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(54) Compressor with at least one compressor stage and a moisture separator

(57) Compressor with at least one compressor stage and a moisture separator, whereby the compressor stage contains a housing (1) provided with an inlet (16-17-18) for gas to be compressed and an outlet (21) and at least two cooperating compressor elements (2 and 3) mounted in this housing (1) of which at least one is a rotating element, characterized in that the inlet (16-17-18) of the compressor stage is practically sealed by a fast rotating body (19) made of cellular material with open cells which has a sufficiently low flow resistance for the gas to be compressed in order to let the gas through, but which retains moisture particles and other particles and flings them away radially, which body (19) is incorporated in the housing (1).

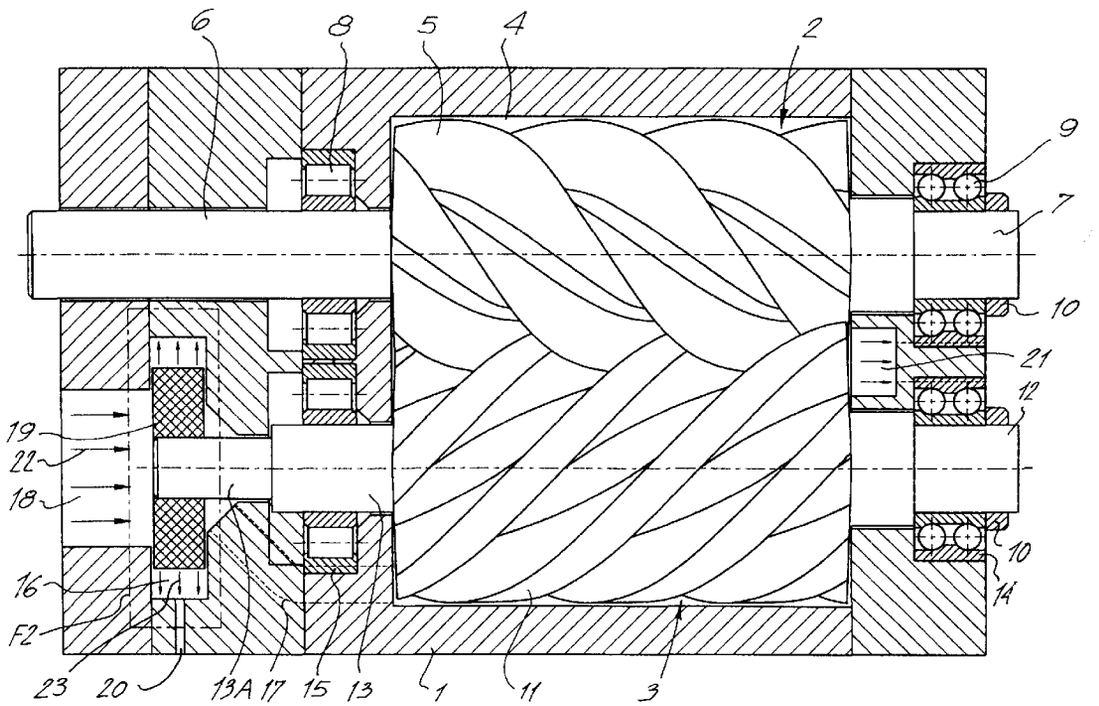

Fig. 1

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Description

The present invention concerns a compressor with at least one compressor stage and a moisture separator, whereby the compressor stage contains a housing provided with an inlet for gas to be compressed and an outlet and at least two cooperating compressor elements mounted in this housing of which at least one is a rotating element.

In a multi-stage compressor, the gas which is compressed by a compressor stage and which is heated by this compression, is cooled in an intercooler. During this cooling, the moisture which is present in this gas is condensed in the shape of moisture particles which are carried along by the gas to the next compressor stage.

In order to prevent that these moisture particles end up in the next compressor stage, a moisture separator is usually placed between the intercooler and the subsequent compressor stage in the known compressors.

However, these separate moisture separators occupy a lot of space, they are relatively expensive and have a limited separation output.

Also, before the first compressor stage or in the case of a single-stage compressor, a moisture separator is placed before this stage when moisture may be present in the gas to be compressed.

The present invention aims a compressor which excludes the above-mentioned and other disadvantages and which makes it possible to efficiently separate moisture from the gas to be compressed with a simple, compact design and in a relatively cheap manner.

This aim is reached according to the invention in that the inlet of the compressor stage is practically sealed by a fast rotating body made of cellular material with open cells which has a sufficiently low flow resistance for the gas in order to let the gas through, but which retains moisture particles and other particles and flings them away radially, which body is incorporated in the housing.

Such bodies are already used for separating water from a flow of air, but in individual separators.

The body may be driven by the flow of gas itself or by an external source of power, but preferably the inlet extends over a shaft with which the rotating compressor element is bearing-mounted in the housing, and the body is fixed to this shaft.

At the height of said body, the inlet may have a widening forming a chamber in which the flung-away moisture is collected.

In order to better explain the characteristics of the invention, the following preferred embodiment of a compressor with at least one compressor stage and a moisture separator according to the invention is described as an example only without being limitative in any way, with reference to the accompanying drawings, in which:

figure 1 schematically represents a section of one stage of a compressor according to the invention;

figure 2 represents the part which is indicated with F2 in figure 1, but with reference to another embodiment.

Figure 1 shows a compressor stage of a screw-type compressor which mainly consists of a housing 1 in which two cooperating compressor elements 2 and 3 formed of helical rotors are mounted in a rotatable manner.

In view of the design, the housing 1 consists of various parts which are fixed to one another by means of for example bolts.

The housing 1 circumscribes an inner space 4 in which the rotating compressor elements 2 and 3 are situated.

The rotating compressor element 2 consists of a helical body 5 which is axially provided with a shaft 6, 7 respectively, on both ends.

The shaft 6 is supported on a bearing 8 which is mounted in the housing 1 and it is connected to a driving motor which is not represented in figure 1, either directly or by means of a transmission.

The shaft 7 is bearing-mounted in a ball bearing 9 which is incorporated in the housing 1. On the outside of this ball bearing 9, a ring 10 is clamped on the shaft 7.

In an analogous manner, the rotating compressor element 3 contains a helical body 11 and a shaft 12, 13 respectively on both ends thereof.

On one side, the shaft 12 is bearing-mounted in a ball bearing 14 which is fixed in the housing 1. A clamping ring 10 is also clamped on the outside of said ball bearing 14 on the shaft 12.

On the other side, the shaft 13 is bearing-mounted in a bearing 15 which is also incorporated in the housing 1.

This shaft 13 extends with an elongated end 13A past the bearing 15, namely in a chamber 16 which is formed in an end wall of the housing 1 and which is part of the inlet 16-17-18 which thus extends over the shaft 13.

The part 17 of the inlet connects the chamber 16 to the low-pressure side of the room 4, whereas the part 18 of the inlet, which has a smaller cross section than the chamber 16, connects this chamber 16 to the outside of the housing 1.

In the chamber 16 is fixed a body 19 in the shape of a round disc, made of cellular material with open cells, on the elongated end 13A of the shaft 13.

The diameter of the body 19 is smaller than the diameter of the chamber 16 but larger than the diameter of the part 18 of the inlet 18-19-20, which is almost entirely sealed by the body 19.

The body 19 has a sufficiently low flow resistance in order to let the gas to be compressed, in particular air, through.

This body 19 preferably consists of a hard foam made of synthetic material, metal or ceramic material.

A very suitable material for the body 19 is a metal

foam made by depositing a metal layer, for example nickel or nickel chromium, by means of a galvanic process on a polyurethane foam and by subsequently removing this polyurethane foam by means of pyrolysis, or a foam of ceramic material made by depositing a ceramic material on a polyurethane foam and by subsequently thermally removing this polyurethane foam, for example by means of pyrolysis.

To the chamber 16 is connected a little discharge duct 20 which extends outside the housing 1.

Through the housing 1, an outlet 21 for the compressed gas extends on the opposite side of the inlet 16-17-18.

The working of the compressor is simple and as follows.

By means of the drive, the body 5 is rotated via the shaft 6 and rotates the body 11 in turn by means of gear wheels or through direct contact.

The gas to be compressed, which is possibly already derived from a previous compressor stage, is brought in the space 4 via the inlet 16-17-18 and compressed by the compressor elements 2 and 3. The compressed gas is discharged via the outlet 21.

This gas to be compressed hereby flows through the rotating body 19 which is entirely incorporated in the housing 1, where the moisture particles are stopped and are radially flung out of the body 19.

The direction of flow of the gas to be compressed is indicated by the arrows 22.

These moisture particles are collected at the bottom of the chamber 16, which is indicated by the arrows 23, and they are discharged via the discharge duct 20.

Thus, the above-described compressor does not require a separate moisture separator. The body 19 forms a moisture separator which is incorporated in the compressor stage, as a result of which the whole is compact and relatively inexpensive.

Instead of on the shaft 13 of the compressor element 3, the body 19 can be mounted on the shaft 6 of the compressor element 2, in which case the inlet has to extend over this shaft 6.

The compressor, a part of which is represented in figure 2, differs from the one represented in figure 1 in that means are provided to make the gas to be compressed flow mainly in the cross direction in the body 19 towards the shaft 13.

These means consists of a ring-shaped plate 24 which covers the side of the body 19 which is directed to the part 18 of the inlet 16-17-18, and which is fixed against this body, for example glued onto it, and of a second ring-shaped plate 25 which is fixed to the opposite side of the body 16, but which only covers the outer part of this side.

The gas to be compressed flows via the chamber 16 and the outer edge of the body 19 in this body 19 and leaves this body in the vicinity of the shaft 13 after the separation of the moisture particles which are radially flung outward.

The invention is not restricted to screw-type compressors, but it can also be applied to other compressors, preferably with at least one rotating compressor element upon which the body can be mounted.

The present invention is by no means limited to the above-described embodiments represented in the accompanying drawings; on the contrary, such compressors can be made in all sorts of variants while still remaining within the scope of the invention.

Claims

1. Compressor with at least one compressor stage and a moisture separator, whereby the compressor stage contains a housing (1) provided with an inlet (16-17-18) for gas to be compressed and an outlet (21) and at least two cooperating compressor elements (2 and 3) mounted in this housing (1) of which at least one is a rotating element, characterized in that the inlet (16-17-18) of the compressor stage is practically sealed by a fast rotating body (19) made of cellular material with open cells which has a sufficiently low flow resistance for the gas to be compressed in order to let the gas through, but which retains moisture particles and other particles and flings them away radially, which body (19) is incorporated in the housing (1).

2. Compressor according to claim 1, characterized in that the inlet (16-17-18) extends over a shaft (13) with which the rotating compressor element (3) is bearing-mounted in the housing (1), and in that the body (19) is fixed to this shaft (13).

3. Compressor according to claim 1 or 2, characterized in that the body (19) is situated in a chamber (16) which consists of a widening of the inlet (16-17-18).

4. Compressor according to claim 3, characterized in that a little discharge duct (20) is connected to the chamber (16).

5. Compressor according to any of claims 1 to 4, characterized in that the body (19) has the shape of a disc.

6. Compressor according to any of claims 1 to 5, characterized in that the body (19) is made of metal, synthetic material or ceramic material.

7. Compressor according to claim 6, characterized in that the body (19) was made by first coating synthetic foam with open cells with metal in a galvanic manner or by coating it with ceramic material and by subsequently thermally removing the synthetic foam.

8. Compressor according to any of claims 1 to 7, characterized in that it is a screw-type compressor and in that the compressor stage contains two rotating screw-type compressor elements (2 and 3) which have a shaft (6-7-12-13) on both ends with which they are bearing-mounted in the housing (1) and in that the body (19) is mounted on one of these shafts (6 or 13) in the inlet (16-17-18).

9. Compressor according to any of the preceding claims, characterized in that means are provided to make the gas to be compressed flow at least partially in the cross direction through the body (19), towards the geometrical axis of rotation of this body (19).

10. Compressor according to claim 9, characterized in that the above-mentioned means contain at least one plate (24) which at least partly covers the side of the body (19) directed towards the incoming gas to be compressed.

11. Compressor according to claim 10, characterized in that the above-mentioned means contain a plate (24) which at least partly covers the side of the body (19) directed towards the incoming gas to be compressed and a plate (25) which partly covers the opposite side of the body (19).

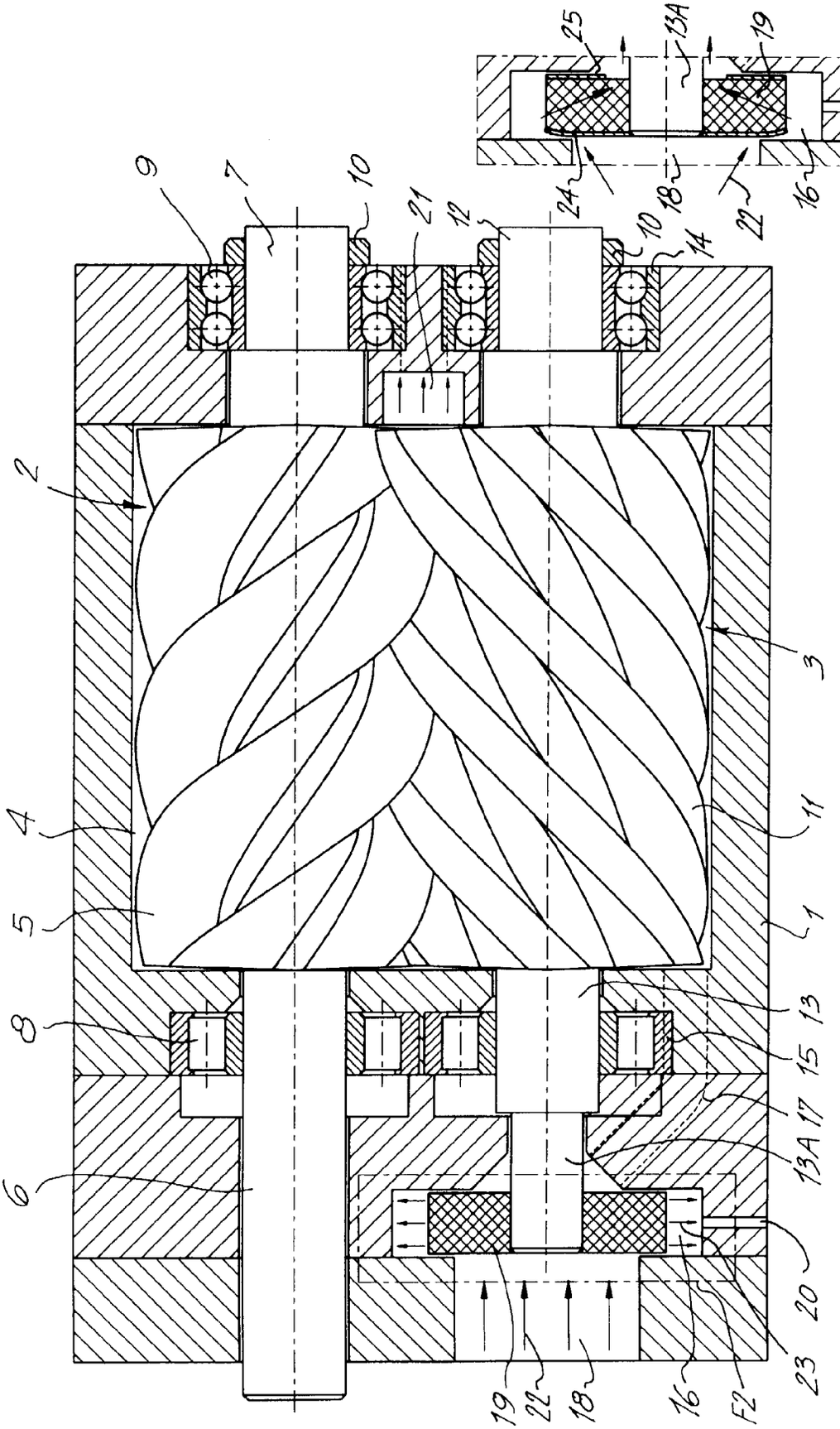
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Fig.2

Fig.1

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EUROPEAN SEARCH REPORT

Application Number
EP 98 20 0009

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.6)
A	US 4 685 509 A (KOELLER) * claim 1; figure 1 * ---	1	F04C29/00 F04C18/16
A	US 5 435 975 A (BASTOS) * claim 1; figure 1 * ---	1	
A	US 2 204 814 A (NEWELL) * page 1, right-hand column, line 42 - page 2, right-hand column, line 23; figures 1,2 * ---	1-5	
A	PATENT ABSTRACTS OF JAPAN vol. 9, no. 125 (C-283), 30 May 1985 & JP 60 014920 A (MITSUBISHI DENKI KK), 25 January 1985, * abstract * -----	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

F04C
F01C
F16J
B01D
B04B
F16N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	16 March 1998	Dimitroulas, P

CATEGORY OF CITED DOCUMENTS

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