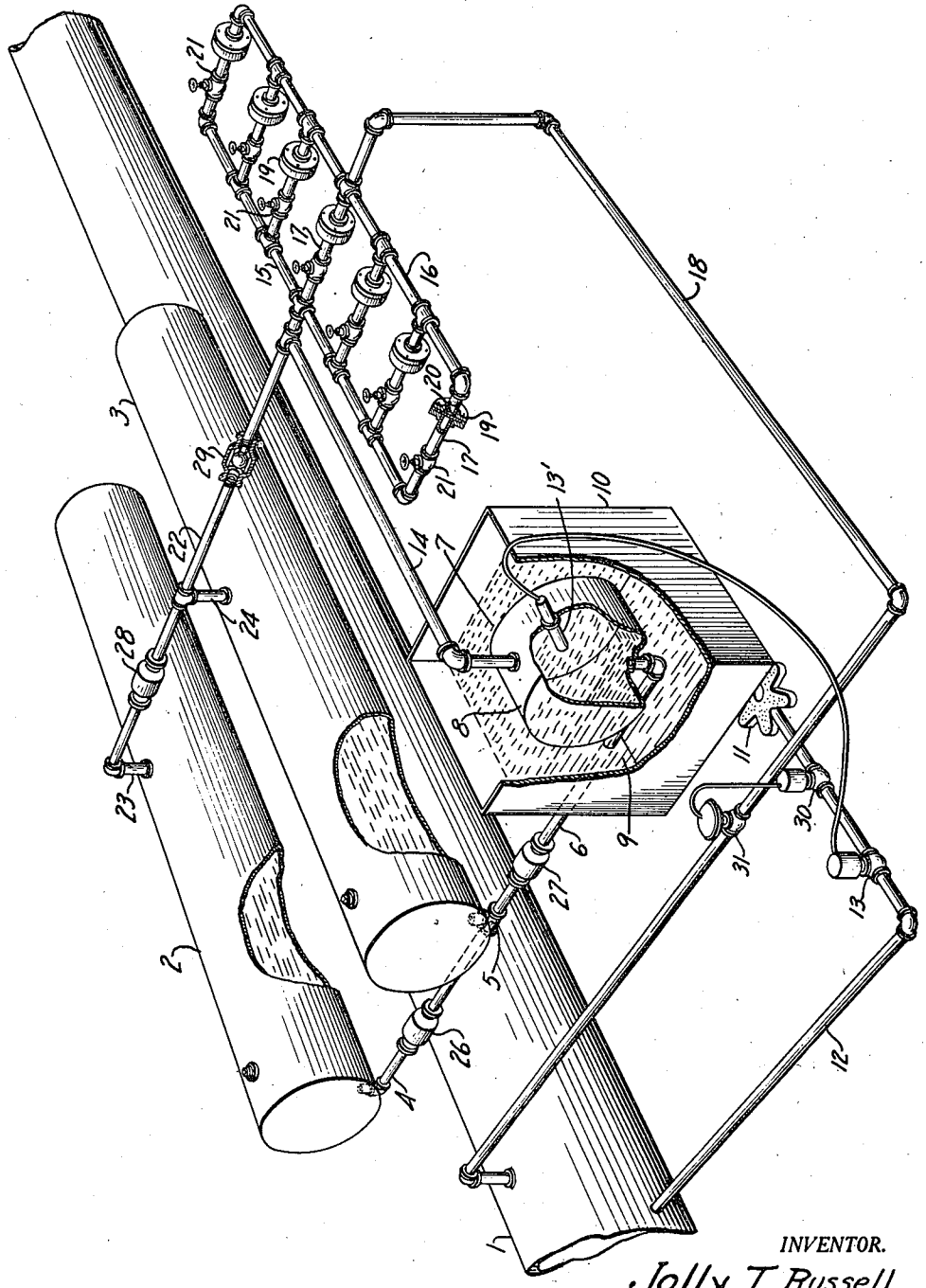
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METHOD OF PREVENTING FREEZE-UPS IN GAS TRANSMISSION LINES

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METHOD OF PREVENTING FREEZE-UPS IN GAS TRANSMISSION LINES

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4 Claims. (Cl. 48—190)

This invention relates to a method of preventing freeze-ups in gas transmission lines and particularly those for transmission of natural gas from a source of supply to a distant market.

In operating systems of this character, much difficulty has been encountered and serious accidents have resulted incidental to freeze ups when the temperatures drop below 50° F. It has recently been determined that these freeze ups are caused through formation of hydrates in the lines and not by frozen water vapor as heretofore supposed. It is now known that whenever the ground temperatures drop below the dew point of the gas under transportation, entrained moisture therein condenses and the high line pressures cause components of the natural gas to react therewith to form crystalline compounds, namely, gas hydrates. These gas hydrates resemble snow or ice and collect upon obstructions on the interior surfaces and in low portions of the lines to such an extent that they block flow of gas therethrough. When the crystalline deposits start to form, they rapidly increase in size due to the fact that the hydrates are of hygroscopic character and therefore additionally strip the gas of its water content.

It is, therefore, the principal object of the present invention to prevent formation of gas hydrates when the ground temperatures drop below a critical value in relation to line pressures and temperatures.

In carrying out this and other objects of the invention, as hereinafter pointed out, I have found that by delivering into the line a compound that is sufficiently volatile to be gaseous under line temperatures and pressures and which has a greater affinity for water than the gas under line pressure and temperature, the compound will form a hydrate with the water to the exclusion of the components of the natural gas.

In selecting such a compound, it is necessary that it not only form a hydroxide with the water at a much quicker rate than the water reaction with components of the natural gas to form hydrates, but it must not react with, nor chemically attack, metal parts of the system.

It is, therefore, imperative that the compound be of substantially neutral or alkaline character so that it will have no deleterious effect upon the pipe, fittings, compressor cylinders, and other parts of the system with which it may come in contact.

It is also desirable that the compound be in the form of gas for line pressures and temperatures in order that it may distribute through all parts of the system in association with the natural gas.

Considering these requirements, I have found that nitrogenous substances such as ammonia or any of the amines that are sufficiently volatile to be gaseous under line pressures and temperatures are most suitable for the purpose as they readily react with the water to form hydroxide to the exclusion of the natural gas constituents that ordinarily cause the formation of gas hydrates. Since these hydroxides remain in liquid condition under line pressures and temperatures, they will not interfere with movement of natural gas through the line.

The compound may be introduced into the line by several methods. I have found, however, that it is most practicable to inject the compound into the system at the source of gas supply by means of pressure generating apparatus illustrated in the accompanying drawing, wherein the single figure represents a portion of a pipe line equipped with my improved injecting apparatus.

Referring more in detail to the drawing:

1 designates a section of pipe line located adjacent the source of gas supply and through which the gas is pumped under high pressures to a distant market. Associated with the portion 1 of the line are receivers 2 and 3 for containing a supply of the compound to be injected into the line. The containers 2 and 3 are preferably of small diameter and of sufficient length to contain the required supply of compound in liquid form; for example, anhydrous ammonia, NH_3.

Extending from the bottoms of the receivers are outlet pipes 4 and 5 connected with a line 6 leading to a pressure generating apparatus 7 wherewith the vapor pressure of the liquid anhydrous ammonia is raised to a point greater than the pressure carried in the transmission line 1. The pressure generating apparatus includes a small boiler 8 submerged in a body of liquid 9 that is contained within an outer receptacle 10. The liquid within the receptacle 10 is heated by a suitable burner 11 located thereunder and supplied with gas from the transmission line 1 through a branch line 12.

The liquid is thus heated by the burner to raise the temperature thereof sufficiently to cause vaporization of the liquid ammonia in the boiler 8 and to raise the vapor pressure thereof to a point greater than the pressure of the gas in the line 1.

In order to control the temperature of the heat transfer liquid in the receptacle 10, the pipe 12 is provided with a thermostatically controlled valve 13 operated by a thermostat bulb 13' located within the vapor space of the boiler 8 so that when the temperature therein is such as to raise the vapor pressure to the required degree, the valve 13 is automatically operated to shut down flow of gas to the burner 11 to maintain temperature of the heat transfer liquid at such a value that the selected pressure is maintained in the boiler.

Connected with the vapor space of the boiler 10 is a discharge pipe 14 that is connected with a header 15 which in turn is connected with a header 16 through a plurality of branch pipes 17, the header 16 being connected with the line 1 by a pipe 18. Located in each of the branch pipes 17 are orifice plates 19 each having a different size orifice 20 for controlling the rate of flow of ammonia vapor under boiler pressure into the line 1. Located in the pipes 17 ahead of each of the orifice plates is a shut off valve 21 whereby any one of the branch lines may be made effective in delivering flow of ammonia gas to the line.

Thus by selectively employing the branch having the desired size orifice, the flow of gas therethrough may be proportioned to the flow of natural gas being transported through the line 1.

A branch is therefore selected that will admit the ammonia vapor in such a quantity that enough thereof will combine with the water which has condensed throughout the entire transmission system to give a hydroxide solution in which the water of the solution has a greater affinity for the ammonia, NH_3, to form the hydroxide than it does for the natural gas components to form hydrates.

In order to equalize pressures in the receivers 2 and 3 and boiler 8, they are connected by a pipe 22 having branches 23, 24 and 14, respectively connected with the upper portions of the receivers and with the vapor space of the boiler. The pipes 6 and 22 are provided with check valves 26—27 and 28—29, respectively, which are adapted to close in case of sudden rush of pressures through the line but which are normally retained in open position to allow movement of the liquid ammonia from the receivers to the boiler.

In order to further regulate the pressure within the boiler, the pipe 12 is equipped at a point intermediate the thermostatic control of the burner with a pressure operated valve 30 that is actuated by a pressure regulator 31 in the line 18 so that should the pressure rise above a set value, the valve 29 will be operated to shut off supply of fuel to the burner 11.

I have found that such a method is most practicable for preventing freeze-ups as the amount of anhydrous ammonia required is as low as .0042 of one percent of the volume of natural gas delivered through the line 1.

Aside from use of the ammonia to prevent freeze-ups of natural gas, the ammonia vapor is adapted to thaw lines which have frozen or partly frozen, the thaw being brought about since the ammonia vapor has the property of decomposing the gas hydrate constituting the freeze-up.

The ammonia vapor also acts to provide an odorizer whereby leaks in the line may be readily noted.

While I prefer to use the apparatus above described, it is obvious that liquid anhydrous ammonia may be delivered into the line through a suitable drip regulator or equivalent injection devices.

What I claim and desire to secure by Letters Patent is:

1. The method of preventing formation of gas hydrates in natural gas including injecting into the natural gas anhydrous ammonia.

2. The method of treating natural gas to prevent formation of gas hydrates under flow pressure in a pipe line including raising vapor pressure of anhydrous ammonia to a pressure higher than the flow pressure in the line, and injecting the anhydrous ammonia vapor while at said pressure into the line.

3. The method of preventing formation of gas hydrates in a gas transmission system including confining a body of anhydrous ammonia, heating said body of ammonia to raise the vapor pressure above pressure of the gas, and injecting the vapor into the gas.

4. The method of treating natural gas to prevent the formation of gas hydrates under line flow pressures including injecting ammonia into the natural gas.

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