

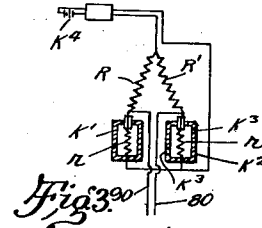
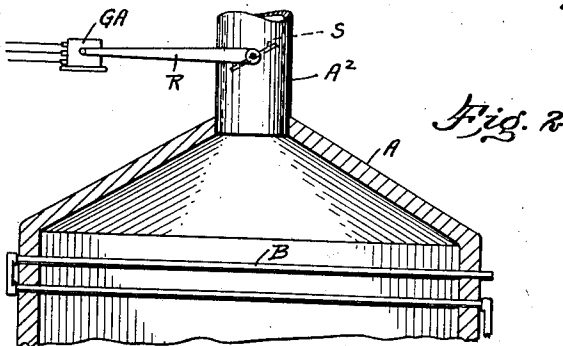
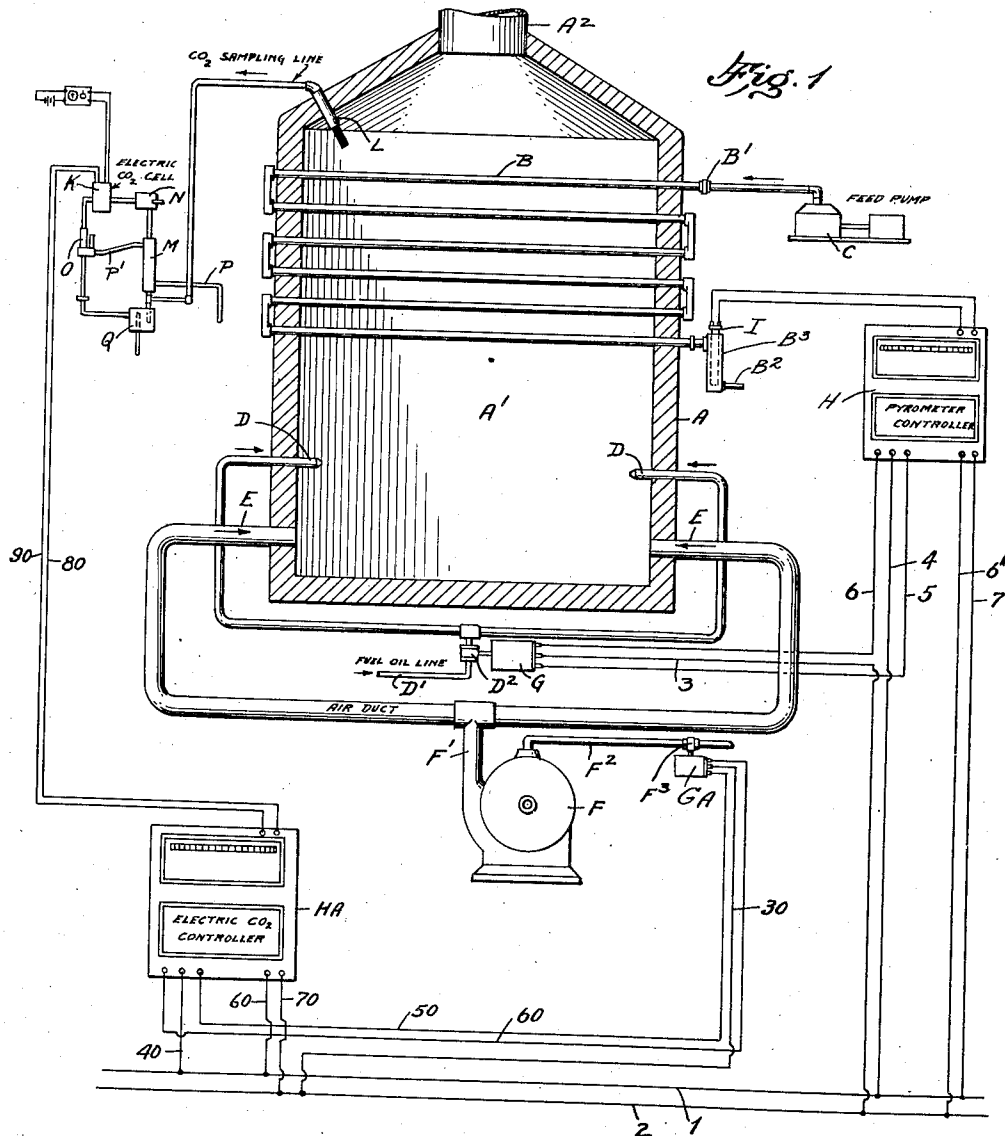
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TUBE STILL CONTROL

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TUBE-STILL CONTROL.

Application filed January 2, 1926. Serial No. 78,775.

The general object of the present invention is to provide a simple and effective method of and means for controlling combustion conditions in an oil refining tube still in such manner as to secure the proper oil heating effect while maintaining efficient combustion conditions in the still furnace.

The invention is characterized by the fact that the general rate of combustion is made responsive to the heat requirements of the still, and the ratio of fuel and combustion supporting air supplied to the furnace is made dependent on the composition of the flue gases, and that this result is obtained with the use of simple and effective instrumentalities which may be of standard commercial types. In carrying out my invention, I provide means for regulating the supply of fuel to the still combustion chamber and provide other means for regulating the supply of combustion supporting air to said chamber, and provide means for adjusting one of said supply regulating means in automatic response to the changes in the temperature to which the oil is heated, and provide means for adjusting the other supply regulating means in response to changes in the composition of the flue gases leaving the furnace.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described preferred forms of apparatus for use in carrying out the invention.

Of the drawings:

Fig. 1 is a diagrammatic representation of an oil refining tube still regulating devices; and

Fig. 2 is a view taken similarly to Fig. 1 showing a portion of a tube still equipped with a modified form of regulating means; and

Fig. 3 is a diagrammatic representation of the electrical connections of the gas analysis apparatus.

In Fig. 1 I have diagrammatically illustrated an embodiment of the present invention including a tube still A of conventional type. As shown the tube still A comprises a

combustion chamber A' beneath a bank of horizontal tubes B which are swept by the heating gases passing from the combustion chamber A' to the furnace stack outlet A². The tubes B are connected at their ends so that the oil passes successively through tubes B at successively lower levels from an oil inlet B' to an oil outlet B². The oil to be refined is supplied to the inlet B' by a fuel pump C, which, in the preferred mode of use contemplated by me, is operated to supply oil to the still at a constant rate.

Fluid fuel, which ordinarily is oil, is supplied to the combustion chamber A' through burner nozzles D. The burner nozzles D receive fuel from a suitable pressure source (not shown) through a supply pipe D' at a rate depending on the adjustment of a fuel supply regulating valve D². Air for combustion is supplied to the combustion chamber A' through supply pipes E receiving air from the outlet F' of a blower F at a rate dependent on the adjustment of a blower regulator F³ which, when the blower is turbine driven as contemplated in the particular arrangement shown in Fig. 1, is a valve in the pipe F² supplying impelling steam to the blower.

In accordance with the present invention the valve D² is adjusted to increase and decrease the supply of fuel to the combustion chamber as the temperature to which the oil is heated in passing through the tubes B falls below or rises above a predetermined temperature. This result is obtained with the form of construction illustrated by means of a reversible electric motor G energized for operation in one way to increase the supply of fuel and in the opposite direction to decrease the supply of fuel by means of a pyrometer controller H which is responsive to the temperature to which a thermo-responsive device I is subjected. As shown the thermo-responsive device I is a thermo-couple inserted in a thermometer well B³ in the path of oil flow at or adjacent the still outlet B². The terminals of the thermo-couple are connected by conductors 8 and 9 to corresponding terminals of the pyrometer controller H. As shown, one terminal of the motor G is connected by a conductor 3 to the conductor 2 of an electric current supply or power circuit. The controller H operates in response to the potential developed by the thermo-couple I to

connect one terminal 6 of the motor G to the conductor 1 of the power circuit through a conductor 4, and thereby cause the motor G to rotate in a direction to close the valve D² when the temperature to which the thermo-couple I is subjected exceeds the predetermined oil temperature. Conversely, when the temperature to which the thermo-couple I is subjected falls below the predetermined oil temperature, the pyrometer controller H connects a second terminal 5 of the motor G to the conductor 4 and thereby to the supply conductor 1, and thereby causes the motor G to rotate in the direction to open or increase the flow through the valve D².

The pyrometer controller H may be of any usual or suitable form of instrument for the purpose. In general, it includes a voltmeter having its terminals connected by the thermo-couple I, and includes a switch mechanism controlled by the voltmeter pointer and serving to connect the motor terminal 6 to the conductor 4 when the oil temperature is above the predetermined value and to connect the motor terminal 5 to the conductor 4 when the oil temperature is below the predetermined value. The switch mechanism in an instrument of this type is ordinarily actuated by a motor or other relay which may be energized from the supply conductors 1 and 2 through the conductors 6' and 7. I have not thought it necessary to illustrate and describe in detail the construction of the pyrometer controller H, for the reason that the present invention does not depend on the specific form of the controller and various forms of control instruments suitable for the purpose are known. For example, the controller H may be of the type disclosed in the patent to Brown No. 1,355,448, granted October 12, 1920.

In accordance with the present invention the supply of air for combustion to the combustion chamber A' to the furnace inlets E is regulated to maintain a desirable and approximately constant flue gas composition. In the arrangement shown in Fig. 1, this regulation is obtained by means of an electrical flue gas analyzing system including a CO₂ controller HA which directly controls the motor GA to increase and diminish the air supplied by the inlets E accordingly as the CO₂ content of the flue gas falls below or rises above a predetermined value. The flue gas analyzing means may be of any usual or suitable type. As diagrammatically illustrated, it is of the known type in which a small stream of flue gas is withdrawn from the furnace adjacent the stack outlet through a sample tube L, condenser M, filter N, and an electrical gas analysis cell device K by an aspirator O in which water supplied by a pipe P serves as the impelling

fluid. As shown, the pipe P passes water into the cooling water space of the condenser M, and the water passing from said space to the aspirator through a pipe P'. In the known type of gas analysis apparatus conventionally illustrated in Fig. 1, the different thermal conductivities of the flue gas and of a standard or comparison gas, which ordinarily is air, in cells of the device K, give different temperatures and thereby different resistance values to resistors forming a part of a suitably energized Wheatstone bridge. In the diagrammatic representation of Fig. 3, K' represents the standard or comparison cell containing a resistor r and air or other standard gas by which heat resulting from the current flow through the resistor r is conducted to the metal wall of the cell K'. K² is the test gas cell of the device K and has located in it a resistor r' . The cells K² and the resistor r' may be identical with the cell K' and the resistor r except that the cell K' is normally sealed after being filled with air or other comparison gas, while the cell K² is formed with ports K³ for the influx and efflux of flue gases. The resistors r and r' are connected into a Wheatstone bridge of which they form two arms. The other two arms of the bridge are formed by so-called balance resistors R and R'. K⁴ represents a source of current for energizing the Wheatstone bridge. The bridge potential difference varied by temperature variations of said resistors r and r' is transmitted by the conductors 80 and 90 to the CO₂ controller HA. The controller HA may be identical in construction and mode of operation with the controller H, and operates the motor GA to increase and decrease the supply of air in response to changes in the CO₂ content of the flue gases in exactly the same manner as the controller H operates the motor G in response to changes in the temperature of the oil to which the thermo-couple I is subjected. The connections between the controller HA, the motor GA, and the power circuit conductors 1 and 2 include conductors 30, 40, 50, 60, and 70, corresponding respectively to the conductors 3, 4, 5, 6, and 7.

In the normal intended operation of the apparatus shown in Fig. 1, oil is passed at a constant rate through the still tubes and is therein heated to the desired final delivery temperature. The fuel is supplied at the exact rate required to provide the necessary heating effect, and the air supply is regulated to insure the desired efficiency of combustion. The simple and effective regulating provisions thus insure a uniform thermal efficiency which may be the maximum practically obtainable. The actual thermal efficiency obtained will depend, of course, upon conditions such as the character of the fuel burned, and the weight of heating

gases per pound of fuel burned considered desirable in order to insure the desired rate of heat absorption by different portions of the heat absorbing surface, and the desirability of avoiding temperatures tending to local overheating of any portion of the tubes B. The rate at which the oil to be heated is supplied to the tubes B depends on the speed of the pump C and the latter may be provided with any suitable manual or automatic speed control means. While I contemplate a nonfluctuating or constant oil feed to the tubes B, the rate at which the oil to be heated is supplied may be varied in response to changes in conditions, such as the progressive building up of carbon deposits on the inner walls of the tubes B which occurs between periods in which the latter are cleaned.

In lieu of controlling the composition of the flue gases by directly regulating the air supplied to a furnace operated with forced draft, as shown in Fig. 1, other means may be employed to secure the same control of the flue gas composition. For example, as shown in Fig. 2, in a furnace operating with a stack draft, the stack damper S may be adjusted as through a belt R by a motor GA controlled in the same manner as is the motor GA of Fig. 1.

Having now described my invention what I claim as new and desire to secure by Letters Patent is:

1. In heating oil to a refining temperature in a tube still, the improvement which consists in maintaining an approximately constant oil temperature at the still outlet by

regulating the relative rates at which oil is passed through the tube still and at which fuel is burned to heat the still in automatic response to said oil temperature, and maintaining efficient combustion conditions by supplying air for the combustion of the fuel in automatic response to the composition of the heating gases as required to maintain said composition approximately constant.

2. The method of operating an oil refining tube still which consists in passing oil at a constant rate through the still tubes and heating the latter by the combustion of fuel supplied at a rate varying with the temperature to which the oil is heated as required to maintain said temperature approximately constant and supplying air for the combustion of the fuel as required to maintain an approximately constant flue gas composition.

3. An oil refining still comprising a combustion chamber, tubes heated by the combustion of fuel supplied to said combustion chamber, means passing the oil to be refined through said tubes at a predetermined rate, means responsive to the temperature at which the oil is heated regulating the supply of fuel to said combustion chamber, and means responsive to the composition of the gaseous products of combustion formed in said combustion chamber regulating the supply of combustion supporting air to said combustion chamber.

Signed at Philadelphia, in the county of Philadelphia and State of Pennsylvania, this 28th day of December, A. D. 1925.

FOSTER M. POOLE.