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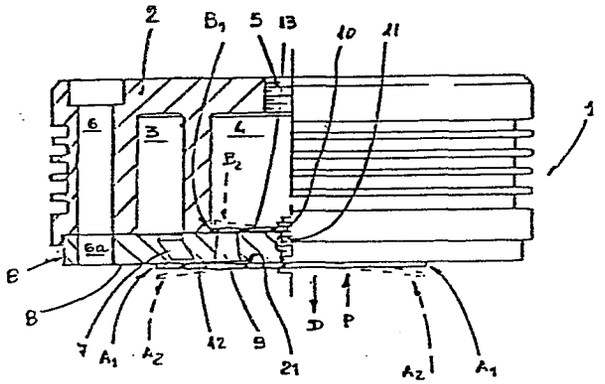
(54) Valve supporting plate for reciprocating engines and in particular for air compressors.

(57) A valve plate (8) for reciprocating engines and in particular for air compressors, which can be mounted on the head (1) of such a machine above the relevant compression chamber; the said head (1) has a first cavity (3) where the air coming from outside is introduced and a second cavity (4) where the compressed air is sent; a single valve plate (12, 13) is provided with first holes (7) connecting the first cavity (3) with the compression chamber and second holes (9) connecting the said chamber with the second cavity (4). A first and second valves (12, 13) have the purpose of controlling the said first and second holes (7, 9), on the side of the said chamber and on the side of the said second cavity (4), respectively.



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VALVE SUPPORTING PLATE FOR RECIPROCATING ENGINES AND IN PARTICULAR FOR AIR COMPRESSORS.

The invention relates to a valve plate with fluid movement which is coaxial to the valve axis and comprises self-acting suction and delivery valves; said plate is suitable for being mounted on the head of reciprocating engines and in particular, but not solely, on air compressor heads.

There exist already heads for this kind of equipment having valve supporting plates, i.e. plates meant to house the suction and delivery valves for the working of the compressor.

The known types of plates are usually made of steel and consist of two parts, the first of which houses the first sections of the first air openings towards the pumping cylinder chamber and the first sections of the second air openings towards the compressed air tank; the second one houses the second sections of the said first and second openings; each first portion ends in a first semi-housing obtained in the said first plate and each second portion comes out from a second semi-housing obtained in the said second plate; the said semi-housing forming in the practice a housing for a check valve, preferably of the steel disc type.

The disadvantages of the known systems are fundamentally the following:

high machining costs of the plates, to ensure the accuracy of the said semi-housings and to achieve a good air tightness between the two plates or a good fitting of air sealing materials, once the two plates have been mounted on the compressor;

remarkable clearance volumes, which lower the volumetric efficiency of the compressor, in particular due to the said second sections of the above-mentioned first and second openings facing the compression chamber;

remarkable lack of stability of the check valves located in the said housings which bring about a rapid wear of the valve seats;

inertia by the valves to move from open to closed position and vice-versa, which causes a reduction of the mechanical efficiency of the compressor.

Finally, the known plates are rather bulky, just because they have a two-piece structure.

This invention is designed to overcome these problems; the invention, such as it is characterized in the claims, solves the main problem of having a valve plate of compact size as compared to the known plates, which can be made by die-casting and whereby the suction and delivery valves are located in such a way so as to make the mounting on the compressor head easier and to improve, during the use, the global efficiency of the compressor itself, by eliminating clearance volumes and especially those which are due to the existence of the said second sections of the said second openings. The overall efficiency is also improved by the response of said valves to the opening and closing impulses.

The advantages achieved with this invention are basically represented by the adoption of a single-piece plate, whereby the suction and delivery valves are automatically operated by the force which the suction or compression pressure exerts on them, which are due to the reciprocating

movement of the compressor piston.

The invention is illustrated in greater detail in the accompanying drawings, which show a non-restrictive manufacturing method, in which:

- Fig. 1 illustrates a general view of the compressor head including a plate according to the present invention, in a mixed sectional and side elevation;
- Fig. 2 is a plan view of the head shown in Fig. 1;
- Fig. 3 shows one of the disc valves which the valve plate is fitted with;
- Fig. 4 illustrates a construction detail of the head according to Fig. 1.

Referring to the drawings 1 and 2, 1 indicates the compressor head which lies, in the practice, on a cylinder which is not illustrated; the head body 2 encloses a ring-like cavity 3 which communicates with the open air or with a suitable vessel fitted with a filter (not shown), by means of known means, for instance a hole, which is also not shown. The head 1 is also provided with a cylindrical cavity 4, from which an adequate piping (not shown), which is screwed into the hole 5, leads the compressed fluid towards the storage tank. The head is also provided with four holes 6, suitable for fastening screws (not shown), which are designed to fix it onto the compressor cylinder.

The head 1 houses a plate 8, which is locked to the body 2 of the said head and to the cylinder, herewith not shown, by means of the said fastening screws; to this purpose the plate 8 is provided with four holes 6a having coincident axes with the said holes 6.

The plate 8 has three holes 7 which connect the ring-like space 3 with the compression chamber; it also has three holes 9, meant to connect the said compression chamber with the cavity 4. The three holes 7 are provided with appropriate slots which form a round circle having its centre in the central point 10 and are symmetrically located with respect to the centre 10; the three holes 9 are provided with appropriate slots which form a round circle having its centre on 10 and a smaller radius as compared to the afore-mentioned round circle; also these slot-shaped openings are symmetrical about the centre 10; the three holes 9 end in a ring-like groove 21, which is to be found on the plate on the side of the said compression chamber. The plate 8 is provided with a central hole 10, suitable for a fastening screw 11 for the two disc-type valves 12 and 13, which are placed on the lower and upper surface of the plate 8, respectively; such hole 10 is fitted with traditional means to avoid any transfer of air to or from the cavity 4.

The disc-type valves 12 and 13 illustrated in Fig. 3 are geometrically similar, but have a different size as the first valve 12 controls the three holes 7 and the second valve 13 controls the three holes 9. Said valves consist of an outer round crown 14, three slots 15, three ribs 16 and a central hole 17, for the fastening screw 11. The round crown 14 of valve 12 has an appropriate dimension so as to lie on the outlet ports of the three holes 7 on the lower side of the plate 8, in order to prevent the air from passing from the compression chamber to the cavity 3, but not vice-versa; the round crown 14 of valve 13 has an

appropriate dimensions so as to lie on the outlet ports of the three holes 9, on the upper side of the plate 8, in order to prevent the air from passing from the cavity 4 to the compression chamber, but not vice-versa.

The valve 12 is mounted in such way that the slots 15 rest on the ring-like groove 21, so as to permit communication between the compression chamber and the holes 9, therefore the three slots 15 of the valve 12 have been made to the required size. The slots of the valve 13 form three ribs in the inner part of the same valve. The purpose of such ribs 16, in both valves, is to make them elastic so that the two crowns 14 of the valves 12 and 13, respectively, are driven away by pressure forces from the outlet ports of the holes 7 and 9 so as to connect the ring-like cavity 3 with the engine compression chamber and the latter with the cavity 4.

It is advisable that the valve 13 has a limited movement under the action of the pressure forces; for this reason a device as shown in Fig. 4 is used, which consists of a disc 18 mounted on a spacer hub 19; the said disc is fixed inside the cavity 4 and is held by the fastening screw 11.

The working of the assembly as shown in the above mentioned drawings can be illustrated as follows:

When the compressor is not working, the two valves 12 and 13 are both lying completely on the lower and upper surface of the plate 8; said positions of the two valves 12 and 13 are indicated in Fig. 1 as A_1 and B_1, respectively.

When the compressor is working, the reciprocating movement of the piston originates alternating pressures in the

compression chamber to be found under the plate 8, and these pressures exert alternating forces on the surfaces which are subject to these forces.

Let us suppose that in a first stage the compressor piston moves downwards; in the compression chamber a suction pressure is established, which causes the surface which is concerned by the force to move in the direction of the arrow D; the result of this action on the members subject to elastic strain is the following: the valve 12 is bent in the position A_2 shown by a dotted line in Fig. 1, so that the outer crown 14 is driven away from the outlet ports of the three holes 7; therefore the air contained in the ring-like space 3 flows into the compression chamber being attracted by the vacuum therein created. The same suction pressure also acts on the crown 14 of the valve 13 which is lying on the outlet ports of the three holes 9; the effect of such depression on the valve 13 is to press it even more on the said outlet ports, thus increasing the tightness of the valve itself.

In a second stage, the compressor piston moves upwards; in the compression chamber a pressure is established, which causes the surface which is concerned by the force to move in the direction of the arrow P; the result of this action on the members subject to elastic strain is the following: the valve 12 returns in the position A_1 as shown in Fig. 1, thus closing the outlet ports of the holes 7; the valve 13 is bent in the position B_2 shown by a dotted line in Fig. 1, whereby the compression chamber can communicate with the cavity 4 which receives the air compressed by the piston; then the air flows through the hole 5.

At this stage the purpose of the ring-like groove 21 is to call the air flow from the compression chamber towards the holes 9 and to avoid the build-up of possible deposits on the face of the plate 8 which is in contact with the valve 12. The two valves 12 and 13 open and close immediately under the action of the suction and compression forces, which cause on the ribs 16 elastic bending and torsional stresses which make the closing of the same valves even more rapid; the instantaneous opening and closing ensure higher mechanical efficiency of the compressor, as compared to the plates which use known valves, as little energy is required to move the valves 12 and 13 in the described directions.

On the other hand, the fact of having restricted the clearance volumes to the holes 9 only, means an increase of the volumetric efficiency as compared to the traditional compressors, since it eliminates the air volume which is pumped into the holes 7 without entering definitely into the compression chamber. The fact that the air flow has a coincident axis with the plate axis enables to obtain a reduction of the plate size and to increase the compressor efficiency, especially when the air outflow speeds are near to critical values. The valve working is very smooth; this eliminates any disturbing noise caused by the knocking of the valves against the seal surface and reduces remarkably the wear of the contact surfaces.

CLAIMS

1) Valve plate for reciprocating engines and in particular for air compressors, designed to be mounted on the head of said compressors above the relevant compression chamber, whereby the said head has a first cavity where the air to be sucked is introduced and a second cavity where the compressed air is sent; the said plate is characterized by the fact of being made of a single body, which is provided with first holes connecting the said first cavity with the engine compression chamber and second holes connecting the said compression chamber with the said second cavity; the plate being fitted with a first and second valve designed to control the outlet ports of the said first and second holes ending in the said compression chamber and in the said second cavity, respectively; the said first and second valve having a structure which is subject to elastic strains by the pressure forces acting inside the compression chamber of the said compressor, in order to open and close the said openings.

2) Valve plate as claimed in Claim 1, characterized by the fact that the said first valve has the purpose of closing the outlet ports of the first holes, so as to eliminate the clearance volume represented by the said first openings, since the valve is placed on the side of the said plate facing the said compression chamber.

3) Valve plate as claimed in Claim 1, characterized by the fact that the first holes are located in a first round circle in the said plate, having its centre in the centre of the said plate, by the fact that the said second holes are

located in the plate in a round circle which is homocentrical with the said first round crown, but it has a smaller radius, and by the fact that the two valves are mounted on the same axis of the said first and of the said second round crown, being the first valve placed on the lower side of the said plate and the second valve on the upper side of the plate.

4) Valve plate as claimed in Claim 1, characterized by the fact that the said plate presents a ring-like groove located on the plate surface facing the said compression chamber and where the said second openings end.

5) Valve plate as claimed in Claim 1, characterized by the fact that each one of the said valves consists of a flat round plate which can be deformed by bending and by twisting; the said first and second valves being fixed in the centre of the said plate on the side of the said compression chamber and of the said round cavity, respectively; the said valves having such a size so as to cover with their own outer crowns the said outlet ports and being characterized by a number of slots, which constitute a structure capable of elastic deformation under the action of the pressure forces existing in the compression chamber.

6) Valve plate as claimed in Claim 1, characterized by the fact that the said first valve has a number of slots suitable to connect, in the practice, the said compression chamber with the said ring-like groove and/or with the said second openings.

7) Valve plate as claimed in Claim 1, characterized by a device capable of limiting the movement of the said second valve.

FIG1

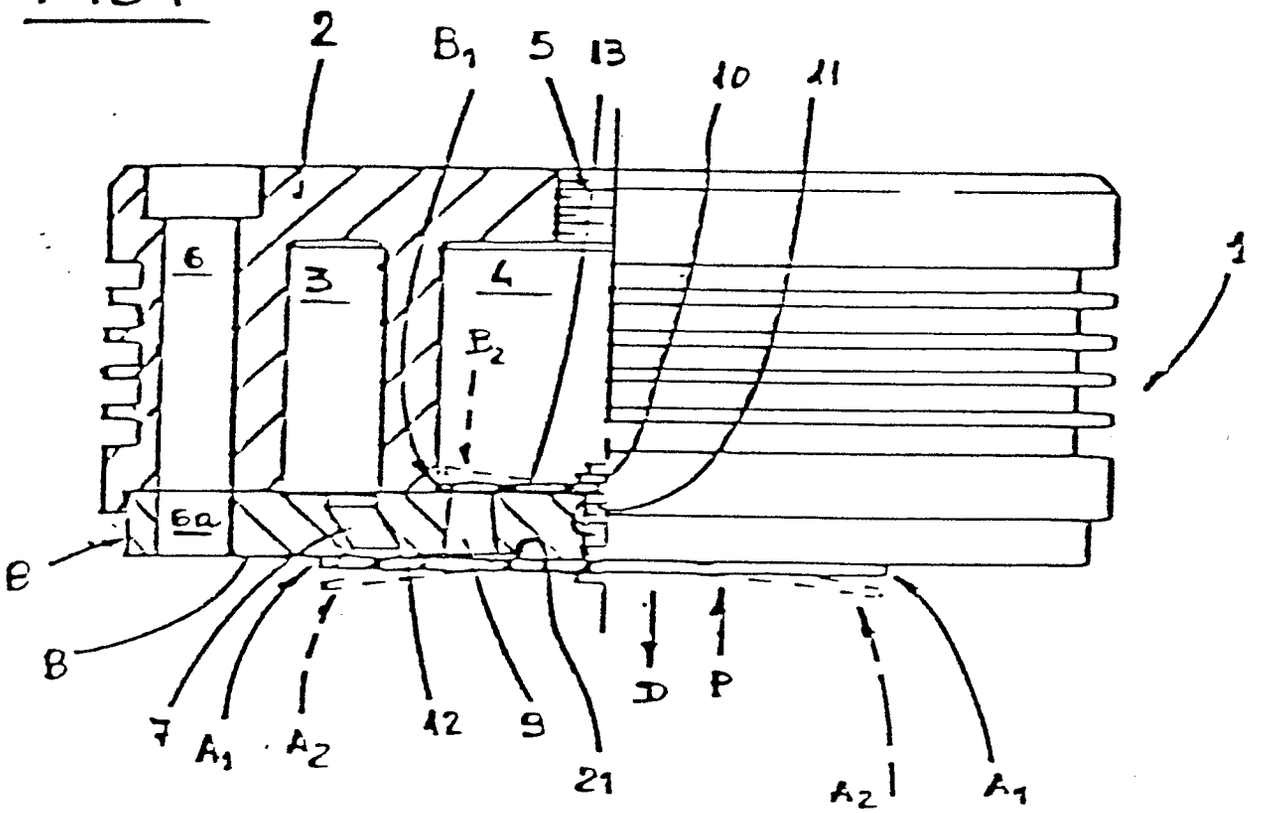

2
B1
5
13
10
11
1
6
3
4
P2
6a
E
B
7
A1
A2
12
9
21
D
P
A2
A1

FIG2

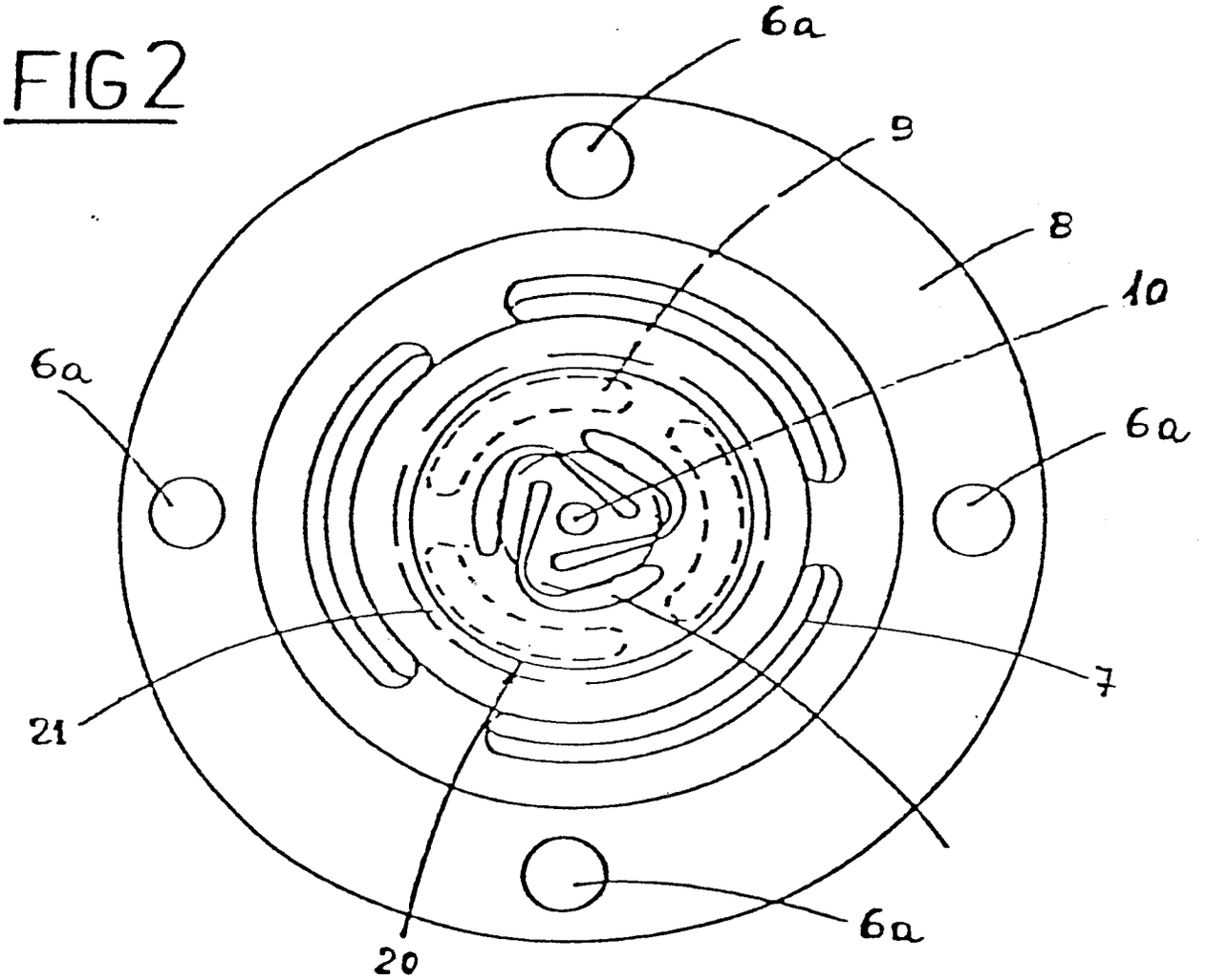

6a
9
8
10
6a
6a
7
21
20
6a

FIG 3

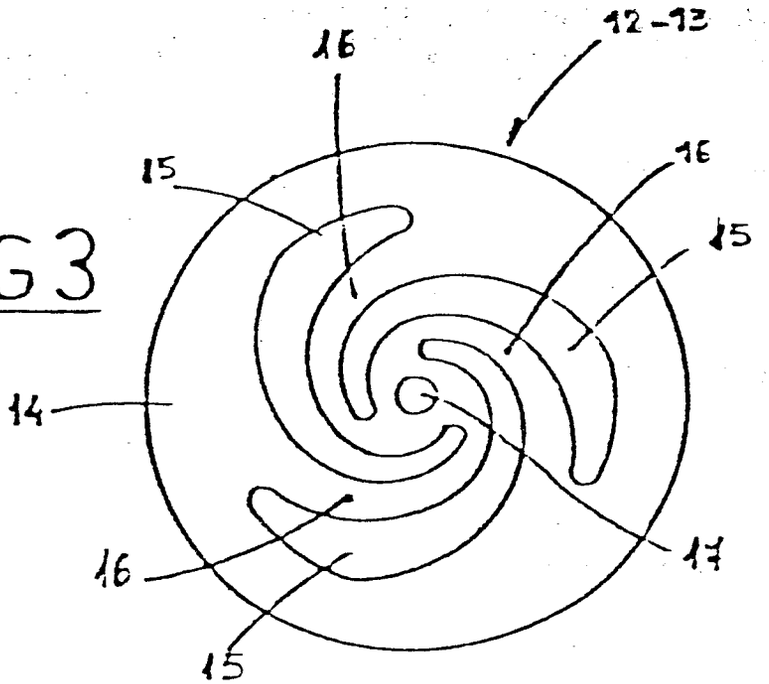
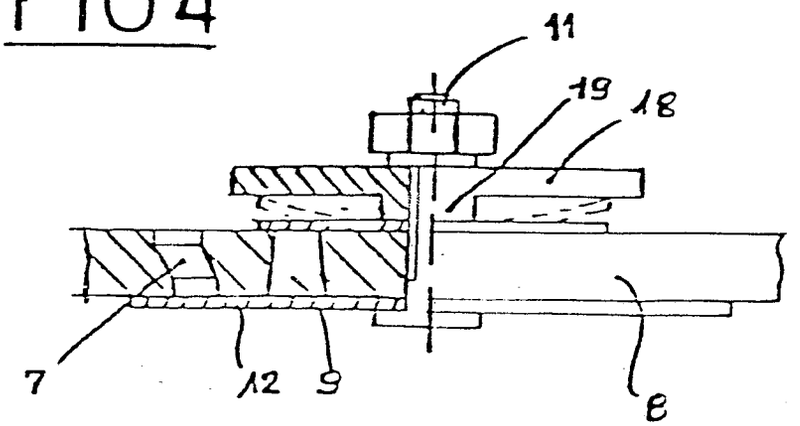


FIG 4



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EUROPEAN SEARCH REPORT

Application number

EP 83830126.5

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X Y	AT - B - 294 295 (ROBERT BOSCH) * Totality *	1 2-7	F 04 B 39/10
Y	CH - A - 365 171 (CARRIER CORPORATION) * Totality * & GB-A-859 927	2-7	
Y	AT - B - 47 158 (GERICKE) * Fig. 3-5; page 2, lines 4-15 *	2,3	

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

F 04 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	21-10-1983	WITTMANN

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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