major source of loss in efficiency in compressors and can contribute from 5 to 20% of the overall operating costs. In existing reed valve, poppet valve, plate valve, ring valve and channel valve assemblies used in the compression process, the gas has to make two right angle turns to get by the sealing element while passing through the valve. The greater the turning angle, the greater the resistance to the flow through the compressor; directly affecting the efficiency adversely.

[0010] The amount of time required to install a valve successfully, determines the amount of time that a machine is down and, in turn, the amount of money that is lost due the machine being down. For valves installed in the field, it is very difficult to check the quality of the assembled valve as this depends on the tolerance of all the parts and how it is assembled. A minor problem in a seat or guard can mean that none of the sealing elements seal properly – and this can only be found after the entire valve has been assembled and installed.

SUMMARY

According to a first aspect of the present invention, there is provided a reed valve module, comprising:

a module body comprising a seating surface, one or more first sealing faces on a first side of the module body and one or more second sealing faces on a second side of the module body, and one or more fluid conduits, each of the one or more fluid conduits leading from the seating surface to a respective one of the one or more first and second sealing faces, wherein an inside surface of the module body defines a cavity;

a plurality of transverse ribs reinforcing the cavity, wherein each of the plurality of transverse ribs extends across the cavity from the first side of the module body to the second side of the module body and has an end surface that is flush with a respective one of the one or more first and second sealing faces; and

one or more reed petals, wherein each of the one or more reed petals is positioned over a respective one of the one or more first and second sealing faces of the module body and over the end surface of at least one rib of the plurality of transverse ribs, wherein the respective first or second sealing face and the end surface of the at least one rib are adapted to support the respective reed petal when the respective reed petal is in a closed position, and wherein a spacing between each of the plurality of transverse ribs is adapted to enable each respective one of the one or more reed petals to withstand a differential pressure acting thereon when the respective reed petal is in said closed position.

According to a second aspect of the present invention, there is provided a method of assembling a reed valve module, the method comprising: obtaining at least one reed petal;

obtaining a modular reed valve body comprising a seating surface, one or more first sealing faces on a first side of the module body and one or more second sealing faces on a second side of the module body, and one or more fluid conduits, each of the one or more fluid conduits leading from the seating surface to a respective one of the one or more first and second sealing faces, wherein an inside surface of the modular reed valve body defines a cavity that is reinforced by a plurality of transverse ribs, wherein each of the plurality of transverse ribs extends across the cavity and has an end surface that is flush with a respective one of the one or more first and second sealing faces, and wherein the at least one reed petal is sized to cover at least one of the one or more first and second sealing faces and the end surface of at least one rib of the plurality of transverse ribs; and positioning the at least one reed petal over the at least one of the one or more first and second sealing faces and the end surfaces of the at least one rib of the plurality of transverse ribs, wherein the at least one respective sealing face and the end surface of the at least one rib are adapted to support the at least one **reed** petal when the at least one reed petal is in a closed position, and wherein a spacing between each of the plurality of transverse ribs is adapted to enable the at least one reed petal to withstand a differential pressure acting thereon when the at least one reed petal is in said closed position.

According to a third aspect of the present invention, there is provided a reed valve assembly, comprising:

a seat plate comprising one or more fluid conduits;

one or more receiving recesses, wherein each of the one or more receiving recesses is positioned proximate a respective one of the one or more fluid conduits; and

one or more reed valve modules as defined in the first aspect, sized to fit either individually or collectively within one of the one or more receiving recesses.

According to a fourth aspect of the present invention, there is provided a method of assembling a reed valve assembly according to the third aspect, the method comprising: obtaining one or more reed valve modules as defined in the first aspect;

obtaining a structure having one or more fluid conduits and one or more receiving recesses, wherein each of the one or more receiving recesses is positioned proximate a respective fluid conduit of the one or more fluid conduits in the seat plate; and

inserting one of the one or more reed valve modules into a respective receiving recess of the one or more receiving recesses.

According to a fifth aspect of the present invention, there is provided a method of disassembling a reed valve assembly according to the third aspect, comprising: removing the retainer plate from the seat plate, and emptying the respective receiving recesses of the one or more receiving recesses.

According to a sixth aspect of the present invention, there is provided a mechanical device, comprising: a frame comprising at least two fluid chambers; and one or more reed valve modules according to the first aspect connected to the frame to control the flow of a fluid between the chambers through the one more reed valve modules.

[0011] Certain ~~aspects~~embodiments commensurate in scope with the originally claimed invention are set forth below. It should be understood that these ~~aspects~~embodiments are presented merely to provide the reader with a brief summary of certain forms the invention might take and that these ~~aspects~~embodiments are not intended to limit the scope of the invention. Indeed, the invention may encompass a variety of ~~aspects~~ embodiments that may not be set forth below. Embodiments of the present invention generally relate to a novel reed valve module and its valve assembly. In some exemplary embodiments, a reed valve module includes a body including a seating surface, one or more sealing faces, and one or more fluid conduits leading from the seating surface to the sealing faces. The reed valve module also includes a single or plurality of reed petals positioned over the sealing face of the module body and one or more walls opposite the body from the single or plurality of reed petals. In another embodiment, a reed valve module comprises a modular valve body having a plurality of faces and one or more ports and one or more reed petals each sized to substantially cover one or more of the one or more ports of the modular valve body. The reed valve module also includes a modular housing sized for a frictional fit when disposed within a receiving recess with the modular valve body and the one or more reed petals within and secured by a seat plate. In yet another embodiment, a reed valve module comprises a modular valve body having a plurality of faces and one or more ports and one or more reed petals each sized to substantially cover one or more of the

one or more ports of the modular valve body. The modular valve body and the one or more reed petals are collectively sized for a frictional fit when disposed within a receiving recess with the modular valve body and the one or more reed petals within.

[0012] In another embodiment, a modular reed valve assembly comprises a seat plate including one or more fluid conduits and one or more receiving recesses, each proximate a respective fluid conduit of the one or more fluid conduits in the seat plate. The modular reed valve assembly also includes a retainer plate including one or more fluid conduits and one or more reed valve modules, sized to fit either individually or collectively within one of the one or more receiving recesses. In yet a further embodiment, a modular reed valve assembly comprises a seat plate including one or more fluid conduits and one or more receiving recesses, each proximate a respective fluid conduit of the one or more fluid conduits in the seat plate. Each of the one or more receiving recesses includes a groove and one or more reed valve modules. Each reed valve module comprises a modular housing including a protrusion sized to fit into the groove to secure the reed valve module when the modular housing is inserted into a respective one of the one or more receiving recesses.

[0013] In another embodiment, a method of assembling a reed valve module comprises the ~~following:~~following: obtaining a modular reed valve body including a seating surface, one or more sealing faces, and one or more fluid conduits leading from the seating surface to the sealing faces; obtaining at least one reed petal, sized for one or more of the one or more sealing faces; obtaining a modular housing; placing the at least one reed petal over the one or more of the one or more sealing faces; and placing the modular reed valve body and the at least one reed petal into the modular housing. In a further embodiment, a method of assembling a reed valve assembly comprises the following: obtaining one or more reed valve modules; obtaining a seat plate including one or more fluid conduits and one or more receiving recesses, each of the one or more receiving recesses proximate a respective fluid conduit of the one or more fluid conduits in the seat plate; and inserting one of the one or more reed valve modules into a respective receiving recess of one or more receiving recesses. Another ~~aspect~~embodiment of the present invention is a compressor comprised of a frame, a plurality of mechanical components disposed with the frame that compress a working fluid, and at least one modular reed valve assembly coupled to the frame

CLAIMS:

1. A reed valve module, comprising:

a body including a seating surface, one or more sealing faces, and one or more fluid conduits leading from the seating surface to the sealing faces; and

a single or plurality of reed petals positioned over the sealing face of the module body;

wherein a cavity within the valve body is reinforced by ribs, the end surfaces of the ribs are flush with the sealing face(s) and spaced to enable the reed petal(s) to withstand a differential pressure acting on reed petal(s).

2. The reed valve module of claim 1, wherein the one or more sealing faces on the module body are each at an angle substantially perpendicular to the seating surface so that the flow of a fluid through the reed valve module experiences minimal turning.

3. The reed valve module of claim 1, wherein the reinforcing ribs in the module body divide the cavity into separate independent flow passages.

4. The reed valve module of claim 1, further comprising one or more walls opposite the module body from the single or plurality of reed petals, the wall(s) formed by a modular housing and holding the single or plurality of reeds to the valve body to comprise a subcomponent of a functional valve.

5. The reed valve module of claim 4, wherein the inner surface(s) of the one or more walls of the modular housing act as a petal guard for the reeds.

6. The reed valve module of claim 5, wherein the petal guard surface is contoured to reduce impact forces on one or more of the single or plurality of petals when opening the petals.

7. The reed valve module of claim 6, wherein material is removed from a lower portion of an inner surface of the petal guard in a predetermined way to prevent sticking of any of the one or plurality of reed petals.

8. The reed valve module of claim 4, wherein the modular housing includes a protrusion sized to fit into a groove to secure the reed valve module when inserted into a receiving recess.

9. The reed valve module of claim 4, wherein the modular housing includes a mechanism that snap fits into a receiving recess to secure the reed valve module in a valve assembly.

10. The reed valve module of claim 4, wherein the upper surface of the walls of the modular housing is contoured and sized for frictional clamping of the single or plurality of the reeds to the corresponding surface of the module body when the module is disposed within a receiving recess and is secured by a seat plate within a valve assembly.

11. The reed valve module of claim 1, wherein the one or more reed petals comprise a contiguous single petal that covers a plurality of ports provided in the module body.

12. The reed valve module of claim 1, wherein a portion of the reed petals is shaped to positively engage the module body when the module is disposed within a receiving recess and is secured by a seat plate within a valve assembly.

13. The reed valve module of claim 4, wherein the reed petals in the module, the walls of the modular housing, and the sealing face of the module body have juxtaposed cut outs and projections that positively engage each other when the module is assembled and hold the one or more reeds positively against the module body by the walls of the modular housing.

14. A method of assembling a reed valve module according to claim 1, the method comprising:

obtaining a modular reed valve body including a seating surface, one or more sealing faces, and one or more fluid conduits leading from the seating surface to the sealing faces, the body including a cavity reinforced by ribs, the end surfaces of the ribs are flush with the sealing face(s);

obtaining at least one reed petal, sized for one or more of the one or more sealing faces; and

placing the at least one reed petal over the one or more of the one or more sealing faces, wherein the ribs of the body are spaced to enable the reed petal(s) to withstand the differential pressure acting on reed petal(s).

15. A method of assembling a reed valve module of claim 14, further comprising obtaining a modular housing and placing the modular reed valve body and the at least one reed petal into the modular housing.

16. A reed valve assembly, comprising:

a seat plate including one or more fluid conduits;

one or more receiving recesses, each proximate a respective fluid conduit of the one or more fluid conduits in the seat plate; and

one or more reed valve modules, sized to fit either individually or collectively within one of the one or more receiving recesses.

17. The reed valve assembly of claim 16, wherein each of the one or more reed valve modules is held into one of the one or more receiving recesses by the seat plate and secured by one or more fasteners.

18. The reed valve assembly of claim 16, wherein the one or more receiving recesses are located within the seat plate, which seat plate may be an integral part of a structure, and the modules are held in the recesses by a snap fit mechanism.

19. The reed valve assembly of claim 16, wherein the one or more receiving recesses are located within the seat plate, which seat plate may be an integral part of a structure, and a retainer plate secures the modules in the valve assembly by the use of one or more fasteners.

20. The reed valve assembly of claim 16, wherein the one or more receiving recesses are located within a retainer plate, which retainer plate may be an integral part of a structure, and the seat plate secures the modules in the valve assembly by the use of one or more fasteners.

~~21. The reed valve assembly of claim 16, wherein the one or more receiving recesses are~~ located within a separate structure, which separate structure may be an integral part of a second structure, and is sandwiched between the seat plate and a retainer plate and held together by one or more fasteners.

22. The reed valve assembly of claims 16, 17, 19, or 21, wherein the walls of the one or more receiving recesses include a contour that secures the single or plurality of reeds to the module body, when the module is disposed within the recess and secured in the valve assembly.

23. The reed valve assembly of claim 16, further comprising one or more sets of reed valve modules wherein each set of reed valve modules has a different set of dimensions.

24. A method of assembling a reed valve assembly according to claim 16, the method comprising:

obtaining one or more reed valve modules;

obtaining a seat plate including one or more fluid conduits and one or more receiving recesses, each of the one or more receiving recesses proximate a respective fluid conduit of the one or more fluid conduits in the seat plate; and

inserting one of the one or more reed valve modules into a respective receiving recess of the one or more receiving recesses.

25. The method of claim 24, wherein at least one of the one or more reed valve modules and at least one of the one or more receiving recesses in the seat plate include a mating surface for a snap fit mechanism, the method further comprising:

fitting the reed valve module into the respective recess to secure at least one of the one or more reed valve modules.

26. The method of claim 24, further comprising attaching a retaining plate over the seat plate.

27. A method of disassembling a reed valve assembly according to claim 19, 20 or 21,

comprising:

removing the retainer plate from the seat plate, and

emptying the respective receiving recesses of the one or more receiving recesses.

28. A compressor, comprising:

a frame;

a plurality of mechanical components disposed with the frame that compress a working fluid; and

one or more reed valve modules connected to the frame and the plurality of mechanical components to control the flow of the working fluid through the one or more reed valve modules.

29. The compressor of claim 28, further comprising:

at least one modular reed valve assembly having one or more receiving recesses for insertion of the one or more reed valve modules, wherein the at least one modular reed valve assembly is coupled to the frame and the plurality of mechanical components to control the flow of the working fluid through at least one modular reed valve assembly.

30. A mechanical device, comprising:

a frame comprising at least two fluid chambers; and

one or more reed valve modules connected to the frame to control the flow of a fluid between the chambers through the one or more reed valve modules.

31. The mechanical device of claim 30, further comprising:

at least one modular reed valve assembly having one or more receiving recesses for insertion of the one or more reed valve modules, wherein the at least one modular reed valve assembly is coupled to the frame and the plurality of mechanical components to control the flow of the fluid through at least one modular reed valve assembly.

CLAIMS:

1. A reed valve module, comprising:

a module body comprising a seating surface, one or more first sealing faces on a first side of the module body and one or more second sealing faces on a second side of the module body, and one or more fluid conduits, each of the one or more fluid conduits leading from the seating surface to a respective one of the one or more first and second sealing faces, wherein an inside surface of the module body defines a cavity;

a plurality of transverse ribs reinforcing the cavity, wherein each of the plurality of transverse ribs extends across the cavity from the first side of the module body to the second side of the module body and has an end surface that is flush with a respective one of the one or more first and second sealing faces; and

one or more reed petals, wherein each of the one or more reed petals is positioned over a respective one of the one or more first and second sealing faces of the module body and over the end surface of at least one rib of the plurality of transverse ribs, wherein the respective first or second sealing face and the end surface of the at least one rib are adapted to support the respective reed petal when the respective reed petal is in a closed position, and wherein a spacing between each of the plurality of transverse ribs is adapted to enable each respective one of the one or more reed petals to withstand a differential pressure acting thereon when the respective reed petal is in said closed position.

2. The reed valve module of claim 1, wherein the one or more first and second sealing faces on the module body are each at an angle substantially perpendicular to the seating surface.

3. The reed valve module of claim 1, wherein the plurality of transverse ribs extending across the cavity divide the cavity into a plurality of separate flow passages, each of the plurality of separate flow passages being adapted to direct a flow of fluid from the seating surface to one of the one or more first and second sealing faces.

4. The reed valve module of claim 1, further comprising one or more walls positioned opposite the module body from the one or more reed petals, wherein the one or more walls

comprise a modular housing and each of the one or more walls is adapted to hold at least one of the one or more reed petals against the module body.

5. The reed valve module of claim 4, wherein an inner surface of the one or more walls of the modular housing is adapted to act as a petal guard for the one or more reed petals.

6. The reed valve module of claim 5, wherein the inner surface of the one or more walls of the modular housing that is adapted to act as a petal guard has a contoured surface that is adapted to reduce impact forces on the one or more reed petals when each respective one of the one or more reed petals is opened during operation of the reed valve module.

7. The reed valve module of claim 6, wherein a lower portion of the inner surface of the one or more walls of the modular housing that is adapted to act as a petal guard is adapted to prevent stiction of any of the one or plurality of reed petals that are opened during operation of the reed valve module.

8. The reed valve module of claim 4, wherein the modular housing comprises a protrusion sized to fit into a groove formed in a receiving recess of a modular reed valve assembly, the protrusion being adapted to secure the reed valve module when inserted into the receiving recess.

9. The reed valve module of claim 4, wherein the modular housing comprises a snap-fit mechanism that is adapted to secure the reed valve module in a receiving recess of a valve assembly.

10. The reed valve module of claim 4, wherein an upper surface of the one or more walls of the modular housing is contoured and sized for frictional clamping of the one or more reed petals to a corresponding surface of the module body when the module body is disposed within a receiving recess and is secured by a seat plate within a valve assembly.

11. The reed valve module of claim 1, wherein the one or more first and second sealing faces of the module body comprises a plurality of adjacent sealing faces, and wherein the one or more

reed petals comprise a contiguous single reed petal that covers each of the plurality of adjacent sealing faces of the module body.

12. The reed valve module of claim 1, wherein a portion of each of the one or more reed petals is shaped to positively engage a portion of a receiving recess of a valve assembly when the module body and the one or more reed petals are disposed within the receiving recess and is secured by a seat plate within the valve assembly.

13. The reed valve module of claim 4, wherein the one or more reed petals, the one or more walls of the modular housing, and the one or more first and second sealing faces of the module body have juxtaposed cut outs and projections that are adapted to positively engage each other when the reed valve module is assembled to hold the one or more reed petals positively against the module body by the one or more walls of the modular housing.

14. The reed valve module of claim 1, wherein the module body further comprises a plurality of lateral ribs reinforcing the cavity, each of the plurality of lateral ribs extending laterally between an adjacent pair of the plurality of transverse ribs.

15. A method of assembling a reed valve module, the method comprising:

obtaining at least one reed petal;

obtaining a modular reed valve body comprising a seating surface, one or more first sealing faces on a first side of the module body and one or more second sealing faces on a second side of the module body, and one or more fluid conduits, each of the one or more fluid conduits leading from the seating surface to a respective one of the one or more first and second sealing faces, wherein an inside surface of the modular reed valve body defines a cavity that is reinforced by a plurality of transverse ribs, wherein each of the plurality of transverse ribs extends across the cavity and has an end surface that is flush with a respective one of the one or more first and second sealing faces, and wherein the at least one reed petal is sized to cover at least one of the one or more first and second sealing faces and the end surface of at least one rib of the plurality of transverse ribs; and

positioning the at least one reed petal over the at least one of the one or more first and second sealing faces and the end surfaces of the at least one rib of the plurality of transverse ribs, wherein the at least one respective sealing face and the end surface of the at least one rib are adapted to support the at least one **reed** petal when the at least one reed petal is in a closed position, and wherein a spacing between each of the plurality of transverse ribs is adapted to enable the at least one reed petal to withstand a differential pressure acting thereon when the at least one reed petal is in said closed position.

16. The method of claim 15, further comprising obtaining a modular housing and positioning the modular reed valve body and the at least one reed petal inside of the modular housing.

17. A reed valve assembly, comprising:

a seat plate comprising one or more fluid conduits;

one or more receiving recesses, wherein each of the one or more receiving recesses is positioned proximate a respective one of the one or more fluid conduits; and

one or more reed valve modules as claimed in any of claims 1 to 14, sized to fit either individually or collectively within one of the one or more receiving recesses.

18. The reed valve assembly of claim 17, wherein each of the one or more reed valve modules is held into a respective one of the one or more receiving recesses by the seat plate and secured by one or more fasteners.

19. The reed valve assembly of claim 17, wherein the one or more receiving recesses are located within the seat plate, and each of the one or more reed valve modules is held in a respective one of the one or more receiving recesses by a snap fit mechanism.

20. The reed valve assembly of claim 17, wherein the one or more receiving recesses are located within the seat plate and a retainer plate secures each of the one or more reed valve modules in the reed valve assembly by the use of one or more fasteners.

21. The reed valve assembly of claim 19 or 20, wherein the seat plate is an integral part of a structure.

22. The reed valve assembly of claim 17, wherein the one or more receiving recesses are located within a retainer plate and the seat plate secures each of the one or more reed valve modules in the reed valve assembly by the use of one or more fasteners.

23. The reed valve assembly of claim 22, wherein the retainer plate is an integral part of a structure.

24. The reed valve assembly of claim 17, wherein the one or more receiving recesses are located within a separate structure that is sandwiched between the seat plate and a retainer plate and held together by one or more fasteners.

25. The reed valve assembly of claim 24, wherein the separate structure is an integral part of a second separate structure.

26. The reed valve assembly of any one of claims 17, 18, 20, 21, 24, or 25, wherein walls of the one or more receiving recesses include a contour that secures the one or more reed petals of a respective one of the one or more reed valve modules to a respective module body when the respective module body is disposed within a respective receiving recess and secured in the valve assembly.

27. The reed valve assembly of claim 17, further comprising one or more sets of the one or more reed valve modules, wherein each set of the one or more reed valve modules has a different set of dimensions.

28. A method of assembling a reed valve assembly according to claim 17, the method comprising:

obtaining one or more reed valve modules as claimed in any of claims 1 to 14;

obtaining a structure having one or more fluid conduits and one or more receiving recesses, wherein each of the one or more receiving recesses is positioned proximate a respective fluid conduit of the one or more fluid conduits in the seat plate; and

inserting one of the one or more reed valve modules into a respective receiving recess of the one or more receiving recesses.

29. The method of claim 28, wherein at least one of the one or more reed valve modules and at least one of the one or more receiving recesses in the structure include a mating surface for a snap fit mechanism, the method further comprising:

fitting the at least one reed valve module into the respective at least one receiving recess to secure the at least one of the one or more reed valve modules with the snap fit mechanism.

30. The method of claim 28, wherein the structure comprises a seat plate, the method further comprising attaching a retaining plate over the seat plate.

31. A method of disassembling a reed valve assembly according to any one of claims 20 to 25, comprising:

removing the retainer plate from the seat plate, and

emptying the respective receiving recesses of the one or more receiving recesses.

32. A mechanical device, comprising:

a frame comprising at least two fluid chambers; and

one or more reed valve modules according to any of claims 1 to 14 connected to the frame to control the flow of a fluid between the chambers through the one or more reed valve modules.

33. The mechanical device of claim 32, further comprising:

at least one modular reed valve assembly having one or more receiving recesses for insertion of the one or more reed valve modules, wherein the at least one modular reed valve assembly is coupled to the frame and the plurality of mechanical components to control the flow of the fluid through at least one modular reed valve assembly.