

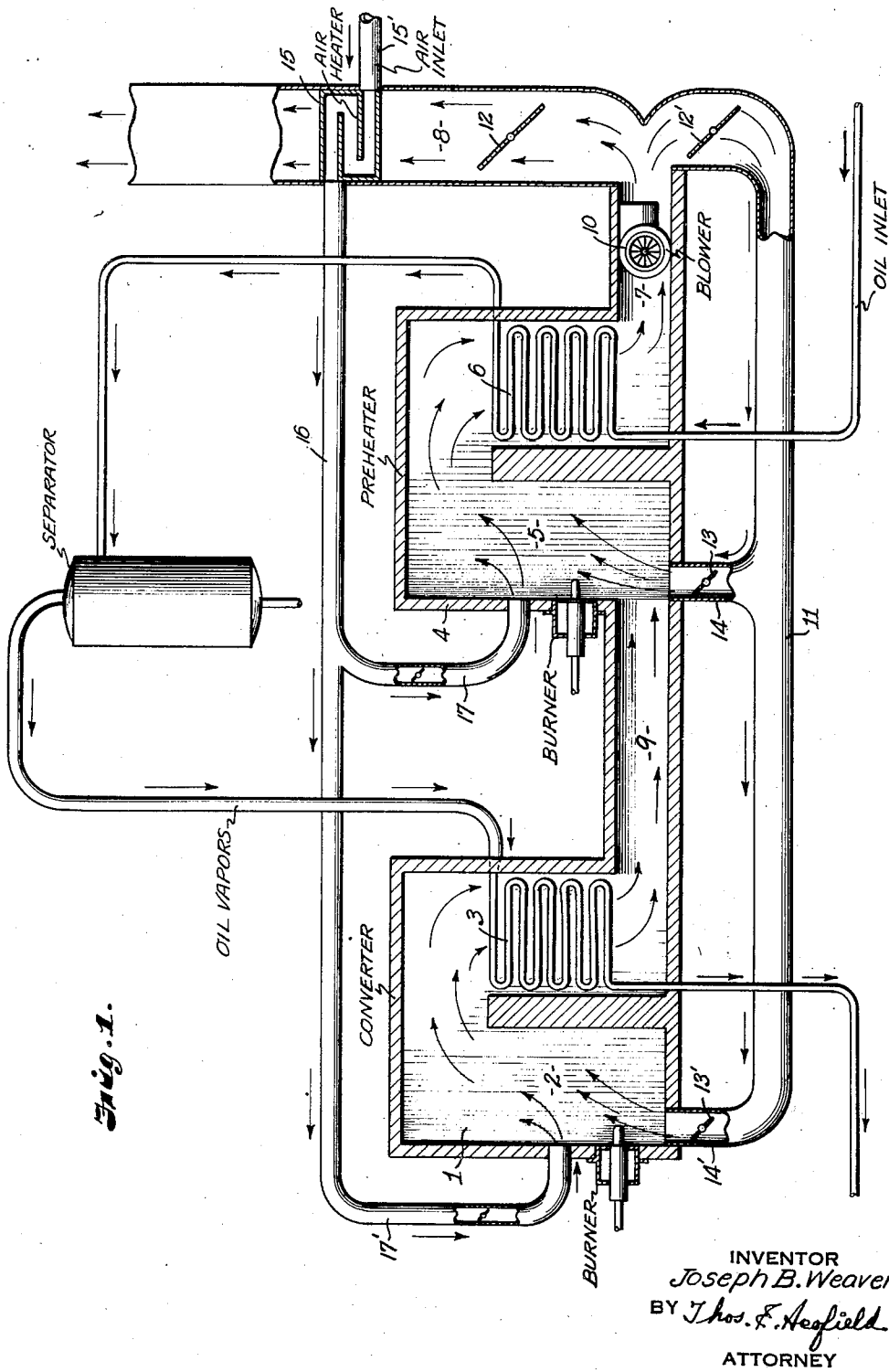
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APPARATUS AND PROCESS FOR TREATING HYDROCARBON OILS

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APPARATUS AND PROCESS FOR TREATING
HYDROCARBON OILSJoseph B. Weaver, Chicago, Ill., assignor, by
mesne assignments, to Gyro Process Company,
a corporation of Michigan

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10 Claims. (Cl. 196—116)

This invention relates to apparatus and process for treating hydrocarbon oils and refers more particularly to an improved apparatus and process for treating hydrocarbon oils in the vapor phase.

Among the objects of the invention are—to provide an improved apparatus and process wherein the heat necessary for the vapor phase treatment is economically employed and where the effect of the oxidizing conditions of the gases at the high temperatures necessarily employed is greatly reduced, and, in general, to provide a more efficient and economical apparatus and process for treating hydrocarbon oils wherein the converting or cracking takes place while the oil is in the vapor phase.

The invention further resides in connection with apparatus and process where the oil is converted in the vapor phase while in the presence of a suitable agent, such as a catalytic agent, or a chemical reagent, and in such combinations of steps and features of construction and arrangements of parts as will more fully hereinafter appear.

In the drawing the single figure shows diagrammatically an apparatus embodying my invention and capable of carrying out the process of my invention.

Describing in detail the particular embodiment illustrated in the drawing, 1 represents diagrammatically a convertor, which may be one of many types suitable for treating hydrocarbon oils in the vapor phase. In this convertor, 2 designates the combustion chamber and 3 the heating elements through which the products of combustion from the combustion chamber 2 pass. These heating elements may be any suitable heat interchanger. For example, a convertor of the type shown in my pending application Serial No. 45,365, now U. S. Patent 1,708,247, may be employed, in which convertor the vaporized oil is compelled to pass through or over a suitable agent, which may be a metal oxid, such as ferric oxid.

4 represents a suitable preheater or vaporizer in which the products of combustion from the combustion chamber 5 pass through the heating element 6. The preheated oil is then vaporized and subjected to the converting action in the convertor 1 by any suitable piping arrangement and the excess products of combustion pass through the flue 7 to the stack 8.

In the vapor phase cracking process such high temperatures are necessarily required that difficulty is encountered in maintaining satisfactory thermal efficiency in the apparatus and also for preventing injury to the equipment due to the

oxidizing condition of the gases at such high temperatures. In my pending application Serial Number 45,365 I have described an apparatus and process for utilizing the heat in the waste gases from the convertor in the preheater or vaporizer and my present application relates to further improvements, which result in increased thermal efficiency and advantages. It is important that high velocities of the flue gases through the heating elements of the convertors and preheaters are employed in order to obtain a rapid heat interchange between the gaseous products of combustion and the hydrocarbons being treated. The volume of gas produced by the combustion of sufficient fuel to furnish the required heat for the convertor (the convertor action taking place, for example, at temperatures in excess of approximately 1000° F.) is not sufficient to give the desired velocities of the hot gases, and previously I have admitted cold air in sufficient volume to attain the desired velocities of the combined hot gases. This, however, materially reduces the thermal efficiency and also the supply of additional air aids in the detrimental oxidation of the convertor parts.

In the present invention I overcome this objection by introducing part of the waste heat from the preheater in place of the excess cold air above referred to. It is also found that this greatly changes the oxidizing conditions of the flue gases in the apparatus, as only enough air to support combustion need be admitted to the system, and if proper regulation is maintained, it is possible to realize practically neutral conditions of the flue gases.

Referring again to the diagrammatic drawing, it is to be noted that the convertor 1 at its outlet end in place of being connected to a stack, is connected by a flue 9 to the combustion chamber of the preheater or vaporizer, and a suitable fan or other draft means 10 is located in the flue 7 so that any desired velocity through the convertor and the preheater can be maintained. The flue 7 not only has a connection to the stack 8, but it also has a connection to a return flue 11 for recirculating the waste gases or products of combustion. The amount of waste gases that go to the stack 8 or to the return flue 11 can be governed by the dampers 12 and 12'. Also the waste gases which pass through the return flue 11 can be divided between the convertor 1 and the vaporizer 4 by means of the dampers 13 and 13' located in the passages 14 and 14' respectively.

The heat from the portion of the hot products of combustion which pass to the stack 8 is also

utilized in place of cold air for supplying the additional velocity necessary in the preheater and the convertor. As shown in the diagrammatic drawing, a heat interchanger 15 is located in the stack 8, this heat interchanger having a cold air inlet 15' through which the air passes to the heat interchanger 15 where it absorbs any excess heat that is in the stack gases and then passes through the ducts 16 to the branch ducts 17 and 17' leading to the combustion chambers 5 and 2 respectively.

The above arrangement of parts not only makes it possible to utilize to the fullest extent all the available heat of the system, but it also provides the necessary velocities without reducing the thermal efficiency of the system and by properly regulating the fan 10 and the valves or dampers 12, 12', 13 and 13', a practically neutral condition of the flue gases can be maintained so that the apparatus not only has greater thermal efficiency, but also greater life.

The apparatus as above described is particularly adapted for the treatment of hydrocarbon oils in the vapor phase in which the oil is vaporized and then, while it is in its vapor phase, converted at a temperature in excess of approximately 1000° F., the conversion action taking place preferably in the presence of a metal oxid or of a metal oxid and steam. Owing to the high temperature at which the conversion takes place with reference to the relatively low temperature at which the oil can be vaporized, the excess heat from the convertor may be sufficient in some cases to preheat or vaporize the oil in the preheater 4, although in place of supplying the entire heat for the vaporizer the waste heat in the gases from the convertor may be used in part in the vaporizer and additional fuel supplied in the latter.

I do not desire to limit my invention to the particular details of construction shown, as the drawing merely illustrates diagrammatically an apparatus embodying my invention and one by which my improved process may be carried out.

What I claim as my invention is:

1. In an oil conversion system, a setting formed to include a converting section and a vaporizing section, an oil converter situated in said converting section, an oil vaporizer situated in said vaporizing section, combustion producing means arranged in said converting section to produce furnace gases having sufficient temperature to heat the oil passing through said converter to conversion temperatures in excess of 1000° F., means formed in connection with said setting for transferring waste gases from said converting section to the vaporizing section to heat and vaporize oil passing through said vaporizer, said vaporizing section being provided with a waste gas outlet, and means for recirculating the waste gases obtained from said outlet through either or both the converting and/or vaporizing sections of said setting.

2. In an oil conversion system, a furnace setting formed to include spaced vaporizing and converting chambers, an oil vaporizer situated in said vaporizing chamber, an oil converter arranged in said converting chamber, means for developing combustion in said converting chamber to produce furnace gases of sufficiently high temperature to heat oils passing through said converter to conversion temperatures, means formed in connection with said setting for transferring waste gases from said converting chamber to said vaporizing chamber to heat and vaporize oil passing through said vaporizer, said vaporizing chamber

being provided with a waste gas outlet leading to the atmosphere, a duct communicating with said outlet and provided with branches leading respectively to the converting and vaporizing chambers of said setting, a fan for creating forced circulation of said waste gases through the waste gas outlet of the vaporizing chamber, and damper mechanism arranged in said duct and in the respective branches thereof to govern selectively the passage of waste gases, first, through said duct and, second, through said branches.

3. In an oil conversion system, a furnace setting formed to include spaced vaporizing and converting chambers, an oil vaporizer situated in said vaporizing chamber, an oil converter arranged in said converting chamber, means for developing combustion in said converting chamber to produce furnace gases of sufficiently high temperature to heat oils passing through said converter to conversion temperatures, means formed in connection with said setting for transferring waste gases from said converting chamber to said vaporizing chamber to heat and vaporize oil passing through said vaporizer, said vaporizing chamber being provided with a waste gas outlet leading to the atmosphere, a duct communicating with said outlet and provided with branches leading respectively to the converting and vaporizing chambers of said setting, a fan for creating forced circulation of said waste gases through the waste gas outlet of the vaporizing chamber, damper mechanism arranged in said duct and in the respective branches thereof to govern selectively the passage of waste gases, first, through said duct and, second, through said branches, a heat exchanger arranged in the waste gas outlet of said vaporizing chamber, means for passing air through said heat exchanger to pre-heat the air by the temperature of the waste gases passing through said outlet, and air lines leading from said heat exchanger to the vaporizing and converting chambers of the setting.

4. In an oil conversion system, the combination with a furnace setting formed to include spaced converting and vaporizing sections, each of such sections being provided with a chamber, a transversely extending bridge wall arranged within each of said chambers, a converter arranged in the chamber formed in said converting section and disposed on one side of said bridge wall, a vaporizer disposed in the chamber formed in said vaporizing section and arranged on one side of the bridge wall in the vaporizing chamber, combustion producing means arranged in said converting section to produce furnace gases having sufficient temperature to heat the oil passing through said converter to temperatures of molecular decomposition, said bridge wall serving in said converting chamber to cause the furnace gases to flow in a downward direction while passing through said converter, an elongated duct for transferring waste gases from said converting section to the vaporizing section to heat and vaporize oil passing through said vaporizer, the bridge wall in said vaporizing section being positioned to cause said gases to move downwardly through the vaporizing section when in contact with said vaporizer, a waste gas outlet leading from said vaporizing section, and means for positively recirculating waste gases obtained from said outlet through the converting and vaporizing sections of said setting.

5. In an oil conversion system, the combination with a furnace setting formed to include

spaced converting and vaporizing sections, each of such sections being provided with a chamber, a transversely extending bridge wall arranged within each of said chambers, a converter arranged in the chamber formed in said converting section and disposed on one side of said bridge wall, a vaporizer disposed in the chamber formed in said vaporizing section and arranged on one side of the bridge wall in the vaporizing chamber, combustion producing means arranged in said converting section to produce furnace gases having sufficient temperature to heat the oil passing through said converter to temperatures of molecular decomposition, said bridge wall serving in said converting chamber to cause the furnace gases to flow in a downward direction while passing through said converter, an elongated duct for transferring waste gases from said converting section to the vaporizing section to heat and vaporize oil passing through said vaporizer, the bridge wall in said vaporizing section being positioned to cause said gases to move downwardly through the vaporizing section when in contact with said vaporizer, a waste gas outlet leading from said vaporizing section, means for positively recirculating waste gases obtained from said outlet through the converting and vaporizing sections of said setting, means for introducing air into said converting and vaporizing sections, and means for pre-heating the air delivered to said sections by the waste gases passing through said outlet.

6. A method of heating oil which comprises establishing a stream of furnace gases in heat exchange with surfaces in contact with said oil, removing the furnace gases from contact with said surfaces and recirculating withdrawn furnace gases to a plurality of places along said stream to modify the temperature of said stream at a plurality of separated points relative to its passage in contact with said surfaces.

7. A method of heating oil which comprises passing the oil through heat exchanger zones in series establishing a stream of furnace gases in heat exchange with said oil and recirculating a portion of said stream and introducing the same unmixed with hot gases to a point intermediate the initial and final heat exchange of said stream with said oil.

8. An oil conversion system comprising a first heating section and a second heating section, means arranged in said first heating section to generate combustion gases, means for transferring waste gases from said first heating section to said second heating section, said second heating section being provided with a waste gas outlet, a duct communicating with said outlet and provided with branches leading respectively to the first and second heating sections, a fan for creating forced circulation of said waste gases through the waste gas outlet to the second heating section, and damper mechanism arranged in said duct and in the respective branches thereof to govern selectively the passage of waste gases through said duct and through said branches.

9. An oil conversion system comprising a first heating section and a second heating section, means arranged in said first heating section to generate combustion gases, means for transferring waste gases from said first heating section to said second heating section, said second heating section being provided with a waste gas outlet, a duct communicating with said outlet and provided with branches leading respectively to said heating sections, a fan for creating forced circulation of said waste gases through the waste gas outlet to said second heating chamber, damper mechanism arranged in said duct and in the respective branches thereof to govern selectively the passage of waste gases through said duct and said branches, a heat exchanger arranged in the waste gas outlet of said second heating section, means for passing air through said heat exchanger to preheat the air by heat exchange with said waste gases and an air duct leading from said heat exchanger to the first heating section.

10. Apparatus of the character described, including a heating chamber, spaced, series connected fluid-conducting units in said chamber, means for inducing flow of a fluid heating medium in successive surface contact with said units, and means leading directly to the space between the units for discharging a temperature reducing medium into the heating medium between the units.

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