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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 comprises a housing (1) which is provided with an inlet (16-17-18) for gas to be compressed, and an outlet (21), and comprises at least two cooperating compressor elements (2 and 3) mounted in this housing (1), at least one of which is rotatable, characterized in that the inlet (16-17-18) is almost closed off from the compressor stage by a rapidly rotating body (19) made of material having a sufficiently low flow resistance for the gas to be compressed in order to let this gas pass, but which keeps back moisture particles and other particles and whirls them radially away, which body (19) is integrated in the housing (1).

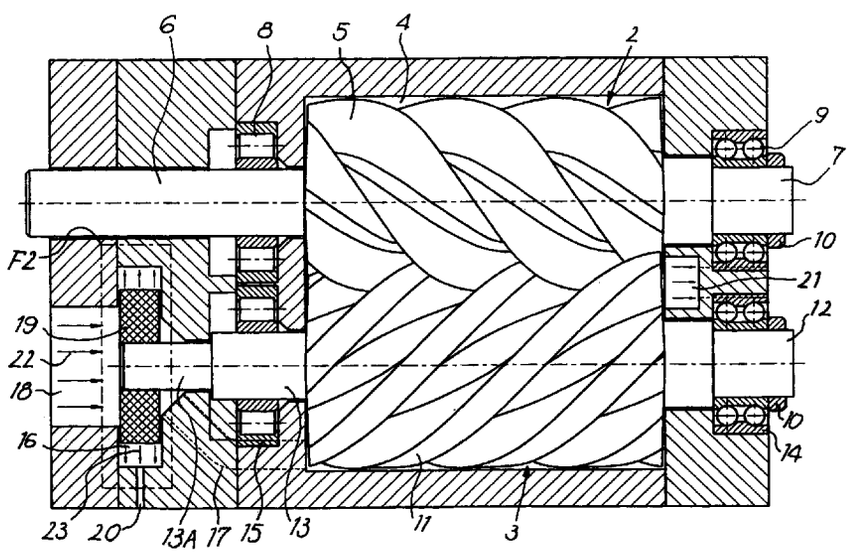

Fig. 1

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Description

This invention relates to a compressor with at least one compressor stage and a moisture separator, whereby the compressor stage comprises a housing which is provided with an inlet for gas to be compressed and an outlet and comprises at least two cooperating compressor elements mounted in this housing, whereby at least one of which is rotatable.

In a multi-stage compressor, the gas compressed by a compressor stage, which is heated by this compression, is cooled in an intermediate cooler. During this cooling, the moisture present in this gas is condensed in the form of humidity particles which are carried along with the gas to the subsequent compressor stage.

In order to prevent that these moisture particles get into the subsequent compressor stage, in the known compressors mostly a moisture separator is placed between the intermediate cooler and the subsequent compressor stage.

These separate moisture separators, however, take a lot of space, are relatively expensive and have a limited separation capacity.

Also for the first compressor stage or in a one-stage compressor, if moisture might be present in the gas to be compressed, a moisture separator is placed before this stage.

This invention aims at a compressor which excludes the aforementioned and other disadvantages and which, in a constructionally simple, compact and relatively cheap manner, makes it possible in a practical manner to separate moisture from the gas to be compressed.

According to the invention, this aim is achieved in that the inlet of the compressor stage is almost closed off by a rapidly rotating body made of material having a sufficiently low flow resistance for the gas in order to let the gas pass, but which keeps back moisture particles and other particles and whirls them radially away, which body is integrated in the housing.

Such bodies are already used for the separation of water from an air stream, however, in separate separators.

The body may be driven by the gas stream itself or by an external power source, but preferably, the inlet extends over a shaft with which the rotatable compressor element is beared in the housing, and the body is fixed on this shaft.

At the height of this body, the inlet may be provided with an enlargement forming a chamber wherein the whirled-away moisture is collected.

This body may consist of cellular material with open cells or may be formed by a brush.

With the intention of better showing the characteristics of the invention, hereafter, by way of example without any limitative character, a preferred form of embodiment of a compressor with at least one compressor stage and a moisture separator according to the invention is described, with reference to the accompanying drawings, wherein:

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

figure 2 represents the section which is indicated by F2 in figure 1, but in respect to another form of embodiment;

figure 3 represents the section from figure 2, but in respect to still another form of embodiment.

In figure 1, a compressor stage of a screw compressor is represented which substantially consists of a housing 1 in which two cooperating compressor elements 2 and 3, formed by screw-shaped rotors, are mounted in a rotatable manner.

Due to constructive purposes, the housing 1 consists of various parts which are fixed to each other, for example, by means of bolts.

The housing 1 determines an innermost space 4 in which the rotatable compressor elements 2 and 3 are situated.

The rotatable compressor element 2 consists of a screw-shaped body 5 which, at both extremities, is axially provided with a shaft 6, 7 respectively.

The shaft 6 is beared in a bearing 8 mounted in the housing 1 and connects directly or by the intermediary of a transmission to a drive motor, not represented in figure 1.

The shaft 7 is beared in a ball-bearing 9 integrated in the housing 1. At the outside of this ball-bearing 9, a ring 10 is clamped onto the shaft 7.

In an analogous manner, the rotatable compressor element 1 comprises a screw-shaped body 11 and, at both extremities thereof, a shaft 12, 13 respectively.

At one side, the shaft 12 is beared in a ball-bearing 14 which is fixed in the housing 1. At the outside of this ball-bearing 14, a clamping ring 10 is also clamped onto the shaft 12.

At the other side, the shaft 13 is beared in a bearing 15 which is also integrated in the housing 1.

This shaft 13 extends with a prolonged extremity 13A beyond the bearing 15, namely up into a chamber 16 which is formed in an end wall of the housing 1 and forms 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 space 4, whereas the part 18 of the inlet, which has a smaller cross-section than the chamber 16, connects this chamber 16 to the exterior of the housing 1.

In the chamber 16, a body 19 in the form of a round disc is fixed at the prolonged extremity 13A of the shaft 13, which body is manufactured of cellular material with open cells.

The diameter of the body 19 is smaller than the diameter of the chamber 16, but larger than the diame-

ter of the part 18 of the inlet 16-17-18 which, anyhow, is closed off almost completely 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, pass.

In the form of embodiment represented in figure 1, this body 19 consists of a hard foam made of synthetic material, of metal or of ceramic material.

A very suitable material for the body 19 is a foam made of metal which is manufactured by depositing a metal layer, for example nickel or nickel-chromium, by means of a galvanic procedure on a polyurethane foam and subsequently removing this polyurethane foam by pyrolysis, or a foam made of ceramic material which is manufactured by the deposition of a ceramic material on a polyurethane foam and the subsequent thermic removal of this polyurethane foam, for example, by pyrolysis.

A discharge channel 20 which extends up to outward the housing 1, is connected to the chamber 16.

An outlet 21 for the compressed gas extends through the housing 1, at the side opposed to the inlet 16-17-18.

The working of the compressor is simple and as follows.

Due to the actuation, by means of the shaft 6, the body 5 is rotated which, in its turn, rotates the body 11 by means of gearwheels or by direct contact.

The gas to be compressed, which possibly is already coming from a preceding compressor stage, is brought through the inlet 16-17-18 into the chamber 4 and compressed by means of the compressor elements 2 and 3. The compressed gas is discharged through outlet 21.

Thereby, this gas to be compressed flows through the rotating body 19 which is completely integrated in the housing 1, where the moisture particles are kept back and whirled radially out of the body 19.

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

Said moisture particles are collected at the bottom in the chamber 16, which is indicated by arrows 23, and discharged by the discharge channel 20.

The compressor described heretofore, thus, does not need a separate moisture separator. The body 19 forms a moisture separator integrated in the compressor stage, as a result of which the whole unit is compact and relatively cheap.

Instead of being mounted on the shaft 13 of the compressor element 3, the body 19 may 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 direct the flow of the gas to be compressed in the body 19 substantially in the transverse direction towards the shaft 13.

Said means are formed by a ring-shaped plate 24 which covers the side of the body 19 directed towards the part 18 of the inlet 16-17-18 and is fixed against this body, for example, glued, and by a second ring-shaped plate 25 which is fixed against the opposite side of the body 19 but which solely covers the exterior part of this side.

The gas to be compressed flows through the chamber 16 and along the exterior edge of the body 19 into this body 19 and leaves this body next to the shaft 13, after separating the liquid particles which are radially whirled outside.

The form of embodiment represented in figure 3 differs from the form of embodiment according to figure 1 by a different construction of the body 19 which, instead of a disc made of foam, is a round and, for example, disc-shaped brush.

This brush preferably comprises steel bristles 26 which are directed almost radially and are fixed to a core 27, sitting, for example, clamped in a U-shaped groove. This core 27 is fixed, for example, glued, clamped of screwed on the prolonged extremity 13A of the shaft 13.

The brush also lets the gas to be compressed pass, but keeps back moisture particles which, during rotation of the shaft 13 and, therefore, also of the brush, are whirled away radially and are collected in the chamber 16.

The invention is not limited to screw compressors, but also applicable in other compressors, preferably with at least one rotatable compressor element upon which the body can be mounted.

The present invention is by no means limited to the forms of embodiment described heretofore and represented in the figures, on the contrary may such compressors be realized in various variants without leaving the scope of the invention.

Claims

1. Compressor with at least one compressor stage and a moisture separator, whereby the compressor stage comprises a housing (1) which is 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), at least one of which is rotatable, characterized in that the inlet (16-17-18) is almost closed off from the compressor stage by a rapidly rotating body (19) made of material having a sufficiently low flow resistance for the gas to be compressed in order to let this gas pass, but which keeps back moisture particles and other particles and whirls them radially away, which body (19) is integrated 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 rotatable compressor element (3) is

beared in the housing (1) and the body (19) is fixed on this shaft (13).

3. Compressor according to claim 1 or 2, characterized in that the body (19) is situated in a chamber (16) wich is formed by an enlargement of the inlet (16-17-18).

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

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

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

7. Compressor according to any of the preceding claims, characterized in that the body (19) is manufactured of cellular material with open cells.

8. Compressor according to claim 7, characterized in that the body (19) is manufactured by first covering plastic foam with open cells in a galvanic manner with metal or covering it with ceramic material and subsequently removing the plastic foam thermically.

9. Compressor according to any of the claims 1 to 6, characterized in that the body (19) is a brush.

10. Compressor according to claim 9, characterized in that the body (19) is a brush with almost radially directed bristles (26).

11. Compressor according to any of the claims 1 to 10, characterized in that it is a screw compressor and the compressor stage comprises two rotatable, screw-shaped compressor elements (2 and 3) which, at both extremities, have a shaft (6-7-12-13) with which they are beared in the housing (1) and the body (19) is mounted on one of these shafts (6 or 13) in the inlet (16-17-18).

12. Compressor according to any of the preceding claims, characterized in that means are provided in order to let the stream of the gas to be compressed through the body (19) flow, at least partially, into the transverse direction, towards the geometrical rotation axis of this body (19).

13. Compressor according to claim 11, characterized in that the aforementioned means comprise at least one plate (24) which at least partially covers the side of the body (19) directed towards the incoming gas to be compressed.

14. Compressor according to claim 13, characterized in that the aforementioned means comprise a plate (24) which at least partially covers the side of the body (19) directed towards the incoming gas to be compressed, and a plate (25) partially covering the opposite side of the body (19).

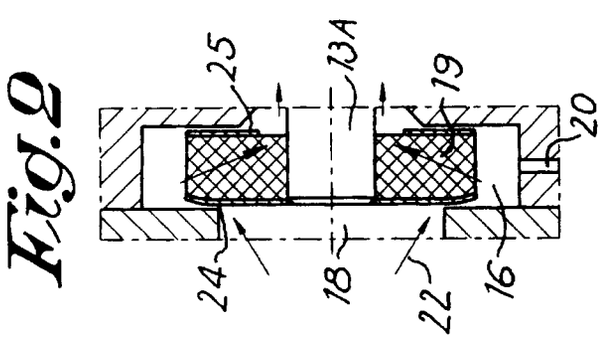

Fig.2

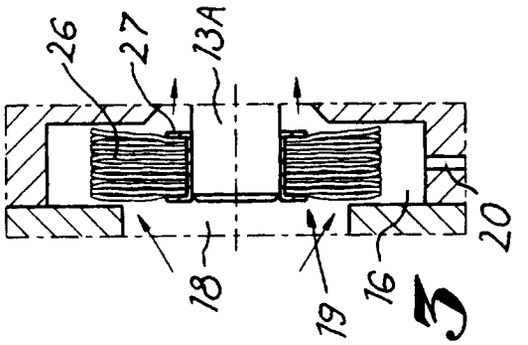

Fig.3

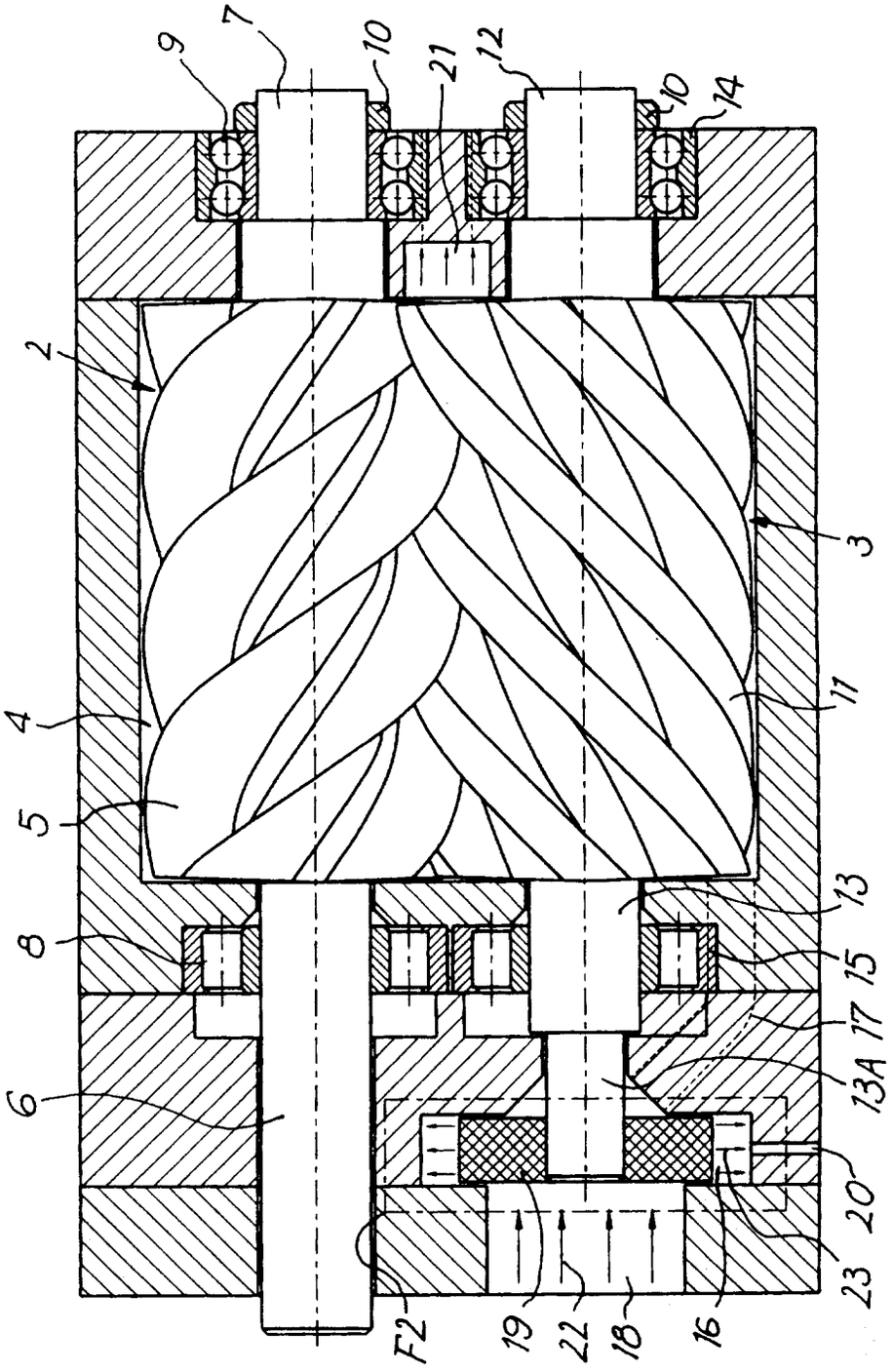

Fig.1

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 20 1582

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)
E,L	EP 0 854 290 A (ATLAS COPCO AIRPOWER N.V.) 22 July 1998 * the whole document *	1-14	F04C29/00 F04C18/16
A	US 4 685 509 A (KOELLER) 11 August 1987 * claim 1; figure 1 *	1	
A	US 5 435 975 A (BASTOS) 25 July 1995 * claim 1; figure 1 *	1	
A	US 2 204 814 A (NEWELL) 18 June 1940 * 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 K.K.), 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	25 August 1998	Dimitroulas, P

CATEGORY OF CITED DOCUMENTS

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