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(54) VALVE FOR REFRIGERATION COMPRESSOR AND APPLICATION HEREOF

VENTIL FÜR EINEN KÜHLKOMPRESSOR UND ANWENDUNG DAVON

SOUPAPE POUR COMPRESSEUR DE RÉFRIGÉRATION ET APPLICATION DE CETTE SOUPAPE

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Description

[0001] The invention relates to a piston based refrigeration compressor with a built-in valve mounted therein, where the piston is moved in a cylinder with a cylinder head, which draws in a coolant via a suction gate, which is separated from the cylinder by an induction valve and after compression presses the coolant out via a pressure gate where the valve includes a partially cylindrical sliding body, which slides in a sleeve, which is placed between the cylinder head and a top of a valve housing.

[0002] The invention also relates to use of the piston based refrigeration compressor.

[0003] In cooling or frost facilities with piston based refrigeration compressors, which move a coolant in a closed circuit with a vaporizer and a condenser, CO_2 based coolants such as R744 are used in still increasing extent.

[0004] Another of these often-used types of coolants is called R 404 A, which is used as example in this patent application, and provides the following characteristics for the refrigeration unit.

[0005] The pressure Po in the vaporizer is 0.6 bar at -35°C.

The pressure Pc in the condenser is 17 bar at + 40°C.

[0006] With the known technique, the above characteristics provide the following functionality in a piston based refrigeration compressor provided with a pressure controlled induction valve in the suction gate where the coolant is added to the compressor and a likewise pressure controlled pressure valve in a pressure gate where the coolant is pressed out of the refrigeration compressor.

[0007] When the piston in the refrigeration compressor moves down and the pressure above the piston becomes lower than Po, which in the example is 0.6 bar, the induction valve opens and the gas from the vaporizer flows through the suction gate into the cylinder above the piston.

[0008] At the time when the piston reaches the bottom and subsequently begins to move up, the pressure in the cylinder is equal to the Po pressure of 0.6 bar.

[0009] When the piston moves up, the pressure increases over the piston and the induction valve closes.

[0010] Since the pressure valve will not open before the pressure is equal to or larger than the Pc pressure of 17 bar, the piston must almost move fully to the top before this occurs.

[0011] Most of the stroke is thus used to balance the pressure between Po and Pc, where the compressor in these phases neither sucks nor presses out coolant.

[0012] JP1262388 A describes the known technique consisting of a valve for a piston based refrigeration compressor, where the piston is moved in a cylinder with a cylinder head, which draws in a coolant via a suction gate, which is separated from the cylinder by an induction valve and after compression presses the coolant out via a pressure gate characterized in that the valve includes a partially cylindrical sliding body, which slides in a sleeve, which is placed between the cylinder head and a top of a valve, where the sliding body is pressed down towards a hole in the cylinder head and where the sleeve is penetrated by an inlet pipe placed near the cylinder head and an outlet pipe placed near the top of the valve.

[0013] In terms of efficiency, it is a drawback of the known technique that such a high part of the stroke is used for pressure equalization instead of moving the coolant in a cooling or freezing facility.

[0014] It is therefore an object of the invention to improve the known technique, which includes piston based refrigeration compressors.

[0015] The object of the invention is achieved by a piston based refrigeration compressor with a built-in valve of the in the introduction to claim 1 stated type, which is characterized in that a spring is mounted between the top of the valve housing and the sliding body, which presses the sliding body down towards a hole in the cylinder head and where an internal valve is placed in the sliding body.

[0016] In this way it thus becomes possible to move the coolant in the cooling system in an enlarged part of the piston's stroke, whereby the efficiency of the refrigeration unit is increased.

[0017] Further appropriate embodiments of the piston based refrigeration compressor are stated in claims 2 to 5.

[0018] As mentioned, the invention also relates to use of the piston based refrigeration compressor.

[0019] It hereby becomes possible to improve the efficiency of refrigeration units with up to 15%.

[0020] Further preferred embodiments of the use appear from claim 7.

[0021] The invention will now be explained more fully with reference to the drawings, in which:

Fig. 1 shows a section of a simplified drawing of the top of a piston based refrigeration compressor with a built-in valve in relation to the invention where the induction valve is open.

Fig. 2 shows a section of a simplified diagram of the top of a piston based refrigeration compressor with a built-in valve in relation to the invention where both the induction valve and the pressure valve are closed and where the built-in valve is on the way up.

Fig. 3 shows a section of a simplified diagram of the top of a piston based refrigeration compressor with a built-in valve in relation to the invention where both the induction valve and the pressure valve are closed and where the built-in valve is on the way up and where the internal valve is opened.

Fig. 4 shows a section of a simplified diagram of the top of a piston based refrigeration compressor with a built-in valve, in relation to the invention, where the

pressure valve is open.

[0022] In fig. 1 is shown a sectional diagram of the top of a refrigeration compressor with a piston 1, which is on the way down, as indicated with the arrow 19.

[0023] The piston 1 slides in a cylinder with a wall 20, where a volume 4 is over the piston.

[0024] The compressor is provided with a suction gate 3, from which coolant from the cooling / freezing unit is sucked into the compressor.

[0025] The suction gate 3 is normally connected to the outlet of the cooling / freezing unit's vaporizer.

[0026] By application of the coolant called R 404 A, the pressure Po in the vaporizer at - 35°C will be 0.6 bar, which will also be the pressure in the suction gate 3.

[0027] Between the suction gate 3 and the piston 1, there is mounted a pressure controlled induction valve 2, which will only open, when the pressure in the volume 4 above the piston 1 is lower than Po.

[0028] The compressor is also provided with a pressure gate 12 from which the coolant from the cooling / freezing unit is pressed out from the compressor.

[0029] The pressure gate 12 is typically connected to the inlet of the cooling / freezing unit's condensator or gas cooler.

[0030] By application of the coolant called R 404 A, the pressure Pc in the condensator will at + 40°C be 17 bar, which thus will also be the pressure in the pressure gate 12.

[0031] Between the pressure gate 12 and the piston 1, there is mounted a pressure controlled pressure valve 11, which will only open, when the pressure in the volume 4 above the piston 1 is larger than Pc.

[0032] In fig. 1 can furthermore be seen, that a built-in valve (5,8,10,13,16,17) is mounted in the suction gate 3.

[0033] The built-in valve (5,8,10,13,16,17) includes a partially cylindrical sliding body 17, which slides in a sleeve 16, which is placed between the cylinder head 21 and the top of a valve housing 22, where a spring 10 is mounted between the top of the valve housing 22 and the sliding body 17, which presses the sliding body 17 down towards a hole 18 in the cylinder head 21 and where an internal valve 8 is placed in the sliding body 17 and where the sleeve 16 is penetrated by an inlet pipe 13 placed near the cylinder head 21 and an outlet pipe 5 placed near the top of the valve housing 22.

[0034] In a preferred embodiment, the sliding body 17, in direction towards the cylinder head 21, is shaped conically and shaped complementary to a conically shaped hole 18 in the cylinder head 21, which the sliding body 17 interacts with.

[0035] From fig. 1 can furthermore be seen that the internal valve 8, which is placed in the sliding body 17, is longer than the sliding body 17 in the sliding body's 17 direction of motion.

[0036] It is furthermore seen that the inlet pipe 13 is provided with a check valve 7 with a flow direction stated with the arrow 14.

[0037] It further appears from fig. 1 that the outlet pipe 5 has outlet in the cylinder head 21 controlled by the compressor's induction valve 2.

[0038] In a preferred embodiment, the inlet pipe 13 is connected to e.g. a liquid undercooler or a pressure drop valve placed between condensator or gas cooler and the vaporizer.

[0039] Hereby, coolant, by a pressure Pe, can be added to the built-in valve (5,8,10,13,16,17).

[0040] With such a system setup, the following functionality of the refrigeration unit is achieved, at the built-in valve (5,8,10,13,16,17) explained from the drawings 1 to 4.

[0041] In fig. 1, the piston 1 is on the way down and the induction valve 2 opens.

[0042] The coolant fumes flow through the inlet gate 3 into the cylinder's volume 4 at the vaporization pressure Po.

[0043] When the induction valve 2 opens, the balancing pipe 5 is simultaneously opened to the top of the built-in valve (5,8,10,13,16,17).

[0044] The piston 1 continues downwards until it reaches the point in the bottom where it turns.

[0045] In fig. 2 the piston 1 moves upwards, the induction valve 2 is closed and the balancing pipe 5 is sealed off.

[0046] The pressure in the cylinder's volume 4 increases and the built-in valve (5,8,10,13,16,17) moves up.

[0047] Hereby, the inlet pipe 13 is opened to the built-in valve (5,8,10,13,16,17) and gas from intercooler-undercooler-Flasch gas or similar flows into the volume 4 through the check valve 7 at the pressure Pe.

[0048] In fig. 3, the piston 1 moves up and the pressure in the volume 4 increases to a pressure, which is larger than the pressure Pe and the check valve 7 closes.

[0049] The built-in valve (5,8,10,13,16,17) moves up further as a result of pressure increase in the volume 4 and the top of the internal valve 8 hits the valve housing 22 and opens.

[0050] The opening of the internal valve 8 can in a preferred embodiment be adjusted with a mounted external adjusting screw.

[0051] The pressure in the volume 4 above the piston 1 and the top of the built-in valve (5,8,10,13,16,17) is balanced by the passage through the now open internal valve (8).

[0052] The built-in valve (5,8,10,13,16,17) closes by help from the balanced pressure and the top spring 10.

[0053] In fig. 4, the piston moves up and the pressure in the volume 4 increases to the condensation pressure Pc.

[0054] The pressure valve 11 opens and the gas leaves the cylinder through the pressure valve 11 and the pressure gate 12.

[0055] The piston 1 reaches the top point, where it turns, and the process repeats itself.

[0056] With the invention, the part of the piston stroke, where coolant is moved by the piston compressor, is in-

creased, with the surprising result that the efficiency and thereby the energy efficiency of the refrigeration compressor is increased with up to 15 %.

Claims

1. Piston based refrigeration compressor comprising a cylinder (20), a piston (1) and a built-in valve (5,8,10,13,16,17), where the piston (1) is moved in the cylinder (20) with a cylinder head (21), which draws in a coolant via a suction gate (3), which is separated from the cylinder (20) by an induction valve (2) and after compression presses the coolant out via a pressure gate (12), where the built-in valve (5,8,10,13,16,17) includes a partially cylindrical sliding body (17), which slides in a sleeve (16), which is placed between the cylinder head (21) and the top of a valve housing (22) for the built-in valve (5,8,10,13,16,17), and where the sleeve (16) is penetrated by an inlet pipe (13) placed near the cylinder head (21) and an outlet pipe (5) placed near the top of the valve housing (22), **characterized in that** a spring (10) is mounted between the top of the valve housing (22) and the sliding body (17), which presses the sliding body (17) down towards a hole (18) in the cylinder head (21) and where an internal valve (8) is placed in the sliding body (17).

2. Piston based refrigeration compressor according to claim 1, **characterized in that** the sliding body (17), in direction towards the cylinder head (21), is shaped conically and shaped complementary to a conically shaped hole (18) in the cylinder head (21), which the sliding body (17) interacts with.

3. Piston based refrigeration compressor according to claim 1 or 2, **characterized in that** the internal valve (8), which is placed in the sliding body (17), is longer than the sliding body (17) in the sliding body's direction of motion.

4. Piston based refrigeration compressor according to one or more of claims 1 to 3, **characterized in that** the inlet pipe (13) is provided with a check valve (7).

5. Piston based refrigeration compressor according to one or more of claims 1 to 4, **characterized in that** the outlet pipe (5) has outlet in the cylinder head (21) controlled by the compressor's induction valve (2).

6. Use of piston based refrigeration compressor according to one or more of claims 1 to 5 in a cooling or frost facility.

7. Use according to claim 6, wherein the coolant is a CO_2 based coolant.

Patentansprüche

1. Kolbenbasierter Kühlkompressor mit einem Zylinder (20), einem Kolben (1) und einem eingebauten Ventil (5, 8, 10, 13, 16, 17), wobei der Kolben (1) in dem Zylinder (20) mit einem Zylinderkopf (21) bewegt wird, der ein Kühlmittel über eine Saugpforte (3) einzieht, die von dem Zylinder (20) durch ein Einlassventil (2) getrennt ist, und das Kühlmittel nach der Kompression über eine Druckpforte (12) hinausdrückt, wobei das eingebaute Ventil (5, 8, 10, 13, 16, 17) einen teilzylindrischen Gleitkörper (17) enthält, der in einer Hülse (16) gleitet, die zwischen dem Zylinderkopf (21) und dem oberen Ende eines Ventilgehäuses (22) für das eingebaute Ventil (5, 8, 10, 13, 16, 17) platziert ist, und wobei die Hülse (16) von einem Einlassrohr (13), das in der Nähe des Zylinderkopfes (21) platziert ist, und einem Auslassrohr (5), das in der Nähe des oberen Endes des Ventilgehäuses (22) platziert ist, durchdrungen wird, **dadurch gekennzeichnet, dass** eine Feder (10) zwischen dem oberen Ende des Ventilgehäuses (22) und dem Gleitkörper (17) montiert ist, die den Gleitkörper (17) nach unten in Richtung auf ein Loch (18) in dem Zylinderkopf (21) drückt, und wobei ein Innenventil (8) in dem Gleitkörper (17) platziert ist.

2. Kolbenbasierter Kühlkompressor nach Anspruch 1, **dadurch gekennzeichnet, dass** der Gleitkörper (17) in Richtung auf den Zylinderkopf (21) konisch geformt und konisch komplementär zu einem konisch geformten Loch (18) in dem Zylinderkopf (21) geformt ist, mit dem der Gleitkörper (17) zusammenwirkt.

3. Kolbenbasierter Kühlkompressor nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das Innenventil (8), das in dem Gleitkörper (17) platziert ist, länger als der Gleitkörper (17) in der Bewegungsrichtung des Gleitkörpers ist.

4. Kolbenbasierter Kühlkompressor nach einem oder mehreren der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** das Einlassrohr (13) mit einem Rückschlagventil (7) versehen ist.

5. Kolbenbasierter Kühlkompressor nach einem oder mehreren der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** der Auslass des Auslassrohres (5) in dem Zylinderkopf (21) von dem Einlassventil (2) des Kompressors gesteuert wird.

6. Verwendung des kolbenbasierten Kühlkompressors nach einem oder mehreren der Ansprüche 1 bis 5 in einer Kühl- oder Gefrieranlage.

7. Verwendung nach Anspruch 6, bei der das Kühlmittel ein Kühlmittel auf CO_2-Basis ist.

Revendications

1. Compresseur frigorifique basé sur un piston, comprenant un cylindre (20), un piston (1) et une soupape intégrée (5, 8, 10, 13, 16, 17), dans lequel le piston (1) se déplace dans le cylindre (20) comprenant une tête de cylindre (21), qui introduit par aspiration un réfrigérant via une grille d'aspiration (3) qui est séparée du cylindre (20) par une soupape d'admission (2) et, après compression, expulse le réfrigérant par pression via une grille de pression (12) ; dans lequel la soupape intégrée (5, 8, 10, 13, 16, 17) englobe un corps coulissant partiellement cylindrique (17) qui coulisse dans un manchon (16) qui est placé entre la tête de cylindre (21) et le sommet d'un logement de soupape (22) pour la soupape intégrée (5, 8, 10, 13, 16, 17) ; et dans lequel un tuyau d'entrée (13) placé à proximité de la tête de cylindre (21) et un tuyau de sortie (5) placé à proximité du sommet du logement de soupape (22) pénètrent dans le manchon (16), **caractérisé en ce qu'**un ressort (10) est monté entre le sommet du logement de soupape (22) et le corps coulissant (17), qui comprime le corps coulissant (17) vers le bas en direction d'un trou (18) pratiqué dans la tête de cylindre (21), et dans lequel une soupape interne (8) est placée dans le corps coulissant (17).

2. Compresseur frigorifique basé sur un piston selon la revendication 1, **caractérisé en ce que** le corps coulissant (17), dans une direction s'étendant vers la tête de cylindre (21), possède une configuration de forme conique et possède une configuration dont la forme est complémentaire à celle d'un trou (18) possédant une configuration de forme conique dans la tête de cylindre (21), qui entre en interaction avec le corps coulissant (17).

3. Compresseur frigorifique basé sur un piston selon la revendication 1 ou 2, **caractérisé en ce que** la soupape interne (8) qui est placée dans le corps coulissant (17) est plus longue que le corps coulissant (17) dans la direction de mouvement du corps coulissant.

4. Compresseur frigorifique basé sur un piston selon une ou plusieurs des revendications 1 à 3, **caractérisé en ce que** le tuyau d'entrée (13) est équipé d'un clapet antiretour (7).

5. Compresseur frigorifique basé sur un piston, selon une ou plusieurs des revendications 1 à 4, **caractérisé en ce que** le tuyau de sortie (5) possède une sortie dans la tête de cylindre (21) réglée par la soupape d'admission (2) du compresseur.

6. Utilisation d'un compresseur frigorifique basé sur un piston selon une ou plusieurs des revendications 1 à 5 dans une installation de refroidissement ou de congélation.

7. Utilisation selon la revendication 6, dans laquelle le réfrigérant est un réfrigérant à base de CO_2.

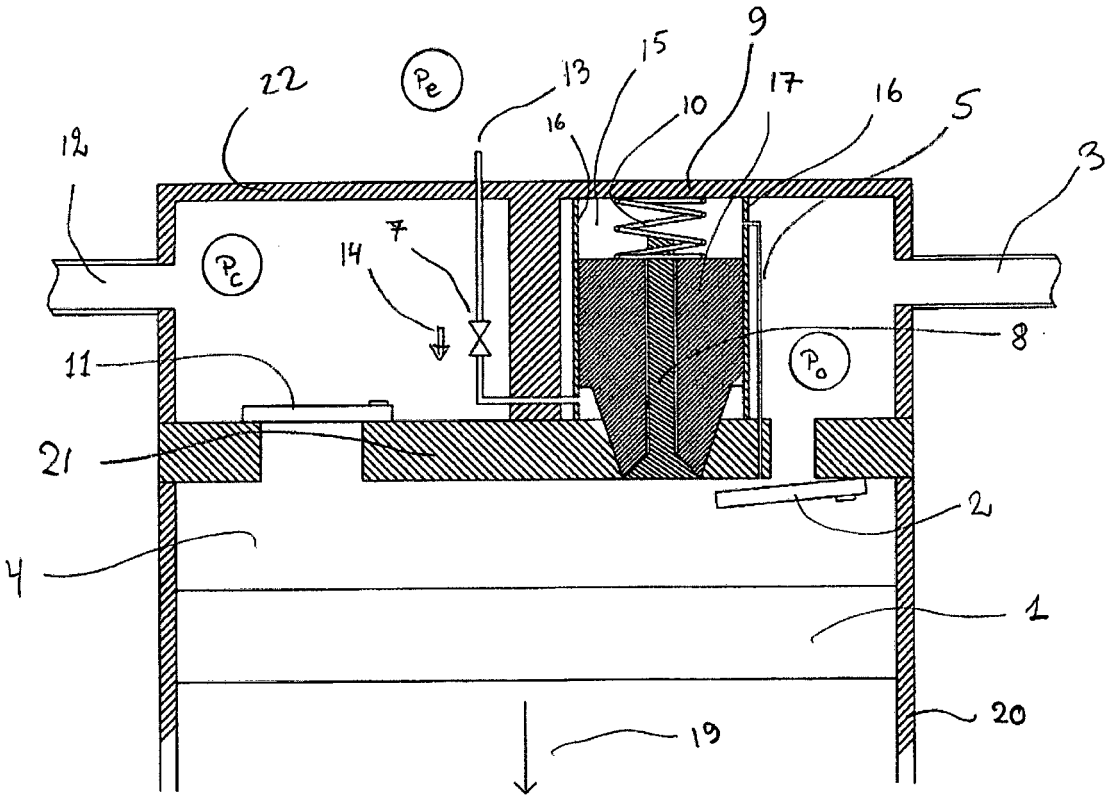
22
Pe
13
15
9
16
10
17
16
5
12
3
Pc
7
14
8
Po
11
21
2
4
1
19
20

Fig.1

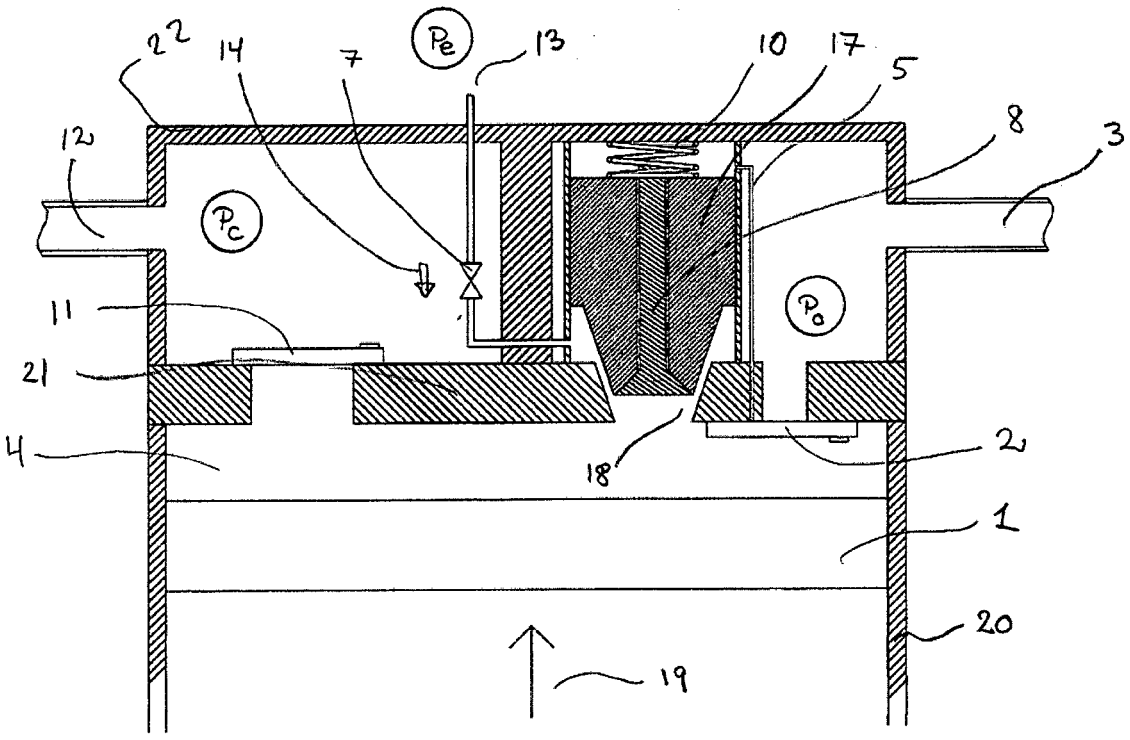
22
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Fig. 2

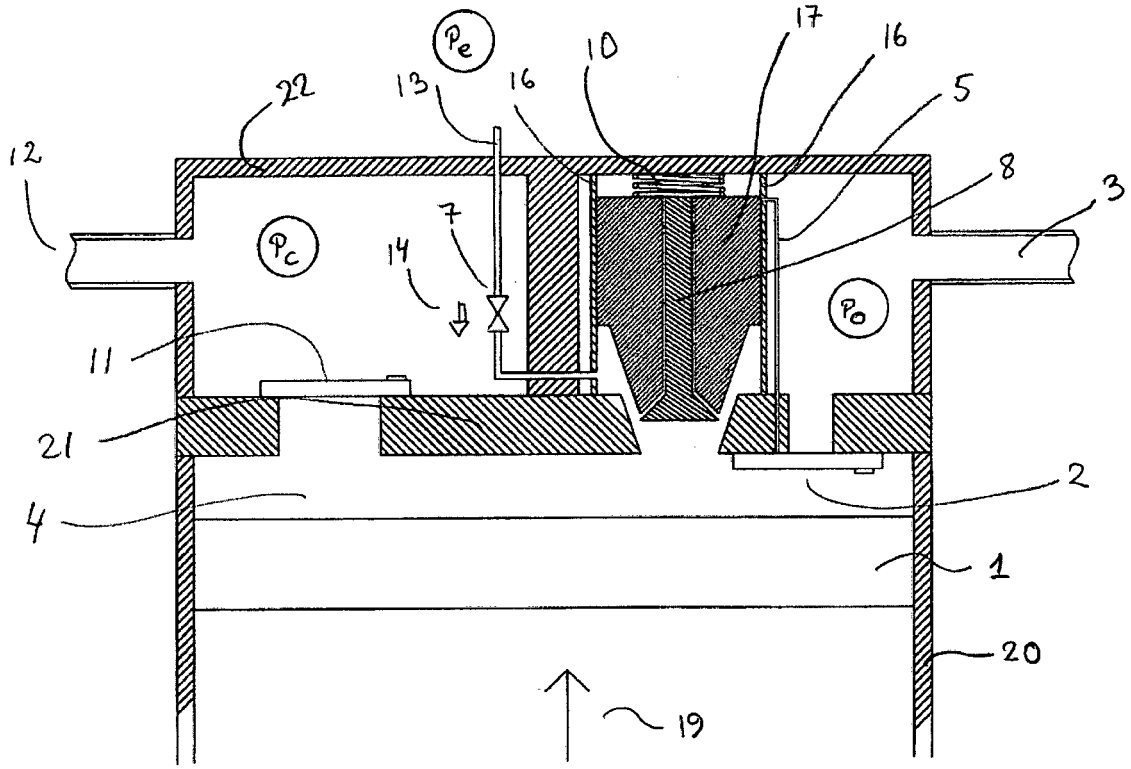
Pe
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Fig. 3

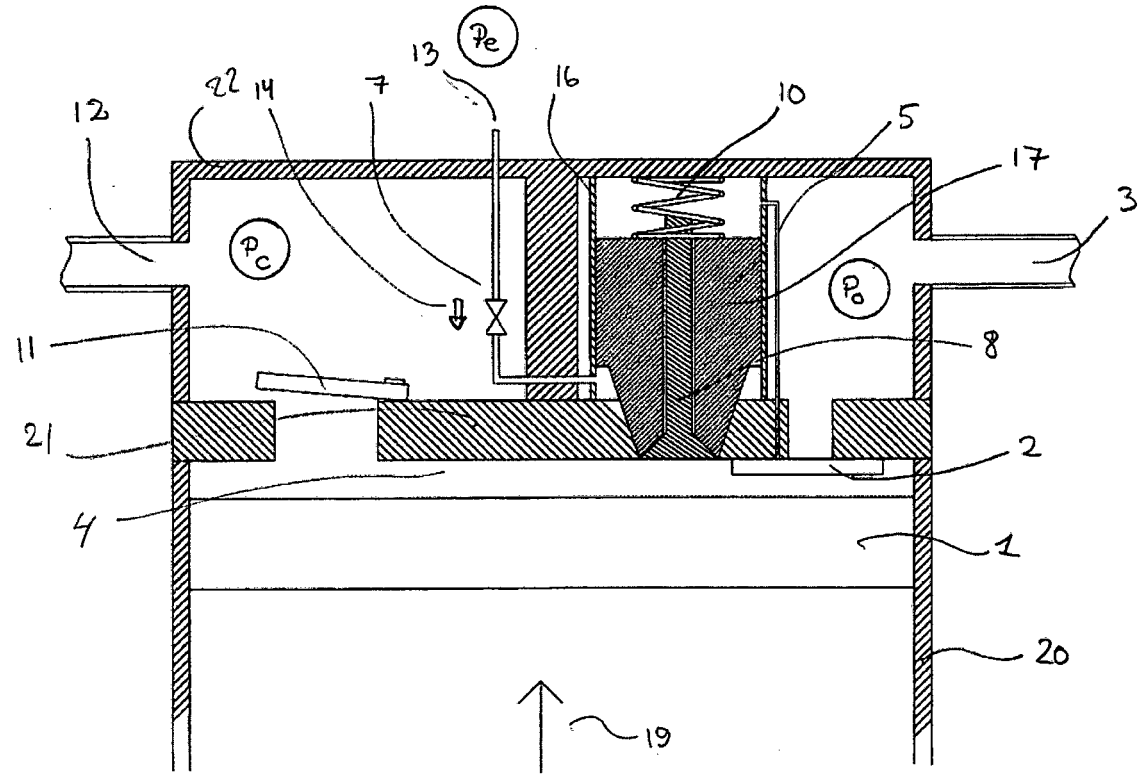
Pe
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Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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