COMBINED PROCESS AND PLANT FOR PRODUCING COMPRESSED AIR AND AT LEAST ONE AIR GAS

Almost all industries currently have at least one compressed-air network for providing compressed air to all types of machines or devices.

Many industries furthermore employ air gases provided by distribution networks, reservoirs or on-site production plants.

As a general rule, the systems for producing and providing compressed air and air gas are separate and independent, and run by different operators.

In the particular field of metallurgy, it has been proposed, in particular in documents US-A-5,538,534 and US-A-5,244,489, in the name of the Applicant Company, to employ a common compression group for the supply of compressed air to metal processing devices, on the one hand, and to an air-gas separation unit, on the other hand.

The object of the present invention is to provide a combined method and plant for producing and providing compressed air and at least one air gas, forming a synergy between the systems for producing and providing these fluids and making it possible to reduce investment and running costs while guaranteeing satisfactory security of the gas provision.

To this end, according to one characteristic of the invention, the process comprises the steps of generating, in nominal operating mode, at least a first and a second air flow which are assigned respectively to the supply of compressed air and the production of the said air gas, and, in temporary operating mode, of assigning at least a part of the second air flow to the supply of compressed air.

According to the invention, a combined plant comprises a compressed-air provision system connected to at least a first pressurized-air source, and at least one system for producing and distributing at least one air gas which is normally connected to at least one second pressurized-air source, and means for at least temporarily switching the second pressurized-air source to the compressed-air supply system.

Thus, according to the invention, the networks for compressed air and air gas can be interconnected so as to make it possible to share the pressurized-air capacities available on site according to compressed-air demand and gas demand, making it possible to reduce the investment in pressurized air sources, typically compression units, as well as the electrical power installed and consumed, while guaranteeing increased production flexibility.

According to the invention, the priority for assigning pressurized air is given to the compressed-air supply system since compressed air is difficult to store for providing large or prolonged flow rates, whereas the air gas can be readily stored, in particular in pre-existing back-up reserves and the user systems can often make do with a reduced level of production from the air-gas production system, possibly supplemented by the said reserves.

First, according to a particular characteristic of the invention, in temporary operating mode, the air gas is provided at least in part by a reservoir of the said gas, typically stored in liquid form.

According to a more particular characteristic of the invention, in temporary operating mode, the second flow is assigned in full to the supply of compressed air, the switching means comprising means for isolating the gas production system from the second source which is thus assigned to the air supply system.

Other characteristics and advantages of the present invention will become apparent from the following description of embodiments which is provided by way of illustration and without implying any limitation, and is given with reference to the appended drawings, in which,

Figure 1 is a schematic view of a first embodiment of a combined plant according to the invention;

Figure 2 is a similar schematic view of a second embodiment of a combined plant according to the invention; and

Figures 3 and 4 respectively illustrate the configurations of the plants in Figures 1 and 2 in temporary operating mode.

The example in Figure 1 represents at least one line L_A of a network for distributing compressed air provided by two pressurized-air sources CO2, CO3, for example two identical or different parallel compression units.

Also represented is at least one line L_G of a network for distributing at least one air gas provided, by separating or treating compressed air originating from at least one pressurized-air source CO1, typically an air compression unit, in a unit for separating or treating air S and/or at least one reservoir R containing the said gas, typically in at least partially liquid form, connected to the line L_G by a valve sensitive to the pressure V and/or another controlled valve. The pressure of the air provided by the source CO1 to the system is typically higher than that provided by the sources CO2 and CO3 to the line L_A.

According to the invention, a line C, advantageously provided with a control and pressure-reducing valve D, allows connection to be established selectively between the upstream parts of the lines L_G and L_A.

In normal or nominal operation, at least the conduit L_G is fed with air gas separated or treated in the unit S, itself fed with pressurized air originating from the source CO1, the reservoir R not normally being made to contribute, except possibly in the event of a demand peak in the conduit L_G. In parallel, the line L_A is fed with pressurized air originating from at least one of the sources CO2, CO3. If one of these sources CO2, CO3 malfunctions, as represented in Figure 3, at least a part of the air flow originating from the

source CO1 is sent, typically with reduced pressure or stepped down by controlling the source CO1, via the line C to the line L_A in order to maintain the requisite compressed-air flow in the latter. If need be, the unit S may be at least partially isolated upstream by a control and/or isolation valve V, the unit S operating in this case at a reduced level, the air gas in the line L_G being provided fully or in part by the standby reserve in the reservoir R so that the valve V may be manually controlled, synchronized with the actuation of the valve D, or actuated in response to at least one output parameter of the system S, typically the flow rate and/or the pressure of the air gas in the line L_G.

Figure 2 represents an embodiment in which the separation unit S operates with a pressurized air feed pressure substantially identical to that of the compressed air in the network L_A. In this case, the three sources CO1, CO2, CO3 deliver into the same conduit T, from where the pressurized air is distributed to the compressed-air network L_A and to the separation unit S for provision to the line L_G. If one of the sources COi malfunctions, typically if one compressor (CO1 in Figure 4) is shut down, the remaining sources CO2, CO3 are fully assigned to the supply of compressed air to the line L_A, the valve V being closed and isolating the system S, and the gas reserve in the reservoir R stepping in to ensure the supply of air gas in the line L_G.

The separation or treatment unit S is at least in part of the type with cryogenic distillation and/or of the type with a permeation membrane and/or of the type with pressure swing adsorption for the supply of nitrogen and/or oxygen-enriched air and/or pure oxygen and/or dehydrated and, if appropriate, decarbonated dry air, and is capable of operating, on request or automatically according to the gas demand, in at least one reduced running status, thus making it possible to reduce its compressed-air consumption.

In the case when the pressurized-air sources COi are independent compressors, they are generally provided with means m for control and/or automatic regulation (idling, shutdown, flow-rate adjustments, etc.) which make them adapt to the instantaneous requirements of the air line L_A and/or the unit S, thus making it possible to optimize the energy consumption.

Furthermore, coupling according to the invention makes it possible to obtain a lower running level for the air gas production with an energy saving because the excess air available for the separation can in part be fed back to the compressed-air network, with a corresponding reduction in the power consumed by the compressors normally assigned to this compressed-air network.

Advantageously, to this end, a system will be provided for controlling the compressed-air sources which can alter the air flow rates which are provided, as a function of the pressure and/or flow rate which are desired in one or other of the lines, for example by idling or shutting down some of the compressors, or reducing their flow rate.

By way of example, with a unit S of the cryogenic-distillation type for providing nitrogen, a combined plant according to Figure 1, with a compressor CO1 capable of making up for the malfunction or interruption for maintenance of one of the compressors in the pair CO2, CO3, makes it possible to reduce the investment and installed power for the air compression by close to 25% and to optimise the specific energy during the phases of producing nitrogen at a reduced running level.

Although the present invention has been described with reference to particular embodiments, it is in no way limited by this, and it may moreover receive modifications and variations which occur to the person skilled in the art in the scope of the claims below.

Thus, instead of two sources in parallel, a single air source may be provided, for example a variable-speed compressor, with at least one pressurized-air storage vessel, which can simultaneously feed, if appropriate with partial pressure reduction, the two networks or only one of them at the required pressure. Similarly, in particular when the flow rates needed for the two networks are relatively close to one another, a set of over-engineered compressors whose maximum service pressure is greater than that which the compressed-air network alone would need, may be installed according to their approach in Figure 2, with a set of valves making it possible to direct the air production of the various compressors to one or other of the networks, thus making it possible to reduce the energy costs and greatly optimise the equipment maintenance.

Furthermore, although as a general rule the lines L_A and L_G supply sites which are common in part, they may also supply, at least in part, one or more of the same plants on a given site, for example burners or combustion units, waste processing units, in particular employing ozonizers fed with air and/or oxygen, or more generally any plant using at least one air gas and employing at least one item of equipment or instrument using compressed air, where appropriate dehydrated, by passing it through a unit S of the drier type, using a membrane and/or using adsorption.

CLAIMS

1. Process for producing compressed air and at least one air gas separated in at least one air treatment device (S), comprising the steps of generating, in nominal operating mode, at least a first and a second pressurized-air flows which are assigned respectively to the supply of air and the production of the said air gas, and, in temporary operating mode, of assigning at least a part of the second air flow to the supply of compressed air.

2. Process according to Claim 1, characterized in that, in temporary operating mode, the air gas is provided at least in part by a reservoir (R) of the said gas.

3. Process according to Claim 2, characterized in that, in temporary operating mode, the second air flow is assigned in full to the supply of compressed air.

4. Process according to Claims 1 to 3, characterized in that the pressure of the second air flow can be adjusted.

5. Process according to one of Claims 1 to 4, characterized in that the first and second air flows are substantially at the same pressure.

6. Process according to one of Claims 1 to 4, characterized in that the second air flow is normally at a pressure which is higher than that of the first air flow and can be modified selectively, at least for the supply of the compressed air flow in temporary operating mode.

7. Process according to one of the preceding claims, characterized in that the air separation device (S) is at least temporarily operated in at least one reduced running status.

8. Process according to one of the preceding claims, characterized in that the air gas is nitrogen.

9. Process according to one of the preceding claims, characterized in that the air gas is oxygen.

10. Process according to one of the preceding claims, characterized in that the air gas is dry air.

11. Process according to one of the preceding claims, characterized in that at least a part of the compressed air and at least a part of the said air gas are employed in the same consumer plant.

12. Combined plant comprising at least one compressed-air supply system (L_A) connected to at least a first pressurized-air source (CO2, CO3), and at least one system (L_G) for producing and distributing at least one air gas which is normally connected to at least one second pressurized-air source (CO1), and means (V; D) for at least temporarily switching the second source (CO1) to the air supply system (L_A).

13. Plant according to Claim 12, characterized in that the switching means comprise means (V) for isolating the air gas production system (L_G) from the second source (CO1).

14. Plant according to Claim 13, characterized in that the isolating means comprise a valve means sensitive to at least one output parameter (x) of the air gas production system.

15. Plant according to Claim 14, characterized in that the parameter (x) is the flow rate of air gas produced.

16. Plant according to one of Claims 12 to 15, characterized in that the production system (L_G) furthermore comprises at least one reservoir (R) of the said air gas.

17. Plant according to one of Claims 12 to 16, characterized in that it includes means (m) for controlling the parameters of the air flows provided by the sources (COi).

18. Plant according to one of Claims 12 to 17, characterized in that at least one of the first and second sources (CO1, CO2, CO3) consists of a compression unit.

19. Plant according to Claim 17 and Claim 18, characterized in that it includes means (m) for controlling the compression units (COi).

20. Plant according to one of Claims 12 to 19, characterized in that the air gas production system comprises at least one separation unit (S) which is at least in part of the adsorption type.

21. Plant according to one of Claims 12 to 20, characterized in that the air gas production system comprises at least one separation unit (S) which is at least in part of the permeation type.

22. Plant according to one of Claims 12 to 21, characterized in that the air gas production system comprises at least one separation unit (S) which is at least in part of the cryogenic distillation type.