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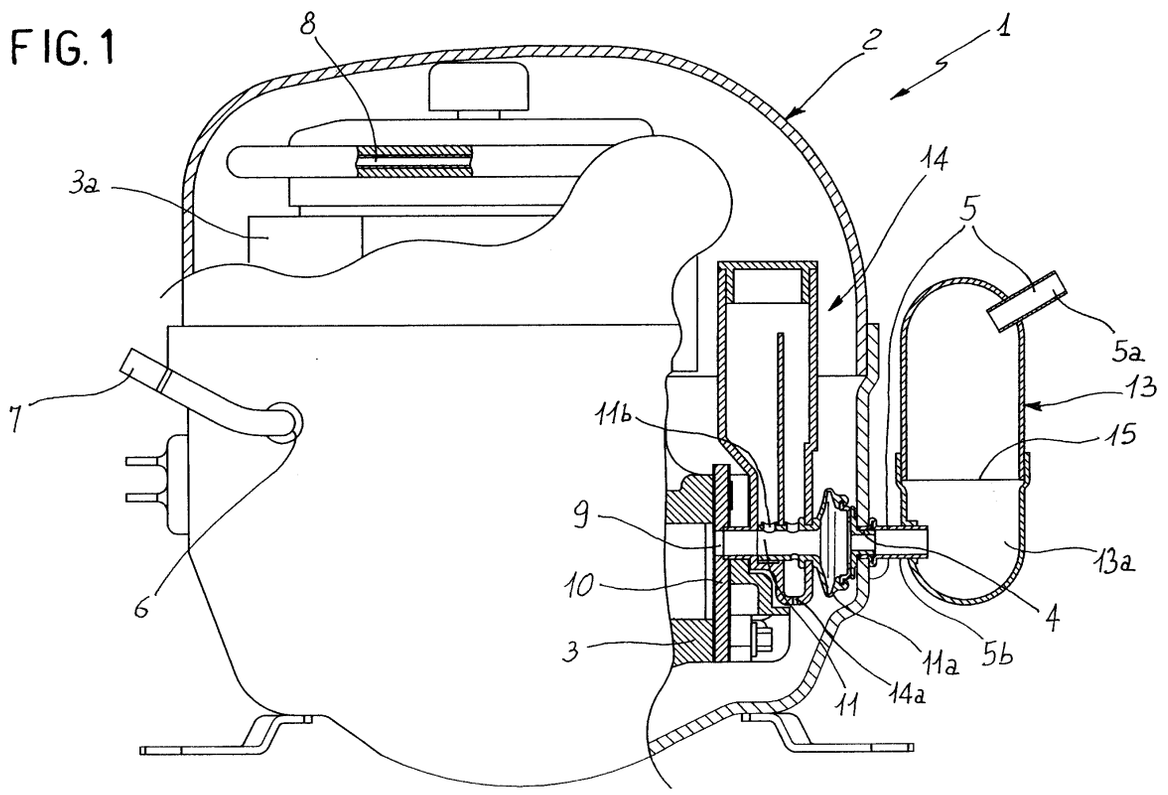
(54) Reciprocating hermetically-sealed motor-driven compressor, in particular for refrigerating apparatuses

(57) A hermetically sealed motor-driven alternating compressor is provided for refrigerating apparatuses and the like comprising a sealed case (2) presenting a first hole (4) connected to an external pipe (5) for the intake of the refrigerating gas and a second hole (6) connected to an external delivery pipe (7), a conduit (11) for directly conveying the gas between the first hole (4) and an intake port (9) positioned on the head (10) of the compressor and elastic means (1 la) able to dampen the transmission of mechanical vibrations between the head of the compressor and the sealed case (2).

FIG. 1



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Description

[0001] The present invention relates to a hermetically sealed motor-driven alternating compressor, particularly for refrigerating apparatuses, comprising a sealed case able to house an electric motor and an alternating compressor and presenting at least a first hole connected to an external pipe for the supply of the refrigerating gas and a second hole connected to an external pipe for the delivery of said gas positioned in continuation of an internal delivery pipe within the case itself.

[0002] As is well known, refrigerating apparatuses are generally fitted with hermetically sealed motor-driven compressors of the alternating type each constituted by an electric motor and by an alternating compressor housed within a hermetically sealed container. The latter presents a first hole connected to an external pipe for the intake of the refrigerating gas and a second hole connected to an external delivery pipe which, in turn, is positioned in continuation of a delivery pipe internal to the case itself.

[0003] The efficiency of a hermetically sealed motor-driven compressor is measured by specific parameters that relate the refrigerating efficiency to electrical consumption. Since international standards currently set out for refrigerating apparatuses a determined number of classes of daily or monthly energy consumption, which in the near future is due to be reduced to the one with the lowest value, it is essential to increase the overall efficiency of hermetically sealed motor-driven compressors.

[0004] To attain this goal, several technical solutions exist aimed at improving both the efficiency of the electric motor and the efficiency of the thermodynamic cycle, defined on the basis of the refrigeration units produced per unit of volume of gas pumped by the compressor.

[0005] The latter's efficiency, and hence the thermodynamic efficiency, can be improved by maintaining the temperature of the intake gas at the lowest possible levels. For this purpose, currently adopted techniques propose to reduce as far as possible the absorption of heat by the flow of gas coming from the external intake pipe and headed, as soon as it enters the hermetically sealed case, towards the inlet port positioned on the head of the compressor cylinder.

[0006] This flow of gas tends to increase its temperature due to the presence, within the hermetically sealed case, both of the warm walls of the compressor and of the motor, and of warm gas.

[0007] A first known technique called semi-direct intake provides for the use inside the sealed case of an intake plenum connected in correspondence with its outlet directly to the input port of the compressor cylinder and presenting an inlet that opens in proximity to the hole of the case whereto the external intake pipe is connected.

[0008] The intake plenum is subdivided into chambers and gas passages duly dimensioned according to the resonator and/or silencer technique and it serves the purpose of reducing the noise level due to the pressure waves or pulsations that are transmitted through the intake gas.

[0009] In practice the gas coming from the intake pipe must travel a short route without any canalisation before being taken in by the inlet of said intake plenum.

[0010] However, it has been observed that in the short distance between the intake plenum and the external intake pipe a partial dispersion of the gas occurs inside the sealed case and the gas mixes with the warm gas that is present therein.

[0011] The Applicant has further perceived that the chambers and the passages of said intake plenum determine both a head loss, i.e. a pressure loss, of the gas and a prolongation of the route of the intake gas in an environment that is not adequately insulated from the warm space inside the case of the motor-driven compressor.

[0012] The intake gas tends therefore to raise its own temperature to the detriment of the efficiency of the thermal cycle, thereby partially cancelling the benefits that might be obtained with semi-direct intake.

[0013] A second known technique called direct intake, partly overcomes the first of the drawbacks described above with reference to semi-direct intake, sending the gas directly into the inlet of the intake plenum through an elastically yielding tubular connecting element, interposed between said intake plenum and the wall of the case in correspondence with the hole connected to the external intake pipe. The elastic yielding quality of the connecting element prevents the transmission of vibrations of the compressor to the external case.

[0014] However, this second known technique still retains the other drawbacks of semi-direct intake and hence does not allow to reach optimal conditions for the delivery of the gas into the compressor cylinder.

[0015] In this situation, the technical task set at the basis of the present invention is to devise a hermetically sealed motor-driven compressor for refrigerating apparatuses able substantially to overcome the aforementioned drawbacks.

[0016] Within said technical task, an important aim of the invention is to devise a hermetically sealed motor-driven compressor that allows to minimise the transmission of heat to the intake gas obtaining, for the latter, temperatures considerably lower than those observed in the known technical techniques with semi-direct and direct intake.

[0017] A further important aim of the invention is to devise a hermetically sealed motor-driven compressor that substantially reduces the head losses of the intake gas upstream of the inlet port placed on the head of the compressor cylinder.

[0018] The technical task set out and the specified aim are substantially reached by a hermetically sealed alternating motor-driven compressor that is characterised in that it comprises a conduit for directly conveying

the gas between said first hole and an intake port positioned on the head of the compressor and in that said direct conveyance conduit comprises elastic means able to dampen the transmission of mechanical vibrations between the head of the compressor and of the sealed case.

[0019] The description of a preferred but not exclusive embodiment of a hermetically sealed alternating motor-driven compressor according to the invention is now provided purely by way of indicative and non limiting example, illustrated in the accompanying drawings wherein:

- Figure 1 shows a partially sectioned view along a vertical plane of a motor-driven compressor in accordance with the present invention; and
- Figure 2 highlights an enlarged portion of a partial section of Figure 1.

[0020] With reference to the mentioned figures, the hermetically sealed alternating compressor according to the invention is globally indicated with the number 1.

[0021] It comprises a sealed case 2 able to house an electric motor 3a and an alternating compressor 3 known in itself and thus only partially shown.

[0022] The sealed case 2 presents a first hole 4 connected to an external pipe 5 for the intake of the refrigerating gas and a second hole 6 connected to an external delivery pipe 7 positioned in continuation of a delivery pipe 8 internal to the case 2 itself.

[0023] Originally between the first hole 4 and an intake inlet port 9 positioned on the head 10 a pipe 11 for directly conveying the gas extends, able to serve the function of directly injecting the gas in the compressor 3 thereby minimising the route from the external intake pipe 5 to said intake port 9, i.e. inside the sealed case 2.

[0024] The conveying conduit 11 comprises elastic means 11a able to dampen the transmission of mechanical vibrations between the head of the compressor 10 and the sealed case 2. Said elastic means 11a are defined by an elastic bellows portion of the conveying conduit 11 itself which engages a junction element 12 integrally engaged to the case 2 in correspondence with the first hole 4.

[0025] The reduction of the noise due to the pulsations of the intake gas is preferably effected both by first means 13 for damping the pulsations positioned externally to the case 2 in correspondence with the intake pipe 5, and by second damping means 14 positioned internally to the case 2. The first means 13 for damping the pulsations comprise a plenum 13a for the expansion of the intake gas connected in series along the intake conduit 5.

[0026] The intake conduit 5 presents a first section 5a ending in the expansion plenum 13a and a second section 5b extending from a lower area of the plenum itself to connect to the direct conveying conduit 11 through the first hole 4.

[0027] Inside the expansion plenum 13a, a metallic reticular element 15 with very fine mesh is provided, able not only to serve as an oil separator by retaining the oil particles suspended in the refrigerating gas, but also to dampen the pulsations of the intake gas reducing its noise level and the repercussions on the intake line of the refrigerating system.

[0028] The oil collected in the reticular element 15 is taken from the plenum 13a to the lower part of the case 2 where it is normally present for the lubrication of the motor-driven compressor.

[0029] The second pulsation-damping means 14 are defined by at least one acoustic resonator, more specifically a Helmholtz resonator, positioned to the side of the direct conveyance conduit 11. The latter presents lateral holes 11b communicating with the resonator 14 and able to allow the passage of the acoustic waves due to the pulsations of the intake gas. In practice, the intake gas traverses the conduit 11 without mixing with the warm gas contained inside the Helmholtz resonators. The only sound waves that penetrate and are damped therein are those whose frequencies correspond with those, coinciding with the frequencies produced by the compressor 3, for which the resonator is designed. Moreover, the Helmholtz resonator presents at the bottom one or more discharge holes 14a whose function is both to discharge any oil that may be present within it and to prevent the cavities defined by the resonators themselves, due to the pressure difference created by the "Pitot" effect through the lateral holes 11b of the conveying conduit 11, from being partially emptied of the gas contained therein, thus reducing the effectiveness of the acoustic damping.

[0030] Lastly, in order further to reduce the heating of the intake gas, means 16 for thermally insulating the internal delivery pipe 8 are provided, able to reduce the exchange of heat between the delivery pipe 8 itself heated internally by the compressed gas, and the gas present within the case 2 which in turn conditions, albeit to a limited extent, the temperature of the intake gas from the cylinder of the compressor 3 through the direct conveyance conduit 11.

[0031] The invention attains important advantages.

[0032] The direct conveyance conduit, minimising the route of the intake gas between the external intake pipe and the inlet port in the head of the compressor, allows to minimise heat transfer from the internal space of the case 2 to the intake gas itself and, thus, to maintain the temperature low.

[0033] Moreover, the use of the expansion plenum on the intake line externally to the case of the motor-driven compressor allows to contribute to the reduction of the noise of the intake gas preventing the latter, upstream of the inlet port in the compressor head, from having to pass through the tortuous path of a traditional intake plenum constituted by one or more acoustic resonators.

[0034] In the motor-driven compressor in question, the acoustic resonators are branched off with respect to

the direct conveyance conduit and therefore the flow of the intake gas does not undergo the head losses and the heat exchanges that take place, on the contrary, in the prior art.

[0035] Lastly, it should be stressed that the thermal insulation of the internal delivery pipe contributes to maintain lower the temperature of the gas that stays in the sealed case and, thus, further to reduce thermal exchanges with the intake gas through the direct conveyance conduit.

Claims

1. Hermetically sealed motor-driven alternating compressor, particularly for refrigerating apparatuses comprising a sealed case (2) able to house an electric motor and an alternating compressor (3) and presenting at least a first hole (4) connected to an external pipe (5) for the intake of the refrigerating gas and a second hole (6) connected to an external pipe (7) for the delivery of said gas positioned in continuation of a delivery pipe (8) internal to the case (2) itself,
characterised in that it comprises a conduit (11) for directly conveying the gas between said first hole (4) and an intake port (9) positioned on the head (10) of the compressor (3) and in that said conveying conduit (11) comprises elastic means (11a) able to dampen the transmission of mechanical vibrations between head (10) of the compressor (3) and said sealed case (2).

2. Motor-driven compressor according to claim 1, characterised in that it comprises externally to said case (2) in correspondence with the external intake pipe (5) first means (13) for damping the pulsations of the intake gas to reduce its noise level.

3. Motor-driven compressor according to claim 1 or 2, characterised in that it comprises internally to said case (2) second means (14) for damping the pulsations of the intake gas to reduce its noise level.

4. Motor-driven compressor according to claim 2, characterised in that said first pulsation-damping means (13) comprise at least a plenum (13a) for the expansion of the intake gas.

5. Motor-driven compressor according to claim 4 characterised in that, internally to said expansion plenum (13a) at least a reticular element (15) is provided to separate oil particles suspended in the refrigerating gas and dampen the pulsation of the intake gas.

6. Motor-driven compressor according to claim 4, characterised in that said expansion plenum (13a) is connected in series along the external intake pipe (5).

7. Motor-driven compressor according to claim 3, characterised in that said second damping means (14) comprise at least an acoustic resonator positioned laterally to the conveying conduit (11), said conduit presenting at least a lateral hole (11b) in communication with the acoustic resonator (14) to allow the passage of the acoustic waves due to the pulsation of the intake gas.

8. Motor-driven compressor according to claim 7, characterised in that said acoustic resonator (14) presents at least a discharge hole (14a) positioned at the bottom.

9. Motor-driven compressor according to claim 1, characterised in that said elastic means (15a) are defined by an elastic bellows portion of said direct conveyance conduit (11).

10. Motor-driven compressor according to claim 1 characterised in that it further comprises means for the thermal insulation (16) of said delivery pipe (8) internal to the sealed case (2) to reduce the heat exchange between the delivery pipe (8) itself and the gas contained in the case (2).

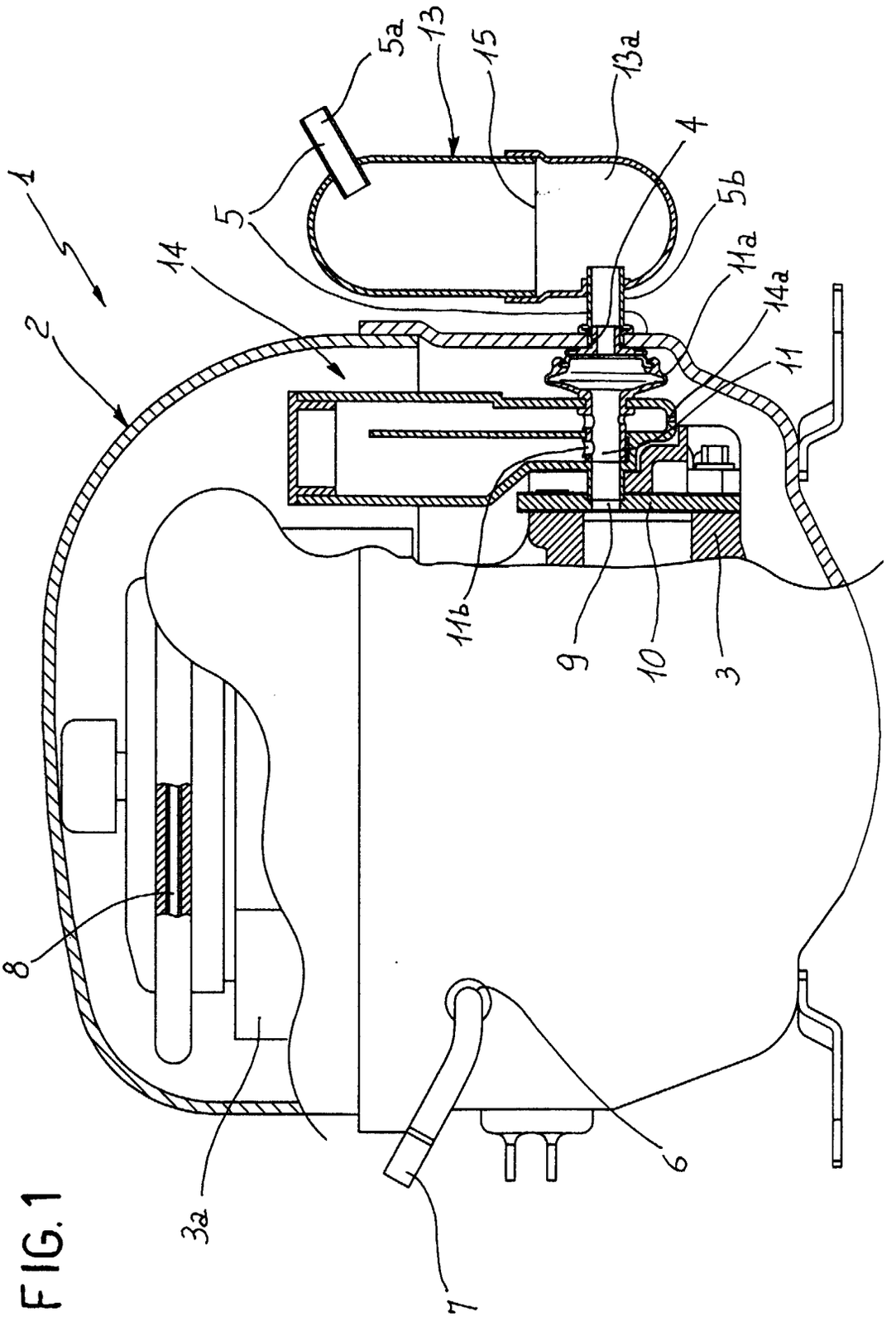

FIG.1

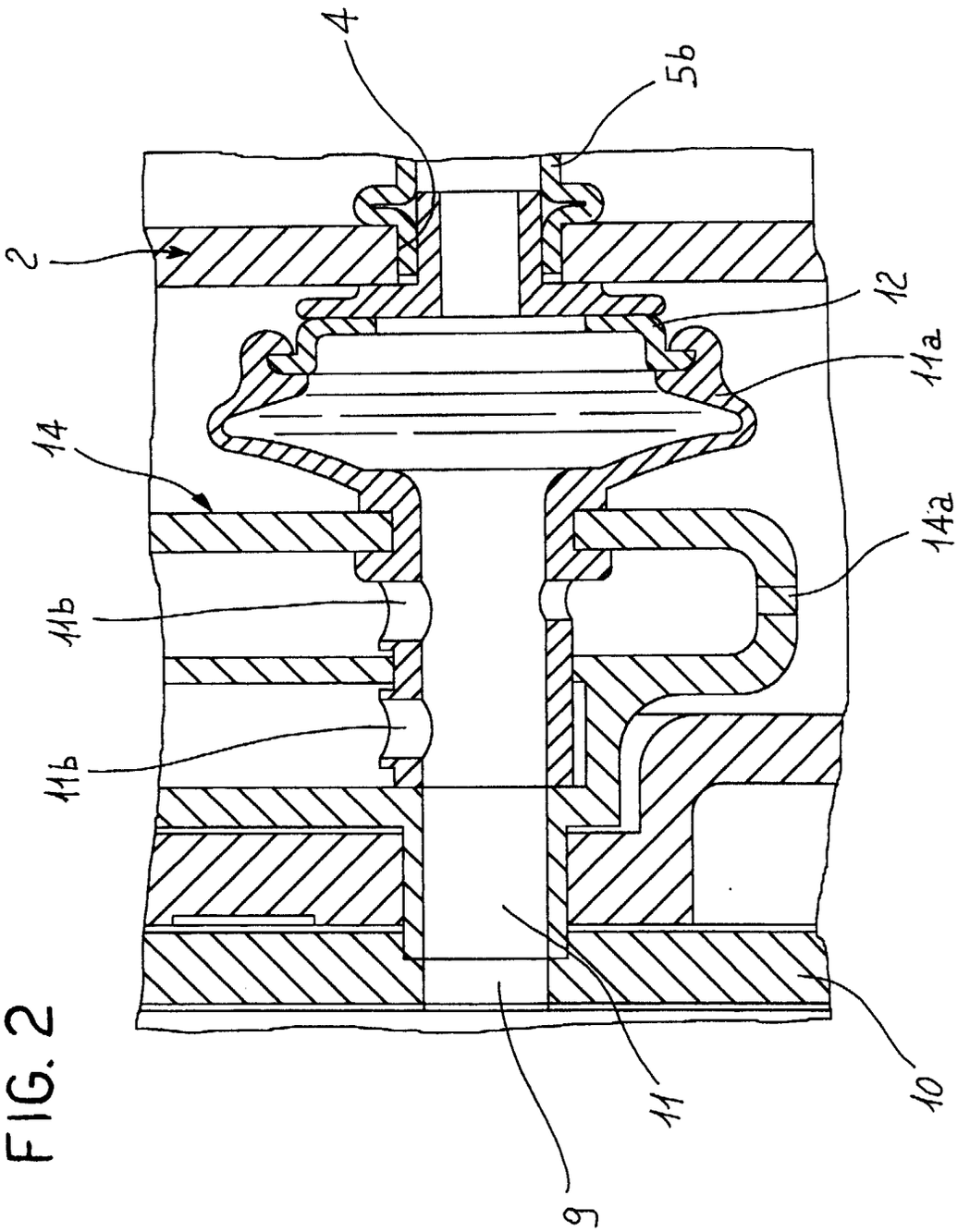

FIG. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 99 83 0102

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION
X	WO 97 43546 A (BRASIL COMPRESSORES SA ;LILIE DIETMAR ERICH BERNHARD (BR); TODESCA) 20 November 1997 (1997-11-20) * page 7, line 16 - page 9, line 24; figures 3,4 *	1,2,4,9	F04B39/12 F04B39/00
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A	* column 2, line 7 - line 35; figure 1 *	4-6	
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			TECHNICAL FIELDS SEARCHED
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 July 1999	Bertrand, G

CATEGORY OF CITED DOCUMENTS

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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