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Description

The invention relates to a ring valve, in particular for condensers, according to the preamble of Claim 1.

Valves of this design are today known in a variety of embodiments and in particular in compressors or condensers for the automatic control of charge changing during use. In order to perform its actual sealing function satisfactorily, the surface of the valve plate facing the valve seat needs to cooperate reliably with the openings of the through channels. However, the prestressing force, which is usually exerted by individual spring elements, also needs to be distributed as uniformly as possible. This often results in problems during the construction of the valves in that it is relatively difficult to find an optimum compromise between stiffness for improving the distribution of the prestressing force and softness or elasticity for improving the actual sealing effect.

A ring valve of the design stated at the beginning is known from the DE-C 202 609. There, the supporting plate is guided in the valve via its own guide plate with flexible guide arms, and the valve rings, which have a conical cross-section, are fastened to the rings of the supporting plate by means of screws. This design is relatively expensive, firstly because special fastening screws with associated boreholes are necessary, which furthermore require additional assembly work for mounting and fastening the valve rings.

The object of the invention is to develop a ring valve of this type so as to ensure that the valve functions reliably, in particular with the simplest possible means, whilst sealing and spring-loading are perfect.

This is achieved with the invention by the features contained in Claim 1. The essential functions of the valve plate are divided between the supporting plate on the one hand and the individual valve rings on the other, without these two components obstructing one another as they perform their function. Since the supporting plate merely rests on the valve rings without being fastened thereto,

the two components of the valve plate can also lift off one another, at least in the lifting direction, under the influence of the flow forces of the medium controlled through the valve, thus guaranteeing that the valve is sealed tightly, even when the individual parts are worn unevenly. In certain embodiments of the valve of the invention, a free displaceability is also provided in the radial direction, which likewise contributes to improving and ensuring the sealing. The supporting plate, which may be rigid, ensures that the spring forces are applied to and distributed over the valve rings in a uniform manner.

The construction of individual, separate, concentrically arranged valve rings is already known per se in the field of valve rings. For example, US-PS 3 536 094 discloses a ring valve for compressors, in which the through channels of the valve seat are controlled by individual valve rings. These valve rings are arranged independently of one another and are each provided with their own locking springs. On their side facing the valve seat, the valve rings have an arcuate profile and project into a funnel-shaped widening of the associated through channel, so that the valve rings are guided in the radial direction. Each individual valve ring is provided with its own spring suspension, and the overall shape of the valve ring is designed in terms of its strength and form so that it can absorb and transmit the spring forces. There is therefore no separation of the said two essential functions of the valve plate.

According to an advantageous further development of the invention, the supporting plate can be fixed relative to the valve seat and the collector in the axial direction in the region of the valve axis and/or its outer periphery and can also form the spring elements directly through its appropriate design and/or the choice of material. The division of the two essential functions of the valve plate, as takes place in accordance with the present invention, is again utilised with advantageous effect. The steps required in order to construct the spring elements in one piece with the supporting plate do not impair the actual sealing function performed by the valve rings in any way.

In this context, a further embodiment of the invention provides that the valve rings can have an even sealing surface and can rest evenly on the valve seat when the valve is closed, and that the supporting plate can be provided with centering projections which rest against at least one edge of the ring plates. The latter can move to a certain extent in the axial direction relative to the supporting plate and/or the other ring plates and can therefore adapt

individually to the flow conditions. The ring plates cannot fall out of their guides, since the flow pressure continuously presses them against the supporting plate and therefore against their guides.

According to another advantageous further development of the invention, at least part of the supporting plate can be provided with groove-shaped recesses, into which the ring plates are inserted. This provides an easy way of producing the mechanisms for guiding and/or centering the individual ring plates relative to the supporting plate.

In all the said variants of the guide and/or centering mechanism for the ring plates, it can also be provided that the inner ring plates with the smaller diameter are thinner or else the associated contact surfaces on the supporting plate are deeper, so that the inner rings can lift earlier under the action of pressure.

According to a further advantageous embodiment of the invention, it is provided that the ring plates are protected against twisting relative to the supporting plate, preferably by radial projections or the like, which engage with radially aligned guiding surfaces on the supporting plate. The described protection of the ring plates against twisting, which is more advantageous than a free twistability of the ring plates for many applications, is easy to achieve and is particularly advantageous in combination with radial guidance and/or centering of the ring plates.

According to a further embodiment of the invention, the supporting plate rests on the ring plates in a sealing manner, at least in the region of their edges, and the ring plates have openings in the sealed region. This ensures that, when the valve is closed, the ring plates are not subjected to strain by the differential pressure which is now acting on the supporting plate via the openings. Even though there are actually two valve seats on the two opposite surfaces of the ring plates, the danger of a double leakage is ruled out by the fact that it is possible to select a correspondingly soft material for the ring plates.

In the latter context, a further embodiment of the invention is advantageous, in accordance with which the supporting plate is provided with sealing strips which rest on the ring plates. These can improve sealing or reduce the danger of a leakage, particularly in the case of soft ring plates consisting at least

partially of synthetic material in accordance with a further embodiment of the invention.

In accordance with the invention, the supporting plate can only rest on a part of the ring plates, e.g. on the outermost ring plate, when the valve is closed, and a free intermediate gap can be provided between the other ring plates and the supporting plate. To this end, the ring plates can be of unequal width where the supporting plate has a constant width, for example, or the supporting surfaces provided on the supporting plate for the individual ring plates can lie in different planes, e.g. can be incorporated in the supporting plate at different depths. This design achieves the additional example that the ring plates, on which the supporting plate rests indirectly when the valve is closed, lift off the valve seat easily and quickly when the flow direction in the piston condenser is reversed, because they are practically free of spring-loading. However, after the valve has been opened, these ring plates also meet the supporting plate so that their opening movement is dampened.

A further advantageous embodiment of the ring valve according to the invention consists in that the ring plates associated with the joint supporting plate are tapered both on their sides facing the valve seat and on their sides facing away from the valve seat and engage in matching funnel-shaped widenings of the valve seat in a manner known per se. This design achieves a particularly simple ring valve with improved functional properties. Through the tapered design of the ring plates, which are also tapered on their surface facing away from the valve seat, the contact surface between the ring plates and the associated supporting plate is reduced so that no disadvantageous adhesion forces occur between the ring plates and the supporting plate, which, particularly in the case of lubricated valves or during the conveyance of gases carrying liquids, could cause the valve to close late with all the disadvantageous consequences which that would bring. Furthermore, additional working surfaces are provided for the medium conveyed through the valve, so that, once conveyance has stopped and right at the start of a developing return flow, additional forces are exerted onto the ring plates which forces bring about immediate closure. Disadvantageous late closures of the valve are thus prevented. Furthermore, the tapered design of the ring plates on both sides brings about a saving in material and a reduction in the weight of the ring plates, which are both advantageous as well.

In a preferred embodiment of the invention, the ring plates have the same profile on both their sides. The ring plates can also be fitted into the valve the other way round, so that it is not necessary to pay any attention to a precise fitting position at the start when the valve is being assembled, but the ring plates can be turned later on when phenomena of wear appear, so that they can be used correspondingly longer.

In a further development of the invention, the ring plates can be formed with a polygonal cross-section. Preference is given to a regular cross-sectional profile which can be produced relatively simply. The edges of the polygonal cross-sectional profile are advisably rounded, thus reducing the danger of tilting and improving the flow conditions along the ring plates.

Finally, a particularly simple embodiment of the invention consists in forming the ring plates in a torus-shaped manner. This annular shape with its circular cross-sectional profile requires little expenditure in terms of the production. Nevertheless, the joint supporting plate brings about a uniform transmission of the spring forces onto the ring plates and a reliable guidance of the same during the lifting movement. However, the cross-sectional profile of the ring plates can also be curved differently, e.g. can be formed in an ellipse-shaped or pea-shaped manner. Furthermore, a rectangular profile which is cambered or rounded on both its sides can be provided.

The ring plates of the invention can advantageously be produced from a non-metallic material, in particular from synthetic material. They are particularly suitable for this on account of their cross-sectional profile.

The drawings show schematically several embodiments of the invention. Fig. 1 shows a partial cross-section through a ring valve formed in accordance with the invention, Fig. 2 shows the valve plate of the embodiment according to Fig. 1 in a partial view from below, Fig. 3 shows a partial cross-section through another embodiment of the invention, only the valve seat and the valve plate being shown here; Figs. 4 and 5 show further embodiments of the invention in a view corresponding to Fig. 3; Fig. 6 shows a further embodiment of the invention in a cross-section corresponding to Fig. 1, Fig. 7 shows a partial plan view of a supporting plate of another embodiment of the invention, Fig. 8 shows a partial cross-section through a further embodiment of the invention, Fig. 9 shows another embodiment again corresponding substantially to Fig. 1 in

the cross-sectional view, Fig. 10 shows a view of the valve plate in accordance with Fig. 9 from below, and Fig. 11 shows a view of the supporting plate in accordance with Fig. 9, likewise from below. Finally, Figs. 12 to 15 each show a partial cross-section through different embodiments of the invention.

The ring valve according to Fig. 1 has a valve seat 2 which has annularly arranged through channels 1 for the controlled medium, a collector 5 which has drainage channels 3 and is mounted above the valve seat 2 leaving a space 4 free, and a valve plate 6 which is arranged in this space 4 and is here dampened by a damper plate 8 supported on the collector 5 via a centering shoulder 7 and is spring-loaded in a manner which is not shown. In the drawn view, the ring valve is closed - as soon as the pressure acting on the side of the through channels 1 is sufficient to overcome the prestressing force exerted on the valve plate 6 via spring elements, the valve plate 6 lifts off the valve seat 2, so that the medium to be controlled can flow from the through channels 1 to the drainage channels 3 via the openings 9 in the valve plate 6.

The valve plate 6 has individual valve rings (ring plates) 10 which are arranged above the through channels 1 of the valve seat 2, and a supporting plate 11 which rests jointly on all the ring plates 10 on the side opposite the valve seat 2 and transmits the force of the spring elements acting thereon. The supporting plate 11 is centred between the valve seat 2 and the collector 5 at the centering shoulder 7 - a borehole 12, which is shown in Fig. 2 and cooperates with a pin on the valve seat in a manner not shown here, serves to protect against twisting.

The supporting plate 11 can be anchored to the individual ring plates 10 so as to be non-displaceable in the radial direction. However, as shown in Figs. 1 and 2, the ring plates 10, which consist e.g. of a suitable synthetic material and/or a softer material improving the sealing at the valve seat 2, can also be fitted loosely with a small amount of play into circumferential grooves 13 on the supporting plate 11, which consists e.g. of a suitable hard material, for example spring steel or the like. Since in the embodiment according to Figs. 1 and 2 the width of the individual ring plates 10 corresponds exactly to the width of the webs 14 of the supporting plate 11 remaining between the openings 9 and lying above the ring plates 10, the grooves 13 are actually only present in the region of the connecting webs 15 remaining between the

openings 9, thus providing centering projections 16 which rest against the edges of the ring plates 10.

Even if - as mentioned - the ring plates 10 are held loosely in the supporting plate 11 with a small amount of play, it is impossible for them to fall out since the pressure of the medium flowing from the through channels 1 to the drainage channels 3 continuously presses the ring plates 10 against the supporting plate 11.

In the embodiment according to Fig. 3, the ring plates 10 have a smaller width than the webs 14 of the supporting plate 11 lying thereabove, so that the grooves 13, which here again are provided for receiving the ring plates 10, are also formed in the region of the openings 9, thus giving improved mounting and/or guidance of the ring plates 10 in the supporting plate 11.

In the embodiment according to Fig. 4, the individual ring plates 10 are not guided by the supporting plate 11 at all and merely lie in conical sealing seats 17 of the valve seat 2. Here, individual spiral springs 18 are used as spring elements for prestressing the valve plate 6, whose spring force is in turn distributed uniformly onto the ring plates 10 and therefore the sealing seats 17 via the supporting plate 11. Since there is no guidance of the ring plates 10 on the supporting plate 11, it must of course be ensured that the possible lifting of the ring plates 10 relative to the sealing seats 17 cannot lead to the former moving out of the sealing seats completely.

The arrangement shown in Fig. 5 again corresponds substantially to the embodiment according to Fig. 1 - as a slight variation from the latter, here the grooves 13 in the supporting plate 11 are wider than the webs 14, so that centering projections 16 are again only formed in the region of the connecting webs 15 between the openings 9 of the supporting plate 11; which here have a smaller width than the openings 9. As a further variation from Fig. 1, the spring elements in Fig. 5 are shown as individual spiral springs 18 as in Fig. 4.

In the embodiment according to Fig. 6, the supporting plate 11 rests against the edges of the ring plates 10 in a sealing manner by way of sealing strips, the ring plates 10 having openings 20 in the sealed region between the sealing strips 19. The ring plates 10 are consequently relieved of pressure and can

easily consist of soft, elastic material, for example synthetic material, even where higher pressures are to be controlled.

Fig. 7 shows a further possible way of guiding, centering or mounting the ring plates (not shown here) on the supporting plate 11. To this end, brackets 21 are provided on the webs 14 at suitable angular distances, which during the production of the supporting plate 11 are bent out of the plane of the drawing along the dotted lines 22, thus providing lateral guidance for the ring plates, though contrary to the drawing this could only take place on one side in each case.

In the embodiment according to Fig. 8, the supporting plate 11 is fixed relative to the valve seat 2 and/or the collector 5 in the axial direction in the region of the valve axis 23 and/or at the centering shoulder 7 in a manner which is not shown further and, through its appropriate design and/or the choice of material, also directly forms the spring elements for the required prestressing of the ring plates 10 relative to the valve seat 2.

In the embodiment according to Figs. 9 to 11, the ring plates 10 are protected against twisting relative to the supporting plate 11, to which end the ring plates 10 are provided with radial projections 24 which engage with guiding surfaces 25 on the supporting plate 11 which are likewise radially aligned. Here, these guiding surfaces 25 are simply formed directly on the sides of the centering projections 16 of the supporting plate 11, which may be formed similar to those described in Fig. 5, for example.

Fig. 9 shows a further variant of the invention, which is independent of the mechanism protecting against twisting and can also be constructed without the latter. There, the two inner ring plates 10 are less thick than the outer ring plate 10 shown on the left, so that a narrow intermediate gap 26 is left between the inner ring plates 10 and the supporting plate 11 when the valve is closed, as shown in Fig. 9. The two inner ring plates 10 are not weighed down by the supporting plate 11 and lift off the valve seat 2 earlier than the outer ring plate 10 when the valve is opened. The same effect can be achieved with ring plates 10 of equal thicknesses if their supporting surfaces on the supporting plate 11 are provided at unequal distances from the sealing surface of the valve seat 2.

In the embodiments according to Figs. 12 to 15 too, annular through channels 1 are arranged concentrically to one another in the valve seat 2. The valve axis, the right-hand half of the valve and the collector are not shown. The through channels 1 are controlled by the valve plate 6, which is formed by the individual ring plates 10 and the associated joint supporting plate 11. On their side facing the valve plate 6, the through channels 11 [sic] are provided with funnel-shaped widenings forming sealing seats 17 which cooperate with the ring plates 10. The ring plates 10 are tapered on their lower side and project into the funnel-shaped widenings, where they cooperate with the sealing seats 17 with their flanks.

The lifting of the ring plates 10 which occurs during the operation of the valve is smaller than the height of the tapered parts of the ring plates 10, with which the latter project into the funnel-shaped widenings. The ring plates 10 are thus guided in the radial direction during the lifting movement; they cannot leave the funnel-shaped widenings. The supporting plate 11 brings about a uniform distribution of the spring forces applied by the spiral springs 18 over the individual ring plates 10, even when the supporting plate 11 is only loaded by a few spiral springs 18 which are only acting on the outermost ring of the supporting plate 11, as shown in the embodiments. Spring plates can also be provided in place of the spiral springs 18, or the spring suspension can be achieved by spring-mounted arms bent out of the supporting plate 11.

In Figs. 12 to 15, the ring plates 10 associated with the joint supporting plate 11 are each tapered both on their side facing the valve seat 2 and on the side facing away from the valve seat 2. In the embodiment according to Fig. 12, the ring plates 10 are bevelled less steeply on their side resting on the supporting plate 11 than on the side of the valve seat 2, where their flanks cooperate with the sealing seats 17. In accordance with Fig. 13, however, the ring plates 10 have the same profile on both their sides. This gives the additional advantage that the ring plates 10 can also be fitted into the valve in the reverse position, because both sides match the sealing seats 17 in the valve seat 2. In Fig. 13, the cross-sectional profile of the ring plates 10 is tapered conically on the upper side and on the lower side. However, it can also have a different shape, in particular it can be polygonal, arcuate, elliptical or cambered in some other manner, possibly with cylindrical flanks. Fig. 14 shows ring plates 10 with an octagonal cross-section, the profile of the ring plate 10 shown on the right

having rounded edges. The ring plates 10 in the embodiment according to Fig. 15 are torus-shaped, i.e. have an annular profile cross-section.

The shown and described shape of the ring plates 10 on the one hand achieves reliable guidance and perfect sealing of the sealing seats 17 in the valve seat 2 and on the other hand reduces the contact surface on the supporting plate 11. Thus, medium flowing back through the openings 9 in the supporting plate 11 to the through channels 1 can act upon the tapered surfaces on the surface of the ring plate 10 and can cause rapid closure of the valve. If the ring plates are the same shape on their upper and lower sides, as shown in Figs. 13 to 15, they can be turned round when the phenomena of wear appear, thus extending their life. The simply profiled ring plates can be produced inexpensively. The supporting plate is likewise simple to produce, because the ring plates 10 do not require any anchoring mechanisms or guide means whatsoever.



Claims

1. A ring valve, in particular for condensers, with a valve seat (2) which has annularly arranged through channels (1) for the controlled medium, with a collector (5) which has drainage channels (3) and is mounted above the valve seat (2) leaving a space (4) free, and with a valve plate (6) which is arranged in this space (4) and which is loaded against the valve seat (2) by spring elements supported on the collector (5), the valve plate (6) consisting of individual valve rings (ring plates) (10), arranged above the through channels (1) of the valve seat (2), and a supporting plate (11), resting jointly on all the valve rings (10) on the side opposite the valve seat (1) and transmitting the force of the spring elements (18) acting thereon, **characterised in that** the supporting plate (11) is centred in the valve and is guided during its lifting movement, and **in that** the valve rings (10) are fitted loosely between the valve seat (2) and the supporting plate (11), without being anchored to the latter in the lifting direction.
2. A ring valve according to Claim 1, **characterised in that** the supporting plate (11) is fixed relative to the valve seat (2) and the collector (5) in the axial direction in the region of the valve axis (23) and/or its outer periphery and also directly forms the spring elements through its appropriate design and/or the choice of material.
3. A ring valve according to Claim 1 or 2, **characterised in that** the valve rings (10) have an even sealing surface and rest evenly on the valve seat (2) when the valve is closed, and **in that** the supporting plate (11) is provided with centering projections which rest against at least one edge of the valve rings (10).
4. A ring valve according to Claim 1, 2, or 3, **characterised in that** at least part of the supporting plate (11) is provided with groove-shaped recesses (13), into which the valve rings (10) are inserted.
5. A ring valve according to any one of Claims 1 to 4, **characterised in that** the valve rings (10) are protected against twisting relative to the supporting plate (11) by radial projections (24) or the like, which engage with radially aligned guiding surfaces (25) on the supporting plate (11).



6. A ring valve according to any one of Claims 1 to 5, **characterised in that** the supporting plate (11) rests on the valve rings (10) in a sealing manner, at least in the region of their edges, and **in that** the valve rings (10) have openings (20) in the sealed region.
7. A ring valve according to Claim 6, **characterised in that** the supporting plate (11) is provided with sealing strips (19) which rest on the valve rings (10).
8. A ring valve according to any one of Claims 1 to 7, **characterised in that** the valve rings (10) consist at least partially of synthetic material.
9. A ring valve according to any one of Claims 1 to 8, **characterised in that** the supporting plate (11) only rests on some of the valve rings (19), e.g. on the outermost valve ring (10), when the valve is closed, and a free intermediate gap (26) is provided between the other valve rings (10) and the supporting plate (11).
10. A ring valve according to any one of Claims 1 to 9, **characterised in that** the valve rings (10) associated with the joint supporting plate (11) are tapered both on their sides facing the valve seat (2) and on their sides facing away from the valve seat (2) and engage in matching funnel-shaped widenings of the valve seat (2).
11. A ring valve according to Claim 10, **characterised in that** the valve rings (10) have the same profile on both their sides.
12. A ring valve according to Claim 10 or Claim 11, **characterised in that** the valve rings (10) are formed with a polygonal cross-section,
13. A ring valve according to Claim 12, **characterised in that** the edges of the polygonal cross-section are rounded.
14. A ring valve according to Claim 10 or according to Claim 11, **characterised in that** the valve rings (10) are torus-shaped.