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(71) Applicant
Hoerbiger Ventilwerke Aktiengesellschaft

(Incorporated in Austria)

Braunhubergasse 23, A-1110 Wien, Austria

(72) Inventor
Gerhard Krzyzanowski

(74) Agent and/or Address for Service
Marks & Clerk,
57-60 Lincoln's Inn Fields, London WC2A 3LS

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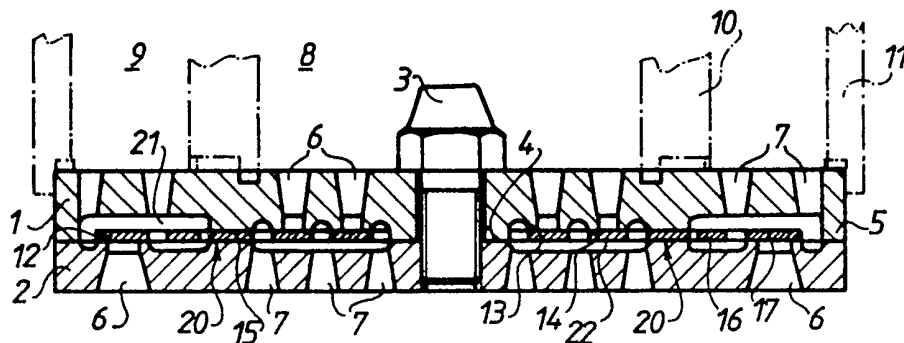
(56) Documents cited
GB 1261971 **DE 1812580** **US 1633772**
GB 1068203 **US 4164238**

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F2V
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(54) **Valve set for reciprocating compressors**

(57) A valve set for reciprocating compressors comprises a suction valve and a compression valve which are arranged concentrically to one another. The two valves are formed by two seating plates (1, 2) which are superposed one above the other and have through ducts (6) controlled by a common closure plate (12) which comprises concentric rings (13, 15, 17) interconnected and guided without friction by flexible guide members (14, 16). The closure plate (12) is clamped by one of its complete plate rings (15) between the two seating plates (1, 2). The flexible guide members (14, 16) are anchored to the said clamped ring (15) and extend both radially inwards and radially outwards to join the continuous plate rings (13, 17), which control the through ducts (6) of the seating plates (1, 2), to define the two valves.

FIG.1



1-1

FIG.1

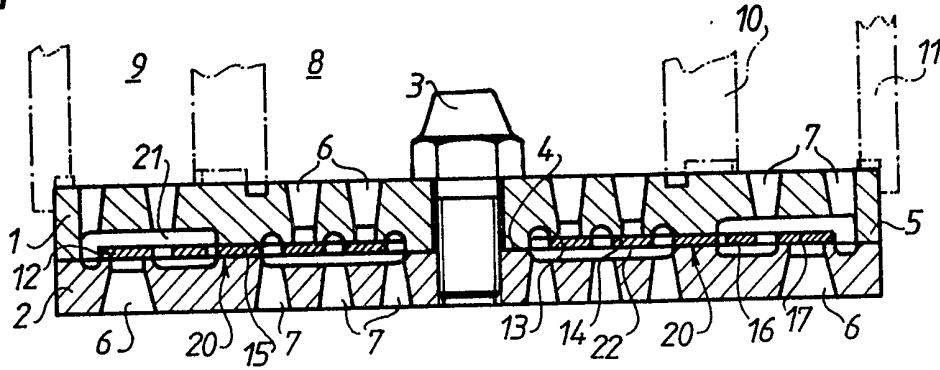
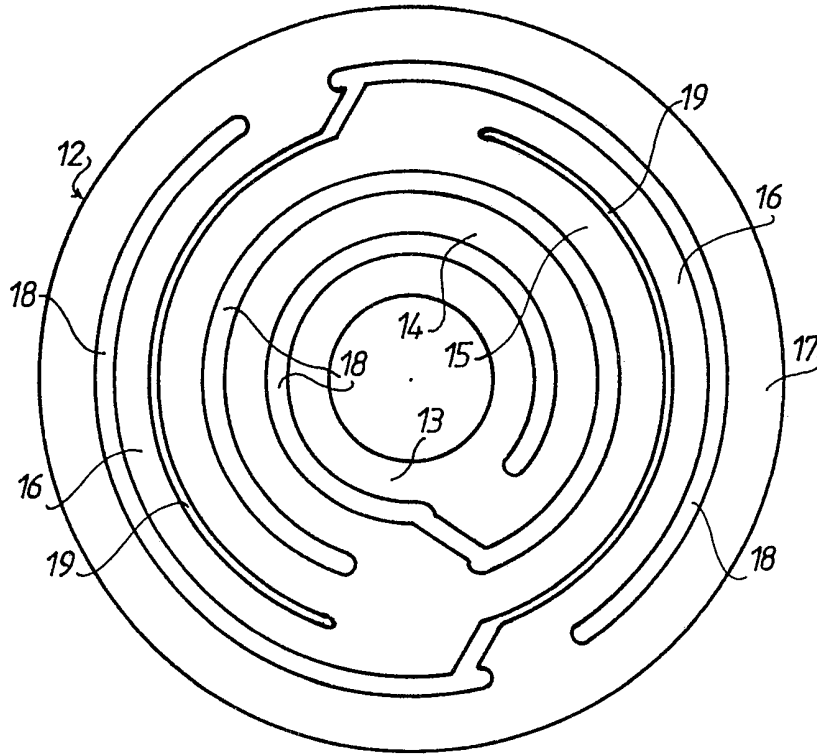


FIG.2



SPECIFICATION

Valve set for reciprocating compressors

5 The invention relates to a valve set for reciprocating compressors, having a suction valve and a compression valve which are arranged concentrically to one another and comprise two seating plates superposed one above the other and having through ducts, which are controlled by a closure plate which comprises concentric rings with slots formed there-between and which is guided without friction by flexible guide members.

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15 Concentric valve sets of this type are already known in various designs. In particular they are suitable for small and medium-sized reciprocating compressors and are clamped on the front face of the cylinder between the latter and the cylinder head of the compressor.

20 From the functional point of view these concentric valves permit a largely uniform flow of the controlled medium without a substantial movement in the cylinder space, since both the suction valve and the compression valve are arranged symmetrically to the longitudinal axis of the cylinder. On the other hand, structural difficulties can arise if a friction-free guidance of the closure plates of the two valves is required, since the flexible guide members which are then necessary demand additional space and restrict the cross-section of the passage through the valve. In this design of the valves the assembled cross-section of the valve is limited by the dimensions of the cylinder bore.

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30 A valve set with valves arranged concentrically to one another is known from the German Auslegeschrift (Published Specification) 18 12 580, Fig. 2, in which the closure plates of the suction valve arranged on the inside and also of the compression valve arranged concentrically around the suction valve are guided without friction by flexible guide members which are formed integrally and concentrically on the outside of the respective closure plate. These flexible guide members extending in a curved manner are formed out of a concentric plate ring by being cut out therefrom. The free ends of the guide members are anchored with the aid of pins which pass through them and which are secured in the seating plates. In this connexion not only do the guide members demand additional space, which is lost to the throughflow cross-section, but relatively awkward structural precautionary steps are also necessary for securely clamping and holding the closure plates. In practice an individual pin must be provided for each end of the guide members and must be anchored between the seating plates, resilient stroke shims also being necessary for maintaining a sufficiently uniform vibration-free clamping of all the guide members.

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a compression valve is known from the US Patent 1 633 772 and comprises two seating plates and a common closure plate. The closure plate comprises a radial through web which is clamped between the two seating plates and is sealed. The assembled cross-section of the valve is diagonally divided in this way into two halves, one half of which comprises the suction valve and the other half the compression valve: In this way the advantageous characteristics in terms of flow dynamics possessed by concentrically arranged valves are lost. From the structural point of view the two halves of the seating plates must be made different, in which case in particular it is not possible to provide through ducts which extend over the entire periphery of the valve and which extend over an entire pitch circle. In addition, in this design it is not possible to make optimum use of the valve cross-section available. The two valves can be formed only as disc valves or flap valves and not as annular valves, so that this design is suitable practically only for small valves and simple compressors.

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The object of the invention is to improve the hitherto known combined valve sets with valves arranged concentrically to one another and with friction-free guidance of the closure plates in such a way that the number of the components is reduced, the guidance of the closure plates in the stroke movement of the valve is simplified and the cross-section of the valve set which can be used for the throughflow is increased.

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This object is attained according to the invention in the case of a valve set as described above in that a common closure plate is provided for the two valves in a manner known *per se*, the closure plate is clamped in the transition region from the suction valve to the compression valve by one of its rings between the two seating plates and is sealed at the clamping position, and the flexible guide members are anchored to the clamped ring of the closure plate and extend from the said ring both radially inwards and radially outwards to form a continuous plate ring. In this design both valves can be constructed as annular valves with the known advantageous properties thereof, without separate closure plates being necessary for the suction valve and for the compression valve. In addition, the seating plates themselves can be kept substantially unchanged as compared with the known designs. Only one common closure plate is clamped between the two seating plates and sealed. At the same time as the closure plate is clamped, the guide members of both valves and thus the plate rings covering the through ducts as well are securely anchored in the valve set, so as to ensure a friction-free guidance, without individual precautionary steps being necessary for clamping the guide members. The valve set according

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to the invention is thus also characterized by few individual components and a high degree of simplicity.

Various additional arrangements of the valve set are possible within the framework of the invention. At least one flexible guide member of the common closure plate can be positioned above a through duct of a seating plate and can control it. This step which is known *per se* is particularly advantageous in the case of the design of the valve set according to the invention, since the flexible guide members are arranged not in the valve axis, but radially further outwards, where relatively long through ducts are possible, so that the design according to the invention provides an appreciable increase in the through cross-section of the valve.

According to a further feature of the invention at least one flexible guide member of the common closure plate can be less wide than the closed rings thereof. This step is likewise used to ensure a maximum through cross-section, since the guide members which have been made narrower demand a correspondingly smaller part of the assembled cross-section, so that a relatively larger proportion can be used for the through flow. In order to increase the flexibility of the guide members, it is also possible to grind the guide members internally in a manner known *per se*, i.e. to make them thinner than the thickness of the closure plate.

The use of the assembled cross-section for the through flow can also be further improved according to the invention in that at least one of the slots of the closure plate adjoining a guide member is formed as a narrow cut. This step can be used everywhere where a wide slot is not required on the sides of the guide member for the through flow of medium controlled by the valve. The cross-sectional area required for the guide member is then smaller by the width of the slot saved, in which case the area saved can be used for the through flow. The narrow cuts can be produced in accordance with any known method which is suitable for cutting or punching steel plates, in particular after a fusion cutting process, e.g. by means of a gas-driven cutting torch, or with the aid of modern laser technology.

One embodiment of the valve set according to the invention is illustrated in the drawing, in which

Fig. 1 is an axial median section through a valve set, and

Fig. 2 is a corresponding plan view of the closure plate.

The valve set illustrated comprises two seating plates 1 and 2, which are disposed one above the other and are connected to one another with the aid of a central screw 3. The two seating plates 1 and 2 bear directly against one another in the region of a hub 4 of the seating plate 1 provided around the

central screw 3 and in the region of the edge 5. Shim rings or seals could also, however, have been inserted between the two seating plates 1 and 2 in these regions.

Through ducts 6 and discharge ducts 7 are provided in each of the two seating plates 1 and 2. The through ducts 6 in the seating plate 1 shown at the top of Fig. 1 start from a suction chamber 8 and form the suction ducts of the suction valve disposed in the centre of the valve set. On the other hand, the discharge ducts 7 of the seating plate 1 open into an annular compression chamber 9 which surrounds the suction chamber 8 concentrically. The partition wall between the suction chamber 8 and the compression chamber 9 is shown in dash-dot lines and designated 10 in Fig. 1. The compression chamber 9 is bounded on the outside by a closure wall 11 likewise shown in dash-dot lines. The partition wall 10 and the closure wall 11 rest on the upper seating plate 1 with the interposition of seals. The through ducts 6 and the discharge ducts 7 of the seating plate 2 which is at the bottom in Fig. 1 start from or open into the cylinder space of the compressor (not shown).

The through ducts 6, both of the suction valve on the inside and of the compression valve on the outside, are controlled by a common closure plate 12. This is shown in plan view in Fig. 2. It comprises a plurality of concentric rings with slots formed between them. In the centre of the closure plate 12 is provided a closed plate ring 13 to which is joined a one-armed guide rod 14 which extends concentrically thereto and which is anchored on a closed plate ring 15 also following on the outside. Two guide members 16, which in turn end in a closed plate ring 17, extend radially outwards from the plate ring 15. Slots 18, through which the controlled medium can flow, are provided between the plate rings 13, 15, 17 and the guide members 14, 16. The slot adjoining the guide rod 16 on one side is formed as a narrow cut 19.

As shown in Fig. 1, the closure plate 12 jointly provided for both valves is clamped sealingly between the two seating plates 1 and 2 with its plate ring 15 at the transition region 20 from the suction valve to the compression valve. The flexible guide members 14 and 16 project radially inwards and outwards from this clamped ring 15 and form friction-free guides for the complete plate rings 14 and 17 adjoining their ends. Annular recesses 21 and 22 in the seating plates 1 and 2 in each case permit the reciprocating movement of the movable parts of the closure plate 12.

Within the scope of the invention the valve set can differ from the embodiment illustrated. The closure plate 12 illustrated in Fig. 2 can also comprise a plurality of continuous plate rings 13, 17 on each side of the clamped plate ring 15. The guide members 14, 16 can be positioned above through ducts 6 of the

seating plates 1, 2 and can control them, but they can also be made narrower than the continuous rings, such as the guide member 16 in Fig. 2. If the valve set is fitted in a compressor, e.g. between the cylinder and the cylinder head, in such a way that the two seating plates 1 and 2 are pressed firmly against one another, the central screw can be dispensed with. The innermost plate ring 13 of the closure plate 12 can then surround the valve axis even more closely. If necessary, fastening screws, which pass through the common closure plate 12 in the clamping region, for example tie members arranged suspended in the cylinder head, as known *per se*, can also be provided at the clamping positions 20 between the two seating plates 1 and 2.

CLAIMS

- 20 1. A valve set for reciprocating compressors, having a suction valve and a compression valve which are arranged concentrically to one another and comprise two seating plates superposed one above the other and having
25 through ducts, which are controlled by a closure plate which comprises concentric rings with slots formed therebetween and which is guided without friction by flexible guide members, characterized in that a common closure
30 plate (12) is provided for the two valves, the closure plate (12) is clamped sealingly at the transition region (20) from the suction valve to the compression valve by one of its rings (15) between the two seating plates (1, 2), and
35 the flexible guide members (14, 16) are anchored to the clamped ring (15) of the closure plate (12) and extend from the said ring both radially inwards and radially outwards to form a continuous plate ring (13, 17).
- 40 2. A valve set according to Claim 1, characterized in that at least one flexible guide member (14) of the common closure plate (12) is positioned above a through duct (6) of a seating plate (1) and can control it.
- 45 3. A valve set according to Claim 1 or 2, characterized in that at least one flexible guide member (16) of the common closure plate (12) is less wide than the continuous rings thereof (13, 17).
- 50 4. A valve set according to Claim 1, 2 or 3, characterized in that at least one of the slots (18) adjoining a guide member (16) is constructed as a narrow cut (19).