Nov. 4, 1947. W. W. KEMP 2,430,344

PREHEATER FOR OIL FOR REFINERY CRACKERS

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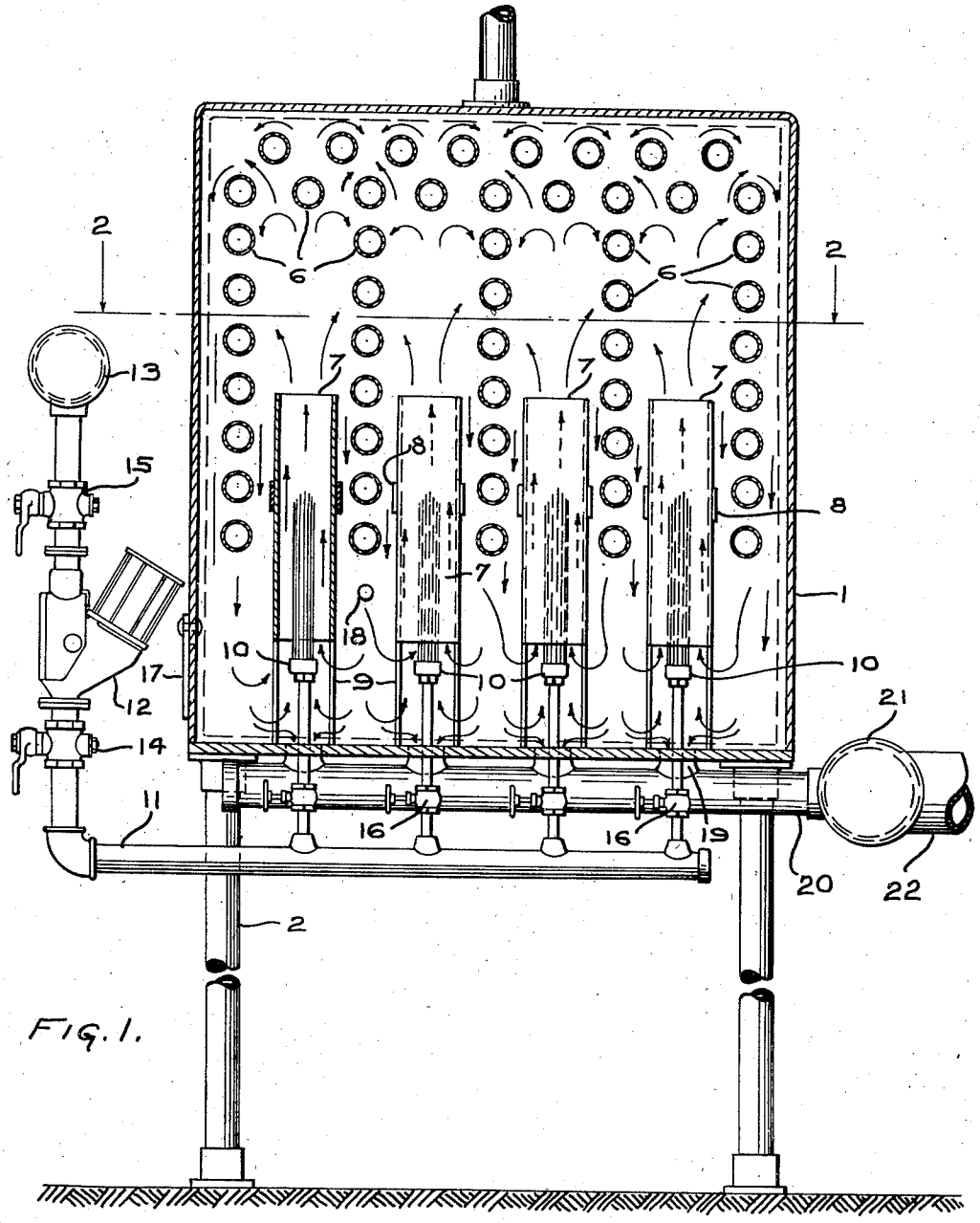


FIG. 1.

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Fig. 2.

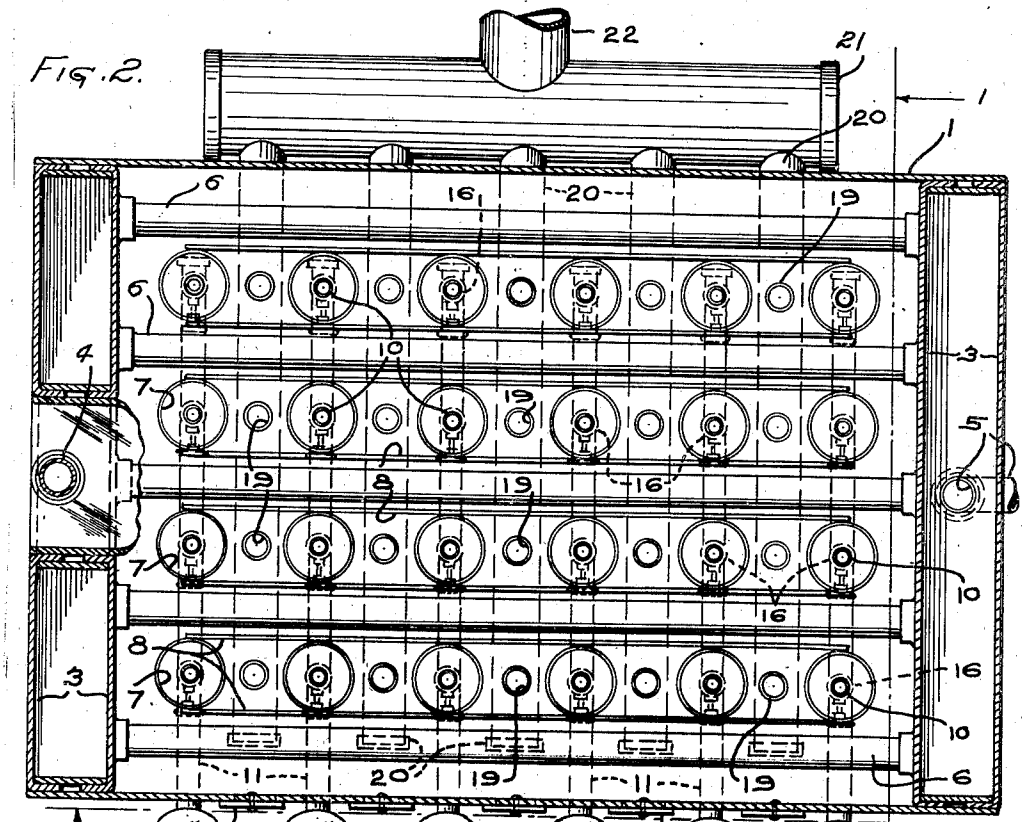


Fig. 3.

Fig. 4.

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PREHEATER FOR OIL FOR REFINERY CRACKERS

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8 Claims. (Cl. 196—116)

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Oil heaters for petroleum crackers have the common disadvantage of being so constructed and operated that the heat application is at times localized and the temperature excessive, there being actual flame contact with the oil pipes resulting in over-heating of the pipes, carbonizing of the oil and actual blistering of the pipes. These blisters finally break away permitting the oil to leak into the furnace or combustion chamber where it burns, due to the excess of air pulled through the furnace by the stack. The oil pipes burning out cause frequent failure and shutdown of the oil heater and consequently of the cracker.

The oil should be pre-heated to a temperature of about 850 degrees Fahrenheit. The flame of combustion of natural gas, still gas or fuel oil, when mixed with the proper amount of air, will have temperatures which will approach if not exceed 3000 degrees Fahrenheit; hence, the danger of flame contact with the oil pipes is apparent. Thirty percent excess air is usually provided; this forms zones of high oxygen content and promotes deterioration and pipe oxidation.

Purposes of this invention, among others not specifically mentioned, are to use as a fuel a complete air-gas mixture such as can be produced by the proportioning air and gas mixing machines described in U. S. Letters Patent to W. W. Kemp et al.: 1,771,223, July 22, 1930, and 1,880,141, September 27, 1932, which complete air-gas mixture produces a short, stiff blast flame which when directed within a tube or cylinder at a central point, produces a discharge or blast of combustion gases at the discharge end of the tube while entraining combustion gases at the bottom or inlet end. In this invention there are a number of these tubes placed preferably in vertical position and in rows, each entraining combustion gases from the floor of the heater and discharging toward the ceiling, thus setting up a circulation of the atmosphere within the heater chamber.

The greater the pressure at which the air-gas mixture is fed to the several burners, the stiffer the blast flame, the more rapid the circulation, consequently, the more uniform the heat distribution. The exhaust openings and pipes are at the bottom of the chamber so that the chamber will fill with gas, and thus maintain a uniform temperature in the whole chamber. Because the air-gas ratio is about complete or correct for complete combustion, no air is drawn in by inspiration or aspiration, and the flame is short,

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entirely confined within the tubes and cannot contact any of the oil pipes, and subject to close control, the differential between the temperature of the gases and oil is kept low, to prevent over heating and damage to the heater. The oil pipes are heated by the rapid passage and circulation of the combustion gases among them. A thermostat placed within the heater and in the passage of the circulating gases is adjusted to limit the temperature of these gases. A second thermostat placed in an oil duct outlet will vary the volume of fuel burned to control the temperature of the oil.

With the furnace of this invention, there is no stack, chimney or exhaust fan. The pressure at which the combustion gas and air mixture is fed to the burners controls the circulation of the combustion gases, and the pressures at which these gases exhaust from the heater. There is very slight pressure drop of gases through the heater, the combustion gases exhaust through openings in the floor of the heater and are carried through a duct to a convection heater for preliminary heating of the oil and finally through heat exchangers or coolers and dryers.

Another purpose of this invention is to supply inert gas, the device serving the double purpose of an oil heater and an inert gas generator. The inert gas is required in the oil refinery for purging, producing inert blanketing atmosphere and, when compressed and dried, can be used for instrument operation.

The complete air-gas mixture above referred to produces the highest and most uniform flame temperature. It is common practice to so adjust the Kemp air and gas proportioning machine, patent numbers previously referred to, to obtain a combustion gas having one-half per cent or less of oxygen and no monoxide, or one-half per cent or less of monoxide and no oxygen, either of which is an ideal inert gas for refinery purposes, especially when the water vapor content is reduced to the desired extent by the heat exchanger or desiccant towers. Under present operating conditions, a broken or leaky oil pipe within the heater can result in a bad fire, flame occurring within the heater and extending to the top of the stack, the atmosphere in the entire system being such as to support combustion. With the apparatus of the present invention, the atmosphere is inert and should an oil leak occur, the petroleum actually playing on the gas flames, the oil and the oil vapor actually could not ignite or combust, as there is no oxygen present to support combustion.

The heater is under a pressure of inert gas of from a few ounces to one pound or more; therefore, it is not possible for atmospheric air to leak in. Should the air and gas mixture flame contact a combustion blast tube, oil piping or any other surface after the mixture is ignited at the face of the burner, the combustion would be retarded, the flame cooled somewhat and monoxide gas produced. Flame contact with any surface is studiously avoided in the construction of this invention.

An apparatus by which the objects of this invention may be carried out is shown in the accompanying drawings, forming a part hereof, and in which Figure 1 is a vertical sectional view on line 1—1 of Figure 2. Figure 2 is a sectional view on line 2—2 of Figure 1. Figure 3 is a partial sectional view on line 3—3 of Figure 2 in reduced scale. Figure 4 is an elevation, partly in section of an oil pre-heater, shown in reduced scale.

Similar numerals refer to similar parts in the several views.

A large chamber 1 is supported on uprights 2, and it has in it two opposed side headers 3—3, having inlet 4 and outlet 5, cold oil coming in the inlet 4 and oil heated to a temperature of approximately 850° Fahrenheit coming out of the outlet 5. Between the headers are oil-carrying pipes or tubes 6 arranged very much like the tubes of a steam boiler. These tubes 6 are closely grouped at the top of the chamber 1 and downwardly near the center of the chamber they are arranged in vertical rows so that the flues 7 may be placed in rows between the tubes. These flues are supported by bands 8 and rest upon the floor of the chamber on stands 9. These stands allow free circulation of air up through the flues from the base of the chamber.

Passing through openings in the bottom of the chamber are a plurality of burners 10, one for each flue. These burners are connected in rows fed from pipes 11 which have back-fire preventers 12 in them prior to their connection with the manifold 13. The manifold 13 has fed to it a substantially completely combustible mixture of fluid fuel such as gas or oil and air. It may be fed by an industrial carbureter such as is illustrated in the Kemp et al. patents above referred to. Valves 14 and 15 in the pipe 11, on each side of the fire preventers may be turned to accurately control the amount of the mixture entering the pipes 11, and valves 16 on each burner may be used to facilitate the lighting of one burner or a group of burners turned on at once. The burners are lit by an igniter inserted through openings in the chamber walls covered by flaps 17.

A thermostat 18 serves to operate a valve on manifold 13 to limit the fuel fed at times when the oil temperature is low so that too much heat may not suddenly be applied. Another thermostat, not shown, is in the oil exhaust pipe 5, operating another valve on manifold 13 to regulate the flow of fuel to give an even accurate predetermined temperature to the oil in the heater.

After the air has been forced from the chamber 1, the chamber fills with the heated inert gases produced by the combustion and these gases constantly circulate around the tubes 6 and through the flues 7, going out at the top and being drawn in again at the bottom in a constant flow of inert gas which is constantly heated by the flame and is constantly circulated upon the tubes 6 to heat them to the desired degree of

approximately 850° Fahrenheit. The contacting of the tubes solely by inert gas gives them the temperature required without over-heating and without blistering, and should a break occur in any of the tubes by any chance, the inert gas will not support combustion and there will be no burning of the oil possibly leaking from the tubes. The inert gases under their own pressure flow from the chamber 1 through openings 19 in the chamber bottom, passing to the pipes 20 and to manifold 21. From the manifold 21 the inert gases may be led by pipe 22 through an oil preheater 23 having baffles 24 therein, the gases passing out at pipe 25. Oil, prior to its entrance to header 3 may be passed through this preheater 23, entering at 26, passing through pipe 27 in the pre-heater, and then passing from the pipe at 28 to the header 3. From pipe 25 the gases may be passed to a heat exchanger and towers of desiccants, not shown, for use in the refinery for purging, producing inert blanketing atmosphere and when compressed and dried it can be used for instrument operation.

From the oil heater above described the oil will pass directly to the reaction chamber of the cracker.

What is claimed as new and desired to be secured by Letters Patent is:

1. A fluid heater comprising a plurality of closely spaced substantially horizontally extending fluid carrying tubes, connections at the ends of said tubes to allow for the passing of fluid constantly through the tubes, a plurality of heating flues extending upwardly between certain and under other of said tubes, a chamber enclosing said tubes and flues, said flues being free of obstruction and spaced from the bottom and top of the chamber to allow the free flow of gas from the chamber therethrough, burners beneath the bottom of the flues and means to feed a combustible mixture of air and fluid fuel to said burners, said flues enclosing the flame from the burners and promoting circulation of gases to and from the flame, the flame from the burners setting up a continuous flow of heated gases vertically around said tubes.

2. A fluid heater comprising a plurality of rows of substantially vertical heating flues, substantially horizontally extending fluid carrying tubes, some extending between and others over said flues, connections at the ends of said tubes to allow for the passage of fluid constantly through the tubes, a chamber enclosing said flues and tubes, the flues being free of obstruction and spaced from the bottom and top of the chamber to allow the free flow of gas from the chamber therethrough, burners beneath the bottom of the flues, and means to feed a combustible mixture of air and fluid fuel to said burners, said flues enclosing the flame from the burners, the flames setting up a continuous circulation of gases through the flues and around the tubes.

3. A fluid heater comprising a plurality of rows of substantially vertical heating flues, substantially horizontally extending fluid carrying tubes, some extending between and others over said flues, connections at the ends of said tubes to allow for the passage of fluid constantly through the tubes, a chamber enclosing said flues and tubes, the flues being free of obstruction and spaced from the bottom and top of the chamber to allow the free flow of gas from the chamber therethrough, rows of burners one beneath the bottom of each flue, a combustible mixture inlet pipe for each row of burners, a manifold for the

group of inlet pipes, and means to feed a combustible mixture of air and fluid fuel to said manifold, said flues enclosing the flame from the burners, the flames setting up a continuous circulation of combusted gases through the flues and around the tubes.

4. A fluid heater and inert gas generator comprising a plurality of closely spaced substantially horizontally extending fluid carrying tubes, connections at the ends of said tubes to allow for the passing of fluid constantly through the tubes, a plurality of heating flues extending upwardly between certain and under other of said tubes, a chamber enclosing said tubes and flues, said flues being free of obstruction and spaced from the bottom and top of the chamber to allow the free flow of gas fram the chamber therethrough, burners beneath the bottom of the flues and means to feed a combustible mixture of air and fluid fuel to said burners, said flues enclosing the flame from the burners and promoting circulation of gases to and from the flame, the flame from the burners setting up a continuous flow of heated substantially inert gases vertically around said tubes and outlets from the bottom of said chamber for the inert gases.

5. A fluid heater and inert gas generator comprising a plurality of rows of substantially vertical heating flues, substantially horizontally extending fluid carrying tubes, some extending between and others over said flues, connections at the ends of said tubes to allow for the passage of fluid constantly through the tubes, a chamber enclosing said flues and tubes, the flues being free of obstruction and spaced from the bottom and top of the chamber to allow the free flow of gas from the chamber therethrough, burners beneath the bottom of the flues, and means to feed a combustible mixture of air and fluid fuel to said burners, said flues enclosing the flame from the burners, the flames setting up a continuous circulation of substantially inert gases through the flues and around the tubes and outlets from the bottom of the chamber for the inert gas.

6. A fluid heater and inert gas generator comprising a plurality of rows of substantially vertical heating flues, substantially horizontally extending fluid carrying tubes, some extending between and others over said flues, connections at the ends of said tubes to allow for the passage of fluid constantly through the tubes, a chamber enclosing said flues and tubes, the flues being free of obstruction and spaced from the bottom and top of the chamber to allow the free flow of gas from the chamber therethrough, rows of burners one beneath the bottom of each flue, a combustible mixture inlet pipe for each row of burners, a manifold for the group of inlet

pipes, and means to feed a combustible mixture of air and fluid fuel to said manifold, said flues enclosing the flame from the burners, the flames setting up a continuous circulation of combusted substantially inert gases through the flues and around the tubes, and outlets from the bottom of the chamber for the inert gas.

7. An oil heater for petroleum refining comprising a heating walled chamber, a series of substantially vertical open flues therein spaced from the top and bottom of the chamber to allow a free flow of gas from the chamber therethrough, each flue having a burner adjacent the bottom thereof to blast a flame within each flue, said walled chamber having exhaust openings adjacent the bottom of the flues, and the walls of the chamber directing combustion gases toward said openings, the burning flame blasting combustion gases from the upper end of each flue and drawing part of the combustion gases into the lower end of each flue and setting up paths of circulation in the heater atmosphere, a plurality of oil carrying tubes within said chamber arranged adjacent said flues and spaced from the tops thereof, and being within the paths set up by the circulating heat from the flues.

8. The process of heating oil for petroleum crackers comprising passing oil through pipes in a chamber, feeding to a burner within the chamber a completely combustible fuel mixture to produce a flame within the chamber, shielding the flame of combustion from contact with the oil carrying pipes, the complete combustion of the fuel producing inert gases substantially free from oxygen and carbon monoxide and setting up a rapid circulation of the heated inert gases around the pipes, the burning fuel mixture drawing the combusted inert gases into contact with the flame of combustion and recirculating the gases around the pipes, and maintaining the chamber under pressure of the inert gases greater than atmospheric pressure.

WILLIAM WALLACE KEMP.

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