An improved process for producing elevated pressure nitrogen including providing an air separation unit with at least two columns. The process includes extracting a first nitrogen stream from the MP column, warming a first portion of the first nitrogen stream in a heat exchanger, thereby producing a product nitrogen stream, and warming a second portion of the nitrogen stream in the heat exchanger, thereby producing warm nitrogen stream. Expanding the warm nitrogen stream in an expander, thereby producing a quantity of work, and a low pressure nitrogen stream and introducing the low pressure nitrogen stream into the LP column. Extracting a second nitrogen stream from the LP column, cooling the second nitrogen stream in condenser, thereby producing a liquid nitrogen stream. Introducing a first portion of the liquid nitrogen stream into the LP column, increasing the pressure of a second portion of the liquid nitrogen stream, thereby producing a pressurized liquid nitrogen stream, and introducing a first portion of the pressurized liquid nitrogen stream into the MP column, and export a second portion of the pressurized liquid nitrogen stream as product.
PRODUCTION OF HIGH-PRESSURE GASEOUS NITROGEN

FIELD OF INVENTION

[0001] The present invention relates to a process and an installation for producing nitrogen under pressure.

BACKGROUND

[0002] In installations for producing nitrogen under pressure, the nitrogen is usually produced directly at the pressure of use, for example between 5 and 10 bars. Purified air, compressed slightly above this pressure, is distilled so as to produce the nitrogen at the top of the column and the reflux is achieved by expansion of the “rich liquid” (liquid at the base of the column formed by air enriched with oxygen) and cooling of the condenser at the top of the column by means of this expanded liquid. The rich liquid is thus vaporized at a pressure of between 3 and 6 bars.

[0003] If the size of the installation justifies this, the vaporized rich liquid is passed through an expansion turbine so as to maintain the installation in the cold state but, often, this refrigerating production is excessive, which corresponds to a loss of energy. In the opposite hypothesis, the cold state is maintained by an addition of liquid nitrogen coming from an exterior source, and the vaporized rich liquid is simply expanded in a valve and then travels through the thermal exchange line serving to cool the initial air. Consequently, here again, a part of the energy of the vaporized rich liquid is lost.

SUMMARY

[0004] The present invention is an improved process for producing elevated pressure nitrogen including providing an air separation unit with at least two columns. The process includes extracting a first nitrogen stream from the MP column, warming a first portion of the first nitrogen stream in a heat exchanger, thereby producing a product nitrogen stream, and warming a second portion of the nitrogen stream in the heat exchanger, thereby producing warm nitrogen stream. Expanding the warm nitrogen stream in an expander, thereby producing a quantity of work, and a low pressure nitrogen stream and introducing the low pressure nitrogen stream into the LP column. Extracting a second nitrogen stream from the LP column, cooling the second nitrogen stream in condenser, thereby producing a liquid nitrogen stream. Introducing a first portion of the liquid nitrogen stream into the LP column, increasing the pressure of a second portion of the liquid nitrogen stream, thereby producing a pressurized liquid nitrogen stream, and introducing a first portion of the pressurized liquid nitrogen stream into the MP column, and export a second portion of the pressurized liquid nitrogen stream as product.

BRIEF DESCRIPTION OF THE FIGURES

[0005] FIG. 1 is a schematic representation of a portion of one embodiment of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0006] Illustrative embodiments of the invention are described below. While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the drawings and are herein described in detail. It should be understood, however, that the description herein of specific embodiments is not intended to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

[0007] It will of course be appreciated that in the development of any such actual embodiment, numerous implementation-specific decisions must be made to achieve the developer’s specific goals, such as compliance with system-related and business-related constraints, which will vary from one implementation to another. Moreover, it will be appreciated that such a development effort might be complex and time-consuming, but would nevertheless be a routine undertaking for those of ordinary skill in the art having the benefit of this disclosure.

[0008] Turning now to FIG. 1 that illustrates one embodiment of the present invention. Compressed, filtered, and pre-cooled air stream 101 enters main heat exchanger 102 where it is cooled by indirect heat exchange with at least streams 113 and 114, thus producing cooled air stream 103, which is then introduced into MP distillation column 104.

[0009] Rich liquid stream 105 is removed from the bottom of MP distillation column 104, passed through auxiliary heat exchanger 106 where it is subcooled by indirect heat exchange with at least stream 109, thereby producing cold rich liquid stream 107 which is then introduced into LP distillation column 108. Cooling stream 109 exits the top of condenser 110. After being in indirect heat exchange with rich liquid stream 105, cooling stream 109 is warmed, thereby producing warmed stream 111.

[0010] First nitrogen stream 112 is extracted from MP column 104 and split into at least first nitrogen portion 113, second nitrogen portion 114, and third nitrogen portion 115. First nitrogen portion 113 is warmed in main heat exchanger 102, thereby producing product nitrogen stream 116. Optionally, product nitrogen stream 116 may be further compressed in product compressor 117, thereby producing pressurized product nitrogen stream 118. Second nitrogen portion 114 is warmed in main heat exchanger 102, thereby producing warm nitrogen stream 119. Warm nitrogen stream 119 is expanded in expander 120, thereby producing a quantity of work, and low pressure nitrogen stream 121, which is introduced into LP distillation column 108. Third nitrogen portion 115 may be introduced into LP column vaporizer 122, wherein it is condensed resulting in condensed nitrogen stream 132, which is introduced into MP column 104 as reflux.

[0011] Second nitrogen stream 123 is extracted from LP distillation column 108, and cooled in condenser 124, thereby producing liquid nitrogen stream 125. Liquid nitrogen stream 125 is split into at least first liquid nitrogen portion 126 and second liquid nitrogen portion 127. First liquid nitrogen portion 126 is introduced into LP distillation column 108. The pressure of second liquid nitrogen portion 127 is increased in pump 128 thereby producing pressurized liquid nitrogen stream 129. Pressurized liquid nitrogen stream is split into at least first pressurized nitrogen portion 130 and second pressurized nitrogen portion 131. First pressurized nitrogen portion 130 is introduced into MP distillation column 108. Second pressurized nitrogen portion 131 is exported as product.
The particular embodiments disclosed above are illustrative only, as the invention may be modified and practiced in different but equivalent manners apparent to those skilled in the art having the benefit of the teachings herein. Furthermore, no limitations are intended to the details of construction or design herein shown, other than as described in the claims below. It is therefore evident that the particular embodiments disclosed above may be altered or modified and all such variations are considered within the scope and spirit of the invention. Accordingly, the protection sought herein is as set forth in the claims below.

What is claimed is:

1. An improved process for producing elevated pressure nitrogen, comprising:
   providing an air separation unit with at least two columns, an LP column and an MP column,
   extracting a first nitrogen stream from said MP column,
   warming a first nitrogen portion of said first nitrogen stream in a heat exchanger, thereby producing a product nitrogen stream, and warming a second nitrogen portion of said nitrogen stream in said heat exchanger, thereby producing warm nitrogen stream,
   expanding said warm nitrogen stream in an expander, thereby producing a quantity of work, and a low pressure nitrogen stream, and introducing said low pressure nitrogen stream into said LP column,
   extracting a second nitrogen stream from said LP column,
   cooling said second nitrogen stream in condenser, thereby producing a liquid nitrogen stream,
   introducing a first liquid nitrogen portion of said liquid nitrogen stream into said LP column,
   increasing the pressure of a second liquid nitrogen portion of said liquid nitrogen stream, thereby producing a pressurized liquid nitrogen stream, and introducing a first pressurized nitrogen portion of said pressurized liquid nitrogen stream into said MP column,
   and export a second pressurized nitrogen portion of said pressurized liquid nitrogen stream as product.

2. The process of claim 1, wherein a third nitrogen portion of said first nitrogen stream is introduced into an LP column vaporizer.

3. The process of claim 1, wherein said product nitrogen stream is further compressed in a product compressor, thereby producing a pressurized product nitrogen stream.

4. The process of claim 1, further comprising:
   removing a rich liquid stream from said MP column,
   removing a cooling stream from said nitrogen condenser, indirectly exchanging heat between said rich liquid stream and said cooling stream, thereby producing a subcooled rich liquid stream which is then introduced into said LP column.

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