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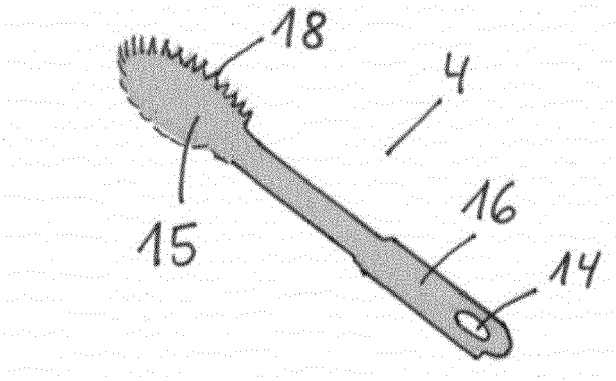
(54) **HOUSEHOLD APPLIANCE WITH A COMPRESSOR CONTAINING A REED VALVE**

(57) The invention relates to a household appliance with a compressor 1 containing a reed valve 4,19, wherein the reed valve 4,19 is a serrated reed valve 4 and/or a valve seat 17 comprises a turbulence reducing structure selected from the group consisting of a porous material, a protuberance or a valve seat serration.

Fig. 5



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Description

[0001] The invention relates to a household appliance with a compressor containing a reed valve.

[0002] Household appliances, in particular air conditioners or refrigerators often contain a compressor with a valve opened and closed to draw or discharge a refrigerant. Often in such a compressor a suction hole for drawing a refrigerant from a suction chamber into a cylinder bore and a discharge hole for discharging a compressed refrigerant from the cylinder bore into a discharge chamber are formed in a valve plate placed between a cylinder head and the cylinder bore, and a suction valve and a discharge valve of a reed valve structure for opening and closing the suction hole and the discharge hole are attached to the valve plate. In this case, a valve seat is in general formed in an outer peripheral portion of each of the suction hole and the discharge hole. When, upon the opening of the valve, a negative suction pressure or a discharge pressure from the cylinder bore increases and is equal to or higher than the valve opening pressure, the valve opens. However, pressure pulsations because of suction pulsations or discharge pulsations occurring at this time increase the noise in the compressor and decrease its efficiency.

[0003] The publication EP 2 685 103 A1 describes a valve device for a compressor, which has a reed valve structure, comprising a valve plate in which a valve hole opened and closed to draw or discharge a refrigerant is formed; a valve seat formed in an outer peripheral portion of the valve hole in the valve plate so as to protrude in a boss shape to a groove formed around an outside thereof; and a valve body having a proximal end connected to the valve plate and a distal end allowed to freely come into and out of contact with a seat surface of the valve seat, wherein the valve seat or a peripheral portion including the valve seat is formed so that a portion corresponding to a distal side of the valve body is reinforced relative to a portion corresponding to a proximal side of the valve body. A noise suppression effect is asserted.

[0004] The publication EP 0 926 345 A2 describes a compressor having a discharge valve mechanism, comprising a valve plate having at least one discharge passage for providing fluid communication between a piston cylinder and a discharge chamber, a discharge valve reed, and a valve retainer, and said at least one discharge passage comprising a first piston cylinder-side opening having an area, a discharge chamber-side opening having an area and a sidewall extending between said openings, wherein at least a portion of said discharge passage sidewall is tapered and wherein said discharge chamber-side opening area is greater than said first piston cylinder-side opening area.

[0005] In view of this situation it is an object of the present invention to provide a household appliance with a compressor containing a reed valve in which a significant noise reduction can be achieved.

[0006] This object is achieved according to the invention with a household appliance having the features of the independent claim. Preferred embodiments of the household appliance are disclosed in the corresponding dependent claims.

[0007] The invention is thus directed to a household appliance with a compressor containing a reed valve, wherein the reed valve is a serrated reed valve and/or a valve seat comprises a turbulence reducing structure selected from the group consisting of a porous material, a protuberance or a valve seat serration.

[0008] "Serrated" means in general that a serrated structure is provided at the edge of the reed valve, in particular the edge of a head part that serves to open and close a discharge opening. The corresponding serration can extend vertically or obliquely from the edge.

[0009] In order to reduce turbulence and therefore noise the shape, height width, inclination of serration, the shape of protuberances and the number or hole diameter of the porous material can be adjusted.

[0010] In the household appliance of the present invention the compressor is not specifically limited as long as it contains a reed valve. The compressor might be for example a reciprocating compressor, a scroll compressor or a rolling piston rotary compressor.

[0011] In a preferred embodiment of the household appliance, the compressor is a rolling piston rotary compressor.

[0012] A household appliance is moreover preferred that comprises a heat pump.

[0013] In general, a household appliance is preferred, wherein the household appliance is selected from the group consisting of a dryer, washer-dryer, dishwasher, air conditioner and residential heat pump. More preferably, the household appliance is a dryer or washer-dryer.

[0014] In a preferred embodiment of the household appliance of the present invention, the reed valve is a serrated reed valve. It is then preferable that a serration on the serrated reed valve is oriented in the direction of a discharge opening.

[0015] The serration applied in the present invention is not particularly limited. A household appliance is however preferred, wherein the serration of the serrated reed valve comprises serration peaks and serration valleys. Preferably, the serration peaks have identical height and the serration valleys have identical depths. The height of the serration peak can be termed 2h and a pitch of the serrated shape, i.e. the base of for example a triangle can be termed λ. In the case of a circular serration edge, the pitch may be termed rotational pitch. The angle defined by two edges that are not fully connected to the reed valve may be termed 2Θ.

[0016] In a preferred embodiment of the household appliance, an angle Φ between a plane defined by the reed valve and the plane in which the serration is located is in the range of from 0 to 60 °.

[0017] In order to reduce noise, the serration height, in particular the height of the triangle (2h), and the other serration parameter mentioned above will be adjusted

for nominal working conditions including pressure, temperature and type of gas/refrigerant.

[0018] The reed valve comprises in general a head part which serves to close the discharge opening and a root part that is fixed to a main body, the valve seat.

[0019] The compressor used in the present invention contains in general a valve reed retainer. Namely, under usual working conditions, pressure increases in a compression chamber of the compressor until the pressure is higher than the force exerted by the valve, in particular higher than the pressure on the other side of the valve reed, which is usually a flat metal sheet, made for example of steel. The serrated valve will open to allow the flow of the discharged gas. The function of the valve reed retainer is to avoid a big distortion of the reed valve. Depending on the working conditions (pressure and temperature of compressed air/refrigerant), the reed valve will lift up more or less and it could happen that a large deflection creates a plastic deformation in the reed valve. The retainer is a stop to prevent a plastic or permanent deformation.

[0020] The valve reed will be lifted and compressed gas/refrigerant will flow through the discharge port at high speed.

[0021] The present invention has the advantage that a household appliance with a compressor containing a reed valve is provided in which a significant noise reduction can be achieved.

[0022] The invention is described in the following in more detail by referring to the attached Figures 1 to 6.

Fig. 1 shows as an example of a compressor which may be used in the present invention a rolling piston rotary compressor in four states of its action.

Fig. 2 shows above in a side view a serrated reed valve that is fixed via a bolt on a valve seat and below a top view of the serrated reed valve.

Fig. 3 shows a side view of a serrated reed valve with a serration inclined by an angle Φ.

Fig. 4 shows in a) an unserrated reed valve according to the state of the art and in b) a serrated reed valve as used in the present invention.

Fig. 5 shows a perspective view of the serrated reed valve shown in Fig. 4 b).

Fig. 6 shows in detail a part of the head part of the reed valve wherein the serration can be seen in detail.

[0023] Fig. 1 shows as an example of a compressor 1 which may be used in the present invention a rolling piston rotary compressor 1 in four states of its action. The rolling piston rotary compressor 1 comprises a cylinder 7 in which a rolling piston 6 is rotated around a crank shaft 8. A cooling agent (here for example air) is introduced via a suction opening 2. 11 indicates the flow direction of the sucked air. The sucked air is transported by the rolling piston 6 in the direction of a discharge opening 3 (see for example A). The eccentric movement of the rolling piston 6 separates the zone of increasing pressure 9 (see B and C) from the sucked air. A flexible arranged vane 5 separates moreover the flows of sucked and discharged air. On the discharge opening 3 a serrated reed valve 4 is provided that is in A in a closed position and in D in an opened position. Accordingly, the compressed air may leave the cylinder in D through the discharge opening 3. 10 indicates the flow direction of the discharged gas.

[0024] Fig. 2 shows in the upper part in a side view a serrated reed valve 4 that is fixed via a bolt 13 on a valve seat 17. 3 means a discharge opening which is here circular. A valve reed retainer 12 protects the serrated reed valve 4 against disturbances which might result in an excessive form change of the serrated reed valve 4. 18 refers to the serration of the reed valve 4. In the lower part of Fig. 2, a top view of the serrated reed valve 4 is shown. The serrated reed valve 4 comprises a head part 15 and a root part 16 with a hole 14 for fixation of the serrated with a bolt that is not shown here. The head part 15 is of essentially circular form and thus adapted to the circular shape of the discharge opening. The serration 18 can be seen here in more detail.

[0025] Fig. 3 shows a side view of a serrated reed valve 4 with a serration 18 at the head part inclined by an angle Φ. 18 refers to the serration, 15 to the head part of the reed valve 14, 17 to the valve seat 17, 3 to the discharge opening.

[0026] Fig. 4 shows in a) an unserrated reed valve 19, i.e. a reed valve without serration, according to the state of the art and in b) a serrated reed valve 4 as used in the present invention. 18 refers to the serration, 15 to the head part of the reed valve 14, and 16 to root part of the reed valve 4.

[0027] Fig. 5 shows a perspective view of the serrated reed 4 valve shown in Fig. 4 b). The reference signs have the same meaning as in Fig. 4 b).

[0028] Fig. 6 shows in detail a part of head part 15 of the serrated reed valve 4 wherein the serration 18 can be seen in detail. The serration 18 is here formed by an essentially triangular structure with equidistant valleys of serration 24 and serration peaks 25. The (rotational) pitch λ, i.e. 23, is the base of a respective triangle. The distance 21 between the base circumference and a serration peak 25 is the length of serration (2h) 21. The angle 2θ 22 is defined by 2 edges that are not fully connected to the reed valve or wing edge. 10 indicates the flow direction of discharged gas.

REFERENCE SIGNS

[0029]

1 compressor; rolling piston rotary compressor
2 suction opening
3 discharge opening
4 discharge valve; serrated reed valve
5 vane
6 rolling piston
7 cylinder
8 crank shaft
9 zone of increasing pressure
10 direction of discharged gas
11 direction of sucked gas
12 retainer; valve reed retainer
13 bolt
14 hole in the reed valve for the bolt
15 head part of the reed valve
16 root part of the reed valve
17 valve seat
18 serration
19 reed valve without serration
20 angle Φ between a plane defined by the reed valve and the plane in which the serration is located
21 length of serration (2h); distance between base circumference and serration peak
22 angle 20 defined by 2 edges that are not fully connected to the reed valve (edge)
23 (rotational) pitch λ of serrated shape, i.e. base of triangle
24 valley of serration
25 serration peak

Claims

1. A household appliance with a compressor (1) containing a reed valve (4,19), **characterized in that** the reed valve (4,19) is a serrated reed valve (4) and/or that a valve seat (17) comprises a turbulence reducing structure selected from the group consisting of a porous material, a protuberance or a valve seat serration.

2. Household appliance according to claim 1, wherein the compressor (1) is a rolling piston rotary compressor.

3. Household appliance according to claim 1 or 2, comprising a heat pump.

4. Household appliance according to any of claims 1 to 3, wherein the household appliance is selected from the group consisting of a dryer, washer-dryer, dishwasher, air conditioner and residential heat pump.

5. Household appliance according to claim 4, wherein the household appliance is a dryer or washer-dryer.

6. Household appliance according to any of claims 1 to 5, wherein the reed valve (4) is a serrated reed valve (4).

7. Household appliance according to claim 6, wherein a serration (18) on the serrated valve (4) is oriented in the direction of a discharge opening (3).

8. Household appliance according to claim 6 or 7, according to which the serration (18) of the serrated reed valve (4) comprises serration peaks (25) and serration valleys (24).

9. Household appliance according to any of claim 7 to 9, wherein an angle Φ (20) between a plane define by the reed valve (4) and the plane in which the serration is located is in the range of from 0 to 60 °.

10. Household appliance according to any of claims 1 to 9, wherein the reed valve (4,19) contains a flat metal sheet or consists of a flat metal sheet.

Fig. 1

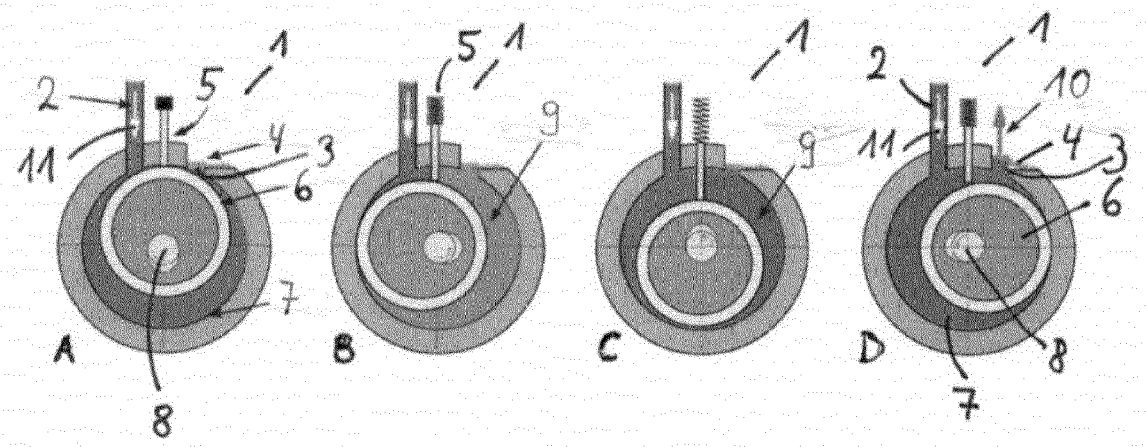


Fig. 2

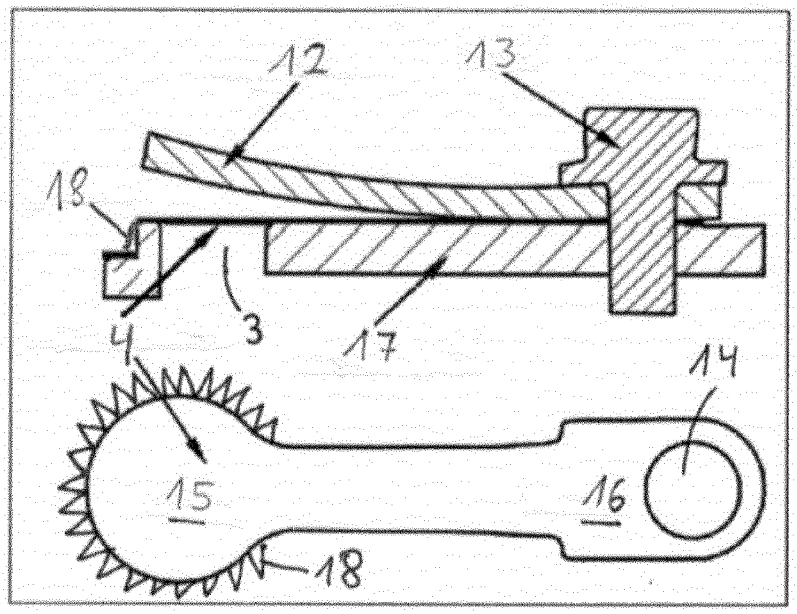


Fig. 3

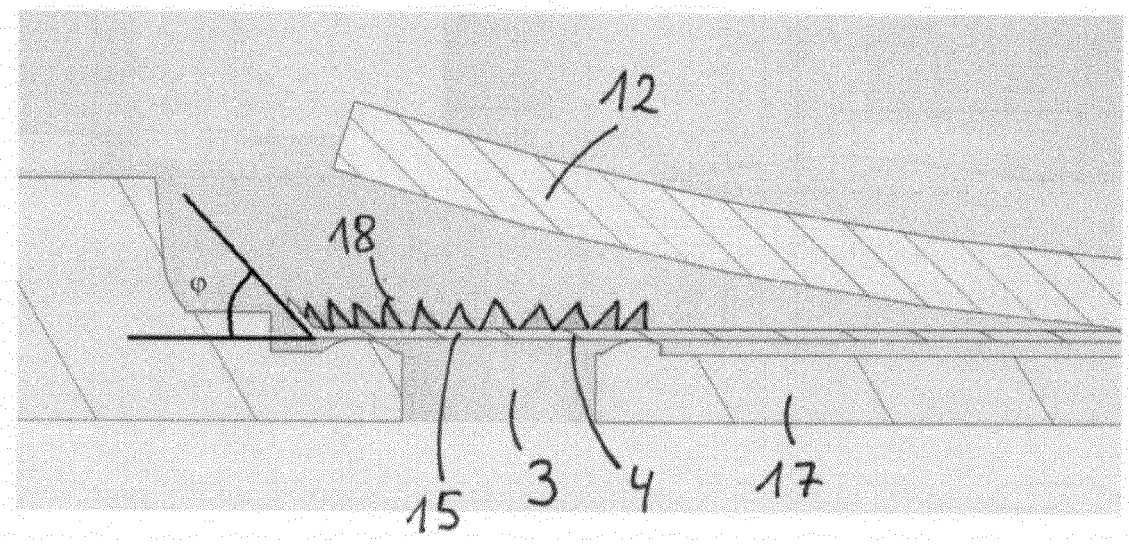


Fig. 4

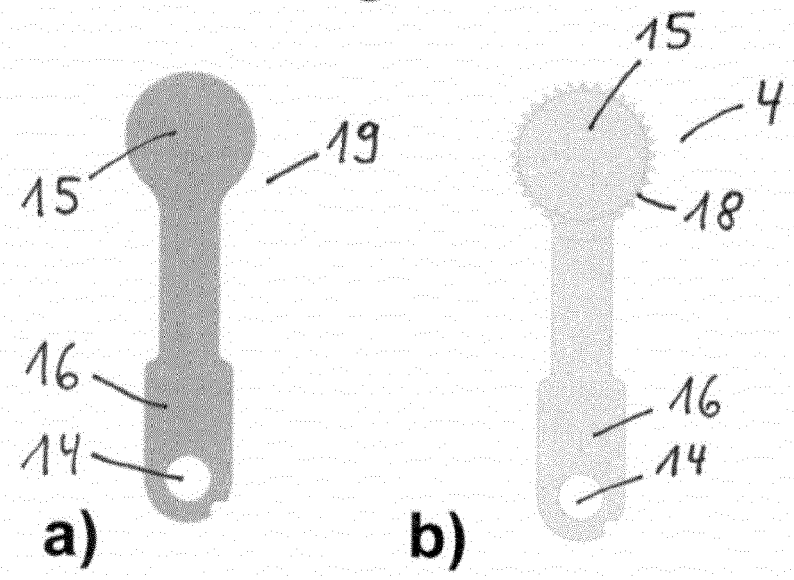


Fig. 5

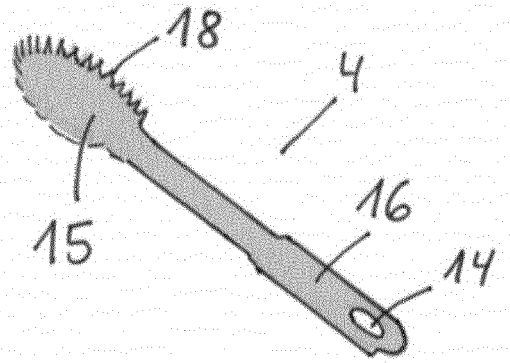
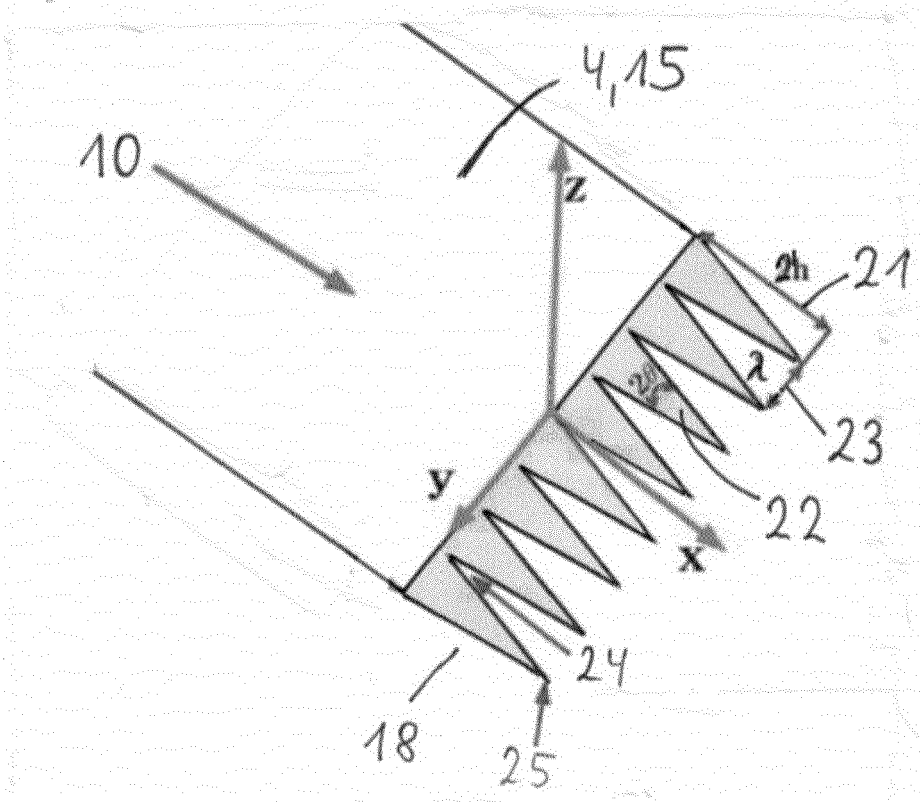


Fig. 6



REFERENCES CITED IN THE DESCRIPTION

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- EP 0926345 A2 **[0004]**