Aug. 2, 1932. A. C. SPENCER 1,869,626

METHOD AND MEANS FOR THE CONTROL OF HEAT IN THE DISTILLATION OF OIL

Filed May 11, 1929 2 Sheets-Sheet 1

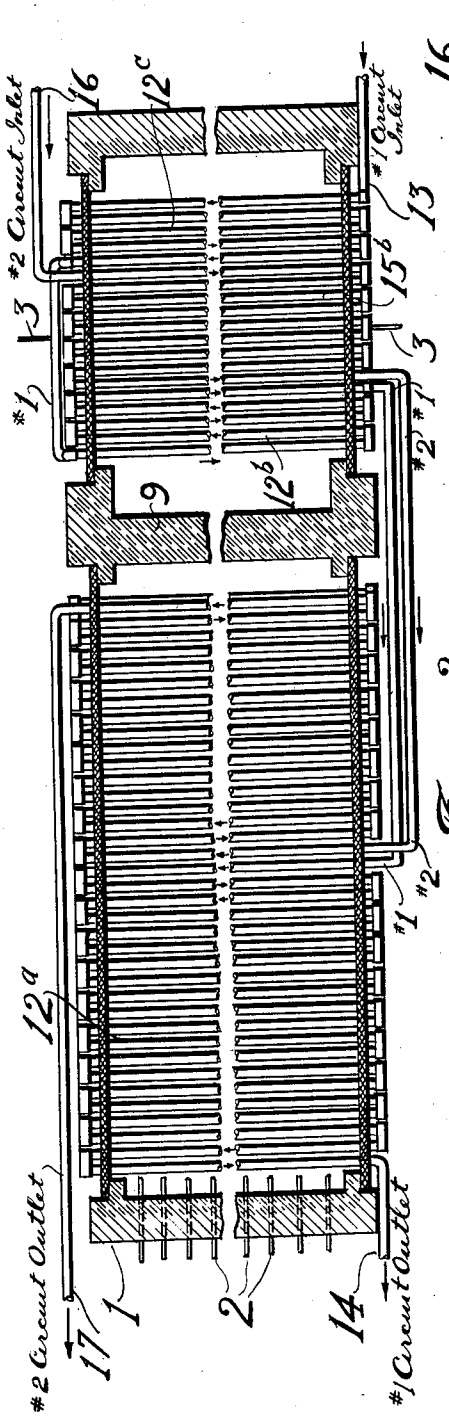


Fig. -2

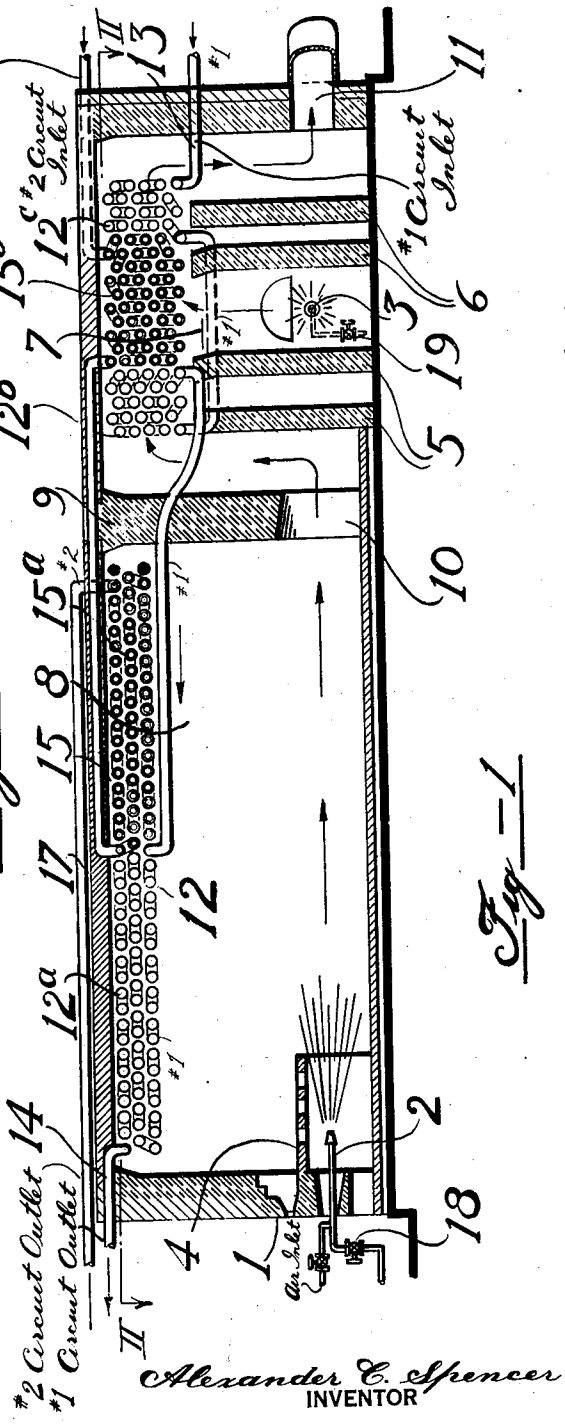


Fig. -1

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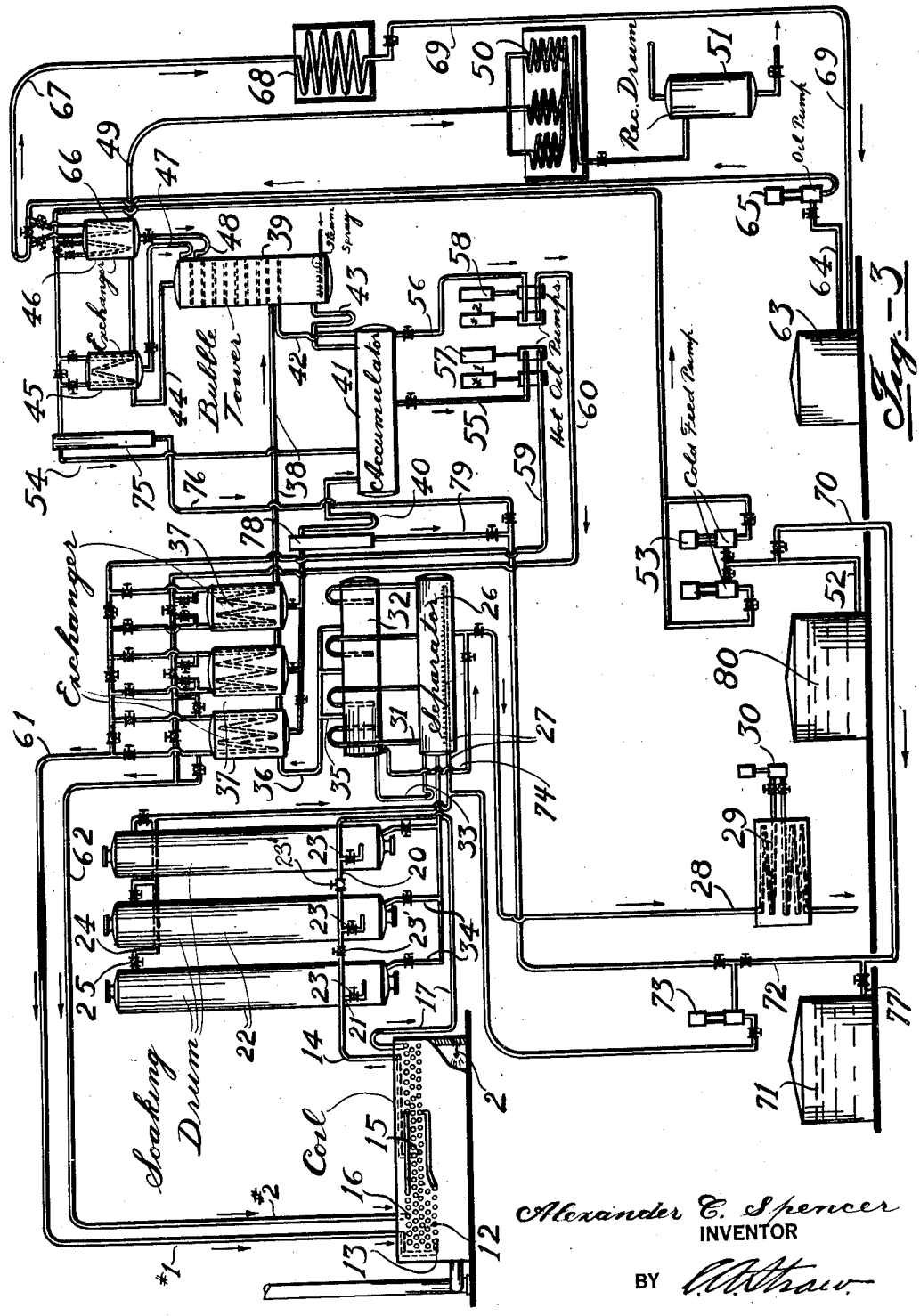


Fig. 3

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UNITED STATES PATENT OFFICE

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METHOD AND MEANS FOR THE CONTROL OF HEAT IN THE DISTILLATION OF OIL

Application filed May 11, 1929. Serial No. 362,270.

This invention relates to improvements in methods and apparatus for distilling hydrocarbon oils and more particularly to the cracking distillation of such oils. The principal objects of the invention are to secure increased capacity and economy of operation by interrelated control of heat supplied from independent or semi-independent sources to a plurality of heating circuits. In a preferred embodiment of my invention, the equipment used is a single furnace setting, having two controllable sources of heat and two tube circuits.

The invention will be fully understood from the following description read in connection with the accompanying drawings, in which

Fig. 1 is a diagrammatic vertical section through a preferred type of furnace;

Fig. 2 is a diagrammatic horizontal section of the same taken on line II—II of Fig. 1; and

Fig. 3 is a diagrammatic side elevation, partly in section, showing a combination of a cracking furnace with equipment for recovering cracked products.

Referring first to Fig. 1, numeral 1 denotes an elongated furnace setting having a principal source of heat, for example in the form of burners 2 near one end, and an auxiliary source of heat, for example in the form of burners 3 near the other end. Short horizontal perforated arches 4 are arranged over the main burners 2. The auxiliary burners 3 are installed within walls 5 and 6 which form an auxiliary combustion chamber 7. The main combustion chamber is designated 8. A bridge wall 9, with an opening 10 near the bottom, separates the setting into two parts. Gases escape from the setting through a port 11 to a stack, not shown.

There are two heating tube circuits connected in parallel. The tube circuit 12 which receives its heat principally from the main burners 2, will be referred to as the primary heating circuit. It consists of a section 12*a* arranged to receive the radiant heat from burners 2, a section 12*b* interposed in the path of gases from the burners 2, and a section 12*c* which is traversed by gases from both the main burners 2 and the auxiliary burners 3. The inlet of this circuit is at 13 and the outlet at 14.

The secondary circuit 15 is composed of a section 15*a* arranged in chamber 8 and a section 15*b* disposed over auxiliary burners 3. The inlet of this circuit is at 16 and the outlet at 17.

The main burners are controlled by valves 18 and the auxiliary burners by valves 19. These valves may be manually operated but it is preferred to connect them to automatic temperature responsive means set to hold the desired temperature. Means for doing this is well known in the art and need not be further described here.

Although only two sources of heat and two tube circuits are illustrated, a plurality of either or both may be provided.

Referring to Fig. 3, a furnace of the type shown in Figs. 1 and 2 is connected to equipment for further cracking and for recovering cracked products. In this figure, the primary tube circuit 12 discharges through line 14 into a header 20 which has branch lines 21 entering the lower parts of each of three digesting chambers or soaking drums 22. The secondary heating circuit 15 discharges through line 17 into the header 20. Valves 23 are provided in connections 21. Valves 23 and 23′ are arranged in the header and the respective branches 21 so that the oil from either or both the heating circuits 12 and 15 may be routed into any of the soaking drums.

These drums, or so many of them as are in use, discharge through lines 24, in which pressure control valves 25 are installed, into a primary separator 26. The cracked product from the drums preferably enters the separator through a perforated header 27, longitudinally arranged. Tar is taken off through a line 28 and cooler 29 by a pump 30. Vapors from the separator 26 pass upward through lines 31 into a secondary separator 32, which has a run-back line 33 leading into separator 26. Lines 34 connect the bottoms of the soaking drums 22 with separator 26. These lines are suitably valved and are intended for use if at any time it is desired to vent liquid oil from a drum to the separator.

Vapors from the secondary separator 32 pass through lines 35 and header 36 into heat exchangers 37. Vapors escaping condensation in the heat exchangers flow through line 38 into a mid-portion of a bubble tower or other fractionating device 39. Liquid oil formed in the heat exchangers runs through a line 40 into an accumulator 41. Vapors pass from accumulator 41 through a line 42 into the bubble tower 39 at a point below the entry of the vapors through line 38. Condensate formed in tower 39 flows into the accumulator 41 through a line 43.

Vapors pass from bubble tower 39 through a line 44 into heat exchangers 45 and 46. Condensate formed in these is refluxed to the tower through lines 47 and 48. Uncondensed vapors pass through line 49 to a cooler 50 and the condensate formed therein is run into a receiving drum 51.

Feed oil for the process is supplied from a tank 80 through a line 52 and pump 53 for indirect heat exchange with vapors in exchangers 45 and 46 from which the preheated feed oil flows into accumulator 41 through line 54. The mixed condensate and feed oil in the accumulator is drawn off through lines 55 and 56. Each of these lines has installed in it hot feed pumps 57 and 58, respectively. These forward the mixed oil through lines 59 and 60 through independent or semi-independent heat exchange circuits in exchangers 37. Valves are arranged, as shown, to permit control of flow throughout all the exchangers. The preheated oil flows from exchangers 37 through lines 61 and 62 to the inlet 13 of the primary heating circuit and the inlet 16 of the secondary heating circuit, respectively.

A secondary cooling circuit for heat exchanger 46 is provided and includes a tank 63 for the cooling oil, connected through a line 64, in which there is a pump 65 with a coil 66 in the heat exchanger. The return circuit of the oil from the heat exchanger includes a line 67 in which there is a spray cooler 68 connected by line 69 to the tank 63.

There is also provided means for controlling the gravity of the tar formed in the separator 26. This means comprises a line 70 connected to the feed oil line 52 and a line 77 connected to an auxiliary fluxing oil supply in tank 71. The oil selected for fluxing is pumped through line 72 by pump 73 into the separator header 27 in accordance with the requirements for controlling the gravity of the tar. A line 74 may connect the separator 32 with the tar line 28 from separator 26. Instead of securing oil for control of tar gravity in this way, it may be obtained from traps 75 or 78 which receive oil from lines 54 and 40 respectively and supply same through lines 76 or 79 to the pump 73.

For illustration, the use of the invention will be described in connection with the cracking of petroleum oil but it will be understood that non-cracking distillation or other uses of the principles disclosed, may be made. These principles in general are applicable to tube still installations. By using two or more tube circuits and independently controlling the total heat supplied to each circuit, I secure a much greater work capacity than that of a single circuit having the same volume capacity as the separate circuits.

I have found that the capacity of cracking coil equipment may be substantially increased with improved yields of gasoline by the interrelated control of heat input from a plurality of heat sources to a plurality of heating circuits, preferably arranged in the same furnace setting. In the furnace illustrated in Figs. 1 and 2, this result is accomplished by supplying the principal amount of heat to the primary heating circuit 12 through radiation from main burners 2. This heating is accomplished in the section 12*a*. Before the oil reaches this point in its circuit, it is subjected in sections 12*b* and 12*c* to convection heat from gases generated by main burners 2 and auxiliary burners 3. Excessive heating of sections 12*b* and 12*c* is avoided by introducing in the zone of radiant heat from auxiliary burners 3, a substantial section (15*b*) of the secondary circuit 15. In this section, the oil passing through the secondary circuit receives the amount of heat necessary for the control of the total heat input to this circuit and the final heating is given by radiation in section 15*a*. The control of the total heat input to the secondary circuit is thus vested in the auxiliary burners.

The heat supplied from both sets of burners will be regulated to maintain the desired temperatures throughout the two heating circuits. By arranging these circuits in the manner described, to enable each to receive heat by convection from both sources of heat, high efficiency is obtained. Control of temperature is easily accomplished, since each source of heat is the dominant source for one of the circuits. That is, the main burners 2 are regulable to fix the liquid temperatures in circuit 12 and the auxiliary burners 3 have the same function with respect to circuit 15.

Suitable temperature measuring instruments will be provided at the inlet and outlet of the tube circuits, and elsewhere, to aid the operator in interrelating the heating effect from the separate sources of heat to obtain the desired regulation.

When using the additional equipment shown in Fig. 3, the streams of oil in the furnace setting emerge at about 880° F. and at about 700 to 1000 pounds per square inch and enter the soaking drums at that temperature and pressure. The oil from each stream is preferably passed through the header 20 separately into two of the soaking drums, leaving the third in reserve, to be used when one

of the others must be cut out for cleaning.

The operation of the heat exchange and recovery system shown in Fig. 3 is similar to that described in the application of Alexander C. Spencer and Eric W. Luster, Ser. No. 212,266, filed August 11, 1927, and therefore need not be described in detail here. It will be sufficient to note that feed oil is pumped through heat exchangers 45 and 46 and enters accumulator 41 at about 300° F. Mixed feed oil and condensate are pumped from the accumulator through lines 59 and 60 to heat exchangers 37, thence through lines 61 and 62 to the tube circuits 12 and 15. The oil enters these at about 600–625° F. under a pump pressure of 800–1100 lbs. per sq. in.

The temperature in the separator 26 may be about 700–725° F. The pressure on the system past the release valves 25 on the soaking drum outlets may be about 60 lbs. per sq. in.

It will be understood that the conditions of operation given above are merely illustrative and that various changes and alternative arrangements may be made within the scope of the appended claims, in which it is my intention to claim all novelty inherent in the invention as broadly as the prior art permits.

I claim:

1. In a tube still, an elongated furnace setting, a fuel burner near each end of the same, a heat radiation chamber for each burner, a convection heat chamber for one burner, a tube circuit arranged to receive radiant heat from one burner and convection heat from both burners, a separate tube circuit arranged to receive radiant heat from both burners, and means for controlling the heat supplied from both burners.

2. In a tube still, an elongated furnace setting, a main fuel burner near one end of the same, an auxiliary fuel burner near the other end, a primary tube circuit arranged to receive radiant heat from the main burner and convection heat from the auxiliary and main burner, a secondary tube circuit arranged to receive radiant heat from the auxiliary and main burner, a portion of the secondary tube circuit being interposed as a shield between radiant heat from the auxiliary burner and the primary circuit and means for controlling the heat from the auxiliary and main burner.

3. In the art of heating oil in tube stills, the improvement which comprises establishing separate heating circuits for the oil, applying heat to the circuits from a plurality of sources, utilizing a portion of one circuit to shield the other circuit from radiant heat from one of the sources and regulating the heat from each source in accordance with the temperature desired in the circuits.

4. In the art of heating oil in tube stills, the improvement which comprises supplying radiant and convection heat from each of a plurality of separate sources to each of a plurality of separate tube circuits in parallel connection, and interrelating the amount and character of heat supplied to each circuit.

5. In a cracking of hydrocarbon oils by heating said oil in a tube still to cracking temperature and discharging the oil into one or more enlarged reaction zones, the improvement which comprises passing the oil to independent tube circuits in parallel connection in said tube still, supplying radiant and convection heat from each of a plurality of separate sources to each of the tube circuits, interrelating the amount and character of heat supplied in each circuit and recovering cracked products.

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