may include a stator (not shown) and a rotor (not shown). It will be appreciated, however, that other embodiments may employ other types of electric motors including, but not limited to, synchronous motors, induction motors, and brushed DC motors. The driver may also be a hydraulic motor, an internal combustion engine, a steam turbine, a gas turbine, or any other device capable of driving the rotary shaft 102 of the compressor 100 either directly or through a power train.

[0015] The compressor 100 may be a single-stage compressor or a multi-stage compressor (not shown). As illustrated in Figure 1, the compressor 100 is a single-stage compressor capable of providing a compression ratio of at least about 10:1 or greater. While the compressor 100 of Figure 1 may be a single-stage compressor capable of generating a 10:1 or greater ratio, it may be appreciated that the compressor 100, in other embodi-

ments, may include multiple stages of compression including a first stage of compression, one or more intermediate stages of compression, and/or a final stage of compression configured to generate a 10:1 or greater ratio.

[0016] As shown in Figure 1, the compressor 100 may include a housing 104. The driver (not shown) may be disposed outside of or within the housing 104, such that the housing 104 may have a first end, or compressor end, and a second end (not shown), or driver end. The housing 104 may be configured to hermetically seal the driver and the compressor 100 within, thereby providing both support and protection to each component of the compression system. The housing 104 may also be configured to contain the process fluid flowing through one or more portions or components of the compressor 100.

[0017] The drive shaft (not shown) of the driver and the rotary shaft 102 of the compressor 100 may be supported, respectively, by one or more radial bearings 106, as shown in Figure 1 in an overhung configuration. The radial bearings 106 may be directly or indirectly supported by the housing 104, and in turn provide support to the drive shaft and the rotary shaft 102, which carry the compressor 100 and the driver during operation of the compression system. In one embodiment, the radial bearings 106 may be magnetic bearings, such as active or passive magnetic bearings. In other embodiments, however, other types of bearings (*e.g.*, oil film bearings) may be used. In addition, at least one axial thrust bearing 108 may be provided to manage movement of the rotary shaft 102 in the axial direction. In an embodiment in which the driver and the compressor 100 are hermetically-sealed within the housing 104, the thrust bearing 108 may be provided at or near the end of the rotary shaft 102 adjacent the compressor end of the housing 104. The axial thrust bearing 108 may be a magnetic bearing and may be configured to bear axial thrusts generated by the compressor 100.

[0018] The housing 104 may form or have an axial inlet 110 defining an inlet passageway 112 through which the process fluid may be drawn into the compressor 100. Although illustrated as an axial inlet 110 in Figure 1, in one or more other embodiments, the inlet may be a radial inlet. The inlet passageway 112 may be fluidly coupled with an impeller cavity 114 defined in the housing 102 and configured to receive therein an impeller 116. The compressor 100 further includes a diffuser 118 fluidly coupled to the impeller cavity 114 and the impeller 116, and a collector 120 fluidly coupled to the diffuser 118, and an outlet (not shown) formed by or coupled to the housing 104. As arranged, the inlet passageway 112, the impeller cavity 114, the diffuser 118, and the collector 120 form a fluid passageway through which the process fluid may flow to achieve the desired compression ratio.

[0019] As shown in Figure 1, the axial inlet 110 defining the inlet passageway 112 of the compressor 100 may include one or more inlet guide vanes 122 of an inlet guide vane assembly configured to condition a process

fluid flowing therethrough to achieve predetermined or desired fluid properties and/or fluid flow attributes. Such fluid properties may include flow pattern (e.g., swirl distribution), velocity, mass flow rate, pressure, temperature, and/or any suitable fluid property and fluid flow attribute to enable the compressor 100 to function as described herein. The inlet guide vanes 122 may be disposed within the inlet passageway 112 and may be static or moveable, i.e., adjustable. The inlet guide vanes 122 may be airfoil shaped, streamline shaped, or otherwise shaped and configured to at least partially impart the one or more fluid properties and/or fluid flow attributes on the process fluid flowing through the inlet passageway 112.

[0020] The impeller 116 may include a hub 124 and a plurality of blades 126 extending from the hub 124. In the exemplary embodiment of Figure 1, the compressor includes a shroud 128, such that the impeller 116 may be covered, thereby functioning as a "shrouded" impeller 116. In other embodiments, the impeller 116 may be an open or "unshrouded" impeller. The impeller 116 may be at least partially disposed in the impeller cavity 114 and configured to rotate therein to increase the velocity of the process fluid flowing therethrough. For example, the hub 124 of the impeller 116 may be coupled with the rotary shaft 102 configured to rotate the impeller 116 about a center axis 130 (e.g., longitudinal axis) of the compressor 100. The rotary shaft 102 may rotate the impeller 116 at a speed sufficient to draw the process fluid into the compressor 100 via the inlet passageway 112. The rotation of the impeller 116 may further draw the process fluid to and through the impeller 116 and accelerate the process fluid to a tip 132, or periphery, of the impeller 116, thereby increasing the velocity of the process fluid. The plurality of blades 126 may be configured to raise the velocity and energy of the process fluid and direct the process fluid from the impeller 116 to the diffuser 118 fluidly coupled therewith.

[0021] In one or more embodiments, the process fluid at the tip 132 of the impeller 116 may be subsonic and have an absolute Mach number less than one. For example, the process fluid at the tip 132 of the impeller 116 may have an exit absolute Mach number less than one, less than 0.9, less than 0.8, less than 0.7, less than 0.6, or less than 0.5. Accordingly, in such embodiments, the compressor 100 discussed herein may be "subsonic," as the impeller 116 may be configured to rotate about the center axis 130 at a speed sufficient to provide the process fluid at the tip 132 thereof with an exit absolute Mach number of less than one.

[0022] In one or more embodiments, the process fluid at the tip 132 of the impeller 116 may be supersonic and have an exit absolute Mach number of one or greater. For example, the process fluid at the tip 132 of the impeller 116 may have an exit absolute Mach number of at least one, at least 1.1, at least 1.2, at least 1.3, at least 1.4, or at least 1.5. Accordingly, in such embodiments, the compressor 100 discussed herein may be "supersonic," as the impeller 116 may be configured to rotate

about the center axis 130 at a speed sufficient to provide the process fluid at the tip 132 thereof with an exit absolute Mach number of one or greater or with a fluid velocity greater than the local speed of sound of the process fluid.

[0023] Looking now at Figure 2 with continued reference to Figure 1, Figure 2 illustrates an exploded view of a diffuser assembly 134 including the diffuser 118 shown in Figure 1. The diffuser 118 may be located downstream of the impeller 116 and may be disposed circumferentially about the tip 132 of the impeller 116. As arranged, the diffuser 118 may be configured to receive the radial process fluid flow exiting the tip 132 of the impeller 116 and to convert kinetic energy of the process fluid from the impeller 116 into increased static pressure.

[0024] In an exemplary embodiment, the diffuser 118 may include a first stationary wall 136, a second stationary wall 138, and a moveable wall 140 disposed therebetween. The first stationary wall 136 may be coupled with or integral with the housing 104 and may be annular in one or more embodiments. The first stationary wall 136 may have a front face 142, or front side, facing the axial inlet 110 and a rear face 144, or rear side, axially opposing the front face 142. The rear face 144 may form at least in part the collector 120 and may be adjacent the second stationary wall 138 as disposed in the compressor 100. In forming at least in part the collector 120, a radially inward portion 146 of the rear face 144 may form a helical flowpath 148.

[0025] The second stationary wall 138 may be coupled with or integral with the housing 104 and may be annular in one or more embodiments. The second stationary wall 138 may have a front face 150, or front side, facing the axial inlet 110 and the first stationary wall 136. In an exemplary embodiment, the front face 150 may form an outer annular ring 152 (most clearly seen in Figure 4) configured to mate with a radially outward portion 154 of the rear face 144 of the first stationary wall 136 to further form at least in part the collector 120. Accordingly, as arranged in the compressor 100, the first stationary wall 136 and the second stationary wall 138 may be coupled with one another and may form at least in part the collector 120 configured to receive the compressed process fluid from the diffuser 118.

[0026] As shown in Figures 1 and 2, the moveable wall 140 of the diffuser 118 may be disposed between the first stationary wall 136 and the second stationary wall 138. The moveable wall 140 may be annular and may have a diameter less than a diameter of the rear face 144 of the first stationary wall 136. In an exemplary embodiment, the diameter of the moveable wall 140 may be substantially similar to the diameter of the radially inward portion 146 of the rear face 144 forming the helical flowpath 148. The moveable wall 140 may have a front annular face 156, or front annular side, facing the first stationary wall 136 and a rear annular face 158, or rear annular side, axially opposing the front annular face 156 and facing the second stationary wall 138. As arranged in the compressor 100, the front annular face 156 may

form a portion of the collector 120.

[0027] Turning now to Figure 3 with continued reference to Figures 1 and 2, Figure 3 illustrates an enlarged cutaway view of a portion of the diffuser assembly 134 including the first stationary wall 136 and the moveable wall 140, according to one or more embodiments disclosed. As illustrated, the moveable wall 140 of the diffuser 118 may define a plurality of moveable wall grooves 160 extending from an inlet end 162 of the diffuser 118 adjacent the tip 132 of the impeller 116 in a tangential orientation about the impeller 116. In an exemplary embodiment, the moveable wall grooves 160 may be defined in the rear annular face 158 and may extend from the inlet end 162 to a radially outer outlet end 164 of the diffuser 118. At the outlet end 164, a portion of the moveable wall grooves 158 may extend axially and fluidly couple the front annular face 156 and the rear annular face 158, and thus, fluidly couple the moveable wall grooves 160 to the collector 120. Thus, as arranged, the collector 120 may be axially offset with respect to the diffuser 118.

[0028] The moveable wall 140 may further include a plurality of projections 166 extending from the rear annular face 158. A respective projection 166 of the plurality of projections 166 may be disposed between adjacent moveable wall grooves 160 and may form a generally prismatic shape therebetween. Accordingly, each of the projections 166 may extend from the inlet end 162 adjacent the tip 132 of the impeller 116 in a tangential orientation about the impeller 116. In an exemplary embodiment, the projections 166 may extend axially outward from the rear annular face 158 and may extend from the inlet end 162 to the radially outer outlet end 164. At the outlet end 164, a portion of the each of the projections 166 may extend axially between the front annular face 156 and the rear annular face 158.

[0029] Turning now to Figure 4 with continued reference to Figures 1-3, Figure 4 illustrates an enlarged cutaway view of a portion of the diffuser assembly 134 including the second stationary wall 138. As disclosed above, the rear annular face 158 of the moveable wall 140 and the moveable wall grooves 160 therein may be disposed adjacent the second stationary wall 138. In an exemplary embodiment, the second stationary wall 138 may define a plurality of stationary wall grooves 168 extending from the inlet end 162 of the diffuser 118 adjacent the tip 132 of the impeller 116 in a tangential orientation about the impeller 116. In an exemplary embodiment, the stationary wall grooves 168 may be defined in the front face 150 of the second stationary wall 138 and may extend from the inlet end 162 to the radially outer outlet end 164 of the diffuser 118. At the outlet end 164, the stationary wall grooves 168 may be fluidly coupled to the collector 120.

[0030] The front face 150 of the second stationary wall 138 may further define a plurality of recesses 170. A respective recess 170 of the plurality of recesses 170 may be disposed between adjacent stationary wall grooves 168 and may form a generally prismatic shape therebetween.

Accordingly, each of the recesses 170 may extend from the inlet end 162 adjacent the tip 132 of the impeller 116 in a tangential orientation about the impeller 116. In an exemplary embodiment, the recesses 170 may extend from the inlet end 162 to the radially outer outlet end 164. At the outlet end 164, a portion of the each of the recesses 170 may extend axially along the outer annular ring 152.

[0031] In an exemplary embodiment, the stationary wall grooves 168 may be configured in a pattern substantially similar to the moveable wall grooves 160, such that as disposed in the compressor 100 opposing one another, each of the stationary wall grooves 168 and respective moveable wall grooves 160 form respective flow passages 172 (most clearly seen in Figures 5A and 5B) in the diffuser 118. Accordingly, each of the flow passages 172 formed therefrom may extend from the inlet end 162 adjacent the tip 132 of the impeller 116 in a tangential orientation about the impeller 116. As arranged, the diffuser 118 including the flow passages 172 may be referred to as a pipe diffuser. The flow passages 172 may be configured to receive at the inlet end 162 the process fluid discharged from the tip 132 of the impeller 116 and to discharge the compressed process fluid to the collector 120 at the radially outer outlet end 164.

[0032] As arranged in the compressor 100, each of the projections 166 of the moveable wall 140 may be disposed in respective recesses 170, thereby defining and forming sidewalls of each of the flow passages 172. In an exemplary embodiment, a clearance or gap (e.g., 0.005 inches) may be provided between each projection 166 and corresponding recess 170 to allow for movement of the moveable wall 140. One of ordinary skill in the art will appreciate that the gap may be sized to allow for movement of the moveable wall 140 while minimizing unwanted leakage of the process fluid around the projections 166 at the outlet end 164.

[0033] Each of the flow passages 172 may include a throat section 174 (most clearly seen in Figure 3) adjacent the inlet end 162 of the diffuser 118 and a diffusing cone section 176 disposed downstream from the throat section 174 and upstream of the outlet end 164 of the diffuser 118 and the collector 120. In an exemplary embodiment, the throat section 174 may have a generally constant or uniform cross-sectional area along at least a portion thereof. For example, the cross-sectional area of the throat section 174 may be generally constant along the length thereof. In at least one embodiment, the cross-sectional area of the diffusing cone section 176 may generally increase in the downstream direction along at least a portion thereof.

[0034] As illustrated in Figures 1 and 2, the diffuser assembly 134 may further include an actuator assembly 178 configured to adjust or alter the cross-sectional area of at least one of the flow passages 172 in the compressor 100. In an exemplary embodiment, the actuator assembly 178 may be configured to increase or decrease the cross-sectional area of at least one of the flow passages

172 via axial displacement of the moveable wall 140 relative to the second stationary wall 138. To that end, the actuator assembly 178 may include one or more actuators (two are shown 180, 182) operatively coupled to the moveable wall 140 via one or more linkages (two are shown 184, 186).

[0035] In an exemplary embodiment, the actuator assembly 178 may include a first actuator 180 operatively coupled to the moveable wall 140 via a first linkage 184, and a second actuator 182 operatively coupled to the moveable wall 140 via a second linkage 186. The first and second actuators 180, 182 may be linear actuators configured to axially displace the moveable wall 140 relative to the second stationary wall 138, thereby increasing or decreasing the cross-sectional area of the respective flow passages 172. Illustrative actuators may include, but are not limited to, one or more servos, motors, hydraulic cylinders, screw actuators, or any combination thereof.

[0036] The linkages 184, 186, illustrated as a first linkage 184 operatively coupled to the first actuator 180 and a second linkage 186 operatively coupled to the second actuator 182, may each include one or more rods or arms 188, 190, 192, 194 operatively coupling the respective first and second actuators 180, 182 to the front annular face 156 of the moveable wall 140. In an exemplary embodiment, the first linkage 184 may include a first rod 188 and a second rod 190 configured to be actuated by the first actuator 180 to axially displace the moveable wall 140. The first rod 188 and the second rod 190 may be coupled with one another via a u-joint 196. Correspondingly, the second linkage 186 may include a first rod 192 and a second rod 194 configured to be actuated by the second actuator 182 to axially displace the moveable wall 140. The first rod 192 and the second rod 194 may be coupled with one another via a u-joint 198. Each of the second rods 190, 194 may extend through respective apertures 200, 202 defined by the first stationary wall 136 and may be coupled to the moveable wall 140. In an exemplary embodiment, the second rods 190, 194 may be threadingly attached to the front annular face 156 of the moveable wall 140, as most clearly seen in Figure 3.

[0037] The actuator assembly 182 may further include a plurality of seals 204, 206 configured to allow for axial movement of the second rods 190, 194 while minimizing or prohibiting the leakage of process fluid from the compressor 100. In an exemplary embodiment, each of the seals 204, 206 may be disposed about respective second rods 190, 194 of the actuating assembly 182. The seals 204, 206 may be gland style seals disposed about the second rods 190, 194 and adjacent the axial inlet 110 of the compressor 100.

[0038] In at least one embodiment, the compressor 100 and/or the diffuser assembly 134 may include a control system (not shown) operatively and/or communicably coupled with one or more components thereof. The control system may include one or more sensors (e.g., pressure and/or flow sensors) communicably coupled with

one or more components of the compressor 100 and/or the diffuser assembly 134 and configured to monitor one or more operating parameters or conditions thereof. For example, the control system may be configured to monitor a work coefficient, a flow coefficient, a diffusion rate, and/or a diffuser pressure recovery or pressure loss coefficient along one or more sections or regions of the flow passages 172 of the diffuser 118. The control system may include a programmable logic controller (PLC) (not shown) with inputs from the compressor 100 and/or the diffuser assembly 134 and outputs for controlling the operating conditions of the compressor 100 and/or the diffuser assembly 134.

[0039] In one or more embodiments, the control system may be configured to send signals to and/or receive signals from the compressor 100 and/or the diffuser assembly 134 to actuate, adjust, manipulate, and/or otherwise control one or more components of the compressor 100 and/or the diffuser assembly 134. For example, the control system may send signals (e.g., commands) to the first and second actuators 180, 182 to thereby axially displace the moveable wall 140 via the first and second linkages 184, 186. Accordingly, the control system may be configured to actuate the moveable wall 140 between a first or extended position (see Figure 5A) and a second or retracted position (see Figure 5B) to vary the cross-sectional area of the flow passages 172, and correspondingly, the diffusion rate along one or more sections or regions of the flow passages 172. In at least one embodiment, the control system may be configured to vary the diffusion rate along the flow passages 172 during one or more modes or operating conditions of the compressor 100. For example, the control system may be configured to vary the diffusion rate along the flow passages 172 to optimize the efficiency of the diffuser 118 for the operating conditions of the compressor 100. The control system may be integral with the compressor 100 and/or the diffuser assembly 134, or the control system may be remote. The control system may be communicably coupled via any suitable means including, but not limited to, wired connections and/or wireless connections.

[0040] The process fluid flow leaving the outlet end 164 of the diffuser 118 may flow into the collector 120, as most clearly seen in Figure 2. The collector 120 may be configured to gather the process fluid flow from the diffuser 118 and to deliver the process fluid flow to a downstream pipe and/or process component (not shown) via an outlet 208 defined by the second stationary wall 138. In an exemplary embodiment, the collector 120 may be a volute, such as a discharge volute or specifically, a scroll-type discharge volute. The collector 120 may be further configured to increase the static pressure of the process fluid flow by converting the kinetic energy of the process fluid to static pressure.

[0041] Referring now to Figures 5A and 5B with continued reference to Figures 1-4. Figure 5A illustrates an enlarged cross-sectional view of the diffuser 118 arranged to provide the flow passages 172 therein having

a maximum cross-sectional area, according to one or more embodiments disclosed. Figure 5B illustrates an enlarged cross-sectional view of the diffuser 118 arranged to provide the flow passages 172 therein having a minimum cross-sectional area, according to one or more embodiments disclosed.

[0042] One or more exemplary operational aspects of the compressor 100 will now be discussed with continued reference to Figures 1-5B. In operation and use, a process fluid may be provided from an external source (not shown), having a low pressure environment, to the compressor 100. As shown in Figure 1, the compressor 100 may include, amongst other components, the impeller 116 coupled with the rotary shaft 102 and the diffuser 118 disposed circumferentially about the rotating impeller 116. The process fluid may be drawn into the axial inlet 110 of the compressor 100 and through the inlet passageway 112 defined by the axial inlet 110 and across the inlet guide vanes 122 extending into the inlet passageway 112. The process fluid flowing across the inlet guide vanes 122 may be provided with an increased velocity and imparted with at least one fluid property (e.g., swirl) prior to being drawn into the rotating impeller 116. The inlet guide vanes 122 may be adjusted in order to vary the one or more fluid properties imparted to the process fluid.

[0043] The process fluid may be drawn into the rotating impeller 116 and may contact the impeller blades 126, such that the process fluid may be accelerated in a tangential and radial direction by centrifugal force and may be discharged via the blade tips of the impeller 116 (cumulatively, the tip 132 of the impeller 116) in at least partially radial directions that extend 360 degrees around the rotating impeller 116. The rotating impeller 116 increases the velocity and static pressure of the process fluid, such that the velocity of the process fluid discharged from the blade tips (cumulatively, the tip 132 of the impeller 116) may be supersonic in some embodiments and have an exit absolute Mach number of at least about one, at least about 1.1, at least about 1.2, at least about 1.3, at least about 1.4, or at least about 1.5.

[0044] The diffuser 118 including the first stationary wall 136, the second stationary wall 138 and the moveable wall 140 disposed therebetween (see Figure 2) may be disposed circumferentially about the periphery, or tip 132, of the impeller 116 and the first stationary wall 136 and the second stationary wall 138 may be coupled with or integral with the housing 104 of the compressor 100. The radial process fluid flow discharged from the rotating impeller 116 may be received by the diffuser 118 such that the velocity of the flow of process fluid discharged from the tip 132 of the rotating impeller 116 is substantially similar to the velocity of the process fluid entering the inlet end 162 of the diffuser 118. Accordingly, the process fluid may enter the inlet end 162 of the diffuser 118 with a supersonic velocity having, for example, an exit absolute Mach number of at least one, and correspondingly, may be referred to as supersonic process

fluid.

[0045] The flow passages 172, most clearly shown in Figures 5A and 5B, may be configured to receive the process fluid from the rotating impeller 116 (see Figure 1) and convert kinetic energy (e.g., flow or velocity) of the process fluid from the rotating impeller 116 to potential energy (e.g., increased static pressure). As the process fluid enters the diffuser 118, one or more sensors (not shown) of the control system (not shown) may be communicably coupled with one or more components of the compressor 100 and/or the diffuser assembly 134 and may monitor one or more operating parameters or conditions thereof. For example, the control system may monitor a work coefficient, a flow coefficient, a diffusion rate, and/or a diffuser pressure recovery or pressure loss coefficient along one or more sections or regions of the flow passages 172 of the diffuser 118.

[0046] The flow passages 172 may convert the kinetic energy of the process fluid to potential energy by decreasing the flow velocity of the process fluid flowing therethrough. The relative rate in which the flow velocity of the process fluid decreases may be altered or adjusted, at least in part, by the relative increase or decrease in the cross-sectional area along the sections of the flow passages 172. For example, decreasing the cross-sectional area along a section of the flow passages 172, such as the throat section 174, may maintain effective diffusion at lower process fluid flow rates. Correspondingly, increasing the cross-sectional area along a section of the flow passages 172, such as the throat section 174, may maintain effective diffusion in the flow passages 172 at higher process fluid flow rates.

[0047] To that end, if the operation parameter or condition monitored is indicative of a need to decrease the flow rate, the control system may transmit a signal to the first and second actuators 180, 182 of the diffuser assembly including instructions to axially displace the moveable wall 140 toward the second stationary wall 138, thereby decreasing the cross-sectional area of one or more sections 174, 176 of the flow passages 172. The moveable wall 140 may be axially displaced via the first rod 188 and the second rod 190 operative coupled to the first actuator 180 and the first rod 192 and the second rod 194 operative coupled to the second actuator 182. As shown in Figure 5B, the moveable wall may be disposed in a fully extended position providing a minimum cross-sectional area for each of the flow passages 172 to maintain the diffusion of the diffuser 118 at the new lower process fluid flow rate.

[0048] Correspondingly, if the operation parameter or condition monitored is indicative of a need to increase the flow rate, the control system may transmit a signal to the first and second actuators 180, 182 of the diffuser assembly including instructions to axially displace the moveable wall 140 away from the second stationary wall 138, thereby increasing the cross-sectional area of one or more sections 174, 176 of the flow passages 172. The moveable wall 140 may be axially displaced via the first

rod 188 and the second rod 190 operative coupled to the first actuator 180 and the first rod 192 and the second rod 194 operative coupled to the second actuator 182. As shown in Figure 5A, the moveable wall may be disposed in a fully retracted position providing a maximum cross-sectional area for each of the flow passages 172 to maintain the diffusion of the diffuser 118 at the new higher process fluid flow rate.

[0049] Accordingly, the flow passages 178 may be configured to change or vary flow capacities or flow areas thereof relative to other components of the compressor 100 to thereby allow an optimization of the compression process over a wide or broader range of flow conditions and/or operating parameters of the compressor 100. The process fluid exiting the diffuser 118 may have a subsonic velocity and may be fed into the collector 120 or discharge volute. The collector 120 may increase the static pressure of the process fluid by converting the remaining kinetic energy of the process fluid to static pressure. The process fluid may then be routed to perform work or for operation of one or more downstream processes or components (not shown) via the outlet 208 defined by the second stationary wall 138.

[0050] The process fluid pressurized, circulated, contained, or otherwise utilized in the compression system may be a fluid in a liquid phase, a gas phase, a supercritical state, a subcritical state, or any combination thereof. The process fluid may be a mixture, or process fluid mixture. The process fluid may include one or more high molecular weight process fluids, one or more low molecular weight process fluids, or any mixture or combination thereof. As used herein, the term "high molecular weight process fluids" refers to process fluids having a molecular weight of about 30 grams per mole (g/mol) or greater. Illustrative high molecular weight process fluids may include, but are not limited to, hydrocarbons, such as ethane, propane, butanes, pentanes, and hexanes. Illustrative high molecular weight process fluids may also include, but are not limited to, carbon dioxide (CO₂) or process fluid mixtures containing carbon dioxide. As used herein, the term "low molecular weight process fluids" refers to process fluids having a molecular weight less than about 30 g/mol. Illustrative low molecular weight process fluids may include, but are not limited to, air, hydrogen, methane, or any combination or mixtures thereof.

[0051] Figure 6 illustrates a flow chart of a method 300 for adjusting a cross-sectional area of a flow passage of a diffuser in a compressor, according to one or more embodiments. The method 300 may include monitoring one or more operating parameters of the compressor or a process fluid flowing therethrough, as at 302. The method 300 may also include detecting an operating parameter of the one or more operating parameters outside of a predetermined range, as at 304. The method may further include axially displacing a moveable wall of the diffuser via at least one actuator operatively coupled with the moveable wall via at least one linkage, the axial displace-

ment of the moveable wall adjusting the cross-sectional area of the flow passage of the diffuser, as at 306.

[0052] The foregoing has outlined features of several embodiments so that those skilled in the art may better understand the present disclosure. Those skilled in the art should appreciate that they may readily use the present disclosure as a basis for designing or modifying other processes and structures for carrying out the same purposes and/or achieving the same advantages of the embodiments introduced herein. Those skilled in the art should also realize that such equivalent constructions do not depart from the spirit and scope of the present disclosure, and that they may make various changes, substitutions and alterations herein without departing from the spirit and scope of the present disclosure.

[0053] Further embodiments:

1. A diffuser assembly for a compressor, comprising:

a diffuser disposable about an impeller of the compressor and configured to receive and compress a flow of process fluid exiting the impeller, the diffuser comprising

a first stationary wall and a second stationary wall coupled with one another and forming at least in part a volute configured to receive the compressed process fluid from the diffuser, the second stationary wall defining a plurality of stationary wall grooves; and

a moveable wall defining a plurality of moveable wall grooves, the moveable wall disposed between the first stationary wall and the second stationary wall such that respective stationary wall grooves and moveable wall grooves form respective flow passages configured to receive the flow of process fluid exiting the impeller; and

an actuator assembly comprising at least one actuator and at least one linkage operatively coupling the at least one actuator and the moveable wall, the actuator assembly configured to displace the moveable wall to alter a cross-sectional area of each of the flow passages.

2. The diffuser assembly of embodiment 1, wherein the moveable wall comprises a first annular face and a second annular face axially opposing the first annular face, the first annular face adjacent the first stationary wall and operatively coupled with the at least one actuator via the at least one linkage.

3. The diffuser assembly of embodiment 2, wherein the second annular face defines the plurality of moveable wall grooves and comprises a plurality of projections extending from the second annular face,

each projection disposed between adjacent moveable wall grooves.

4. The diffuser assembly of embodiment 3, wherein the second stationary wall further defines a plurality of recesses, each recess being disposed between adjacent stationary wall grooves and configured to receive therein a respective projection of the plurality of projections.

5. The diffuser assembly of embodiment 1, wherein:

the at least one actuator comprises a first actuator and a second actuator, and the at least one linkage comprises a first linkage and a second linkage, the first actuator being operative coupled to the moveable wall via the first linkage, and the second actuator being operatively coupled to the moveable wall via the second linkage.

6. The diffuser assembly of embodiment 5, wherein the actuator assembly further comprises a first seal disposed about the first linkage, and a second seal disposed about the second linkage, the first seal and the second seal configured to substantially reduce or eliminate leakage of the process fluid from the compressor while permitting axial displacement of the first linkage and the second linkage, respectively, relative to the compressor.

7. The diffuser assembly of embodiment 1, wherein the first stationary wall defines at least one aperture extending axially therethrough, and the at least one linkage is configured to extend through the at least one aperture to operatively couple the at least one actuator and the moveable wall.

8. The diffuser assembly of embodiment 1, wherein the diffuser is a pipe diffuser.

9. The diffuser assembly of embodiment 8, wherein each of the flow passages comprises a throat, and the actuator assembly is further configured to axially displace the moveable wall to reduce or increase the throat of each of the flow passages.

10. The diffuser assembly of embodiment 9, wherein at least a portion of each of the flow passages extends parallel to the axial displacement of the moveable wall.

11. A compressor, comprising:

a casing having an inlet and defining an impeller cavity;
a rotary shaft configured to be driven by a driver;
an impeller fluidly coupled with the inlet and dis-

posed in the impeller cavity, the impeller coupled to the rotary shaft and configured to rotate with the rotary shaft to impart energy to process fluid received via the inlet, the impeller further configured to discharge the process fluid in at least a partially radial direction;

a diffuser disposed circumferentially about the impeller and configured to receive and compress the process fluid discharged from the impeller, the diffuser comprising

a first stationary wall coupled with the casing;

a second stationary wall coupled with the first stationary wall and the casing and defining a plurality of stationary wall grooves; and

a moveable wall defining a plurality of moveable wall grooves, the moveable wall disposed between the first stationary wall and the second stationary wall such that respective stationary wall grooves and moveable wall grooves form respective flow passages configured to receive the flow of process fluid discharged from the impeller;

a collector formed at least in part by the first stationary wall and the second stationary wall, the collector configured to receive the compressed process fluid from the flow passages of the diffuser; and

an actuator assembly comprising at least one actuator and at least one linkage operatively coupling the at least one actuator and the moveable wall, the actuator assembly configured to displace the moveable wall to alter a cross-sectional area of each of the flow passages.

12. The compressor of embodiment 11, wherein:

each stationary wall groove of the plurality of stationary wall grooves extends in a tangential orientation about the impeller; and

each moveable wall groove of the plurality of moveable wall grooves extends in a tangential orientation about the impeller.

13. The compressor of embodiment 12, wherein:

the diffuser is a pipe diffuser; and
each of the flow passages comprises a throat, and the actuator assembly is further configured to axially displace the moveable wall to reduce or increase the throat of each of the flow passages.

14. The compressor of embodiment 12, wherein:

the first stationary wall defines at least one aperture extending axially therethrough, and the at least one linkage is configured to extend through the at least one aperture to operatively couple the at least one actuator and the moveable wall; and
the moveable wall comprises a first annular face and a second annular face axially opposing the first annular face, the first annular face adjacent the first stationary wall and operatively coupled with the at least one actuator via the at least one linkage.

15. The compressor of embodiment 13, wherein:

the second annular face defines the plurality of moveable guide vanes and comprises a plurality of projections extending from the second annular face, each projection disposed between adjacent moveable wall grooves; and
the second stationary wall further defines a plurality of recesses, each recess being disposed between adjacent stationary wall grooves and configured to receive therein a respective projection of the plurality of projections.

16. A method for adjusting a cross-sectional area of a flow passage of a diffuser in a compressor, comprising:

monitoring one or more operating parameters of the compressor or a process fluid flowing therethrough;
detecting an operating parameter of the one or more operating parameters outside of a predetermined range; and
axially displacing a moveable wall of the diffuser via at least one actuator operatively coupled with the moveable wall via at least one linkage, the axial displacement of the moveable wall adjusting the cross-sectional area of the flow passage of the diffuser.

17. The method of embodiment 16, wherein:

the diffuser further comprises a first stationary wall and the second stationary wall coupled with one another and forming at least in part a volute configured to receive the process fluid from the diffuser;
the second stationary wall defines a plurality of stationary wall grooves; and
the moveable wall defining a plurality of moveable wall grooves, the moveable wall disposed between the first stationary wall and the second stationary wall such that respective stationary wall grooves and moveable wall grooves form respective flow passages.

18. The method of embodiment 17, wherein:

the first stationary wall defines at least one aperture extending axially therethrough, and the at least one linkage is configured to extend through the at least one aperture to operatively couple the at least one actuator and the moveable wall; and
the moveable wall comprises a first annular face and a second annular face axially opposing the first annular face, the first annular face adjacent the first stationary wall and operatively coupled with the at least one actuator via the at least one linkage.

19. The method of embodiment 18, wherein:

the second annular face defines the plurality of moveable guide vanes and comprises a plurality of projections extending from the second annular face, each projection disposed between adjacent moveable wall grooves; and
the second stationary wall further defines a plurality of recesses, each recess being disposed between adjacent stationary wall grooves and configured to receive therein a respective projection of the plurality of projections.

20. The method of embodiment 18, wherein each of the flow passages comprises a throat, and axially displacing the moveable wall of the diffuser via the at least one actuator operatively coupled with the moveable wall via the at least one linkage comprises:

increasing or decreasing the throat of each of the flow passages.

Claims

1. A diffuser assembly for a compressor, comprising:

a diffuser disposable about an impeller of the compressor and configured to receive and compress a flow of process fluid exiting the impeller, the diffuser comprising

a first stationary wall and a second stationary wall coupled with one another and forming at least in part a volute configured to receive the compressed process fluid from the diffuser, the second stationary wall defining a plurality of stationary wall grooves; and
a moveable wall defining a plurality of moveable wall grooves, the moveable wall disposed between the first stationary wall and the second stationary wall such that respec-

tive stationary wall grooves and moveable wall grooves form respective flow passages configured to receive the flow of process fluid exiting the impeller; and

an actuator assembly comprising at least one actuator and at least one linkage operatively coupling the at least one actuator and the moveable wall, the actuator assembly configured to displace the moveable wall to alter a cross-sectional area of each of the flow passages.

2. The diffuser assembly of claim 1, wherein the moveable wall comprises a first annular face and a second annular face axially opposing the first annular face, the first annular face adjacent the first stationary wall and operatively coupled with the at least one actuator via the at least one linkage.

3. The diffuser assembly according to any of the preceding claims, wherein the second annular face defines the plurality of moveable wall grooves and comprises a plurality of projections extending from the second annular face, each projection disposed between adjacent moveable wall grooves, and/or wherein the second stationary wall further defines a plurality of recesses, each recess being disposed between adjacent stationary wall grooves and configured to receive therein a respective projection of the plurality of projections.

4. The diffuser assembly according to any of the preceding claims, wherein:

the at least one actuator comprises a first actuator and a second actuator, and
the at least one linkage comprises a first linkage and a second linkage, the first actuator being operative coupled to the moveable wall via the first linkage, and the second actuator being operatively coupled to the moveable wall via the second linkage, wherein the actuator assembly in particular further comprises a first seal disposed about the first linkage, and a second seal disposed about the second linkage, the first seal and the second seal configured to substantially reduce or eliminate leakage of the process fluid from the compressor while permitting axial displacement of the first linkage and the second linkage, respectively, relative to the compressor.

5. The diffuser assembly according to any of the preceding claims, wherein the first stationary wall defines at least one aperture extending axially there-through, and the at least one linkage is configured to extend through the at least one aperture to operatively couple the at least one actuator and the moveable wall, and/or wherein the diffuser is a pipe dif-

fuser.

6. The diffuser assembly according to any of the preceding claims, wherein each of the flow passages comprises a throat, and the actuator assembly is further configured to axially displace the moveable wall to reduce or increase the throat of each of the flow passages, and/or wherein at least a portion of each of the flow passages extends parallel to the axial displacement of the moveable wall.

7. A compressor, comprising:

a casing having an inlet and defining an impeller cavity;
a rotary shaft configured to be driven by a driver;
an impeller fluidly coupled with the inlet and disposed in the impeller cavity, the impeller coupled to the rotary shaft and configured to rotate with the rotary shaft to impart energy to process fluid received via the inlet, the impeller further configured to discharge the process fluid in at least a partially radial direction;
a diffuser disposed circumferentially about the impeller and configured to receive and compress the process fluid discharged from the impeller, the diffuser comprising

a first stationary wall coupled with the casing;
a second stationary wall coupled with the first stationary wall and the casing and defining a plurality of stationary wall grooves;
and
a moveable wall defining a plurality of moveable wall grooves, the moveable wall disposed between the first stationary wall and the second stationary wall such that respective stationary wall grooves and moveable wall grooves form respective flow passages configured to receive the flow of process fluid discharged from the impeller;

a collector formed at least in part by the first stationary wall and the second stationary wall, the collector configured to receive the compressed process fluid from the flow passages of the diffuser; and

an actuator assembly comprising at least one actuator and at least one linkage operatively coupling the at least one actuator and the moveable wall, the actuator assembly configured to displace the moveable wall to alter a cross-sectional area of each of the flow passages.

8. The compressor of claim 7, wherein:

each stationary wall groove of the plurality of

stationary wall grooves extends in a tangential orientation about the impeller; and each moveable wall groove of the plurality of moveable wall grooves extends in a tangential orientation about the impeller.

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9. The compressor of claim 7 or 8, wherein:

the diffuser is a pipe diffuser; and each of the flow passages comprises a throat, and the actuator assembly is further configured to axially displace the moveable wall to reduce or increase the throat of each of the flow passages, and/or wherein the first stationary wall defines at least one aperture extending axially therethrough, and the at least one linkage is configured to extend through the at least one aperture to operatively couple the at least one actuator and the moveable wall; and the moveable wall comprises a first annular face and a second annular face axially opposing the first annular face, the first annular face adjacent the first stationary wall and operatively coupled with the at least one actuator via the at least one linkage.

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10. The compressor of any of the claims 7 to 9, wherein:

the second annular face defines the plurality of moveable guide vanes and comprises a plurality of projections extending from the second annular face, each projection disposed between adjacent moveable wall grooves; and the second stationary wall further defines a plurality of recesses, each recess being disposed between adjacent stationary wall grooves and configured to receive therein a respective projection of the plurality of projections.

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11. A method for adjusting a cross-sectional area of a flow passage of a diffuser in a compressor, comprising:

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monitoring one or more operating parameters of the compressor or a process fluid flowing therethrough; detecting an operating parameter of the one or more operating parameters outside of a predetermined range; and axially displacing a moveable wall of the diffuser via at least one actuator operatively coupled with the moveable wall via at least one linkage, the axial displacement of the moveable wall adjusting the cross-sectional area of the flow passage of the diffuser.

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12. The method of claim 11, wherein:

the diffuser further comprises a first stationary wall and the second stationary wall coupled with one another and forming at least in part a volute configured to receive the process fluid from the diffuser;

the second stationary wall defines a plurality of stationary wall grooves; and

the moveable wall defining a plurality of moveable wall grooves, the moveable wall disposed between the first stationary wall and the second stationary wall such that respective stationary wall grooves and moveable wall grooves form respective flow passages.

13. The method of claim 11 or 12, wherein:

the first stationary wall defines at least one aperture extending axially therethrough, and the at least one linkage is configured to extend through the at least one aperture to operatively couple the at least one actuator and the moveable wall; and

the moveable wall comprises a first annular face and a second annular face axially opposing the first annular face, the first annular face adjacent the first stationary wall and operatively coupled with the at least one actuator via the at least one linkage.

14. The method of any of the claims 11 to 13, wherein:

the second annular face defines the plurality of moveable guide vanes and comprises a plurality of projections extending from the second annular face, each projection disposed between adjacent moveable wall grooves; and the second stationary wall further defines a plurality of recesses, each recess being disposed between adjacent stationary wall grooves and configured to receive therein a respective projection of the plurality of projections.

15. The method of any of the claims 11 to 14, wherein each of the flow passages comprises a throat, and axially displacing the moveable wall of the diffuser via the at least one actuator operatively coupled with the moveable wall via the at least one linkage comprises:

increasing or decreasing the throat of each of the flow passages.

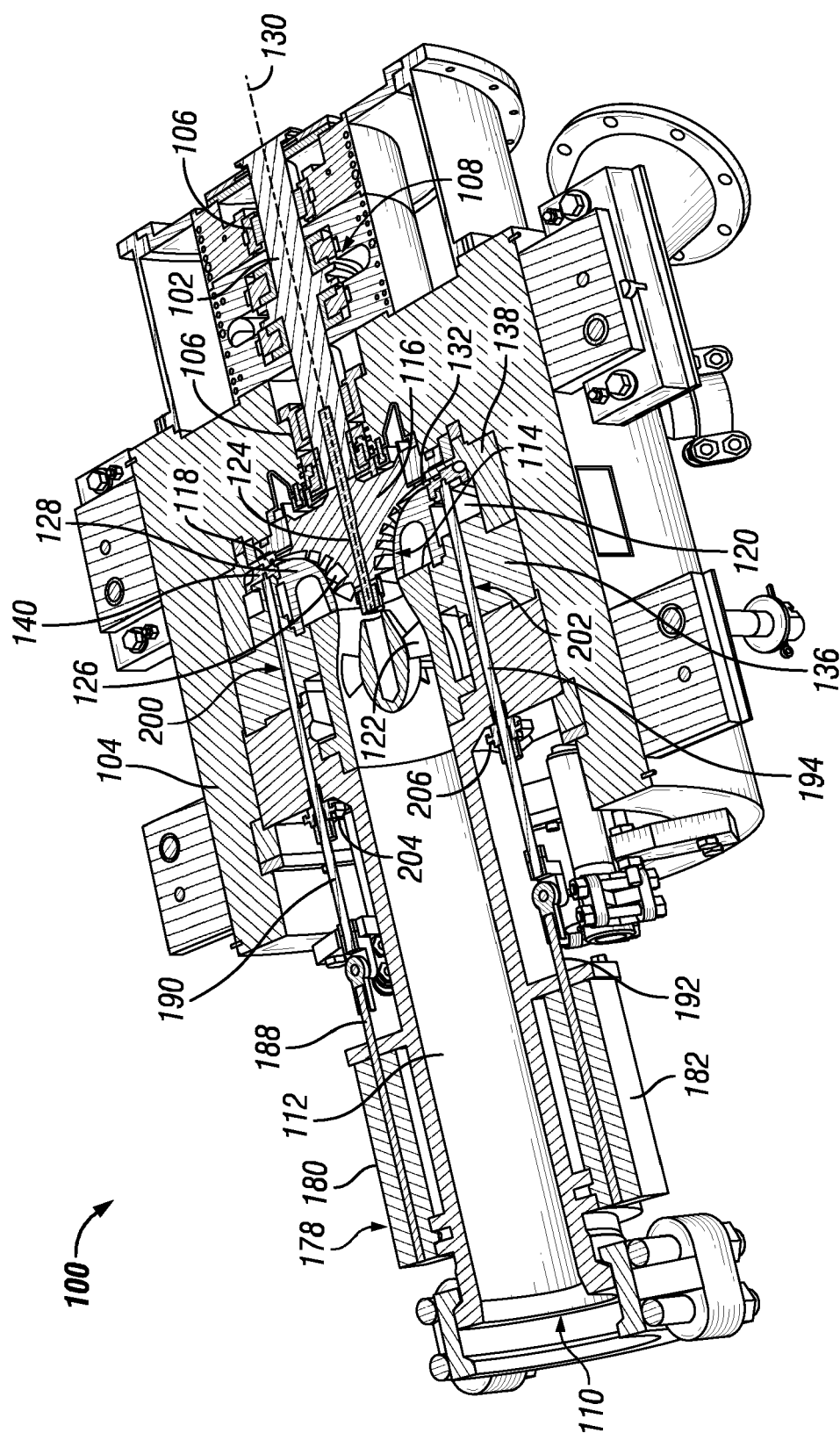


FIG. 1

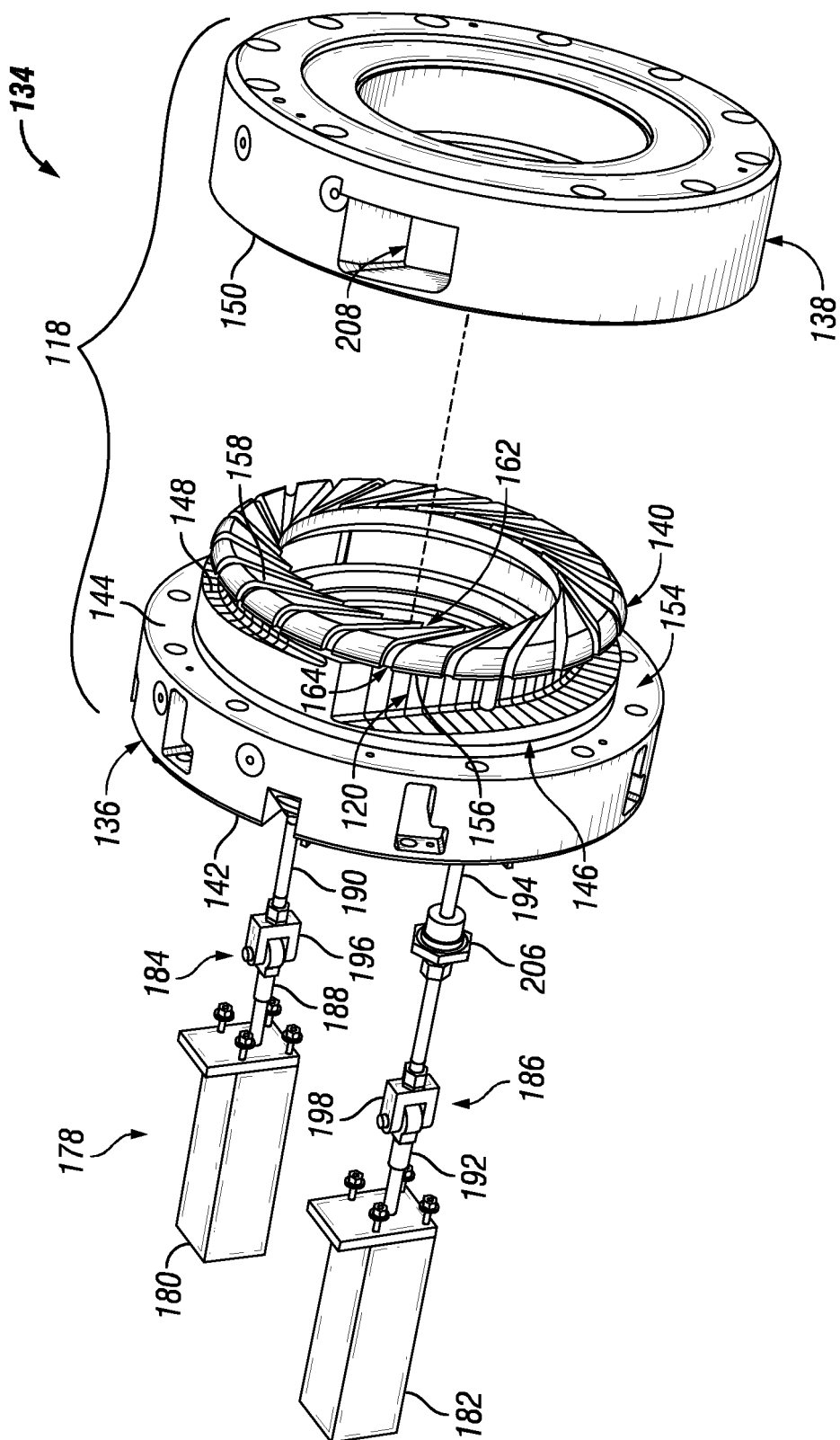


FIG. 2

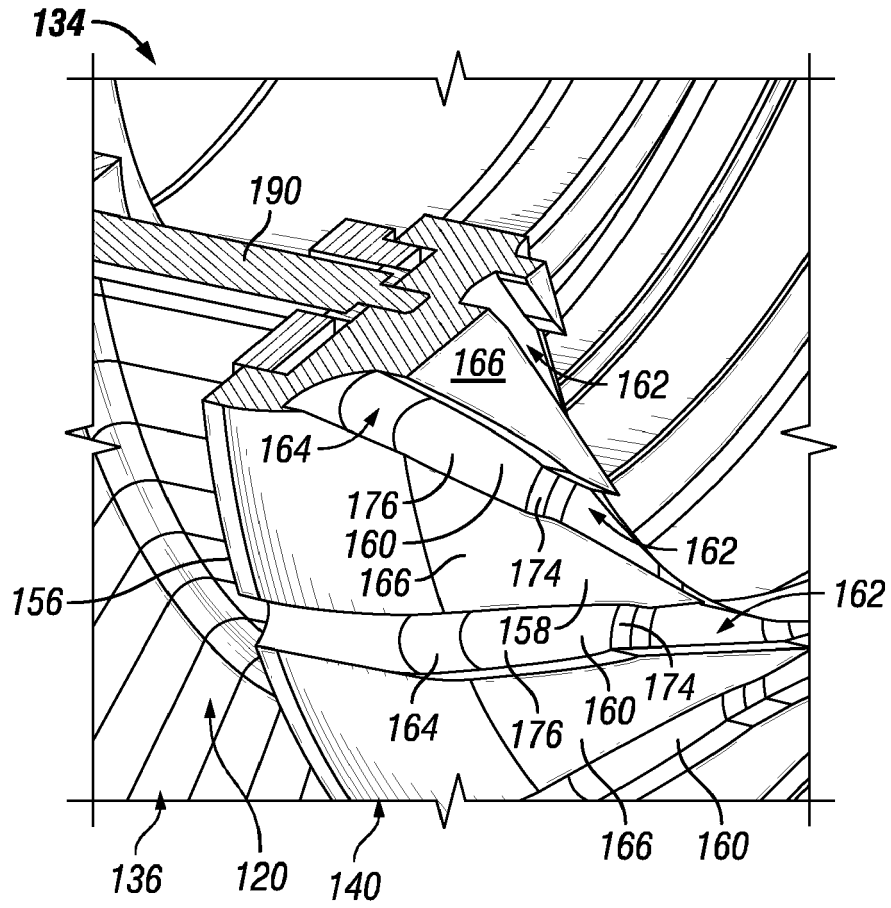


FIG. 3

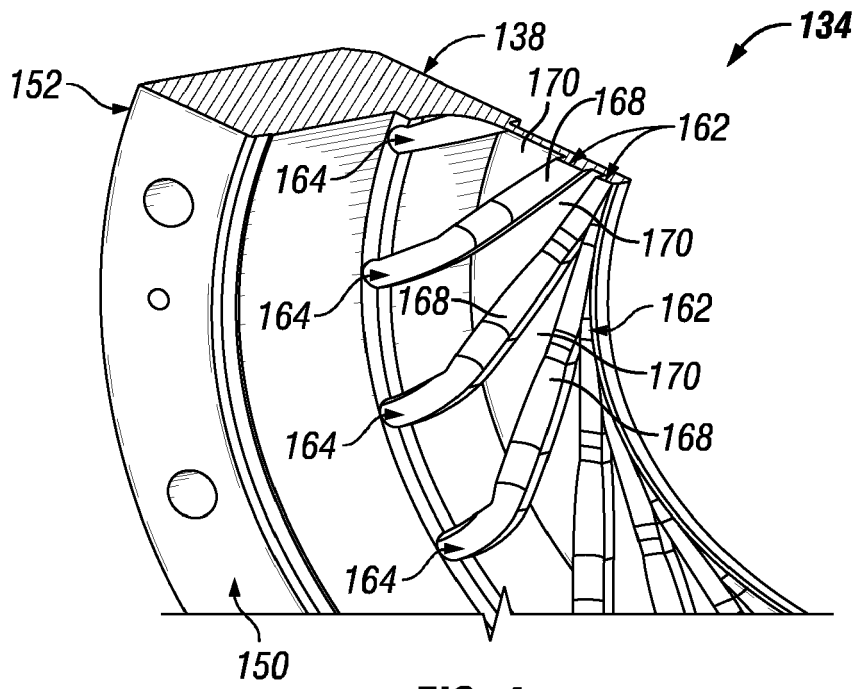


FIG. 4

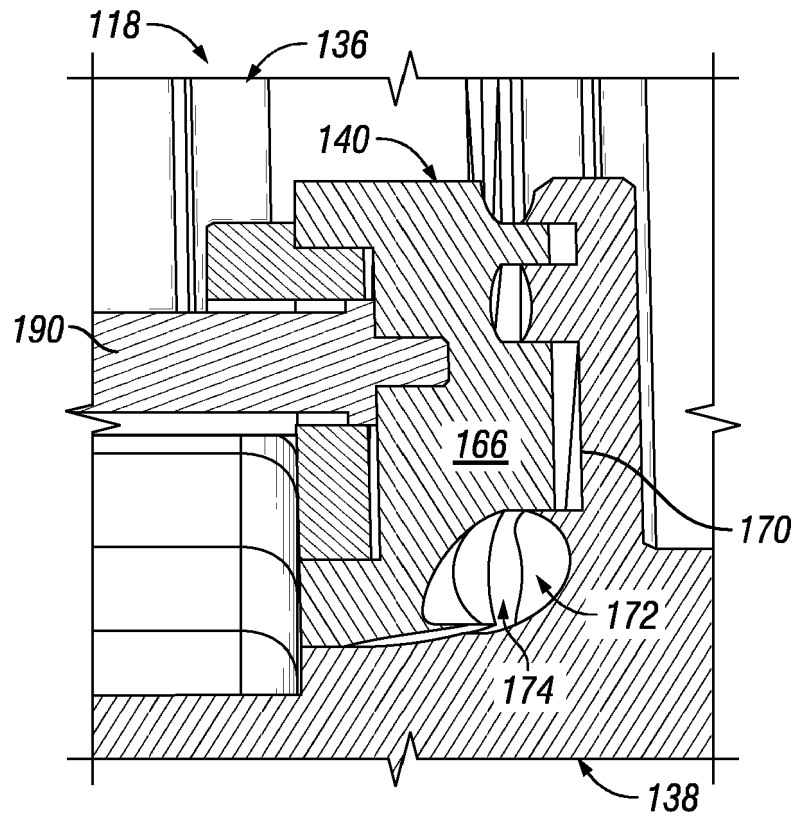


FIG. 5A

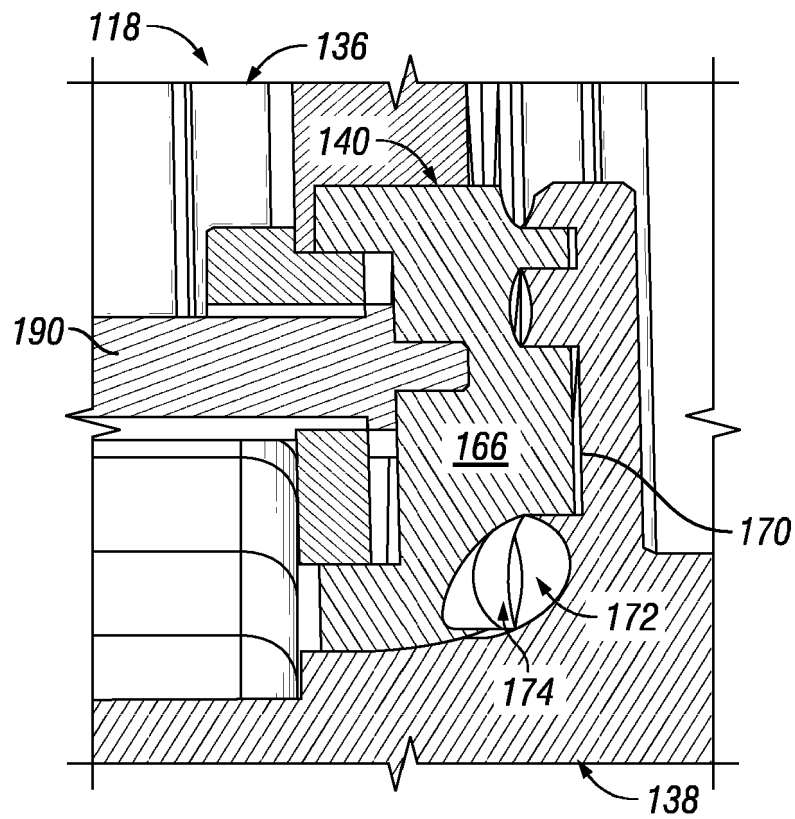
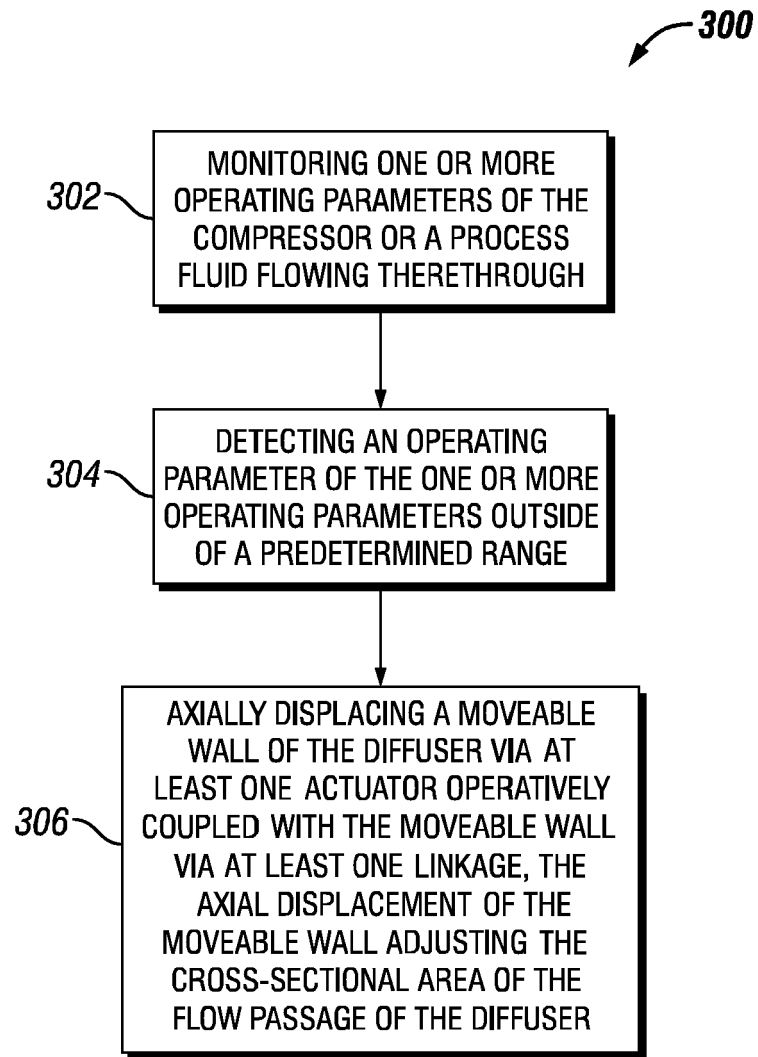


FIG. 5B

**FIG. 6**



EUROPEAN SEARCH REPORT

Application Number
EP 17 17 4132

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Place of search The Hague		Date of completion of the search 13 October 2017	Examiner Oliveira, Damien
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