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DESICCANT AIR DRYER

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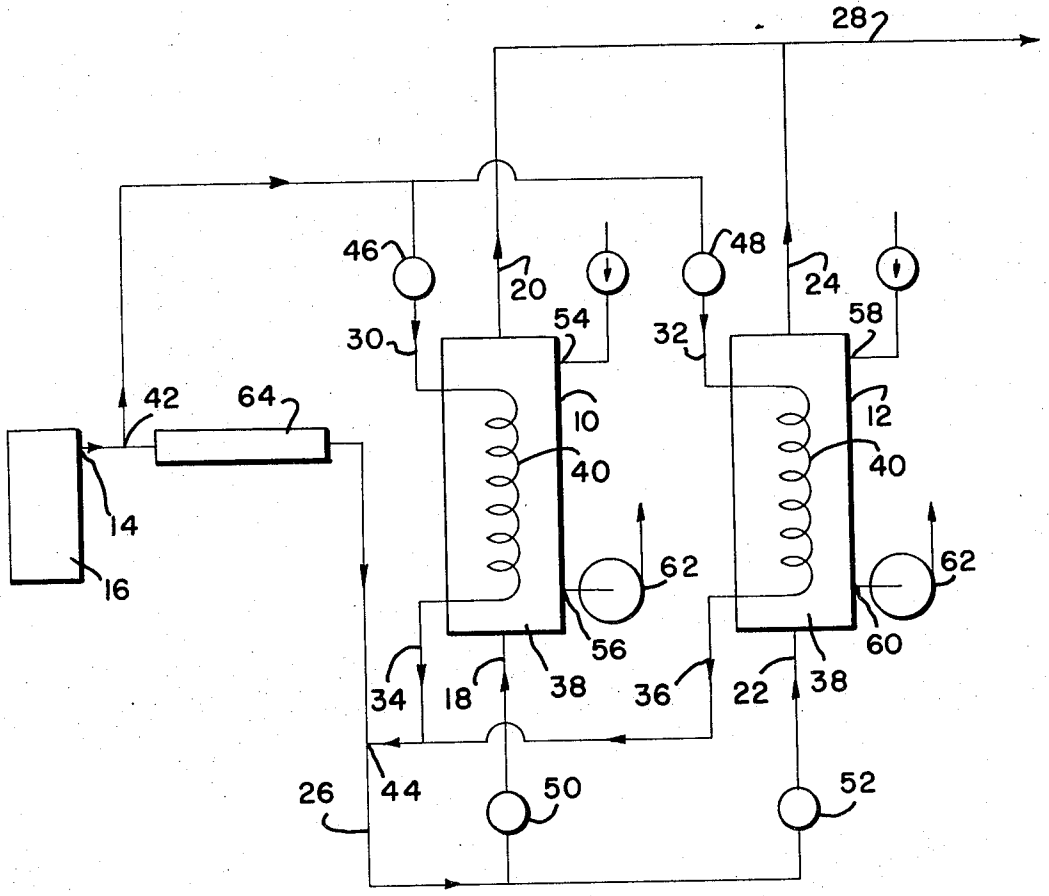

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DESICCANT AIR DRYER

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ABSTRACT OF THE DISCLOSURE

Method, and apparatus for the practice thereof, of dehydrating hot, pressured gas, in which a minor portion of the pressured gas to be dehydrated is conducted through one of a pair of dehydrating desiccant chambers, to reactivate the latter, while the major portion of the gas is conducted through the other chamber of the pair, to dehydrate said major portion.

This invention pertains to gas dehydrating methods, and to apparatus for the practice of such methods, and in particular to dehydrating methods for hot, pressured gas, and apparatus, in which a portion of the very gas to be dehydrated is employed to reactivate the means which are used for extracting the aqueous constituents.

In the prior art types of gas dehydrating methods and apparatus, it is commonly known to employ electrical, steam, or other extraneous sources of what I will call "commercial" energy, or water or refrigerant coolers, to reactivate the dehydrating apparatus. Thus, the embedding of electrical heaters in the desiccant chambers, the introduction of steam thereto, or like methods, are practiced as means for driving off—i.e., separating—the aqueous constituents from the usual chemical desiccant.

The prior art types noted are uneconomical; they require the arrangement for, and coupling and control of the extraneous energy source. Further, the energy used is wholly dissipated in the reactivation process. Additionally, the deployment of other energy sources, in the dehydration of gas and the reactivation of the dehydration means, compounds the maintenance problems and the system failure rate. Failure or malfunctioning of the ancillary electrical subsystem, or the extraneous steam subsystem, will disable the overall gas dehydrating apparatus even though the supply, piping, and control of pressured gas to be treated is without fault.

More efficient, more economical, less given to failure and maintenance difficulties, would be a gas dehydrating method, and apparatus for its practice, in which no ancillary "commercial" energy source is required. Accordingly, it is an object of this invention to teach a gas dehydration method, and apparatus for the practice thereof, in which no ancillary energy source is required for the reactivation of the dehydrating device—other than that of power-moved ambient atmosphere, and the means for its movement. It is another object of this invention to teach a gas dehydration method and apparatus in which the hot pressured gas to be treated—together with the ambient atmosphere—is the energy medium employed for reactivation of the dehydrating devices.

A feature of this invention, both in the method and apparatus taught hereby, comprises the provisioning of both primary and secondary pressured gas inlet and outlet means for the dehydrating devices or means for extracting the aqueous constituents—i.e., the desiccant chambers, in which the secondary means are throughconnected with the primary inlet means. Thus, a minor portion of the to-be-processed pressured gas is passed through one of the extracting means while the major portion of the gas is conducted through the other, or another, of the extracting means. This practice, and the apparatus taught herein,

causes the "process" gas, i.e., the gas to-be-processed, to reactivate the one aqueous extractor, while the major stream of the gas is being dehydrated by the other (or another) aqueous extractor. Further, the throughconnection of the secondary outlet means with the primary inlet means returns the "reactivating" minor portion of the gas to the major stream of "process" gas for its own dehydration.

Further objects and features of this invention will become more apparent by reference to the following discussion taken in conjunction with the accompanying figure. The figure is a schematic diagram of one embodiment of the invention shown in cooperative association with a gas compressor.

As the diagrammatic figure shows, a plurality of aqueous extractors, or desiccant chambers **10** and **12** are coupled to the output **14** of a gas compressor **16**. The teaching of my invention can be practiced with any number of chambers. That is to say that a single desiccant chamber can be used, but in such a circumstance, this type of "system" would have intermittent use. It could dehydrate for only a given period of time, and then it would have to be switched to reactivation. Any plurality of chambers, however, providing that the chamber flow rates and the gas source rates are complementary, will provide continuous dehydration.

Chamber **10** has primary pressured gas inlet and outlet means **18** and **20**, respectively, and chamber **12** has primary pressured gas inlet and outlet means **22** and **24**, respectively. Inlet means **18** and **22** are commonly throughconnected with system inlet line **26**, and outlet means **20** and **24** are commonly throughconnected with system outlet line **28**. Chambers **10** and **12** also have secondary pressured gas inlet and outlet means, these inlet means being **30** and **32**, and these outlet means being **34** and **36**, respectively. All of these several inlet and outlet means, of course, comprise conduits, piping, or the like.

Chambers **10** and **12** confine therewithin a desiccant medium **38**, such as silica gel, or the like, for extracting from gas conducted therethrough the aqueous constituents thereof. Embedded in the desiccant medium **38**, and throughconnected with the secondary inlet and outlet means **30** and **34**, and **32** and **36**, are heat exchanger devices **40**. Devices **40** have openings only at the ends thereof, where they throughconnectedly couple with means **30**, **32**, **34**, and **36**, to insure the confinement of gas therewithin and to provide for the subsequent reclamation of the gas submitted therethrough. Further, secondary inlet means **30** and **32** are commonly throughconnected with inlet line **26**, at a first location **42**, and secondary outlet means **34** and **36** are also commonly throughconnected with inlet line **26**, at a second location **44**. By this arrangement, by this teaching of my method, a minor portion of the hot, pressured gas to be processed can be conducted from the primary inlet line **26**, through the devices **40**, and returned to the line **26**. Location **42** comprises an orificed coupling for admitting a portion of the gas supply to inlet means **30** and **32**, and location **44** comprises an orificed coupling for joining the gas portion, from outlet means **34** and **36**, with inlet line **26**.

By this arrangement, this method, the secondary inlet and outlet means **30** and **34**, and **32** and **36** are commonly throughconnected with the primary inlet means **18** and **22**; after the shunting of a minor portion of the pressured gas to be processed, through the devices **40**, said minor portion is reunited with the main gas stream for dehydration therewith in chamber **10** or **12**—depending upon the status of the system cycle.

The schematic diagram shows valves **46** and **48** in the secondary inlet means or lines **30** and **32**, and valves **50** and **52** in the primary inlet means or lines **18** and **22**. The

purpose of these valves is to insure that chamber **10** admits the major portion of the pressured gas to be processed, for purposes of dehydration thereof, while chamber **12** admits the minor portion of said gas for purposes of reactivation of the desiccant medium **38** therewithin. And, of course, the valves are provisioned to accommodate for the alternate processing, when chamber **10** approaches saturation, and requires reactivation, and chamber **12** has been reactivated, and can accept gas for the dehydration thereof.

Finally it will be noted that chambers **10** and **12** have venting inlet and outlet ports; chamber **10** has inlet and outlet ports **54** and **56**, and chamber **12** has inlet and outlet ports **58** and **60**, respectively. Vacuum pumps **62** are operatively in flow communication with venting outlet ports **56** and **60**, to remove from chambers **10** and **12** the aqueous constituents which the desiccant medium **38** in each extracts from the gas.

As is common practice, the output product of the gas compressor **16** is conducted through a cooler **64** interposed in system inlet line **26**. Cooler **64** is positioned between locations **42** and **44** to insure that the minor portion of supply gas admitted to devices **40** remains in a heated condition.

In operation, by novel method of gas dehydration, which can be practiced with the inventive apparatus represented, by way of example, in the diagram of the figure, conducts the major gas stream via inlet line **26** to the chambers **10** or **12**. For purposes of explanation, let it be assumed that chamber **10** is in condition to dehydrate "process" or aqueous-constituent-laden gas, and chamber **12** is near saturation, requiring reactivation. Control means (not shown) which can be manually actuated, or automatically actuated by means programmed by the quantity or timing of gas flow from compressor **16**, will have closed valves **46** and **52**, and opened valves **48** and **50**. Thus, the major gas flow will be conducted through open valve **50**, through the absorbent desiccant medium **38** in chamber **10**, and conducted out, dehydrated, via system outlet line **28**. Meanwhile, a minor portion of the gas flow will be conducted via open valve **48** through the heat exchanger **40**, in chamber **12**, where it heats the desiccant medium **38** therein. The control means priorly noted are manually or automatically actuated, when the desiccant medium **38** in chamber **12** is sufficiently heated, to operate the vacuum pump **62** associated with outlet port **60**. In this manner, ambient, atmospheric air is introduced to the medium **38**, is heated and expanded, and pulled from the medium **38** by the pump **62** removing the aqueous constituents therefrom. Inlet venting port **58**, and port **54** as well, has check valving associated therewith which is normally closed and opened automatically only in response to the operation of pump **62**.

When chamber **10** is saturated, the control means—of a type well known and commonly employed in the art to which this invention pertains—will close valves **50** and **48** and open valves **46** and **52**. The control means will also, simultaneously, halt the vacuum pump **62** associated with port **60**; when the minor flow of gas from compressor **14** which is now conducted to chamber **10** has sufficiently heated the desiccant medium **38** therein, the control means will cause the vacuum pump **62** associated with port **56** to operate. The chamber **10** will have removed therefrom the aqueous constituents entrained by the medium **38** therewithin, while chamber **12** is then dehydrating the major portion of the "process" gas.

My invention is especially useful in dehydration of hot compressed gas from a gas compressor. Accordingly, a gas compressor **16** is represented in the diagrammatic figure as the source of the hot, pressured gas. Any source of hot, pressured gas, however, will be efficiently dehydrated in accordance with my novel method, or with my novel apparatus.

The teaching of my disclosure is the conducting of the major portion of the gas supply through a first aqueous

extractor, for dehydration, while a minor portion of the gas supply is conducted through a second aqueous extractor for reactivation of the latter. My teaching requires no diverting of any portion of the dehydrated gas product for purposes of reactivation. All the dehydrated gas is available as an output product. What is more, the minor portion of the gas supply which is used for reactivation is only shunted from the principal stream of gas. After it has been conducted through the heat exchanger devices **40**, it is reunited with the principal gas stream. It is joined to the main stream at location **44**, and reclaimed for inclusion in the subsequent output product.

While I have described my invention in connection with a specific embodiment thereof, which embodiment can be used to practice the inventive method here taught, it is to be clearly understood that this is done only by way of example and not as a limitation to the scope of my invention as set forth in the objects thereof and in the accompanying claims.

I claim:

1. Apparatus for dehydrating a supply of hot, pressured gas, comprising:

a plurality of means for extracting aqueous constituents from said gas each means of said plurality confining indirect heat exchange means therewithin;

means interposed between the supply of gas and said plurality dividing said gas into minor and major portions;

each of said extracting means having primary gas inlet and outlet means for admitting the major portion of said gas therethrough for dehydration thereof;

each of said extracting means having secondary gas inlet and outlet means for admitting the minor portion of said gas therethrough for cooperation with said heat exchange means for effecting reactivation of said extracting means; wherein

said primary and secondary means include means for controlling the admittance of gas therethrough; and

said secondary inlet and outlet means of each of said extracting means are shuntedly through connected with one of said primary inlet and outlet means thereof, to cause gas admitted via said secondary means both to be taken from said supply and to be joined with gas admitted via said primary means; and further including

a single cooler through connected with said primary gas inlet means for causing only the major portion of said gas to be cooled thereby.

2. Apparatus, according to claim **1**, wherein:

said plurality of extracting means comprise desiccant chambers.

3. Apparatus, according to claim **1**, wherein:

said heat exchange means are interpositioned between, and connected with, said secondary inlet and outlet means.

4. Apparatus, according to claim **1**, wherein:

said primary inlet and outlet means are disposed for admitting gas therethrough in a first direction.

5. Apparatus, according to claim **4**, wherein:

said secondary inlet and outlet means are disposed for admitting gas therethrough in a second direction.

6. Apparatus, according to claim **1**, further including:

venting inlet and outlet ports for admitting a gas which is cooler than said supply gas through said extracting means to remove extracted aqueous constituents therefrom, said ports and such cooler gas admitted therethrough being cooperative with said heat exchange means and said minor portion of said gas to effect reactivation of said extracting means.

7. Apparatus, according to claim **6**, wherein:

one of said venting ports has an air-mover device operatively through connected therewith.

8. Apparatus, according to claim **1**, wherein:

said controlling means comprise valving means interposed in said inlet means for admitting gas through

one of said primary and one of said secondary inlet means and for prohibiting such admittance through any other of said primary and secondary inlet means.

9. A method of dehydrating a supply of hot, pressured gas, comprising the steps of:

separating the gas supply into minor and major portions;

cooling only the major portion of said supply gas;

conducting the cooled major portion of said supply gas through one of a plurality of aqueous extractor devices which have indirect heat exchange means confined therewithin, to cause aqueous constituents of said supply gas to be extracted therefrom;

conducting the minor portion of said supply gas through another of said plurality of said extractor devices in cooperation with said heat exchange means to reactivate said another device;

joining said minor portion with said major portion for reclamation thereof; and

controlling the admittance of said major and minor portions to said devices; wherein

the step of controlling the admittance of said gas portions comprises admitting said major portion to said one device while prohibiting admittance of said major portion to said another device, and admitting said minor portion to said another device while prohibiting admittance of said minor portion to said one device.

10. A method, according to claim 9, further including he step of:

conducting a gas which is cooler than said supply gas through said devices for effecting the removal of extracted aqueous constituents from said devices and to cooperate with the minor gas portion and the heat exchange means thereby to reactivate said devices.

11. In a compressed gas drying system including a supply of hot compressed gas which passes through a cooler for cooling purposes, the invention comprising:

a pair of chambers, each containing a moisture absorbing material adapted to absorb moisture from a gas on contact and to release said moisture upon being heated;

each of said chambers also containing a passage adapted to convey a heating fluid through said moisture-absorbing material for heating purposes;

means for admitting the cooled compressed gas received from said cooler selectively and alternately to each of said chambers for drying said gas;

other means for selectively and alternately conveying a portion of the gas, in a shunted avoidance of the cooler, to each of said heating fluid passages; and

further means for joining all the gas from each of said heating fluid passages with said cooled gas prior to admission of said cooled gas to one of said chambers.

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