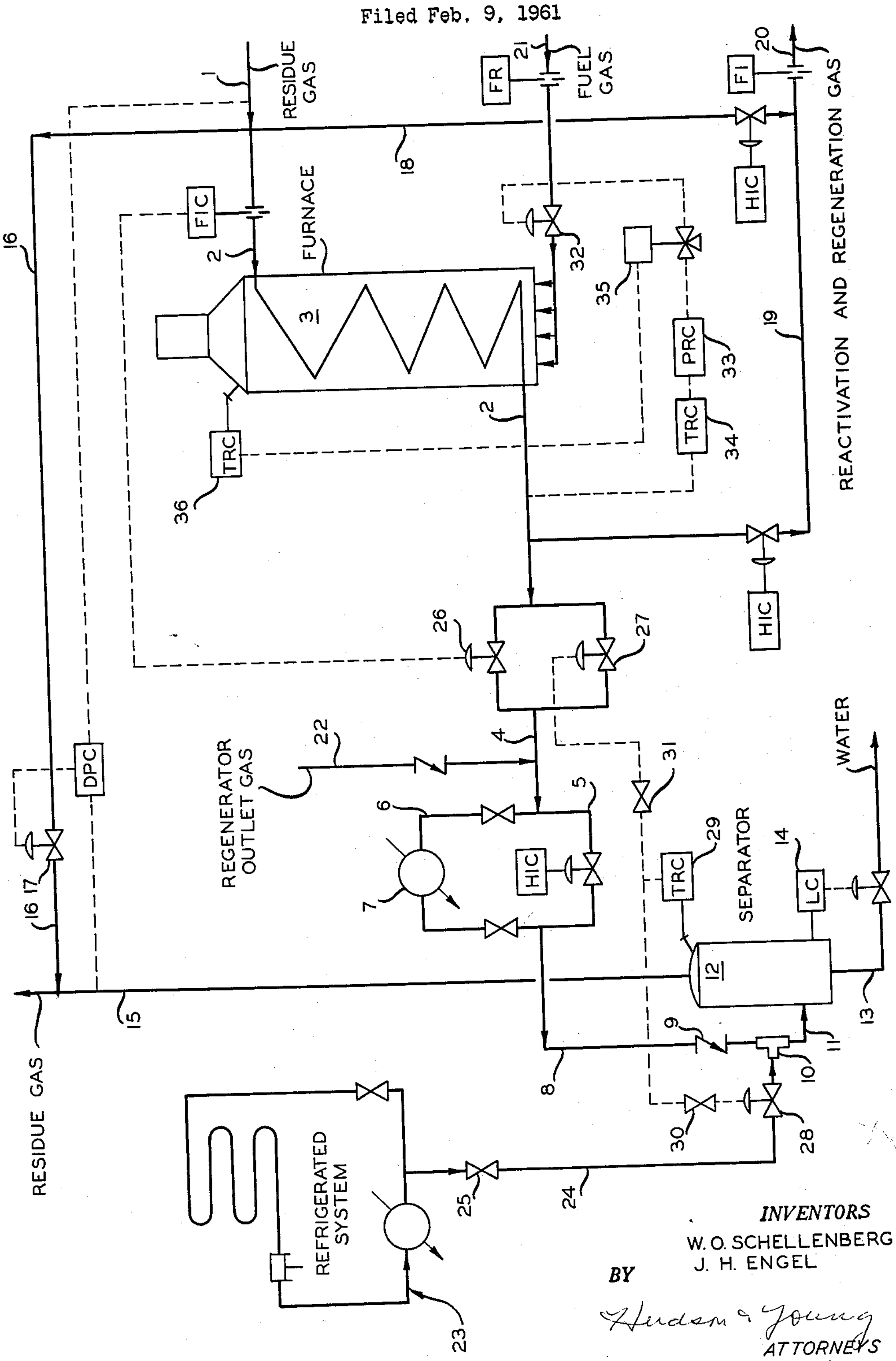
Nov. 5, 1963 W. O. SCHELLENBERG ETAL 3,109,292

SYSTEM FOR HANDLING REFRIGERANT UPON SHUT-DOWN

Filed Feb. 9, 1961

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# United States Patent Office

3,109,292

Patented Nov. 5, 1963


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3,109,292

## SYSTEM FOR HANDLING REFRIGERANT UPON SHUT-DOWN


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Filed Feb. 9, 1961, Ser. No. 88,098

15 Claims. (Cl. 62—52)


This invention relates to process and apparatus for handling refrigerant upon shut-down of a refrigeration system. In one of its aspects, this invention relates to a process for disposal of quantities of cold liquid from a refrigeration system which comprises admixing this cold liquid with a heated gas before disposing of it. In another aspect, this invention relates to a refrigerant liquid removal apparatus which comprises a refrigeration system, a fluid heating means, a fluid mixing means, first conduit means operatively connected between a source of gas and said fluid heating means, second conduit means operatively connected between said fluid heating means and said fluid mixing means, third conduit means operatively connected between said refrigeration system and said fluid mixing means, and fourth conduit means operatively connected between said fluid mixing means and a point of fluid utility. In yet another aspect, this invention relates to a control system for controlling the process and apparatus.

In plants utilizing low-boiling compounds, such as methane, ethane and ethylene, in the liquid phase, there can be considerable difficulty in emptying vessels, lines and other equipment. Plants equipped with small steam-heated finned exchangers to vaporize the low-boiling liquids are generally unsuccessful in rapidly vaporizing large quantities of liquid. The large temperature difference between condensing steam and the boiling hydrocarbon probably tends to retard heat transfer because of vapor blanketing. Release of the materials to conventional flare or fuel gas systems presents the hazard of thermal shock to lines or formation of a liquid phase in normally gaseous fuels. The result of this practice is fractured relief lines and overheated furnace tubes. An expensive alternative is construction of large alloy pipe relief lines and specially designed flares. Most plants utilizing the above refrigerants have small, fired heaters for regenerating desiccant beds. The heaters are generally idle during plant shut-down and at some times during normal operation.

It is an object of this invention to provide process and apparatus for handling large quantities of cold liquid refrigerant. It is another object of this invention to provide process and apparatus for rapid disposal of large quantities of cold liquid refrigerant occasioned by shut-down of related processes. It is still another object of this invention to provide automatic controls for a process and apparatus useful in rapid disposal of large quantities of cold liquid refrigerant.

Other aspects, objects, advantages and features of this invention will become apparent from the following detailed description which is taken in conjunction with the accompanying drawing and appended claims.

According to this invention, there is provided a process for disposal of quantities of cold liquid from a refrigeration system which comprises admixing this cold liquid with a heated gas before disposing of it. There is further provided a process for rapid removal of cold liquid from a refrigeration system which comprises heating a gas stream in a heat exchanger, admixing into the resulting heated gas stream the cold liquid, passing this resulting mixture to a separation zone, separating out and removing any condensed water from the stream, and removing the remainder of the resulting mixture from the separation zone for further utility. There is further provided a refrigerant liquid removal apparatus which comprises a refrigeration system, fluid heating means, fluid mixing means, first conduit means operatively connected between a source of gas in said fluid heating means, second conduit means operatively connected between said fluid heating means and said fluid mixing means, third conduit means operatively connected between said refrigeration system and said fluid mixing means and fourth conduit means operatively connected between said fluid mixing means and a point of fluid utility. There is further provided an automatic control system for the process and apparatus.

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The invention will now be described in connection with the accompanying drawing. A fuel or residue gas or other plant gas is passed by way of conduits 1 and 2 through heater 3. The resulting heated gas can be mixed with gas resulting from regeneration of a desiccant by way of conduit 22. The gas mixture is then passed by way of conduit 4 through conduit 5 and its associated hand indicating controller and/or by way of conduit 6 and its associated cooler 7 to conduit 8 which can contain therein check valve 9. The gas is then passed through mixer 10 by way of conduit 11 to a separator 12. Any liquid contained in this gas stream, such as condensed water, is removed by way of conduit 13 and its associated liquid level controller 14. The dry gas is taken from an upper part of the separator by way of conduit 15 for further utility in the plant, such as e.g. a flare, as desired. There is depicted at 23 a refrigeration system. Cold liquid from this refrigeration unit is passed by way of conduit 24, at such times as may be desired or necessary, to mixer 10. Valve 25 in conduit 24 can be manually operated or can be operated in response to some signal of plant shut-down. Thus, it is seen that the cold liquid in line 24 is mixed with a warm gas in line 8 at mixer 10. The resulting gas mixture in conduit 11 can then be separated as previously recited. A portion of the gas in conduit 1 can by-pass heater 3 and separator 12 by way of conduit 16 and its associated control valve 17. This valve is operated in response to differential pressure obtained between lines 1 and 15. Other portions of the residue gas can be passed by way of lines 18 and 19 and their associated hand indicator controllers to conduit 20, where they can be used to reactivate and regenerate the previously-mentioned desiccant. There can also be associated with conduit 20 a flow indicator. Fuel gas is indicated as being supplied by way of conduit 21 to heater 3, the fuel gas being burned therein to provide heat for the gas in conduit 2. This fuel gas conduit 21 can be provided with a flow recorder, as shown.

In many instances, it is desired to provide automatic control for the above-described system. Flow of heated gas in conduit 2 can be controlled by control valve 26, which is actuated in response to a flow indicator controller in conduit 2. The temperature obtained in separator 12 can conveniently be used to control one of two variables in the process. For this purpose, there is provided a temperature recorder-controller 29 which can, by a proper manipulation of valves 30 and 31, be utilized to control either flow of cold liquid from the refrigeration unit by way of conduit 24 by manipulation of valve 28 or flow of heated gas to the separation zone by manipulation of valve 27 associated with the by-pass around valve 26. As is understood in the art, controller 29 senses a temperature prevailing in separator 12 which can be either a gas or a liquid temperature, and transmits a correcting signal to the proper control valve. There is further provided a temperature control system for heater

3, which will now be described. There is provided in conduit 21 supplying fuel gas to the heater 3 a valve 32 associated with pressure controller 33, which senses pressure in conduit 21. The index point of this pressure controller can be reset in response to signals from temperature recorder-controller 34 sensing temperature in conduit 2. Further, there is interposed in the signal line connecting pressure recorder-controller 33 and valve 32 a cut-off valve 35. This valve is actuated in response to signals from temperature alarm 36, which senses temperature in an upper portion of heater 3.

Thus, it is seen that there is provided in one preferred embodiment of the invention a control system which automatically operates to remove quantities of cold liquid from a refrigeration system at the time of shut-down or when otherwise desirable. The flow of fuel gas to heater 3 is controlled primarily by pressure in the fuel gas line by valve 32 and controller 33. The desired pressure can be reset in response to a temperature signal from controller 34 which senses temperature in the heater effluent. If the temperature of the heater goes above a predetermined point, as sensed by alarm 36, this alarm actuates valve 35 such that control valve 32 is closed.

As stated previously, the temperature controller 29 can be used to control either valve 28 or valve 27 as desired, suitable manipulation of valves 30 and 31 accomplishing this result. Controller 29 can either decrease the flow of cold liquid by manipulation of valve 28 or increase the flow of warm gas by manipulation of valve 27 as temperature in an upper portion of the separator zone decreases.

Instruments, such as level controller 14, pressure controller 33, temperature controller 34, the various hand indicator controllers, flow recorders, flow indicators, temperature alarm, and differential pressure controller, are instruments commercially available. These can be, for example, Model 40 Foxboro units as described in Foxboro Bulletin 5A–10A of November 1955.

As a specific example, the heater inlet conduit 2 is operated at about 118 p.s.i.g. and 50° F., the heater effluent is operated at about 112 p.s.i.g. and 600° F., and the separator vessel is operated at about 110° F. and 97 p.s.i.g. The fuel gas in line 21 is natural gas. The residue gas introduced by way of line 1 is a plant residue gas comprising essentially methane, and the regenerator outlet gas in line 22 is a wet residue gas stream resulting from regeneration of dryers by passing residue gas therethrough. The refrigerant in line 24 comprises a mixture of ethylene and propylene.

It is thus seen that there has been provided a method and apparatus for automatically handling quantities of cold liquid refrigerant.

The normal boiling points of various liquid refrigerants are as follows: methane, −161.5° C.; ethylene, −103.9° C.; ethane, −88.3° C.; and propylene, −47.0° C.

Reasonable variation and modification are possible within the scope of the foregoing disclosure, drawing and the appended claims to the invention, the essence of which is that there are provided a process and apparatus for removal of quantities of cold liquid from a refrigeration system which comprises admixing this cold liquid with a heated gas before disposal thereof.

We claim:

1. A process for rapid removal of cold liquid from a refrigeration system comprising removing said cold liquid from said system, heating a gas stream in a heat exchange zone, admixing into the resulting heated gas stream the thus-removed cold liquid refrigerant, passing the resulting mixture to a separation zone, separating out and removing any condensed liquid therefrom, removing the remainder of said resulting mixture from said separation zone, passing said remainder to further utility, and controlling the rate of admixing in response to a temperature prevailing in said separation zone.

2. Refrigerant liquid removal apparatus comprising a refrigeration system, fluid heating means, first conduit means operatively connected between a source of gas and said fluid heating means, fluid mixing means, second conduit means operatively connected between said fluid heating means and said fluid mixing means, third conduit means operatively connected between said refrigeration system and said fluid mixing means, and fourth conduit means operatively connected between said fluid mixing means and a point of fluid utility, said point of fluid utility comprising vapor-liquid separating means having fifth conduit means operatively connected to a lower portion thereof for liquid removal and sixth conduit means operatively connected between an upper portion of said separating means and a point of vapor utility.

3. The process of claim 1 wherein the rate of flow of said resulting heated gas stream is controlled in response to the rate of flow of said gas stream.

4. The process of claim 3 wherein the rate of flow of heating fluid to said heat exchange zone is controlled in response to the pressure of said fluid.

5. The process of claim 4 wherein said rate of flow of heating fluid is further controlled in response to the temperature in said heat exchange zone.

6. The process of claim 5 wherein said rate of flow of heating fluid is further controlled in response to the temperature of said resulting heated gas stream.

7. The process of claim 1 wherein a portion of said gas stream is passed directly into admixture with said remainder.

8. The process of claim 7 wherein the rate of flow of said portion is controlled in response to the pressure differential prevailing between said gas stream and said remainder.

9. The process of claim 1 wherein the rate of flow of said resulting heated gas stream is controlled in response to both the temperature prevailing in an upper portion of said separation zone and the rate of flow of said gas stream, a second portion of said gas stream being withdrawn for further use.

10. Apparatus of claim 2 further provided with means sensing temperature in an upper portion of said separating means and adapted to control the flow of fluid in said third conduit means.

11. Apparatus of claim 10 further provided with flow sensing means in said first conduit means and adapted to control the flow of fluid in said second conduit means.

12. Apparatus of claim 2 further provided with seventh conduit means operatively connected between said source of gas and said point of vapor utility, said seventh conduit means being provided with flow control means therein adapted to control the flow therethrough in response to the pressure differential obtained between said source of gas and said point of vapor utility.

13. Apparatus of claim 2 further provided with a heating fluid source, eighth conduit means operatively connected between said heating fluid source and said fluid heating means, flow control means in said eighth conduit means normally responsive to signal generating means sensing pressure in said eighth conduit means, said signal generating means being further responsive to temperature of fluid in said second conduit means, and means sensing temperature in said fluid heating means, said means sensing temperature being adapted to disengage said signal generating means from said flow control means in said eighth conduit means upon the temperature in said fluid heating means exceeding a predetermined value.

14. Apparatus of claim 2 further provided with ninth conduit means operatively connected between said fluid heating means and said fluid mixing means, means in said second conduit means adapted to control flow therein in response to flow in said first conduit means, and means in said ninth conduit means adapted to control flow therein in response to temperature in an upper portion of said separating means.

15. A process for treating cold liquid comprising ethyl-

ene and propylene which comprises heating a residue gas stream in a heat exchange zone, admixing into the resulting heated residue gas stream said cold liquid, passing the resulting mixture to a separation zone wherein condensed liquids are removed, removing the remainder of said resulting mixture from said separation zone, passing said remainder to a point of utility, controlling the rate of flow of said resulting heated residue gas stream in response to temperature prevailing in an upper portion of said separation zone, controlling the rate of flow of said resulting heated residue gas stream in response to the rate of flow of said residue gas stream, controlling the rate of flow of heating fluid to said heat exchange zone in response to the pressure thereof and further in response to the temperature in said heat exchange zone and the temperature of said resulting heated residue gas, passing a portion of said residue gas stream directly into admix-



ture wtih said remainder, and controlling the rate of said last-recited passing in response to the pressure differential prevailing between said residue gas stream and said remainder.

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