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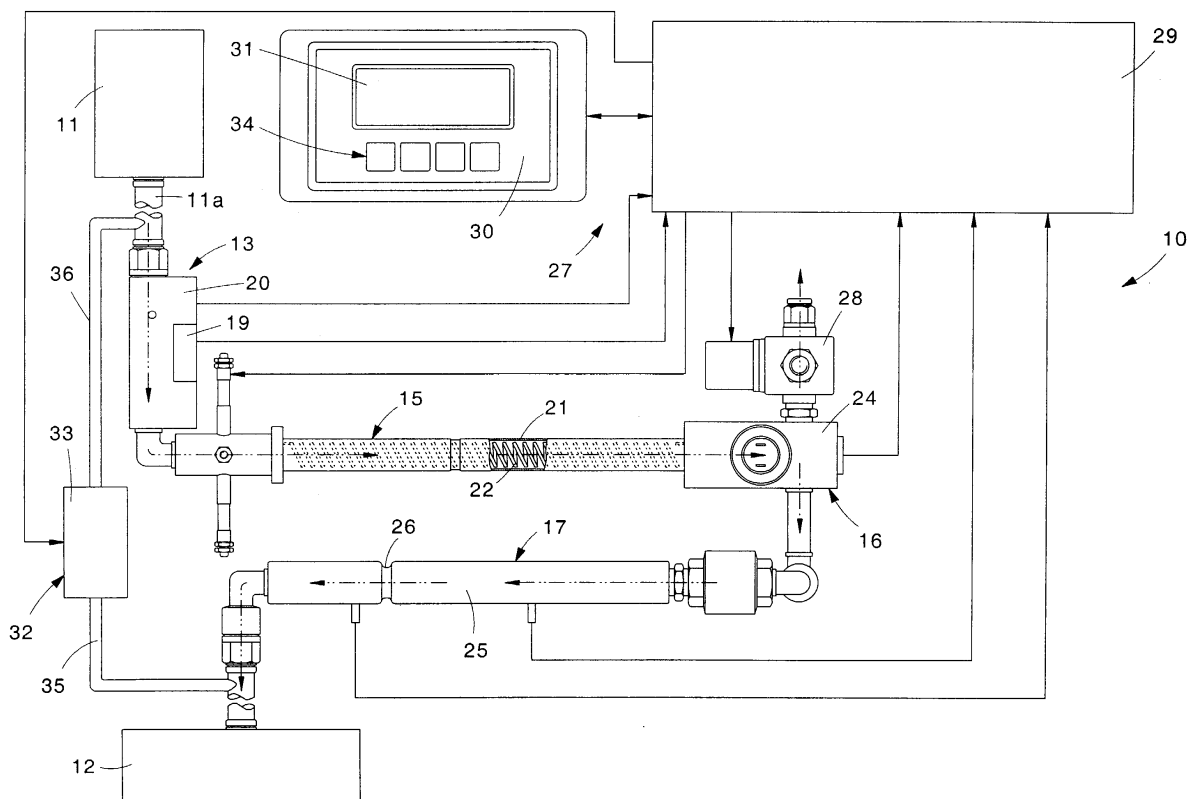
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(54) **Apparatus for the instantaneous heating of compressed air, and relative heating method**

(57) Apparatus (10) and relative method for the instantaneous heating of compressed air. The apparatus (10) is arranged between a compression unit (11) that produces compressed air and a user unit (12) that uses the compressed air. The apparatus (10) comprises heating members (15) for heating the compressed air and a

control unit (27) that selectively activates the heating members (15) according to one of the following parameters: actual use of compressed air by the user unit (12); inlet pressure of the compressed air; outlet pressure of the compressed air; inlet temperature of the compressed air; outlet temperature of the compressed air.



Description

FIELD OF THE INVENTION

[0001] The present invention concerns an apparatus, and the relative method, for the instantaneous heating of compressed air, able to be positioned between an air inlet pipe, connected to a compressor, and an air outlet pipe, connected to a user machine. To be more exact, the present invention is advantageously applied in industrial plants for painting with water paints or ecological paints, that is, which do not contain chemical solvents, wherein the temperature of the compressed air needed for the paint to vaporize must have a determinate value, usually above about 18°C.

BACKGROUND OF THE INVENTION

[0002] Industrial plants for painting with paints containing chemical solvents are known, for example for painting furnishing panels, parts of automobile body work or other, wherein the paints are vaporized by means of a flow of compressed air to the spray gun.

[0003] Normally the compressed air used is taken directly from the environment of the compressor itself, which also has the function of increasing the pressure thereof up to 4-5 bar.

[0004] So-called "ecological" paints are also known in the state of the art, such as for example water paints, which give optimum painting results and are less harmful to the environment.

[0005] In order to be used correctly, such ecological paints must however be vaporized using compressed air with a determinate temperature, above about 18°C, in order to prevent the formation of unwanted particles or lumps.

[0006] In known industrial sites, the environmental air is not always at a temperature of above 18°C, especially in the cold season, and there is therefore the risk that ecological paints are not used in the best way.

[0007] One purpose of the present invention is to achieve an apparatus for the instantaneous heating of compressed air, which is simple and economical to achieve and which allows to increase the temperature of the compressed air, in order to be able to use it in optimum manner also for the vaporization of water paints or ecological paints.

[0008] Applicant has devised, tested and embodied the present invention to obtain these and other purposes and advantages.

SUMMARY OF THE INVENTION

[0009] The present invention is set forth and characterized in the main claims, while the dependent claims describe other characteristics of the present invention or variants to the main inventive idea.

[0010] In accordance with the above purpose, an ap-

paratus for the instantaneous heating of compressed air according to the present invention is able to be arranged between a compression unit that produces compressed air and a user unit that uses said compressed air.

[0011] According to a characteristic feature of the present invention, the apparatus comprises heating means for heating the compressed air and a control unit.

[0012] The control unit is able to selectively activate the heating means according to the following parameters: actual use of the compressed air by the user unit, inlet pressure of the compressed air, outlet pressure of the compressed air, inlet temperature of the compressed air and outlet temperature of the compressed air.

[0013] Advantageously the above parameters are detected by detection means.

[0014] In one form of embodiment, the heating means comprise an electric resistance able to take the compressed air arriving from the compression unit to a determinate temperature value chosen by the user. Advantageously, if the apparatus according to the invention is applied in painting plants using ecological paints, this determinate temperature value is for example comprised between about 18°C and about 80°C. These temperature values are purely indicative and can differ from those indicated, according to the type of ecological paint used.

[0015] According to another form of embodiment, the detection means comprise a first detection unit arranged upstream of the heating means and able to detect the values of pressure and temperature of the compressed air arriving from the compression unit; a second detection unit arranged downstream of the heating means and able to detect the values of pressure and temperature of the compressed air after heating; and a third detection unit arranged downstream of the second detection unit and upstream of the user unit and able to detect the presence or absence of a flow of compressed air towards the user unit.

[0016] As said, the data thus detected are sent to the control unit which, according to determinate reference values, drives, or at least regulates the intensity of, the heating means, so that the compressed air at outlet from the apparatus according to the invention has a temperature comprised within the above temperature values.

[0017] Advantageously, the control unit comprises a control panel provided with a plurality of keys and with a screen, by means of which an operator can constantly control the pressure and temperature values at inlet and at outlet, and can also set in a desired manner the limit temperature values which the compressed air must have at outlet.

[0018] With the apparatus according to the present invention it is thus possible to heat the compressed air simply and rapidly in order to take it to a desired temperature, and then to use it for example for painting with ecological paints and other.

[0019] Another advantage of the present invention is

the simplicity of construction of the apparatus which allows it to be installed almost in any type of already existing compressed air plant.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] These and other characteristics of the present invention will become apparent from the following description of a preferential form of embodiment, given as a non-restrictive example, with reference to the attached drawing, which shows a schematic illustration of an apparatus for heating compressed air according to the present invention.

DETAILED DESCRIPTION OF A PREFERENTIAL FORM OF EMBODIMENT

[0021] With reference to the attached drawing, an apparatus 10 according to the present invention is able to instantaneously heat a determinate quantity of compressed air, and is arranged between a compression unit 11 that produces compressed air and a user unit 12 such as for example the gun of a paint spray or suchlike.

[0022] The apparatus 10 according to the present invention is applied particularly in painting plants with so-called ecological paints, such as for example water paints or similar, which, in order to be used correctly, have to be vaporized with compressed air having a temperature of between about 18° and about 80°C, in order to prevent the formation of particles or lumps.

[0023] Simply to give an example, the compression unit 11 comprises a compressor, of a known type and not shown in the drawing, able to take a determinate quantity of air directly from the environment and to put it into circulation in a relative pipe 11a with a pressure of between about 2 and about 5 bar.

[0024] The apparatus 10 according to the present invention substantially comprises a first detection unit 13 able to detect the temperature at inlet of the compressed air, a heating unit 15 able to heat the compressed air, a second detection unit 16 able to detect the temperature of the compressed air after heating, and a third detection unit 17 able to detect the presence or absence of a flow of compressed air towards the user unit 12.

[0025] In this case, the apparatus 10 according to the invention also comprises a recircling unit 32, able to return the compressed air upstream of the heating unit 15 if the compressed air has not yet reached the desired temperature, or to keep the compressed air at temperature, if it is not used by the user unit 12.

[0026] The first detection unit 13 is connected with the pipe 11a of the compression unit 11 and comprises a thermometer 19 that measures the temperature of the compressed air introduced, and a barometer 20 that measures the value of pressure at which the compressed air is introduced by the compression unit 11 inside the apparatus 10.

[0027] The heating unit 15 is arranged immediately

downstream of the first detection unit 13 and comprises a transit pipe 21 for the passage of the compressed air and an electric resistance 22 arranged inside the transit pipe 21 and able to be selectively activated in order to instantaneously heat the compressed air that passes inside the transit pipe 21.

[0028] The second detection unit 16 is arranged downstream of the heating unit 15 and comprises a second thermometer 24 able to measure the temperature of the compressed air at outlet from the heating unit 15.

[0029] The third detection unit 17 is arranged downstream of the second detection unit 16 and immediately upstream of the user unit 12 connected to the apparatus 10. The third detection unit 17 comprises a tubular element 25 provided with a transverse throttling 26 able to generate a Venturi effect which allows to detect the passage, or absence, of a flow of compressed air inside the tubular element 25, and hence the real requirement of compressed air by the user unit 12.

[0030] The apparatus 10 according to the present invention also comprises an air valve 28 arranged parallel to the second detection unit 16 and able to allow the compressed air to escape from the apparatus 10, when the absence of the flow of compressed air is detected, in order to prevent the electric resistance 22 of the heating unit 15 from overheating.

[0031] The recircling unit 32 comprises a compressor 33 connected to the outlet of the third detection unit 17 by means of a first pipe 35 and to the inlet of the first detection unit 13 by means of a second pipe 36.

[0032] In this way, the compressor 33 induces the compressed air exiting from the third detection unit 17 to return again inside the first detection unit 13, and then inside the heating unit 15.

[0033] The apparatus 10 according to the present invention also comprises a control unit 27 provided substantially with an electronic processing circuit 29 connected to a control panel 30.

[0034] The control panel 30 comprises a plurality of keys 34 able to allow the user to set the value of temperature of the compressed air at outlet, for example a temperature of between about 18° and about 80°C. The control panel 30 also comprises a screen 31 which allows to selectively display the data inserted by the user and the functioning data detected by the detection units 13, 16 and 17.

[0035] The electronic processing circuit 29 is able to receive all the data detected by the detection units 13, 16 and 17 and, as a function thereof and of the data inserted by the user by means of the control panel 30, drives and regulates the functioning of the heating unit 15, of the air valve 28 and of the recircling unit 32.

[0036] The apparatus 10 according to the present invention functions as follows.

[0037] First of all the compression unit 11 is activated, which introduces compressed air with a temperature near ambient temperature and with a determinate pressure into the apparatus 10.

[0038] The compressed air first passes inside the first detection unit 13 where, by means of the thermometer 19 and the barometer 20, the temperature and pressure are measured.

[0039] The values of temperature and pressure thus detected are sent to the electronic processing circuit 29 which, according to the values detected and the set value of temperature of the compressed air at outlet, regulates the electric tension that feeds the electric resistance 22, so as to take the latter to a determinate temperature.

[0040] In this way, when the compressed air passes through the transit pipe 21, it is heated instantaneously by the electric resistance 22 and is taken to a value very near, or slightly above, the set temperature value.

[0041] The compressed air that exits from the heating unit 15 then passes inside the second detection unit 16 where, by means of the second thermometer 24, the real temperature value thereof is measured.

[0042] This measured value is sent to the electronic processing circuit 29, which provides to compare it with the set temperature value, in order to verify the quality of the heating performed and possibly to regulate the temperature of the electric resistance 22.

[0043] In this case, the compressed air still not suitable for use is returned by the compressor 33 upstream of the heating unit 15, so that it is subjected to at least a second heating cycle before it can be used.

[0044] The compressed air that exits from the second detection unit 16 is normally directed towards the third detection unit 17 which, acting as a Venturi tube, measures the delivery upstream and downstream of the throttling 26, so as to perceive the passage or absence of the compressed air, and hence the possible requirement of the latter by the user unit 12.

[0045] In order to prevent overheating and breakage of the electric resistance 22, if the third detection unit 17 detects the absence of the flow of compressed air, a signal is sent to the electronic processing circuit 29, which provides to de-activate the electric resistance 22 and to open the air valve 28, for long enough to return the temperature of the compressed air within determinate safety values.

[0046] In this configuration the compressed air introduced by the compression unit 11 passes, at ambient temperature, inside the transit pipe 21 and emerges through the air valve 28, so as to cool the electric resistance 22 and prevent it overheating.

[0047] By means of the recirculating unit 32 it is also possible to keep the compressed air inside the apparatus 10 at temperature, even when the compressed air is not required by the user unit 12. In fact, when the third detection unit 17 detects the absence of the flow, and the temperature of the electric resistance 22 is not near overheating, the electronic processing circuit 29 commands the compressor 33 to be driven, so that the compressed air passes cyclically inside the heating unit 15 and its temperature is kept inside a desired range of val-

ues.

[0048] This solution, apart from saving the energy used for heating, guarantees that the compressed air at outlet from the user unit 12 always has a temperature near the set temperature.

[0049] The apparatus 10 as described heretofore has substantially limited size and is made with elements of a known type and easily found on the market, and therefore it is extremely easy, quick and economical to make and, where necessary, to maintain.

[0050] Moreover, the apparatus 10 as described heretofore can be installed easily, and without needing substantial modifications, in any existing pneumatic plant, or industrial site.

[0051] It is clear, however, that modifications and/or additions of parts may be made to the apparatus 10 as described heretofore, without departing from the field and scope of the present invention.

[0052] It is also clear that, although the present invention has been described with reference to specific examples, a person of skill in the art shall certainly be able to achieve many other equivalent forms of apparatus for the instantaneous heating of compressed air, all of which shall come within the field and scope of the present invention.

Claims

1. Apparatus for the instantaneous heating of compressed air, able to be arranged between a compression unit (11) which produces said compressed air and a user unit (12) able to use said compressed air, **characterized in that** it comprises heating means (15) for heating said compressed air and a control unit (27), able to selectively activate said heating means (15) according to at least one of the following parameters: actual use of said compressed air by said user unit (12); inlet pressure of said compressed air; outlet pressure of said compressed air; inlet temperature of said compressed air; outlet temperature of said compressed air.
2. Apparatus as in claim 1, **characterized in that** said parameters are detected by detection means (13, 16, 17).
3. Apparatus as in claim 1 or 2, **characterized in that** said heating means (15) comprise an electric resistance (22) able to take said compressed air arriving from said compression unit (11) to a determinate temperature value.
4. Apparatus as in claim 2, **characterized in that** said detection means comprise a first detection unit (13) arranged upstream of said heating means (15) and able to detect the values of pressure and temperature of said compressed air arriving from said com-

pression unit (11), a second detection unit (16) arranged downstream of said heating means (15) and able to detect the values of pressure and temperature of said compressed air after heating, and a third detection unit (17) arranged downstream of said second detection unit (16) and upstream of said user unit (12) and able to detect the presence or absence of a flow of said compressed air towards said user unit (12).

5. Apparatus as in claim 4, **characterized in that** it also comprises an air valve (28) arranged parallel to said second detection unit (16) and able to allow said compressed air to escape from said apparatus (10) when the absence of said flow of compressed air is detected.

6. Apparatus as in claim 5, **characterized in that** said control unit (27) comprises an electronic processing circuit (29) connected to a control panel (30) and able to command and coordinate the functioning of said heating means (15) and of said air valve (28) according to the data detected by said first, second and third detection units (13, 16, 17).

7. Apparatus as in claim 4, **characterized in that** said first detection unit (13) comprises a thermometer (19) able to measure the temperature of said compressed air introduced by said compression unit (11), and a barometer (20) able to measure the value of pressure at which said compressed air is introduced by said compression unit (11).

8. Apparatus as in claim 3, **characterized in that** said heating means (15) comprise a transit pipe (21) for said compressed air, inside which said electric resistance (22) is arranged.

9. Apparatus as in claim 4, **characterized in that** said second detection unit (16) comprises a second thermometer (24) able to measure the temperature of the compressed air at outlet from said heating means (15).

10. Apparatus as in claim 4, **characterized in that** said third detection unit (17) comprises a tubular element (25) provided with a transverse throttling (26) able to generate a Venturi effect that allows to detect the passage of a flow of compressed air inside said tubular element (25).

11. Apparatus as in claim 6, **characterized in that** said control panel (30) comprises a screen (31) able to display reference data inserted by the user and functioning data detected by said detection units (13, 16, 17).

12. Apparatus as in claim 6, **characterized in that** said

control panel (30) comprises a plurality of keys (34) able to allow the user to set the value of the temperature at outlet.

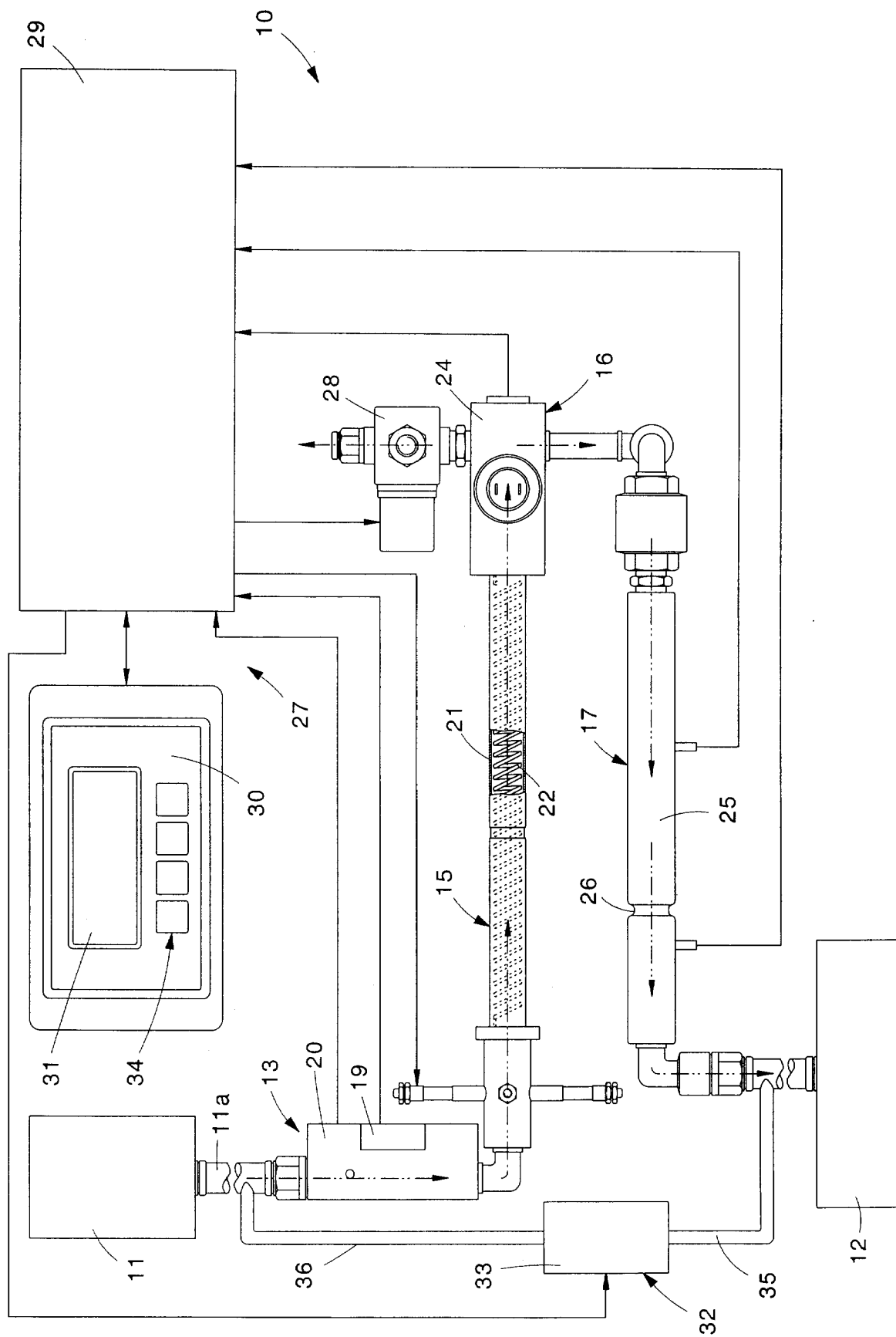
13. Apparatus as in any claim hereinbefore, **characterized in that** it also comprises a recirculating unit (32), able to selectively return said compressed air upstream of said heating means (15).

14. Apparatus as in claim 13, **characterized in that** said recirculating unit (32) comprises a compressor (33) connected to the outlet of said third detection unit (17) by means of a first pipe (35) and to the inlet of said first detection unit (13) by means of a second pipe (36).

15. Method for the instantaneous heating of compressed air arriving from a compression unit (11) and destined for a user unit (12), **characterized in that** it comprises a first step wherein, by means of first detection means (13), at least one of the following parameters is detected: actual use of said compressed air by said user unit (12); inlet pressure of said compressed air; outlet pressure of said compressed air; inlet temperature of said compressed air; outlet temperature of said compressed air; and a second step wherein, by means of heating means (15), said compressed air is heated to a determinate temperature.

16. Method as in claim 15, **characterized in that** it also comprises a third step wherein, by means of second detection means (16), the temperature of said compressed air is measured after heating; and a fourth step wherein, by means of third detection means (17), the real use of said compressed air by said user unit (12) is verified.

17. Method as in claim 15 or 16, **characterized in that** it also comprises a fifth step wherein, by means of a recirculating unit (32), said heated compressed air is introduced again inside said heating means (15) in order to repeat said second step.





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 10 5747

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.7)
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Y	* column 3, line 31 - column 4, line 57; figure 3 *	4,16	

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Y	* abstract; figure 1 *	4	

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Y	* column 2, line 21 - line 32; figures 3,4 *	4	

			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			F24H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 20 January 2005	Examiner Arndt, M
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 04 10 5747

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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