The present invention provides methods and apparatuses for controlling a heater for an oil and gas separator. According to the present invention, a spark is provided for igniting a gas burner. The spark is controlled such that the gas burner is ignited, without unduly complex control or sensor requirements. In the description below, generally an entire temperature-controller separator is described to provide context for the discussion. The invention also contemplates just the heating subsystem, e.g., to mount with existing separators. The invention also contemplates just the heating control subsystem, e.g., to retrofit existing pilot ignition subsystems.
Figure 4b
GAS BURNER CONTROL ANDIGNITION SYSTEM FOR OILFIELD SEPARATORS

BACKGROUND OF THE INVENTION

[0001] This invention relates to the field of oil and gas separation, specifically to methods and apparatuses for igniting a burner for controlling heat the temperature of the contents of a separator.

[0002] Petroleum flowing from a well is not refined product. It is a mixture of crude oil and gas, and impurities such as brine, sand, and other suspended solids. The mixture flows into a separator where gravity can be utilized to separate the mixture into product (oil, gas) from the impurities. The product is then moved, generally by pipelines into storage tanks that are close to the production well(s). From here it is transported to refineries for processing.

[0003] Some oil wells produce considerable salt water along with the oil. Gas also bubbles out of the oil. In order to separate the oil, water, and gas, the fluids can be put into a separator. The separator is a tank, often using gravity to separate the fluids. Gas goes to the top, and the heavier salt water goes to the bottom. In the past, where there was no market for the gas, it was often flared (i.e. burned at the well site). Today, casing gas is used to power pump engines or heat storage tanks. Heating the separator can help separate water and oil if they are mixed in an emulsion.

[0004] Current gas-heated separators use a pilot light to ignite gas. The pilot light is kept burning by a small flow of gas. The pilot light ignites the gas in a main burner when a temperature control system indicates that heating is needed. Pilot light systems can be very simple, and consequently are currently in widespread use with oilfield separators, where ruggedness and simplicity can be important. Alternative ignition systems, in use in other applications, have not been adopted for oilfield separators due to their increased cost and complexity.

[0005] Pilot ignition systems must be kept lit and maintained by human operators. The pilot light can be extinguished by wind or other weather conditions. Also, the small pilot orifice can be easily obstructed, e.g., by sand, extinguishing the pilot light. Cleaning the orifice and relighting it requires time and resources. Also, if the pilot light is extinguished, then the main burner will not ignite, and the separator will not be heated. This can lead to freezes in the separator, interrupting the oil/gas/water flow through the separator. Interrupted flow results in lost revenue.

[0006] Accordingly, there is a need for ignition methods and apparatuses that are sufficiently simple and rugged for oilfield separator applications, and that avoid the shortcomings of current pilot light systems.

SUMMARY OF THE INVENTION

[0007] The present invention provides methods and apparatuses for controlling a heater for an oil and gas separator. According to the present invention, a spark is provided for igniting a gas burner. The spark is controlled such that the gas burner is ignited, without unduly complex control or sensor requirements. In the description below, generally an entire temperature-controller separator is described to provide context for the discussion. The invention also contemplates just the heating subsystem, e.g., to retrofit existing pilot ignition subsystems.

[0008] Advantages and novel features will become apparent to those skilled in the art upon examination of the following description and can be learned by practice of the invention.

DESCRIPTION OF THE FIGURES

[0009] The accompanying drawings, which are incorporated into and form part of the specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

[0010] FIG. 1 is a schematic illustration of an apparatus according to the present invention.

[0011] FIG. 2 is a schematic illustration of an apparatus according to the present invention.

[0012] FIG. 3 is a schematic illustration of an apparatus according to the present invention.

[0013] FIG. 4(a,b) is a circuit diagram of a spark controller subsystem suitable for use with some embodiments of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0014] The present invention provides methods and apparatuses for controlling a heater for an oil and gas separator. According to the present invention, a spark is provided for igniting a gas burner. The spark is controlled such that the gas burner is ignited, without unduly complex control or sensor requirements. In the description below, generally an entire temperature-controller separator is described to provide context for the discussion. The invention also contemplates just the heating subsystem, e.g., to retrofit existing pilot ignition subsystems.

[0015] FIG. 1 is a schematic illustration of an apparatus according to the present invention. A separator vessel 101, such as those known in the art, is mounted and connected as is common in the art. A gas burner 102 mounts with the separator vessel 101, for example by mechanical attachment below the vessel 101 or by other methods that allow transfer of heat 103 from the burner 102 to the vessel 101. A gas control valve 104 is in fluid communication with a gas supply and with the burner 102. A vessel temperature sensor 105 mounts with the vessel 101 such that the sensor 105 can generate a signal representative of the temperature of the contents of the vessel 101. A burner temperature sensor 106 mounts with the burner 102 such that the sensor 106 can generate a signal indicative of the heat generated by the burner 103. A spark generator 108 is mounted with the burner 102 such that a spark from the generator 108 can ignite gas in the burner 102, for example by means of a spark gap mounted in the path of gas from the burner 102, or a spark gap mounted in a gas ignition path to the burner 102. A spark control subsystem 107 enables the spark generator 108 responsive to the two temperature signals.

[0016] In operation, when the temperature of the contents of the vessel 101 falls below a determined value, for
example a value that indicates impaired performance or potential flow reduction, the vessel temperature sensor 105 generates a signal indicating that heat is needed. That signal initiates gas flow from the gas supply to the gas burner 102 through the gas control valve 104. That signal also initiates enablement of the spark generator 108 by the spark control subsystem 107. The spark generator 108 can generate a continuous electric discharge, or can generate a periodic discharge (i.e., a sequence of sparks) to reliably ignite the burner 102. Ignition of the burner 102 will generate heat 103 therefrom. The vessel temperature sensor 106 generates a signal indicative of the heat output from the burner, e.g., a signal indicating that the burner temperature has exceeded a determined threshold. The spark control subsystem 107 then disables the spark generator 108 since the burner 102 is known to have been ignited by the elevated temperature signal. If the burner 102 loses ignition, then the spark control subsystem 107 can re-enable the spark control generator 108. After the burner 102 has supplied sufficient heat to the vessel, the vessel temperature sensor 105 can generate a signal that indicates that heat is no longer required, which signal can cause the gas control valve 104 to cease gas supply to the burner 102 and can cause the spark control subsystem 107 to disable the spark generator 108.

[0017] FIG. 2 is a schematic illustration of an apparatus according to the present invention. A separator vessel 201, such as those known in the art, is mounted and connected as is common in the art. A gas burner 202 mounts with the separator vessel 201, for example by mechanical attachment below the vessel 201 or by other methods that allow transfer of heat 203 from the burner 202 to the vessel 201. A gas control valve 204 is in fluid communication with a gas supply and with the burner 202. A vessel temperature sensor 205 mounts with the vessel 201 such that the sensor 205 can generate a signal representative of the temperature of the contents of the vessel 201. A burner temperature sensor 206 mounts with the burner 202 such that the sensor 206 can generate a signal indicative of the heat generated by the burner 202. A valve sensor 209 mounts with the gas control valve 209 such that it can generate a signal indicative of gas flow through the valve 209, e.g., by monitoring gas pressure in the outlet port of the gas control valve 209 or by monitoring the control signal of the gas control valve 209. The spark generator 208 mounts with the burner 202 such that a spark from the generator 208 can ignite gas in the burner 202, for example by means of a spark gap mounted in the path of gas from the burner 202, or a spark gap mounted in a gas ignition path to the burner 202. A spark control subsystem 207 enables the spark generator 208 responsive to the temperature and valve signals.

[0018] In operation, when the temperature of the contents of the vessel 201 falls below a determined value, for example a value that indicates impaired performance or potential flow reduction, the vessel temperature sensor 205 generates a signal indicating that heat is needed. That signal initiates gas flow from the gas supply to the gas burner 202 through the gas control valve 204. The gas valve sensor 209 indicates that the gas valve 204 is supplying gas to the burner 202, and initiates enablement of the spark generator 208 by the spark control subsystem 207. A flow restrictive device (not shown) such as a needle valve, can mount between the valve 209 and the burner 202, which can increase the time from the opening of the valve 209 and the gas reaching the burner 202 and decrease or eliminate any time that gas is flowing through the burner before a spark is generated. The spark generator 208 can generate a continuous electric discharge, or can generate a periodic discharge (i.e., a sequence of sparks) to reliably ignite the burner 202. Ignition of the burner 202 will generate heat 203 therefrom. The burner temperature sensor 206 generates a signal indicative of the heat output from the burner, e.g., a signal indicating that the burner temperature has exceeded a determined threshold. The spark control subsystem 207 then disables the spark generator 208 since the burner 202 is known to have been ignited by the elevated temperature signal. If the burner 202 loses ignition, then the spark control subsystem 207 can re-enable the spark control generator 208. After the burner 202 has supplied sufficient heat to the vessel, the vessel temperature sensor 205 can generate a signal that indicates that heat is no longer required, which signal can cause the gas control valve 204 to cease gas supply to the burner 202, causing the gas valve sensor 204 to indicate that gas is not being supplied to the burner 202 and cause the spark control subsystem 207 to disable the spark generator 208.

[0019] FIG. 3 is a schematic illustration of an apparatus according to the present invention. A separator vessel 301, such as those known in the art, is mounted and connected as is common in the art. A gas burner 302 mounts with the separator vessel 301, for example by mechanical attachment below the vessel 301 or by other methods that allow transfer of heat 303 from the burner 302 to the vessel 301. A gas control valve 304 is in fluid communication with a gas supply and with the burner 302. A vessel temperature sensor 305 mounts with the vessel 301 such that the sensor 305 can generate a signal representative of the temperature of the contents of the vessel 301. A spark generator 308 mounts with the burner 302 such that a spark from the generator 308 can ignite gas in the burner 302, for example by means of a spark gap mounted in the path of gas from the burner 302, or a spark gap mounted in a gas ignition path to the burner 302. A spark control subsystem 307 enables the spark generator 308 responsive to the temperature signal.

[0020] In operation, when the temperature of the contents of the vessel 301 falls below a determined value, for example a value that indicates impaired performance or potential flow reduction, the vessel temperature sensor 305 generates a signal indicating that heat is needed. That signal initiates gas flow from the gas supply to the gas burner 302 through the gas control valve 304, and causes the spark control subsystem 307 to enable the spark generator 308. The spark generator 308 can generate a continuous electric discharge, or can generate a periodic discharge (i.e., a sequence of sparks) to reliably ignite the burner 302. Ignition of the burner 302 will generate heat 303 therefrom. Heat 303 from the burner 302 will cause a rise in the temperature of the contents of the vessel 301. The vessel temperature sensor 305 can generate a signal that indicates that the temperature of the contents has risen above a determined threshold, e.g., a threshold that has been determined to be adequately indicative of reliable burner operation. The spark control subsystem 307 then disables the spark generator 308 since the burner 302 is known to have been ignited by the elevated temperature signal. If the burner 302 loses ignition, then the spark control subsystem 307 can re-enable the spark control generator 308. After the burner 302 has supplied sufficient heat to the vessel, the vessel temperature sensor 305 can generate a
signal that indicates that heat is no longer required, which signal can cause the gas control valve 304 to cease gas supply to the burner 302, and cause the spark control subsystem 307 to disable the spark generator 308.

[0021] FIG. 4(a,b) is a circuit diagram of an example spark control subsystem suitable for use with some embodiments of the present invention. The components are as set forth in Table 1.

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[0026] The particular sizes and equipment discussed above are cited merely to illustrate particular embodiments of the invention. It is contemplated that the use of the invention may involve components having different sizes and characteristics. It is intended that the scope of the invention be defined by the claims appended hereto.

We claim:
1. A gas burner control and ignition system for an oil and gas separator, the separator capable of indicating when heat is required, comprising:
   a) a gas valve having an inlet and an outlet, where the inlet is adapted to accept gas from a gas supply and the outlet is adapted to supply gas to a gas burner;
   b) a spark generator, adapted to mount with the burner such that a spark from the spark generator ignites gas in the gas burner;
   c) a burner temperature sensor, adapted to mount with the gas burner and generate a burner temperature signal representative of heat generated by the gas burner;
   d) a valve control subsystem, enabling gas flow through the gas valve when the separator indicates that heat is required;
   e) a spark control subsystem, enabling the spark generator when both (1) the separator indicates that heat is desired, and (2) the burner temperature signal indicates that the burner has not generated a determined amount of heat.
2. A gas burner control and ignition system for an oil and gas separator, comprising:
   a) a gas valve having an inlet and an outlet, where the inlet is adapted to accept gas from a gas supply and the outlet is adapted to supply gas to a gas burner;
   b) a spark generator, adapted to mount with the burner such that a spark from the spark generator ignites gas in the gas burner;
   c) a burner temperature sensor, adapted to mount with the gas burner and generate a burner temperature signal representative of heat generated by the gas burner;
   d) a separator temperature sensor, adapted to mount with the separator and generate a signal representative of the temperature of the contents of the separator;
   e) a valve control subsystem, responsive to the separator temperature sensor, enabling gas flow through the gas valve when the temperature of the contents of the separator is below a determined temperature;
   f) a spark control subsystem, enabling the spark generator when both (1) the temperature of the contents of the separator is below a determined temperature, and (2)
the burner temperature signal indicates that the burner has not generated a determined amount of heat.

3. A temperature control system for an oil and gas separator, comprising:
   a) a gas burner, adapted to mount with the separator and impart heat thereto;
   b) a gas burner control and ignition system according to claim 2.

4. An oil and gas separator, comprising:
   a) a separator vessel;
   b) a temperature control system according to claim 3.

5. A gas burner control and ignition system for an oil and gas separator, comprising:
   a) a gas valve having an inlet and an outlet, where the inlet is adapted to accept gas from a gas supply and the outlet is adapted to supply gas to a gas burner;
   b) a spark generator, adapted to mount with the burner such that a spark from the spark generator ignites gas in the gas burner;
   c) a burner temperature sensor, adapted to mount with the gas burner and generate a burner temperature signal representative of heat generated by the gas burner;
   d) a separator temperature sensor, adapted to mount with the separator and generate a signal representative of the temperature of the contents of the separator;
   e) a pressure sensor mounted with the gas valve generating a signal indicative of the state of the gas valve;
   f) a valve control subsystem, responsive to the separator temperature sensor, enabling gas flow through the gas valve when the temperature of the contents of the separator is below a determined temperature;
   g) a spark control subsystem, enabling the spark generator when both (1) the pressure sensor indicates that the gas valve is open, and (2) the burner temperature signal indicates that the burner has not generated a determined amount of heat.

6. A temperature control system for an oil and gas separator, comprising:
   a) a gas burner, adapted to mount with the separator and impart heat thereto;
   b) a gas burner control and ignition system according to claim 5.

7. An oil and gas separator, comprising:
   a) a separator vessel;
   b) a temperature control system according to claim 6.

8. A gas burner control and ignition system according to claim 5, further comprising a gas flow restrictor mounted between the gas valve and the burner.

9. A gas burner control and ignition system according to claim 5, wherein the spark control system comprises an electric energy storage system, and a solar cell charging system.

10. A gas burner control and ignition system according to claim 5, wherein the spark control system comprises:
   a) A power supply;
   b) A spark generating device;
   c) An oscillating circuit connected to the power supply and generating an oscillating circuit;
   d) An energy storage device connected to the oscillating circuit;
   e) An energy transformer connected to the spark generating device;
   f) An energy sensing and triggering circuit, connected to the energy storage device and connecting the energy storage device to the energy transformer when sufficient energy is sensed in the energy storage device.

11. A gas burner control and ignition system according to claim 10, wherein the power supply comprises a battery, and a solar cell charging system connected to the battery.

12. A gas burner control and ignition system according to claim 5, wherein the gas valve supplies gas at a pressure of about 10 pounds per square inch, and wherein the pressure switch indicates that the gas valve is open when the output pressure of the gas valves reaches about 2 pounds per square inch.

13. A gas burner control and ignition system according to claim 5, wherein the burner has an associated outlet stack exhausting heat from the burner after passing in proximity to the separator, and wherein the burner temperature sensor mounts with an outlet stack of the burner, and wherein the burner temperature sensor indicates that sufficient heat has been generated when the burner temperature sensor reaches about 140 degrees Fahrenheit.

14. An oil and gas separator according to claim 7, wherein the separator vessel comprises a horizontal separator.

15. An oil and gas separator according to claim 7, wherein the separator vessel comprises a vertical separator.

* * * * *