July 21, 1936. C. O. MELBERG 2,048,351

FURNACE FOR THE PYROLYTIC TREATMENT OF HYDROCARBON OILS

Filed June 23, 1934 2 Sheets-Sheet 1

Fig. 1.

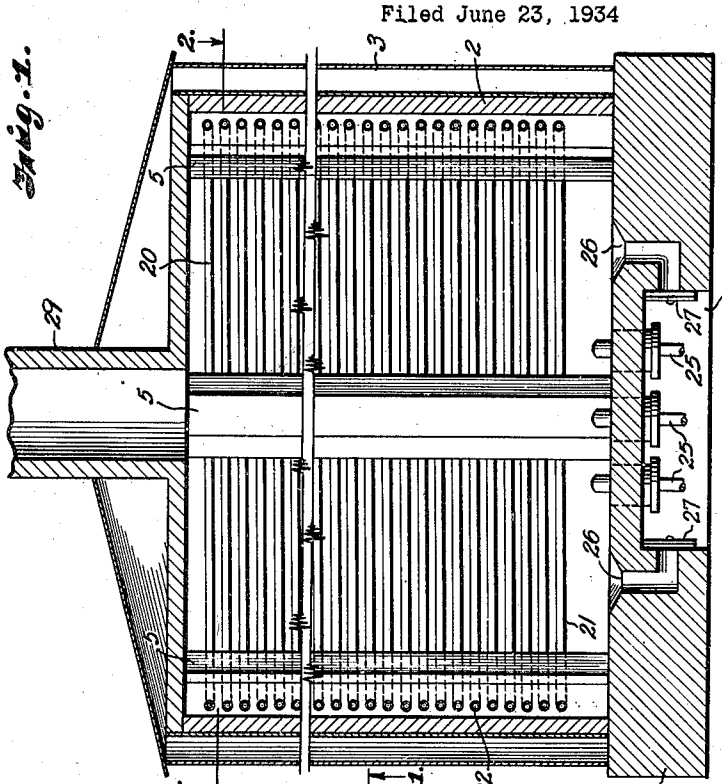


Fig. 4.

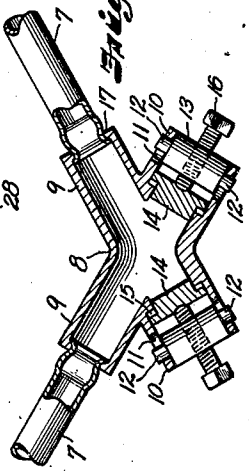


Fig. 2.

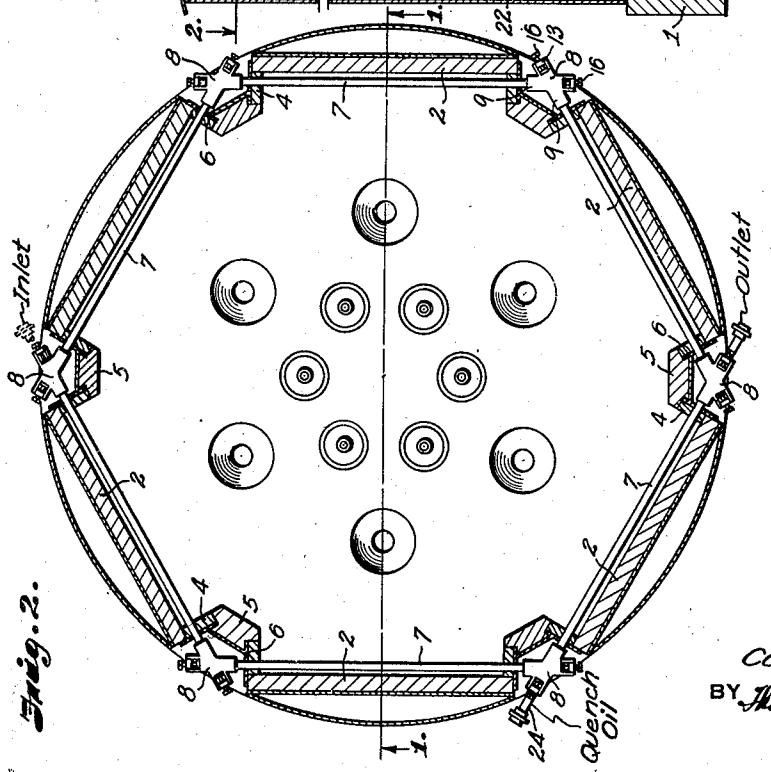
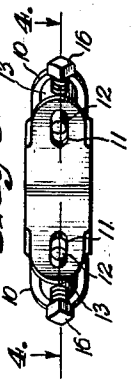


Fig. 3.



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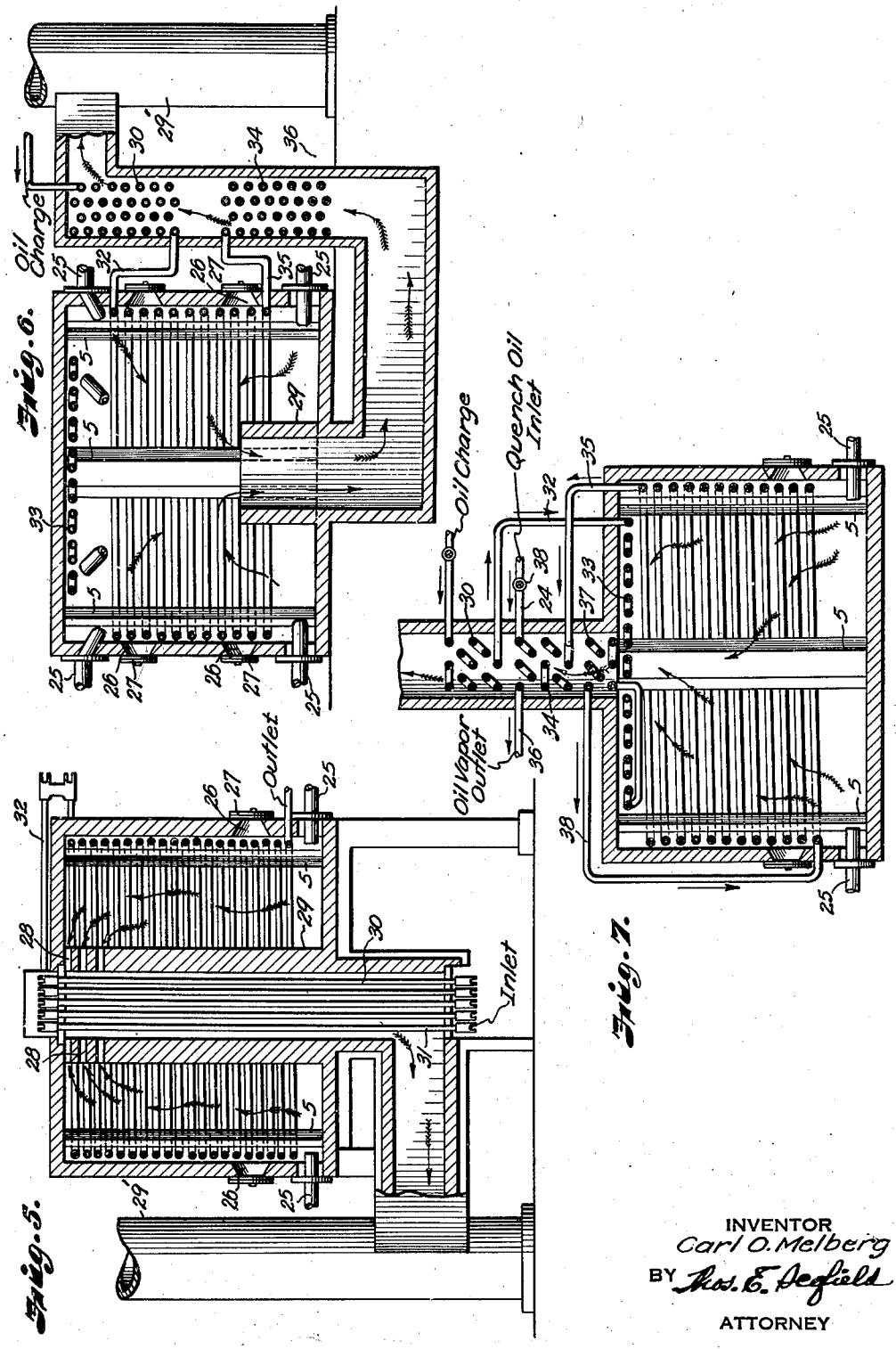


Fig. 6.

Fig. 7.

Fig. 5.

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2,048,351

FURNACE FOR THE PYROLYTIC TREATMENT OF HYDROCARBON OILS

Carl O. Melberg, Ponca City, Okla., assignor to Continental Oil Company, Ponca City, Okla., a corporation of Delaware

Application June 23, 1934, Serial No. 732,051

1 Claim. (Cl. 196—116)

My invention relates to a furnace for the pyrolytic treatment of hydrocarbon oils, and more particularly to a novel furnace construction adapted to be used for cracking, heating, and/or viscosity breaking of hydrocarbon oils.

The use of pipe furnaces in which oil is flowed through a conduit or coil of comparatively small cross sectional area externally heated by either radiant or convection heat has lately become prevalent in the pyrolytic treatment of hydrocarbon oils. The processing and pyrolytic treatment of hydrocarbon oils require comparatively high temperatures very much in excess of those used in heating water to form steam. The hydrocarbon oil is of such character that, if heated to certain temperatures, it tends to decompose to form lower boiling hydrocarbons and this decomposition is attended by deposition of carbon and tarry substances. Frequently, the gases and lower boiling hydrocarbons which may be formed by the pyrolytic treatment of hydrocarbon oils form heavy polymers in the nature of tar or gums. The deposition of these substances in the tubes of a pipe still render frequent cleaning necessary. Then, too, the high temperatures and pressures involved subject the tubes of the pipe still to severe stresses. This produces strains and permanent distortion. Frequently, many hydrocarbon oils being processed contain sulphur compounds and/or mercaptans of a corrosive nature. The attendant corrosion results in the pitting and weakening of the tube walls with the result that failures are experienced. This necessitates the replacing of the tube which has failed.

One object of my invention is to provide a novel construction of a furnace for the pyrolytic treatment of hydrocarbon oils which will enable the tubes of the furnace to be readily cleaned, inspected, removed, and replaced.

Another object of my invention is to provide a novel and efficient arrangement for pyrolytic treatment of hydrocarbon oils whereby they may be heated by radiant and convection heat in an efficient manner.

Other and further objects of my invention will appear from the following description.

In general, my invention contemplates the provision of a furnace setting in the form of a polygon, as for example pentagon, hexagon, heptagon, octagon, or the like. The setting is provided with reentrant portions at the intersection of the sides. Short lengths of tubes extend adjacent the respective sides through the reentrant portions. The tubes are connected by headers, so constructed and positioned that the tubes may be removed, cleaned, inspected, and/or replaced through the headers by removing header covers. The furnace is fired at any suitable point and is provided with a furnace gas duct arranged with its axis coincident with the axis of the setting in order to provide for a straight line flow in the radiant heat section, preventing turbulence. In the duct may be positioned convection tube banks. The oil to be processed may be charged to the convection tube bank and then through the radiant tube bank. It may be charged to a section of the convection tube bank, then to the radiantly heated bank and then to another section of the convection heat bank. The provision is made, if desired, for preventing the overheating of the oil being processed by injecting a quench oil at a suitable place in the heating coil.

In the accompanying drawings which form part of the instant specification and are to be read in conjunction therewith, and in which like reference numerals are used to indicate like parts in the various views,

Figure 1 is a sectional elevation of a furnace embodying one mode of carrying out my invention.

Figure 2 is a sectional plan view taken on a line 2—2 of Figure 1.

Figure 3 is an end view of a header used in carrying out my invention.

Figure 4 is a sectional view taken along the line 4—4 of Figure 3.

Figure 5 is a sectional elevation of a furnace embodying another mode of carrying out my invention.

Figure 6 is a sectional view of a furace embodying still another mode of carrying out my invention.

Figure 7 is a diagrammatic sectional view showing one mode of passing the oil through a furnace embodying one manner of carrying out my invention.

More particularly referring now to the drawings, upon a suitable foundation 1 I build a furnace setting having refractory side walls 2 supported by a suitable steel structure 3. The setting is polygonal in cross section as can readily be seen by reference to Figure 2 in which it is shown as a hexagon. It is to be understood, of course, that any suitable number of sides, from five or more, may be used as desired. The greater the number of sides the shorter the length of the tubes which are used in forming the pipe coil of the furnace. The sides are joined by reentrant portions 4, which are formed by keyed, refrac-

tory blocks 5, which are supported by steel channel columns 6, whose shape can be readily seen by reference to Figure 2. The short tube sections 7 extend through the reentrant portions adjacent the side walls of the furnace. Each tube length 7 has a slight pitch and has its ends extending into a header 8 as can readily be seen by reference to Figure 4. The header 8 consists of a body member having somewhat the form of an X, the angle being determined by the type of polygon being used as the setting. If a hexagon is used as shown in Figure 2, the angle between the tube receiving arms 9 of the header 8 would be 120°.

In axial alignment with each of the tube receiving arms are extensions 10 provided with slots 11 in which are positioned the trunnions 12 of a yoke 13, which is provided with a screw threaded bore. Sealing plugs 14 are adapted to seat upon suitable seats which are provided with metal gaskets 15. Bolts 16 are adapted to be threaded through the screw threaded bores of yokes 13 to press plugs 14 against the seats. This construction can be readily seen by reference to Figures 3 and 4. The ends of the tube 7 are expanded upon suitable seats 17, carried by tube receiving portions 9 of the header 8. The tubes 7, when connected by the headers 8, form a spiral coil composed of short lengths of straight pipe. The lengths of pipe may be curved if desired. It is essential only that they be short so that they may be readily replaced and easily handled. The oil inlet to the pipe coil formed as just described is to the uppermost pipe length 20. The oil inlet may be made through header 8 by removing the plug 14 and replacing it with a pipe connection. In this case, the header may be screw threaded or flanged as desired, in order to permit a connection to be readily made. The oil outlet is from the last header into which the lowermost tube length 21 extends, the outlet being connected to the header into which the lowermost tube extends. Somewhere along one of the lowest passes, as for example along tube length 22, a pipe connection may be made such as for example pipe 24 to which a quench oil may be supplied to control the temperature of the oil being processed. If a cracking operation is going on, over cracking or the temperature of the pyrolytic reaction may be controlled by controlling the quench oil through pipe 24, provided with a suitable valve. The oil may be a low boiling oil, if desired. In the form shown in Figure 1, the fuel burners 25 are positioned in the floor of the furnace, air being supplied through ducts 26 which are provided with suitable registers 27. If desired, the space 28 may be connected to a blower system (not shown) or a system which supplies preheated air. The coil formed by the tube lengths 7 is positioned adjacent the walls of the furnace and the oil flowing through this coil will be heated mainly by radiant heat. The furnace gases will be discharged through an outlet duct 29, which is positioned with its axis in axial alignment with the axis of the setting. This enables a straight line flow of the furnace gases without turbulence and makes for a high velocity of flow.

Referring now to Figure 5, which is a modification of my invention, the setting is a polygonal one as before, with the radiant heat coil arranged as before. The duct 29 extends through the setting and is provided at its upper portion with passages 28 through which the furnace gases flow on their way to the stack 29'. Positioned within this duct, I provide a tube bank 30 which is adapted to be heated mainly by convection heat. The oil to be processed is charged to the bank 30 through pipe 31, flows through the convection heat bank and then passes through transfer line 32 to the coil formed of short lengths in the manner described, in which it is heated mainly by radiant heat. The furnace is fired adjacent the bottom of the setting through burners 25, air being provided through openings 26 supplied with air regulating registers 27. It is understood, of course, that the passages 28 may be made adjacent the bottom of the duct 27 and the furnace fired adjacent the top thereof, if desired. In the form shown in Figure 6, two sets of burners 25 are shown having respective air registers 27. The furnace shown in Figure 6 may be fired either adjacent the top or the bottom or, if desired, both sets of burners may be employed. A tube bank 33 adapted to be heated mainly by radiant heat is positioned adjacent the ceiling of the setting shown in Figure 6. The tube bank may be used for superheating steam or may be connected in series with the coil formed of short lengths in the manner described. The duct 29 is positioned adjacent the bottom of the setting and the gases of combustion are adapted to heat tube banks 30 and 34 mainly by convection heat on their way to the stack 29'. In the form shown in Figure 6, the oil is charged to the convection section 30, passes through transfer line 32 to the radiantly heated coil, from which it passes through transfer line 35 to bank 34, which is heated mainly by convection heat from which it passes through outlet 36.

In the form shown in Figure 7, the oil is charged to convection bank 30, from which it passes to the radiantly heated coil 33 through transfer line 32, then to a convection section 37, then through transfer line 38 to the radiantly heated coil formed of short lengths in the manner described above, then through transfer line 35 to convection section 34, to outlet 36. In the convection section 34, I may introduce a quench oil through pipe 24, controlled by valve 38. It is to be understood, of course, that this quench oil may be introduced at any suitable place in the travel of the oil, preferably in one of the later passes.

It will be seen that I have accomplished the objects of my invention. I have provided a furnace for the pyrolytic processing of hydrocarbon oils in which the oil may be efficiently heated by radiant and convection heat. The tubes of the furnace may be readily removed for replacement, may be cleaned easily and conveniently inspected. It is only necessary to remove two of the header plugs 14 to clean or replace any of the tube lengths of the coil. The tube lengths are short and easily handled. The cleaning and replacement may be done from without the furnace setting so that it is not necessary to permit the furnace to cool to such a degree that a man may enter the setting to do the work. The tube lengths are all of the same length so that a number of spare tubes may be precut and kept on hand. The advantages of this arrangement will be manifest.

It will be understood that certain features and subcombinations 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 claim. It is further obvious that various changes may be made in details within the scope of my claim 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:

In a furnace for the pyrolytic processing of hydrocarbon oils, a polygonal setting having five or more sides, the axis of said setting extending vertically, fuel-burning means within said setting, a coil through which the oil to be processed is adapted to flow, said coil comprising a plurality of substantially horizontally short lengths of tubing connected in series and positioned adjacent the side walls of said setting, a duct positioned within and extending axially of said setting, a flue, means providing communication between said duct and said flue whereby gases of combustion may pass from said setting through said duct, heat exchange means positioned in said duct and means for connecting said coil and said heat exchange means in series.

CARL O. MELBERG.