Oct. 24, 1944. R. E. WELCH 2,361,252

FLOW HEATER

Filed Feb. 2, 1942 3 Sheets-Sheet 1

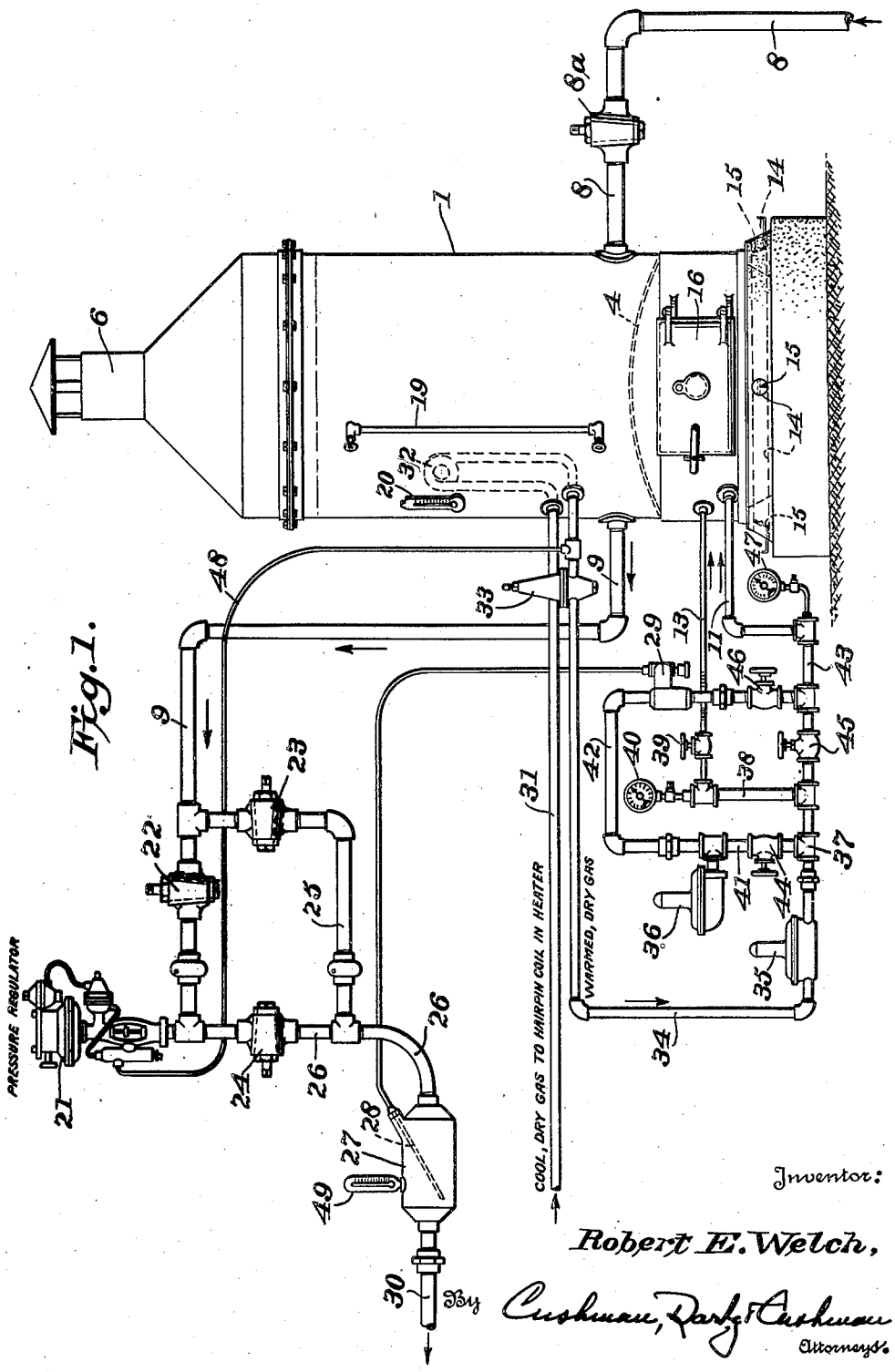


Fig. 1.

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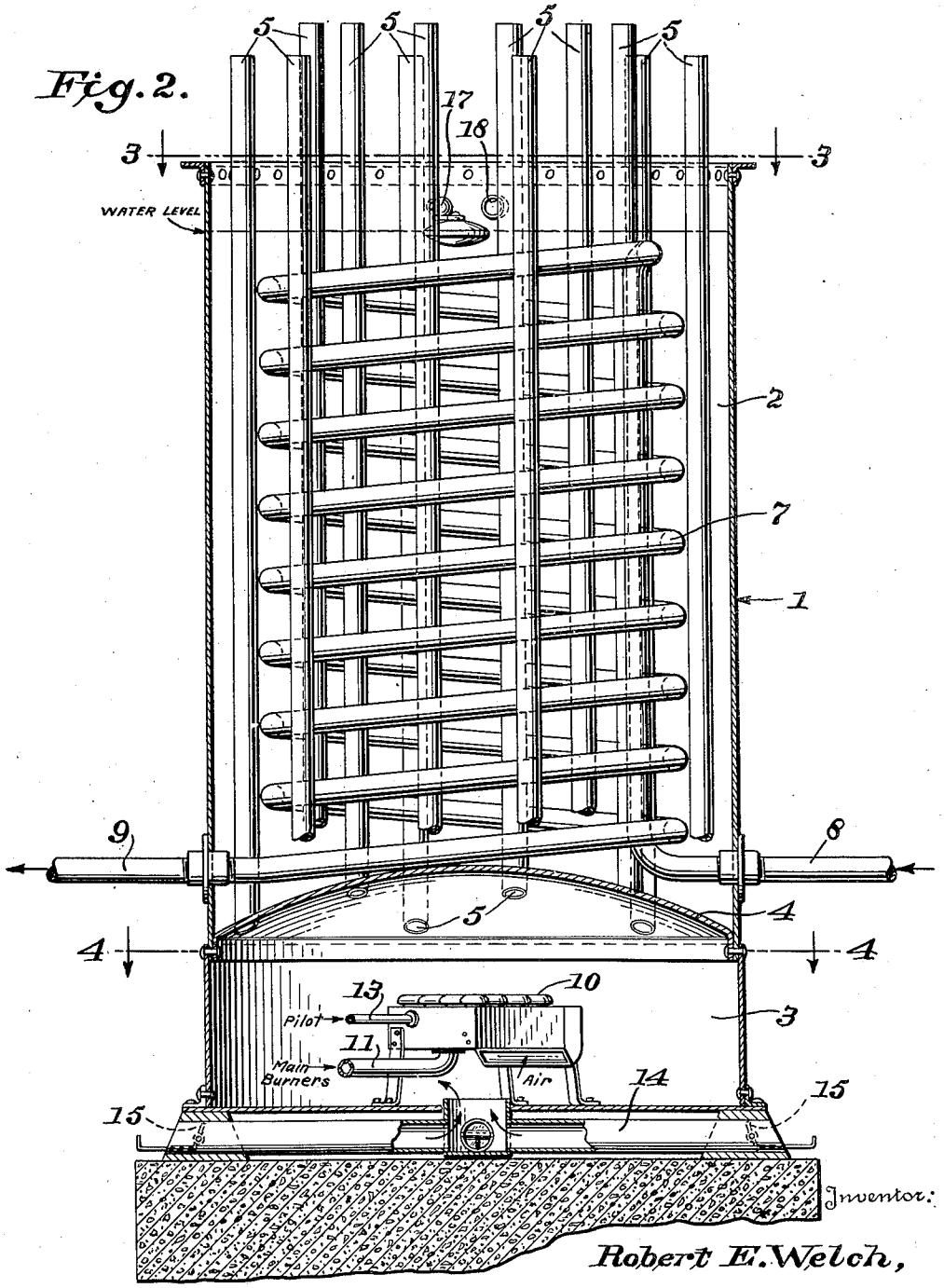
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Filed Feb. 2, 1942 3 Sheets-Sheet 2

Fig. 2.



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FLOW HEATER

Filed Feb. 2, 1942 3 Sheets-Sheet 3

Fig. 3.

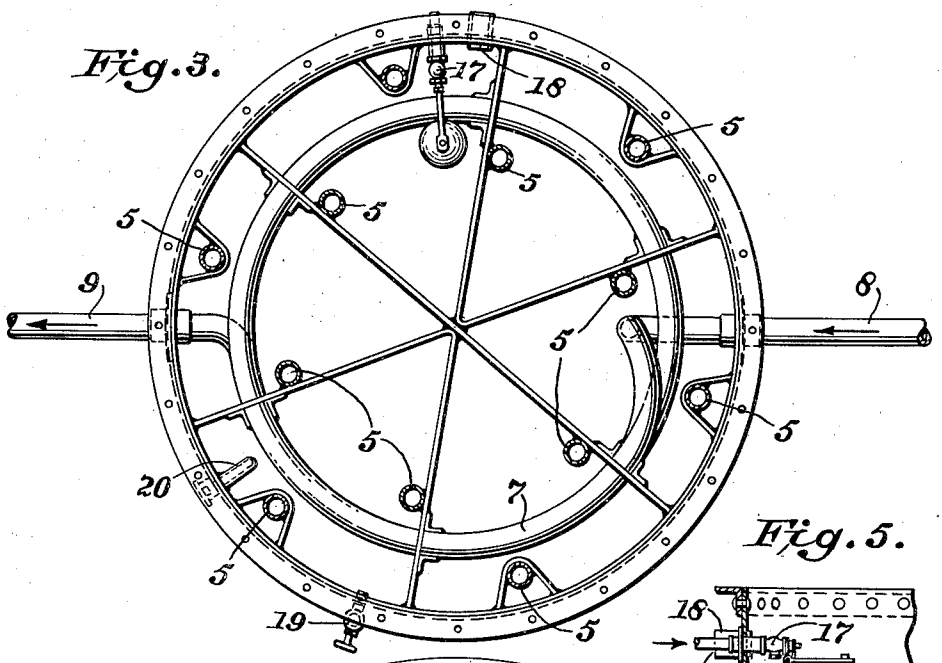


Fig. 5.

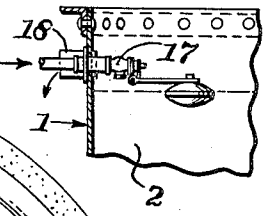


Fig. 4.

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Patented Oct. 24, 1944 2,361,252

UNITED STATES PATENT OFFICE

2,361,252

FLOW HEATER

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Application February 2, 1942, Serial No. 429,351

2 Claims. (Cl. 62—1)

The present invention relates to a flow heater for oil wells.

It is a principal object of the invention to provide suitable apparatus for heating the high pressure wet gas as it flows directly from the oil well.

A further object of the invention is to provide apparatus for automatically heating the high pressure wet gas flow from an oil well, so that a definite temperature of the oil well flow may be maintained after the high pressure flow has been reduced to a pressure suitable for separating.

Many oil wells in use today produce a very high pressure wet gas, the pressure of which must be greatly reduced before it can be separated into its components of oil, water, and gas. It is common practice to heat the high pressure flow from the well, so that the flow will not freeze when the pressure is reduced, in view of the scientific fact that reducing the pressure of a gas also causes a cooling of the temperature of the gas. If the high pressure flow from the well were reduced in pressure at well temperature, great difficulty would be experienced, because the flow would freeze and the pressure regulating valves would freeze. By my invention, I have provided an oil well flow heater which is automatically regulated so that a definite and controlled temperature of flow at reduced pressure is obtained, and the possibility that the flow will freeze and the pressure regulators freeze is avoided.

It is a further object of my invention to provide an oil well flow heater construction, in which the supply of fuel to the heater burners is thermostatically controlled in response to the temperature of the heated oil well flow after pressure reduction.

Further objects and advantages of the invention will be readily understood from the accompanying description and drawings, in which:

Figure 1 is an elevation of the complete heater apparatus, including the pressure reducing regulators and the thermostatic burner controls;

Figure 2 is a vertical section of the heater tank, showing the burner, flues, and flow conducting pipe or coil partly in elevation;

Figure 3 is a cross sectional view taken on the line 3—3 of Figure 2, showing the details of the positioning of the burner flues within the tank;

Figure 4 is a cross sectional view taken on the line 4—4 of Figure 2, and showing the details of the burners and the air supply tubes in the firebox, and

Figure 5 is a fragmentary view, showing a detail of the float controlled water supply to the upper water compartment of the heater.

Referring to the drawings, in which like numerals indicate like parts, 1 indicates generally the vertical upright tank comprising the main heater structure. The vertical tank 1 is divided into an upper water-containing compartment 2 and a lower firebox compartment 3 by a flanged and dished steel head 4, constituting the dome-shaped head of the firebox. Extending from the steel head 4 through the upper water-containing compartment 2, are a series of flues or fire tubes 5. These tubes extend above the level of the water in the compartment 2 and communicate with the atmosphere through the hood and chimney structure 6. Positioned within the upper water-containing compartment 2 and coiled in proximity to the flues 5, is a flow conducting pipe 7. This pipe enters the tank at 8, and is provided on the inlet side with a cut-off valve 8a, by means of which the flow conducting pipe 7 may be valved and connected to the source of high pressure flow from the well. The flow conducting pipe 7 is provided with the outlet pipe 9 for conducting the heated flow to the pressure reducing and regulating valve 21 to be described hereinafter.

Positioned within the firebox 3 are a plurality of low pressure gas burners 10. These burners are nested in a group in the center of the firebox and are supplied with a source of warm dry gas as fuel, by means of the fuel supply pipe 11. A pilot burner 12 is also provided, which is intended to be burning at all times and is supplied with fuel through the pipe 13. Air supply tubes 14 for the burners are positioned in the bottom of the firebox and are provided with damper valves 15 to control the amount of air supplied to the burners. These damper valves are shown as manually operated, although they may be operated in any suitable manner. A firebox door 16, by means of which access to the firebox may be had, is shown in Figure 1 of the drawings.

The upper water-containing compartment of the heater is supplied with water through the float controlled valve 17 which maintains the level of the water at a predetermined water line, as indicated in Figure 2 of the drawings. Above the level of the water line is an overflow pipe opening 18, which will carry away any excess amount of water in the tank, should the float operated valve 17 fail to function. The upper compartment 2 is also provided with a water level sight gage 19, and a thermometer 20, by means

of which conditions of the water in the upper compartment may be ascertained.

The heated high pressure oil well flow, after passing through the flow conducting pipe or coil 7, is conducted through the outlet pipe 9 to the pressure regulator valve, indicated generally at 21, where its pressure is reduced to the desirable pressure for further treatments, such as separating or the like. In order to make repairs on the pressure regulator, should they be necessary, a by-pass system is provided to shunt the flow around the pressure regulator. Valves 22, 23, and 24, together with a piping 25, constitute the by-pass arrangement, and it can be readily seen that by closing the valves 22 and 24 and opening the valve 23, the flow will be by-passed around the pressure regulator. After leaving the pressure regulator, the flow is conducted through the pipe 26 to the thermowel 27, which contains the actuating bulb 28 of the thermostat valve 29 controlling the fuel supply to the burner 10. A temperature indicator 49 is positioned on the thermowel 27 to indicate the temperature of the reduced pressure oil well flow. The treated flow then passes through the pipe 30 to the separator apparatus or other apparatus, which is desired to be used to treat the oil well flow.

The low pressure burners 10 used in this apparatus are supplied with gas as a fuel, of which there is a great abundance in most oil fields, and this gas is usually cold and of high pressure. It is, therefore, necessary to warm the fuel gas and reduce its pressure, and I have provided in my invention apparatus for performing this function. The cool dry fuel gas is supplied through the pipe 31 and passes through a hairpin coil 32 within the upper water-containing compartment of the heater, whereby the fuel gas is warmed. The fuel gas then passes through a pressure regulator 33 and the pipe 34 to the pressure reducing apparatus. In view of the high pressure of the gas, I have provided two pressure reducing regulators 35 and 36 to reduce the fuel gas to the very low pressure needed for the low pressure burners 10. The high pressure fuel gas first passes through the pressure regulator 35. A T fitting 37 is provided to branch the reduced pressure fuel gas into two lines. Some of the reduced pressure gas is conducted through the pipe 38 and the shut-off valve 39 to the pipe 13 which supplies the pilot burner with fuel. A pressure indicator 40 is shown to indicate the pressure of the fuel supply to the pilot. The warmed dry gas at reduced pressure also passes from the T fitting 37 through the pipe 41 to the pressure regulator 36. This further reduces the pressure of the fuel gas so that it is low enough to properly burn in the low pressure burners. This warm and low pressure fuel gas is conducted through the pipe 42 from the pressure regulator 36 to the thermostatically controlled valve 29 which is responsive to the temperature of the oil well flow as it passes the thermowel 27. The thermostatically regulated low pressure fuel gas as supplied by the thermostatic valve 29, then passes through the piping 43 to the main supply pipe 11 of the low pressure burner.

The fuel supply pressure regulators are also provided with by-passes so that the thermostatically controlled valve for regulating the supply of fuel to the burners may be by-passed. The valves 44, 45, and 46 are provided, and it will be readily seen that by closing valves 44 and 46, and opening valve 45, the fuel gas will be supplied directly to the burners and shunted around the pressure regulator 36 and thermostatic valve 29. A pressure indicator 47 may be used to indicate the pressure of the fuel gas supply to the low pressure burners.

The pressure regulator 21 for reducing the pressure of the heated high pressure oil well flow is of the standard construction operated by diaphragms, and in order to prevent freezing, is supplied with a source of warm high pressure gas conducted through the tubing 48 connected to the down-stream side of the hairpin coil 32. The warm dry gas conducted through the tube 48 is used to operate the diaphragms in the pressure regulator 21, and thus minimize the possibility that the pressure regulator will freeze.

As the pressure regulator valves, shut-off valves, thermowel, and thermostatically-controlled valve are all of standard manufacture, it will be readily understood that my invention is not limited to the use of any specific forms of these mechanisms, but that any suitable substitutes may be used.

In operating my flow heater, the flow from the oil wells which is mainly a high pressure wet gas, is conducted through the flow conducting pipe 7 coiled within the upper water-containing compartment 2. This coil is in proximity to the firebox tubes or flues 5, and the heat of burning gases passing through the flues 5 will be transmitted through the water in the upper compartment 2 to the coil 7. This results in a heating of the high pressure wet gas flowing through the coiled pipe 7. The heated high pressure flow then passes through the outlet pipe 9 to the pressure reducing regulator 21. After the pressure of the heated oil well flow is reduced the temperature of the reduced pressure flow is obtained. The thermowel 27 and the actuating bulb 28 of the thermostatically-controlled valve 29 are operated in response to this temperature of the reduced pressure flow. The thermostatic valve 29 controls the operation of the burners 10 which supply the heat to the upper water compartment 2, and hence to the high pressure wet gas flow from the well.

Thus it will be seen that I have provided apparatus for heating the high pressure flow from an oil well and controlling the amount of heat supplied to said high pressure flow in accordance with the temperature of the reduced pressure flow, so that a definite temperature of reduced pressure flow may be maintained. By operating my thermostatic valve on the fuel supply to the burner in response to the temperature of the reduced pressure oil well flow, I can obtain a definite control of the temperature of the reduced oil well flow as it passes the outlet pipe 30.

In the appended claims, the term "flow" is intended to mean the wet gas flowing directly from oil and gas wells.

I claim:

1. In an apparatus of the character described, an upright tank having an upper water compartment and a lower firebox compartment, a burner in said firebox, a series of vertical flues extending from the firebox compartment through the water compartment to communicate with the atmosphere, a line including a flow conducting pipe coiled in proximity to the flues within said upper compartment, said line being adapted to be connected to a source of high pressure gas flow from an oil well, pressure reducing means in said line beyond said tank, and means to control the supply of fuel to the burner in said firebox, said last-named means being responsive

to the temperature in said line beyond said pressure reducing means.

2. In an apparatus of the character described, a line adapted to be connected to an oil well to receive warm high pressure gas from the latter, a pressure reducer in said line, a second line adapted to be connected to a source of cold high pressure gas, gas-fired means to heat said second line and to also heat said first-named line at a point in advance of said pressure reducer, said second line leading to said heating means to supply gas fuel to the latter, and temperature responsive means in said first-named line beyond said pressure reducer to control the flow in said second line.

ROBERT E. WELCH.