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PROCESS FOR THE PYROLYTIC TREATMENT OF HYDROCARBONS
AND CARBONIFEROUS MATERIAL
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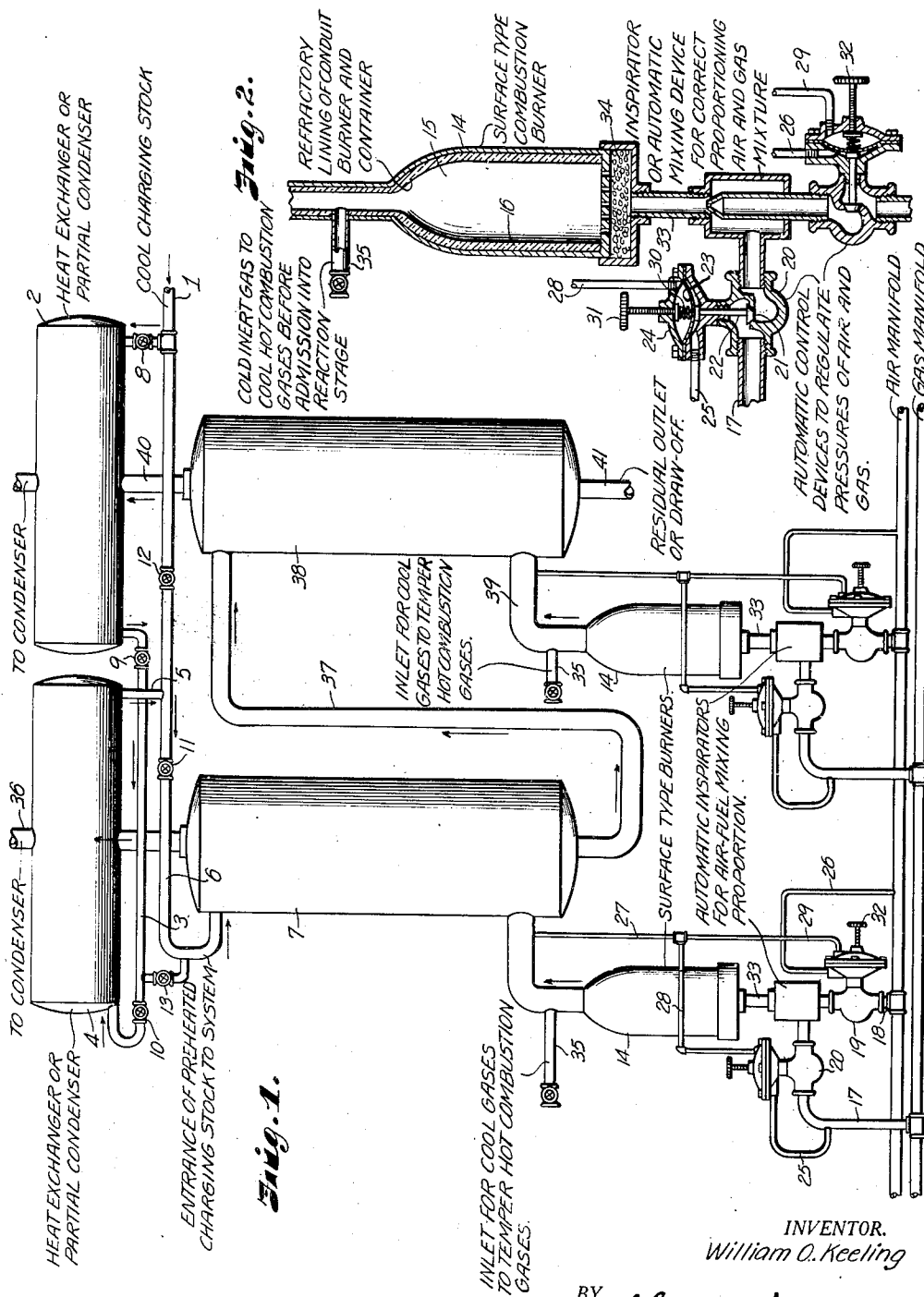


Fig. 1.

Fig. 2.

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PROCESS FOR THE PYROLYTIC TREATMENT
OF HYDROCARBONS AND CARBONIFEROUS MATERIAL

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8 Claims. (Cl. 196—67)

My invention relates to a process for the pyrolytic treatment of hydrocarbons and carboniferous material in general and more particularly to a process wherein hot gases of combustion are used to supply the heat for the pyrolytic treatment.

This application is a continuation in part of my copending application, Serial No. 369,174, filed June 7, 1929.

In the processes of the prior art in which hot gases of combustion are used for the pyrolytic treatment of hydrocarbons, no provision is made to generate the gases at a uniform temperature, pressure and composition. The gases are generated in a combustion space into which the fuel and air are admitted through hand controlled valves. The success of any process of pyrolytic treatment depends upon more or less correct and constant pressure and a uniformity of temperature. If imperfect combustion is obtained, due to an excess, oxygen will be present in the combustion gases resulting in the formation of aldehydes, ketones, acids, gum forming compounds and color forming bodies. If imperfect combustion results, due to deficiency of air, an excess of carbon monoxide will be present which represents a loss of valuable fuel. I have discovered that, in order to obtain perfect combustion, it is necessary to use a surface combustion burner and that the mixture admitted to the burner must be of explosive proportions, that is, the air and gas must be properly proportioned to give substantially perfect combustion. It is impossible to obtain perfect combustion at all times without an automatic control means due to the fact that pressure fluctuations will result, due to variations in the charging stock, the presence of moisture, or to temperature changes which take place within the system. A sudden rise of pressure might extinguish the burner.

One object of my invention is to provide a process of pyrolytic treatment of material by means of hot gases of combustion which will obviate the disadvantages which exist in the present processes.

Another object of my invention is to provide a process of pyrolytic treatment of hydrocarbons or carboniferous material in general in which the hot gases of combustion used to treat the material are generated at uniform temperature and composition, and at a controlled pressure somewhat above the system pressure.

A further object of my invention is to provide a means of reducing or tempering the hot gases of combustion to bring them to the desired tem-

perature for effecting the contemplated treatment.

Further objects of my invention will appear from the following description.

In the drawing:

Figure 1 represents a diagrammatic view of one apparatus capable of carrying out my invention.

Figure 2 is a diagrammatic view of a surface combustion burner used in carrying out my invention.

In general, my invention contemplates, taking for example treating hydrocarbons, introducing the charging stock in heat exchange with the products of treatment and its introduction into a reaction chamber. I contemplate providing one or more reaction chambers in which the material will be treated in a stepwise manner. While I have shown two reaction chambers, it is to be understood that any number of successive stages of reaction may be provided. I make provision for the introduction of hot gases of combustion which are generated by an automatic system into each reaction chamber to supply the heat required for the pyrolytic treatment. While I have shown the use of separate burners for each successive reaction stage, it is to be understood that I may employ a single burner to supply the gases to each reaction stage.

The hot products of combustion are brought to the desired temperature by means of the introduction of a cooler inert gas. The volume and quantity of gas will, of course, control the temperature at which the hot products of combustion enter the reaction stage. It will be understood that different temperatures are required for different kinds of pyrolytic treatment. For example, in the cracking operation, the temperature should be between 700° and 1500° F. For distillation, the temperature of the gases entering the reaction stage should be such that the resulting temperature in the reaction stage will be not above 700° F. The kind of oil or material being treated will necessitate different temperatures as will be obvious to those skilled in the art.

More particularly referring now to the drawing and again, taking for example the treatment of hydrocarbon oil, the charging stock enters through pipe 1 and passes through heat exchanger 2, through pipe 3, into heat exchanger 4, through pipe 5, into pipe 6 to the first treating stage 7. The treating stage may consist of an enlarged chamber lined with refractory material. I provide means for passing the charging

stock through the heat exchangers either in series, in parallel, or in one or the other of said heat exchangers. I am enabled to do this by a valve and pipe arrangement. In the mode of charging in series as above described, it will be understood that valves 8, 9, 10, and 11 are open and that valves 12 and 13 are closed. If it be desired, for example, to charge the charging stock in parallel, valves 8 and 12 will be left open so that the charging stock will enter the two heat exchangers in a divided stream through valve 8 and pipe 5. The products leaving the heat exchangers are passed through valves 9 and 10, through valve 13, into line 6, whence they will be discharged into the first reaction stage. If it is desired to use only heat exchanger 2, valves 10, 11 and 12 will be closed, while valves 8, 9, and 13 will be left open. If it is desired to use only heat exchanger 4, valves 8, 9, and 11 will be closed, while valves 10, 12, and 13 will be left open.

I provide combustion burners 14 which consist of a combustion space 15 lined with a refractory material 16 and an inspirator device 17. The inspirator device consists of fuel and air lines 17 and 18 through which air and fuel flow. I interpose regulating valves 19 and 20 in the air and fuel lines. The regulating valves comprise a diaphragm controlled valve consisting of a valve 21, and valve stem 22, to which is secured a diaphragm 23. The diaphragm is mounted in an enclosed chamber 24 which is divided into two parts by the diaphragm 23. The lower part of the chamber is exposed to the pressure of the fuel or gas, and air supply through branch lines 25 and 26 respectively. The upper portions of the diaphragms are in communication with the pressure of the system through lines 27 and branch lines 28 and 29. Above each diaphragm I provide a spring 30 which may be adjusted to various tensions by adjusting screws 31 and 32. Inasmuch as the air is to act as an inspiring agent, that is the velocity of the air stream will serve to draw in the desired quantity of fuel, the adjusting screws 32 on the air control valves are set to exert lesser pressure than the adjusting screws of the fuel control valves. If desired, instead of using a spring to obtain the differential pressure contemplated, I may use a weight on the control valves of the air lines tending to hold the valves open. The employment of the weight, however, necessitates the mounting of the valves

in a vertical position.

As will be understood, if

sufficiently high to overcome any prospective pressure which might be reached within the system. The air and fuel are obtained from tanks or any other suitable source of supply, not shown. If, for any reason, the source of supply becomes disrupted, the action above described, whereby the valves in the air and fuel lines will tend to close by a reduction of pressure in the respective lines, is for the purpose of shutting off the system, in case of a break in the air and fuel lines. Normally the gas and air supply is sufficiently high to overcome any pressure which may exist in the system.

The fuel and air which is drawn in through my inspirator is passed through mixing lines 33 to insure a perfect mixture of the fuel and air. The mixture will burn with surface combustion along the surfaces of the refractory material packed in the combustion space 34, and issue into the enlarged space 15. Above the zone of perfect combustion I provide inlet pipes 35 for the admission of the tempering gases which will serve to bring the products of combustion to the desired temperature depending upon the nature of the process being practiced. This temperature will vary, as pointed out above. The hot gases of combustion thus generated and tempered to the desired temperature by the tempering gases issuing from lines 35 enter the first treating zone 7 where a pyrolytic treatment is effected. The vaporized portions resulting from the pyrolytic treatment will pass from the reaction stage 7 through line 36 to a suitable condenser not shown. The unvaporized portions will pass through line 37 into a second treating zone 38 in which a fresh supply of hot gases of combustion generated in second burner 14 enter after being tempered through line 39. The vaporized portions in the second treating stage will pass through line 40 to a second condenser not shown. The unvaporized portions may be withdrawn through line 41 and passed to a third treating stage, not shown, it being understood that I may use as many treating stages as desired. If desired, the unvaporized portions may be recycled, that is added to the cool incoming charging stock or introduced directly into the first treating zone and the cycle repeated. By using a plurality of successive steps, I avoid large pieces of equipment. Furthermore, I am enabled to get a more uniform product due to the fact that I do not have to supply the total quantity of heat necessary for the treating in one stage.

It will be appreciated that my process provides a method of pyrolytic treatment by hot combustion gases enabling the treatment to be carried out at an exceedingly high thermal efficiency. The pressure of the gases supplied in treating will be correct and constant. The gases will be substantially devoid of free oxygen or carbon monoxide. The temperature of the gases will be uniform. The resulting product will be of the same nature and will be unusually uniform. By the use of a tempering gas to reduce the temperature of the hot gases of combustion, I am enabled to use my process in treating a variety of materials.

If, for example, it is desired to treat oil shale, a very slight modification of my apparatus can be made. All that is necessary is to provide means for introducing the oil shale into my treating chambers and means for periodically removing the exhausted shale. I may employ my process in the destructive distillation of wood, coal or other carboniferous material.

It will be understood that certain features, subcombinations, and operations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of my claims. It is further obvious that various changes may be made in the details within the scope of my claims without departing from the spirit of my invention. It is, therefore, to be understood that my invention is not to be limited to the specific details shown and described.

Having thus described my invention, what I claim is:

1. In a process for the pyrolytic treatment of hydrocarbon oil with hot combustion gases the steps of mixing fuel and air in such proportions that an explosive mixture will result capable of producing substantially perfect combustion in a surface combustion burner whereby hot combustion gases substantially devoid of free oxygen and carbon monoxide will result, automatically continuously governing the respective pressures of the gas and air entering the mixing stage responsive to the pressure existing in the treating system, maintaining the pressure of the entering air above the pressure of the incoming fuel, burning said mixture with surface combustion to obtain hot combustion gases substantially devoid of free oxygen and carbon monoxide, passing said gases into contact with the oil to be treated in a treating stage, allowing said gases to effect a

pyrolytic treatment of said material, and withdrawing the vaporized and unvaporized products from said treating stage separately.

2. A process as in claim 1 which includes the further step of tempering the hot combustion gases with a cooler inert gas before employing the hot products of combustion in the treating stage.

3. A process as in claim 1 in which the hydrocarbons to be treated are passed in heat exchange relation with the vapors withdrawn from the treating stage.

4. In a process for the pyrolytic treatment of hydrocarbon oil with hot combustion gases, the steps of mixing fuel and air in such proportions that an explosive mixture will result, capable of substantially perfect combustion in a surface combustion burner, automatically continuously governing the respective pressures of the gas and air entering the mixing stage responsive to the pressure existing in the treating system, maintaining the pressure of the entering air above the pressure of the incoming fuel, burning said mixture with surface combustion to produce hot gases substantially devoid of free oxygen and carbon monoxide, passing said hot gases into contact with the hydrocarbon oil to be treated in a first treating stage, withdrawing the vapors evolved in said first treating stage, passing the unvaporized product into a second treating stage, adding a fresh supply of generated hot combustion gases into said second treating stage, allowing a pyrolytic treatment to take place in said second treating stage, and withdrawing the products evolved in said second treating stage.

5. A process as in claim 4 which includes the additional step of passing the hydrocarbon oil to be treated in heat exchange relationship with the products evolved in the treating stages.

6. A process as in claim 4 in which the hot gases of combustion entering the second treating stage are generated in a separate surface combustion burner.

7. A process as in claim 4 in which the hot gases of combustion are tempered with a cooler inert gas before employing the hot products of combustion in the treating stages.

8. A process as in claim 1 in which the unvaporized oil is withdrawn from the first treating stage and similarly treated by hot gases of combustion in at least one subsequent treating stage.

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