Nov. 22, 1966 T. K. KEHLER 3,286,727

MULTIPLE RING VALVE

Filed May 1, 1964

FIG. 1

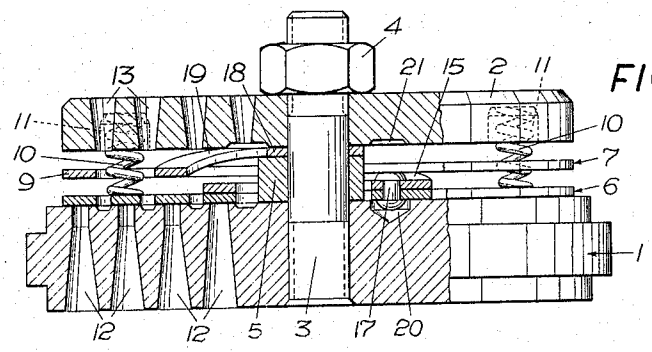


FIG. 2

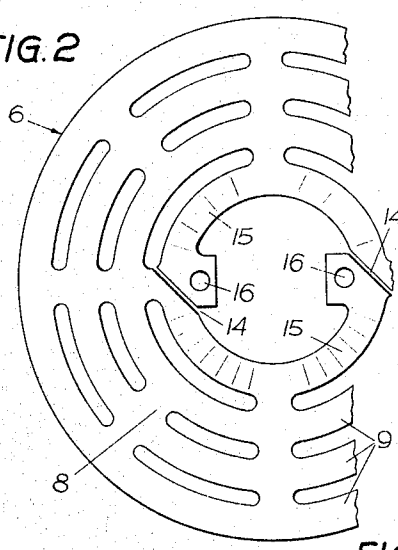


FIG. 3

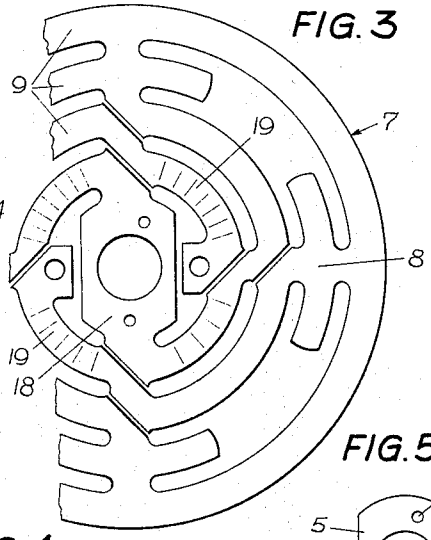


FIG. 5

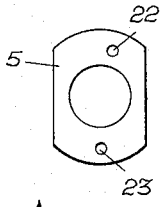


FIG. 4

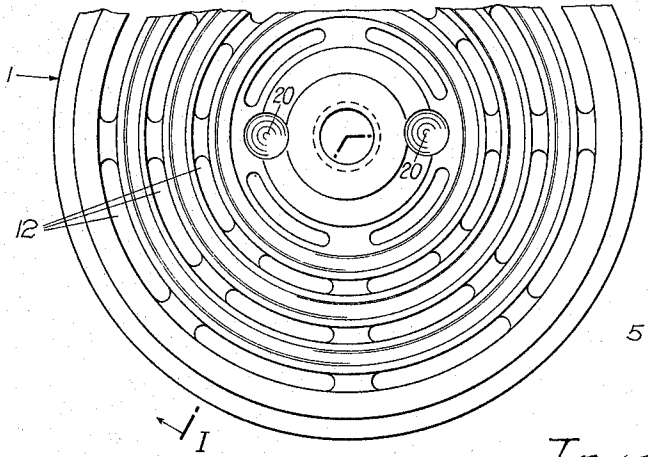
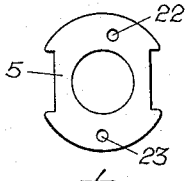


FIG. 6



Inventor
Theodor K. Kehler
By
Watson, Cole, Grindle & Watson
Attys.

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MULTIPLE RING VALVE

Theodor Karl Kehler, Vienna, Austria, assignor to ENFO Entwicklungs- und Forschungs-Aktiengesellschaft, Vaduz, Liechtenstein

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6 Claims. (Cl. 137—516.13)

The invention relates to multiple ring valves, in particular for high-speed, high-pressure compressors, providing frictionless guidance for the valve plate by means of a guide plate comprising a hub locked between the valve seat and the valve guard by means of a spacer, and guide arms cut out of said guide plate, each of said guide arms being connected with a flexible arm of the valve plate.

In view of the considerable progress achieved in piston-type compressor design, the valves of the latter are expected to meet comparatively exacting requirements. In addition to long life, they are in particular required to offer a resistance to flow as low as possible. In conventional multiple ring valves of the aforesaid design resistance to flow is kept low by providing the maximum stroke practicable, a guide plate serving for the frictionless guidance of the valve plate, the guide arms of said guide plate being attached to flexible arms of the valve plate. It is the purpose of the flexible arms of the valve plate to increase the flexibility of the connection between the valve plate and the guide plate, thereby reducing the stress produced on the said connections during the operation of the valve. However, experience goes to show that the practicable increase of the stroke of the valve plate is not always sufficient to adequately reduce resistance of the valve to flow, because particularly in high-speed compressors there is a limit to the increase of the stroke. Moreover, both the guide arms of the guide plate and the flexible arms of the valve plate require a comparatively large space which is lost for flow purposes.

The object of the invention is to improve the conventional design of multiple ring valves, particularly by reducing their resistance to flow without affecting the size of the stroke, by increasing the cross-sectional area available for free flow. According to the invention this is achieved by providing the flexible arms of the valve plate to cover the innermost port of the valve seat closely surrounding the spacer and by preferably segment-shaped cutouts of the said spacer in the area of the connections between the guide arms of the guide plate and the flexible arms of the valve plate, thereby increasing the cross-sectional flow area of the valve by the provision of an additional port covered by the guide arms of the valve plate. In view of the cutout design of the said spacer the said additional port can be approached close to the valve axis. Consequently, the invention combines the advantage of providing flexible connection between the valve plate, affording long life even in high-speed high-pressure compressors involving large strokes of the valve plate on the one hand, and of using the available valve cross-section advantageously for the solution of the flow problem.

According to another feature of the invention each of the flexible arms of the valve plate can be attached to the valve plate by means of radial webs or the like in two places located at different distances from their free extremities connected with the guide arms of the guide plate preferably by means of rivets. This design affords a particularly advantageous shape of the

flexible arms of the valve plate for the most convenient coverage of the innermost port of the valve seat, without impairing the advantageous flexible connection between them and the guide arms of the guide plate.

According to a preferred embodiment of the invention the connections between the flexible arms of the valve plate and the guide arms of the guide plate can be partially or wholly located in the area of the innermost port of the valve seat. This arrangement affords increased availability of the cross-sectional area of the valve for flow purposes, since additional space required for the connection is negligible and the innermost port can be located particularly close to the valve axis.

The said objects and further details of the invention will become apparent from the following description of a preferred embodiment of the invention with reference to the accompanying drawing in which:

FIG. 1 is an elevational view of a multiple ring valve according to the invention, partly in section taken along line I—I of FIGURE 4;

FIG. 2 is a plan view of the valve plate of said multiple ring valve;

FIG. 3 is a plan view of the guide plate;

FIG. 4 is a top view of the valve seat; and

FIGS. 5 and 6 are plan views of two variants of the spacer.

The multiple ring valve illustrated in and by the accompanying drawing comprises a valve seat **1** and a valve guard **2** in spaced relation to the former, both elements being interconnected by means of a bolt **3** and nut **4**. The spacer **5** determines the distance between the valve seat **1** and the valve guard **2** which for greater clarity is shown on a slightly increased scale. Located between the valve seat **1** and the valve guard **2** are the valve plate **6** and the guide plate **7** of approximately identical cross-section, both consisting of concentric rings **9** interconnected by radial webs **8**. The valve plate **6** is loaded by helical springs **10** located in emplacements **11** provided in the valve guard **2**. The ports in the valve seat **1** are designated by reference number **12** and those in the valve guard **2** by number **13**.

As appears from FIG. 2 the innermost ring of the valve plate **6** is ripped open in two diametrically opposite places in the area of radial webs **8** by oblique slots **14**, thereby forming flexible arms **15** at the free extremities of which bores **16** are provided for the purpose of receiving rivets **17** shown in FIG. 1, by means of which the flexible arms **15** are connected with the guide plate **7**. The guide plate **7** carries a hub **18** concentrically locked in the valve between the valve guard **2** and the spacer **5**. The four guide arms **19** of the guide plate **7** are circumferentially connected alternatingly with the hub **18** and by the rivets **17** with the flexible arms **15** of the valve plate **6**. In the valve seat **1** recesses **20** are provided and the valve guard **2** represents a recess **21** for the heads of the rivets **17**.

The location of the innermost port **12** in the valve seat **1** is as close as possible to the valve axis and closely surrounds the spacer **5**. This port is covered by the flexible arms **15** of the valve plate **6**. In order to provide the necessary space for the accommodation of the connections between the flexible arms **15** of the valve plate **6** and the guide arms **19** of the guide plate **7**, the spacer **5** is appropriately cut out in the area of these connections. Flexible connections between the valve plate **6** and the guide plate **7** is provided by the flexible arms **15** of the valve plate **6**, thereby reducing the strain upon the rivet joints between both plate **6** and **7** as well as upon the plates themselves. In view of the consequent reduction of the resistance to flow and of the flexible

and consequently, durable connection between the two plates this arrangement is particularly suitable for use in high-speed compressors. Experience has shown that this valve affords adequate sealing in spite of the fact that the flexible arms **15** of the valve plate **6** are subject to an albeit minor tensile stress by the guide arms **19** of the guide plate **7**, since the differential pressure of the controlled medium acting on the valve plate firmly presses the flexible arms **15** against the valve seat **1**. In order to ensure proper sealing also in the area of the slots **14**, no turned recess is provided in the area of the innermost port **12** of the valve seat **1**.

The spacer **5** illusrated in FIG. 5 is cut out segment-fashion in two diametrically opposite places so as to provide the necessary space for the rivets **17**. By adapting the contours of the cutouts of the spacer **5** to the shape of the two plates **6**, **7** in the area of their connections it is possible to increase the cross-sectional area of the spacer if necessary. FIG. 6 illustrates a spacer **5** of similar design. In both cases, the spacer is provided with bores **22** and **23** for the passage of locking pins maintaining the spacer **5** and the valve guard **2** in their correct position in relation to the valve seat **1**. The pins extending through the bores **22**, **23** are located on different diameters of the spacer and of the valve and at different distances from the valve axis, so as to ensure the proper installation of the spacer **5** in the valve.

As appears likewise from FIG. 4, the recesses **20** provided in the valve seat **1** for the rivet heads of the connection between the valve plate **6** and the guide plate **7** are partly located in the web area between the innermost port **12** of the valve seat **1**, as a result of which the innermost port **12** can be approached even more closely to the valve axis. If necessary or desirable to ensure appropriate flow characteristics, only a comparatively small clearance is preferably left between the flexible arms **15** of the valve plate **6** covering the innermost port **12** and the surface of the spacer **5**. In order to provide adequate sealing for the valve also in the area of the recesses **20**, the innermost port **12** is for example, milled throughout the valve seat, so that the radial webs around the recesses **20** are continuously of the same height as the sealing area of the valve seat **1**.

The valve plate **6** and the guide plate **7** present essentially the same cross-section, in particular also in the area of the interconnected flexible arms **15** and **19**. Consequently, the flexible guide arms **19** o fthe guide plate **7**, the flexibility of which can be increased by grinding them out or by making them narrower than the flexible arms **15** of the valve plate **6**, are wholly covered by the flexible arms **15** not presenting any ground or narrow portions. Thus the sensitive guide arms **19** of the guide plate **7** are protected from the flow which cannot impinge upon them directly, thereby considerably reducing the strain on the guide arms.

I claim:

1. A multiple ring valve, in particular for high-speed, high-pressure compressors, comprising a valve seat and a valve guard in spaced relation to said valve seat, concentrical ports in the valve seat and ports in the valve guard, at least one spacer located between the valve seat and the valve guard determining the distance between the valve seat and the valve guard, a valve plate consisting of concentrical rings and radial webs interconnecting the said rings, the said valve plate covering the ports in the valve seat, and a guide plate of about the same cross-section as the valve plate for the frictionless guidance of the valve plate, both said plates being located between the valve seat and the valve guard, the innermost ring of the valve plate being ripped open by obliquely extending slots to form flexible arms connected with the remaining rings of the valve plate by means of radial webs, the said guide plate comprising a hub locked in the valve axis and the flexible guide arms cut out of the said guide plate, one part of the said guide arms being connected with said hub and the other part thereof being connected with the flexible arms of the valve plate, the flexible arms of the valve plate covering the innermost port of the valve seat, said port being located close to the said spacer and surrounding same, the said spacer being cut out in the area of the connections between the flexible arms of the valve plate and the guide arms of the guide plate, so as to provide space for the connections between the two plates.

2. A multiple ring valve as claimed in claim **1**, wherein the flexible arms of the valve plate covering the innermost port of the valve seat are positively connected with the flexible guide arms of the guide plate by means of rivets.

3. A multiple ring valve as claimed in claim **1**, wherein each of the flexible arms of the valve plate covering the innermost port of the valve seat is connected with the valve plate by means of two radial webs located at different distances from the free extremity of the said arms, the said free extremity being connected with one guide arm of the guide plate.

4. A multiple ring valve as claimed in claim **1**, wherein the connections between the flexible arms of the valve plate covering the innermost port of the valve seat and the guide arms of the guide plate connected with the said flexible arms, are partly located in the area of the innermost port of the valve seat.

5. A multiple ring valve as claimed in claim **1**, wherein the connections between the flexible arms of the valve plate covering the innermost port of the valve seat, and the guide arms of the guide plate connected with the said flexible arms are wholly located within the area of the innermost port of the valve seat.

6. A multiple ring valve as claimed in claim **1**, wherein the flexible arms of the valve plate covering the innermost port of the valve seat and the flexible guide arms of the guide plate are interconnected by means of rivets, recesses for the rivet-heads of the said rivets being provided in the valve seat and in the valve guard.

No references cited.

WILLIAM F. O'DEA, *Primary Examiner.*

H. W. WEAKLEY, *Examiner.*