

APPLICATION FOR PATENT

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Title: Springless Compressor Valve

FIELD OF THE INVENTION

5 [0001] The field of this invention is valves particularly valves that cycle frequently and actuators for them operate without springs...

BACKGROUND OF THE INVENTION

[0002] Compressor valves come in a variety of designs and are powered open by differential pressure and in the typical known design use some type of a spring
10 push the valve to the close position. The main issue with such designs is spring fatigue and failure after a predetermined number of cycles. Thus the problem addressed by the present invention is to present a valve design that can provide an economical construction and a reliably long service life. That objective is accomplished by elimination of the spring and the use of a force that preferably has a
15 longer life cycle by using components that are less affected or better withstand the cycling that is the duty of a valve particularly one in a compressor application. In a preferred embodiment, the closing force is provided by the alignment of like poles of permanent magnets. Other embodiments are contemplated that deliver a closing force through a device that is not prone to fatigue or wear as would be experienced in an
20 application involving a spring.

[0003] In many applications outside of compressor valves not only have springs been used but they have been combined with electromagnets to create an opening force against a spring return. Hydraulic pistons can also be used in conjunction with springs. These variations are all suggested in related U.S. Patents 4,799,507 and
25 4,869,289. Other examples of electromagnets or permanent magnets for solenoid

valves and valve actuators and other applications are U.S. Patents 6,179,268; 6,532,919; and 5,356,211. U.S. Patent 6,799,746 relies on a spring inside the valve to return an actuating piston to an original position in response to movement induced by an electromagnet. In yet other applications, such as a door closer in U.S. Patent

5 4,670,939 a magnet moves a ball that acts as a valve member to control the flow of hydraulic fluid when controlling the closing and opening of a door. U.S. Patent 5,366,506 shows an intraurethral valve with a magnetic valve member that can be selectively opened to allow urine to pass by moving another magnet from outside the body. The following patents show the general state of the art of compressor valves:

10 U.S. Patents 6,810,901; 6,790,018; 6,751,941; 6,684,651; 6,644,945; 6,585,500; 6,152,710; 5,947,708; 5,885,062; 5,547,344; 5,025,828; 4,793,779 and 4,446,608.

[0004] What is needed, particularly in a compressor application where a reciprocating compressor that runs at 300- 1800 RPM and has valves that cycle between 5-20 times per second corresponding to that speed is a more reliable closing force that improves

15 on the service life seen from coil springs or plate type closing springs. While the preferred embodiment is to use neodymium-iron-boron permanent magnets with similar poles facing, those skilled in the art will appreciate the full scope of the invention from the specification and claims, which appear below.

SUMMARY OF THE INVENTION

20 [0005] A valve closure system particularly suited to reciprocating compressors employs no springs and preferably urges the valve in the closed direction by the force generated from magnets positioned to repel each other and in that manner deliver the force to keep the compressor valve closed. Other applications are envisioned and different techniques for replacing the spring component in such valve assemblies are

25 also contemplated.

DETAILED DESCRIPTION OF THE DRAWINGS

[0006] Figure 1 is a section view of a magnet driven closure for a concentric ring type valve; and

[0007] Figure 2 is a section view of a magnet driven closure for a ported plate styled valve in a compressor.

[0008] Figure 3 is a section view of a magnet driven closure for a poppet styled valve in a compressor.

[0009] Figure 4 is a section view of a magnet driven closure for a ring styled valve which uses either a single ring or a multitude of identical rings (not concentric) in a compressor

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0010] Referring to Figure 1, the seat 10 has passages 12 that lead to a seating surface 14. Flow represented by arrow 16 progresses on pressure buildup to push against the valve member 18 to displace it from seating surface 14, whereupon the flow passes through guard 20 through passages 22 as represented by arrow 24. Aligned with the valve member 18 and extending in guard 20 is a small bore 26 leading into a bigger bore 28. A shoe 30 having a bore 32 is secured or mounted in bore 28. A magnet 34 that has a bore 36 aligned in fluid communication with bore 32 is mounted in shoe 30.

A button 38 rides over a portion of the shoe 30 and is slidably retained to it to limit its stroke and to keep the two from being detached in ported plate and ring valves. In poppet valves shown in Figure 3, there is no shoe; instead, a magnet is mounted directly in the poppet, and is not slidably retained. A magnet 40 is mounted to the button 38 in such a manner that the orientations of magnets 34 and 40 is such that like poles face each other creating a repelling force that is overcome by rising

pressure in passages 12 to get the valve member 18 off of seating surface 14. The valve member 18 can be any one of a number of designs. A concentric ring design is illustrated in Figure 1 and a ported plate design is shown in Figure 2, a poppet valve is shown in Figure 3, and a ring, either single ring or multiple same size non-concentric rings for the valve member 18. In all other respects the illustrated embodiments of Figures 1 and 2 and 4 work in the same way. The embodiment also works the same way, but there is no button (magnet is in poppet) in Figure 3, and the poppet is not slidably retained.

[0011] Those skilled in the art will appreciate that the springs on valves particularly in compressor applications can be eliminated using the magnets. The magnets can be permanent or electromagnets or combinations of both. The magnets represent the preferred execution of the invention that comprises the elimination of springs to close the valves. Other solutions to replace the springs in such valves are particularly employing forces that can be delivered over a physical gap without mechanical contact are all within the scope of the invention. Therefore solutions that employ various fields to span a gap or that employ fluid pressure optionally in conjunction with accumulators are all within the scope of the invention.

[0012] It is to be understood that this disclosure is merely illustrative of the presently preferred embodiments of the invention and that no limitations are intended other than as described in the appended claims.

I claim:

1. A compressor valve, comprising:

a body further comprising a seat;

5 a valve member movably mounted to said seat for opposed movement from being on the seat to off the seat;

a device to urge the said valve member toward said seat without the use of a spring.

2. The valve of claim 1, wherein:

10 said device further comprises a force transmission assembly that delivers a force to said valve member across a physical gap.

3. The valve of claim 2, wherein:

said force transmission assembly employs a force field.

4. The valve of claim 3, wherein:

15 said force field is created by at least one magnet.

5. The valve of claim 4, wherein:

at least one of said magnets is a permanent magnet.

6. The valve of claim 4, wherein:

at least one of said magnets is an electromagnet.

20 7. The valve of claim 5, wherein:

at least one of said magnets is neodymium-iron-boron.

8. The valve of claim 4, wherein:

said valve member comprises a ported plate.

9. The valve of claim 4, wherein:

25 said valve member comprises concentric rings.

10. The valve of claim 4, wherein:

said valve member comprises poppets.

11. The valve of claim 4, wherein:

said valve member comprises a single ring, or multiple same-size rings which
5 are not concentric.

12. The valve of claim 4, wherein:

said at least one magnet comprises at least two magnets arranged with like
poles adjacent each other to create a repelling force.

13. The valve of claim 12, wherein:

10 one of said magnets is attached to said valve member or a button that acts on
said valve member, and the other to said body.

14. The valve of claim 4, wherein:

said magnet attached to said valve member is connected through either a
button that is guided for reciprocal movement for a predetermined distance in part
15 defined by the valve member contacting said seat, or mounted directly to said valve
member.

15. The valve of claim 12, wherein:

one of said magnets has a bore therethrough to allow fluid to be displaced as
said valve member moves away from said seat.

20 16. The valve of claim 15, wherein:

said magnet with said bore is stationery.

17. The valve of claim 16, wherein:

said stationary magnet is secured by a housing that created a travel stop for the
movable magnet.