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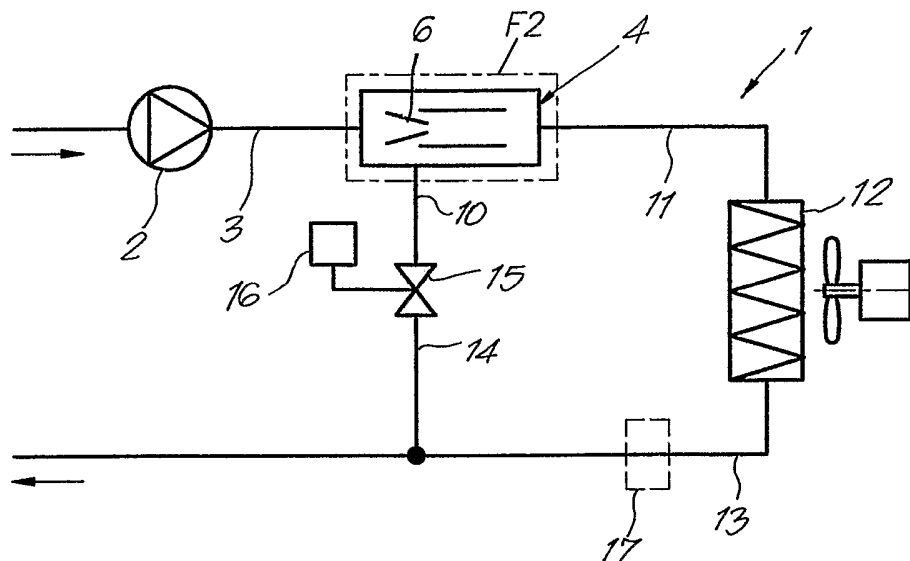
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
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(54) Title: DEVICE FOR COOLING A COMPRESSED GAS



(57) Abstract: Device for cooling compressed gas in a compressor device, which is provided with a pre-cooler and a cooler (12), characterised in that the above-mentioned pre-cooler is made in the form of an ejector (4) for admixing already cooled gas to the compressed gas to be cooled.

Device for cooling a compressed gas.

5 The present invention concerns a device for cooling a compressed gas.

In particular, the invention concerns a device for cooling a compressed gas in a compressor device, which device is
10 provided with a pre-cooler and a cooler.

A device for cooling compressed gas is already known which mainly consists of a feed line for supplying a compressed gas to be cooled, connected to the inlet side of a cooler;
15 and a discharge line which is connected to the outlet side of the cooler.

In the known devices, the above-mentioned feed line is made in the form of at least two line parts in between which is
20 provided a pre-cooler made of stainless steel which cools the gas to an acceptable temperature for the above-mentioned cooler, which is preferably made of aluminium.

The gas to be cooled flows through the pre-cooler made of
25 stainless steel and subsequently through the aluminium cooler, after which the latter can supply the gas via the above-mentioned discharge line at the required temperature.

In these known devices, both coolers are situated in one
30 and the same cooling air circuit, in such a manner that the

cooling air first flows through the aluminium cooler and then through the steel pre-cooler.

A disadvantage of such known devices is the high cost of
5 the pre-cooler which has to cool the gas to acceptable values for the aluminium cooler.

Another disadvantage of such devices is that there is a relatively large pressure drop in the cooling air circuit,
10 which pressure drop is determined by both coolers.

Another disadvantage is that placing both coolers in line in a common cooling air circuit provides a whole which cannot be built in in a flexible manner.

15

The present invention aims to remedy one or several of the above-mentioned and other disadvantages.

To this end, the present invention concerns a device for
20 cooling a compressed gas in a compressor device, which device is provided with a pre-cooler and a cooler, whereby the above-mentioned pre-cooler is made in the form of an ejector for admixing already cooled gas to the compressed gas to be cooled.

25

An advantage of a device according to the invention is that only one conventional cooler is required per compression stage, as a result of which the device is considerably cheaper and pressure losses in the cooling air circuit are
30 reduced.

An additional advantage thereof is that the overall dimensions of such a device are restricted, as a result of which there is more flexibility as far as building-in is concerned.

5

A preferred embodiment of a device according to the invention is provided with a feed line for the supply of a compressed gas to be cooled, which is connected to the inlet side of a cooler; and a discharge line which is
10 connected to the outlet side of the cooler, whereby between the above-mentioned discharge line and the above-mentioned feed line is provided a bypass for admixing already cooled gas.

15 The above-mentioned feed line for compressed gas preferably consists of a first line part and a second line part which are connected to an inlet and an outlet of the above-mentioned ejector respectively, which is provided with a suction opening onto which the above-mentioned bypass is
20 connected.

An advantage of such a device is that there is a very good mix of the compressed, hot gas and the already cooled gas which is fed back, thanks to the above-mentioned ejector.

25

In order to better explain the characteristics of the present invention, the following preferred embodiments of a device for cooling a compressed gas is given as an example only, without being limitative in any way, with reference
30 to the accompanying drawings, in which:

figure 1 schematically represents a device according to the invention;

figure 2 represents the part indicated by F2 in figure 1 into more detail and to a larger scale.

5

A device 1 according to the invention for cooling a compressed gas in a compressor device mainly consists of a supply 2 of compressed gas to be cooled, for example in the form of a single-stage or multi-stage compressor, which is
10 connected to one far end of a first line part 3 of a feed line.

The other far end of the above-mentioned first line part 3 is connected, according to the invention, to an inlet of an
15 ejector 4, in particular to an inlet piece 5 thereof, which ejector 4 forms a pre-cooler.

The above-mentioned inlet piece 5 of the ejector 4 mainly consists of a funnel-shaped body 6 whose narrowed part
20 extends in a channel which is confined by a manifold 1, in particular in a first part 8 of said channel, which narrows conically towards the outlet of the ejector 4.

The second part 9 of the above-mentioned channel widens
25 conically in relation to the first part 8 and opens into the outlet of the ejector 4.

The ejector 4 is also provided, at the height of the first part 8 of the channel, with a crosswise standing line part
30 10 which forms the suction opening of the above-mentioned manifold 7.

The above-mentioned outlet of the ejector 4 is connected to the inlet of a cooler 12 by means of a second line part 11 of the feed line.

5

To the outlet of the above-mentioned cooler 12 is connected a discharge line 13 for discharging the compressed and cooled gas to a compressed air network (not represented) onto which one or several users can be connected.

10

To the above-mentioned discharge line 13 is connected a branch in the form of a bypass 14 which is also connected to the above-mentioned crosswise standing line part 10, either or not as it is made in one piece with it.

15

In the above-mentioned bypass 14 is optionally provided a control valve 15 which is in this case connected to a controller 16.

20 The presence of such a control valve 15 is not required for a device 1 according to the invention, however.

The use of a device 1 according to the present invention is very simple and as follows.

25

Compressed and heated gas is pressed from the above-mentioned supply 2 of compressed gas to be cooled through the above-mentioned feed line to the cooler 12, where it is cooled.

30

The compressed and cooled gas which leaves the cooler is carried to the network via the discharge line, where it can be used.

5 As the inlet piece 5 of the ejector 4 is narrowed, the speed of the gas increases and the static pressure decreases locally, such that, at the outlet opening of said inlet piece 5, a relative underpressure is created, and cooled gas is sucked in through the bypass 14.

10

Pressure losses occurring in the cooler 12 can thus be compensated in a simple manner.

The cooled gas which is sucked in via the bypass 14 is
15 mixed in the ejector with heated compressed gas coming from the supply 2 of compressed and heated gas.

As the second part 9 of the channel in the ejector 4 is conically widened, the rate of flow of the mixture
20 decreases, as a result of which the static pressure is built up again.

The temperature of the mix entering the cooler 12 can be accurately adjusted by means of the control valve 15 which
25 is controlled by means of a controller 16.

To this end, the above-mentioned controller 16 is preferably connected to one or several temperature sensors which are not represented in the figures, provided for
30 example in the above-mentioned feed line or in the cooler 12, such that a pre-set mixing temperature can be obtained.

If the above-mentioned controller 16 records an increase of the mixing temperature at the inlet of the cooler 12, the latter can react by further opening the above-mentioned control valve, as a result of which a larger amount of cooled gas is fed into the ejector 4 and the temperature decreases again.

The other way round, the control valve is further closed when the mixing temperature drops too low for the cooler 12 to be optimally efficient.

In this case, the above-mentioned control valve is connected to a controller 16. It is clear, however, that this is not a pre-requisite and that the control valve 15 can also be made manually adjustable.

It is clear that a device 1 according to the invention is not restricted to the use with a single compression stage, but that it can also be applied between two successive stages of a multi-stage compressor, whereby the above-mentioned device 1 forms an intercooler.

Naturally, the cooler 12 can also be made in the form of different types of known heat exchangers, and it is not restricted to air-cooled heat exchangers as represented in figure 1.

It is also clear that the above-mentioned cooler 12 can be made of all sorts of materials, such as for example aluminium or an aluminium alloy.

In a special embodiment of a device according to the invention, as is schematically represented by means of a dashed line in figure 1, between the cooler 12 and the
5 bypass 14, a water separator 17 is provided as well to collect condensation caused by the cooling of the gas.

In yet another embodiment of a device 1 according to the invention, the above-mentioned ejector 4 is detachable
10 between the above-mentioned first and second line part, 3 and 11 respectively, for example thanks to one or several flange joints.

This is advantageous in that, depending on the supply of
15 compressed and heated gas of the cooler 12 and on the load of the device 1, another ejector 4 can be provided, with other inside dimensions and/or another design, such that an appropriate bypass is made.

20 The present invention is by no means limited to the embodiments given as an example and represented in the accompanying drawings; on the contrary, such a device according to the invention for cooling a compressed gas can be made in all shapes and dimensions while still remaining
25 within the scope of the invention.

Claims.

5 1.- Device for cooling compressed gas in a compressor device, which is provided with a pre-cooler and a cooler (12), characterised in that the above-mentioned pre-cooler is made in the form of an ejector (4) for admixing already cooled gas to the compressed gas to be cooled.

10

2.- Device according to claim 1, characterised in that the above-mentioned device is provided with a feed line (3-11) for the supply of a compressed gas to be cooled, which is connected to the inlet side of the above-mentioned cooler
15 (12); and a discharge line (13) which is connected to the outlet side of said cooler (12), whereby between the above-mentioned discharge line (13) and the above-mentioned feed line (3-11) is provided a bypass (14) for admixing already cooled gas.

20

3.- Device according to claim 2, characterised in that the above-mentioned feed line consists of a first line part (3) and a second line part (11) which are connected to an inlet and an outlet respectively of the above-mentioned ejector
25 (4), which is provided with a suction opening onto which the above-mentioned bypass (14) is connected.

4.- Device according to claim 2, characterised in that the above-mentioned ejector (4) consists of a funnel-shaped
30 inlet piece (5) which is at least partially provided in a channel with its narrowed part, which channel is confined

by a manifold (7) with a standing line part (10) which forms the above-mentioned suction opening; and in that the above-mentioned bypass (14) is connected to this standing line part (10).

5

5.- Device according to claim 2, characterised in that in the above-mentioned bypass (14) is provided a control valve (15).

10 6.- Device according to claim 5, characterised in that the above-mentioned control valve (15) is connected to a controller (16).

15 7.- Device according to claim 6, characterised in that the above-mentioned controller (16) is connected to one or several temperature sensors.

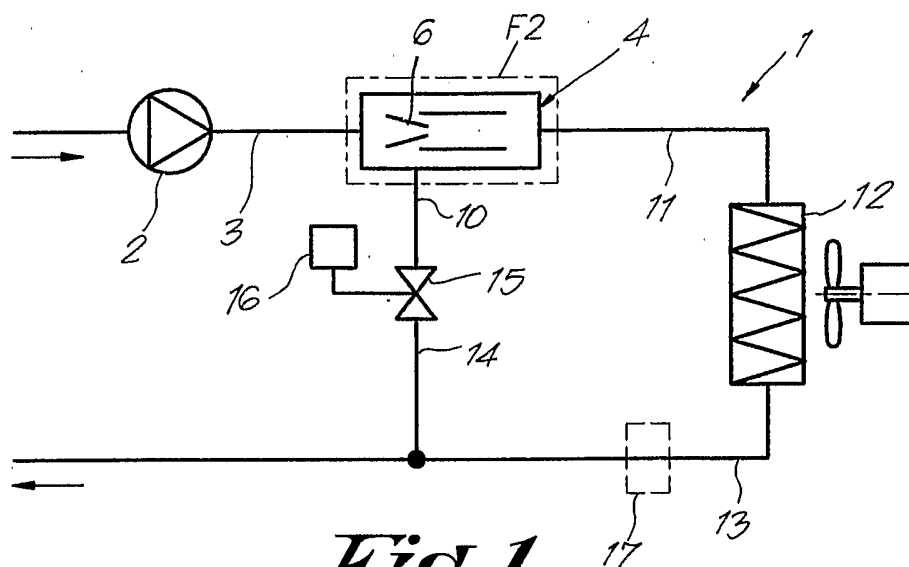
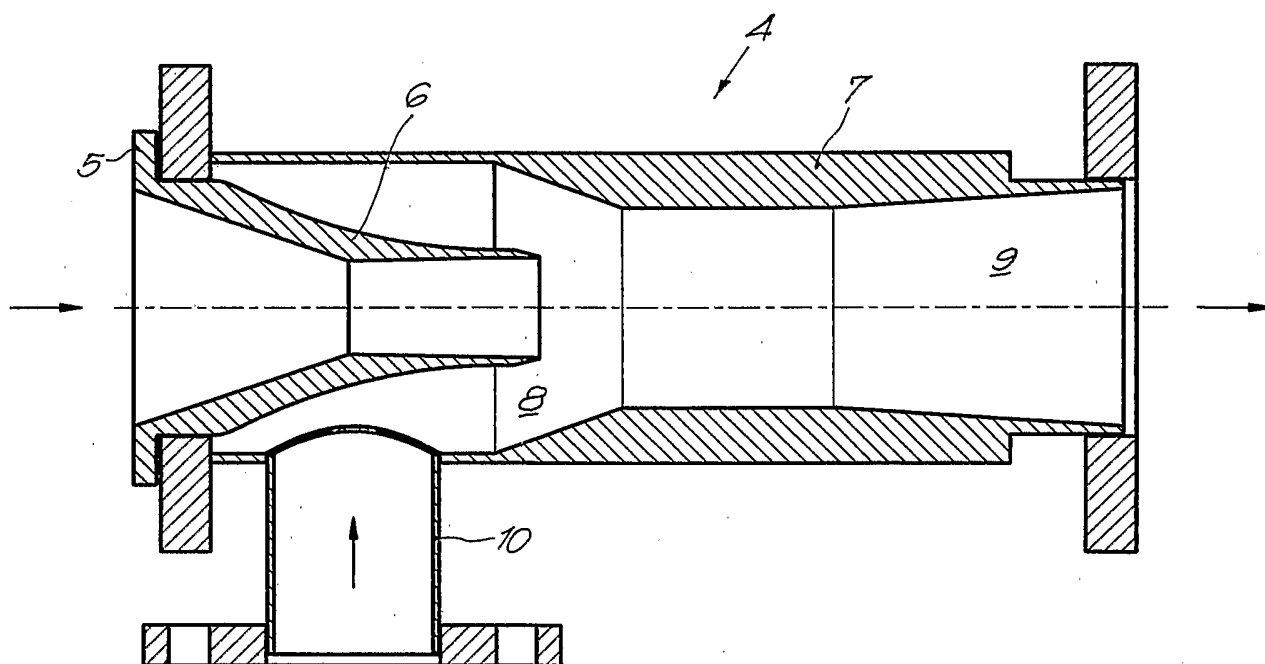
20 8.- Device according to claim 4, characterised in that the above-mentioned funnel-shaped inlet piece (5) extends with its narrowed part in a first part (8) of the above-mentioned channel, which is tapered from the inlet to the outlet of the ejector (14).

25 9.- Device according to claim 8, characterised in that the above-mentioned channel is provided with a second part (9) which widens conically in relation to the first part (8) and which opens into the outlet of the ejector (4).

30 10.- Device according to claim 3, characterised in that the above-mentioned ejector (4) is provided in a detachable

manner between the above-mentioned first and second line parts (3 and 11).

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*Fig. 1**Fig. 2*

INTERNATIONAL SEARCH REPORT

International application No

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A. CLASSIFICATION OF SUBJECT MATTER
INV. F04B39/06 F04C29/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F04B F04C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2 119 201 A (COOK SAMUEL ET AL) 31 May 1938 (1938-05-31)	1-3,10
Y	page 1, column 2, line 40 - page 2, column 1, line 70 figures	4,8,9
X	US 3 807 053 A (SYLVAN B,SW ET AL) 30 April 1974 (1974-04-30)	1
Y	abstract column 2, line 34 - column 4, line 15 figure 2	4,8,9
A	DE 42 01 486 A1 (HITACHI, LTD., TOKIO/TOKYO, JP) 30 July 1992 (1992-07-30) abstract figure 7	1
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INTERNATIONAL SEARCH REPORT

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PCT/BE2006/000022

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 4 929 161 A (AOKI ET AL) 29 May 1990 (1990-05-29) abstract figure 2 -----	1

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Information on patent family members

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