Aug. 23, 1932. T. DE C. TIFFT 1,873,070

ART OF CRACKING HYDROCARBONS

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Fig. 1.

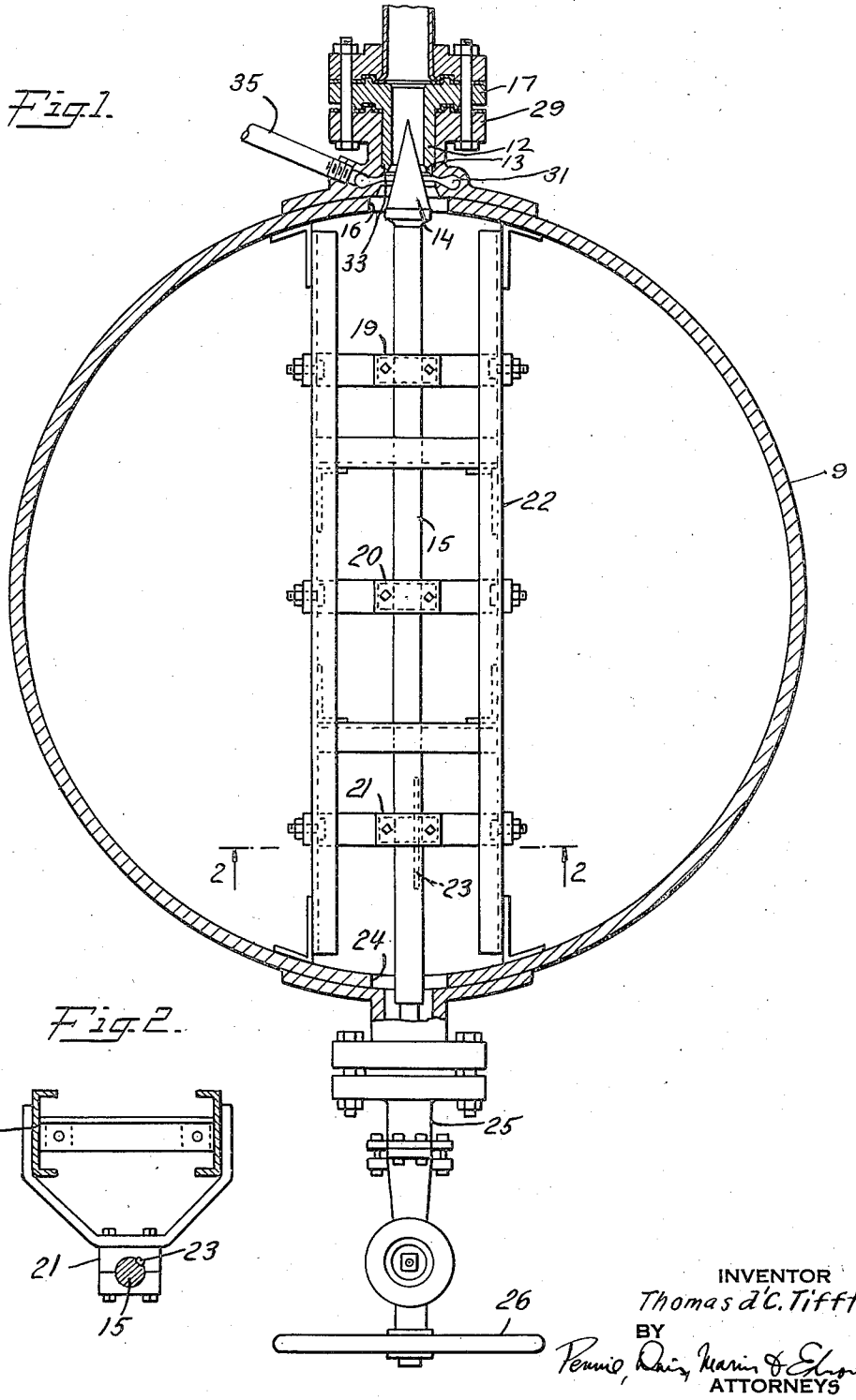


Fig. 2.

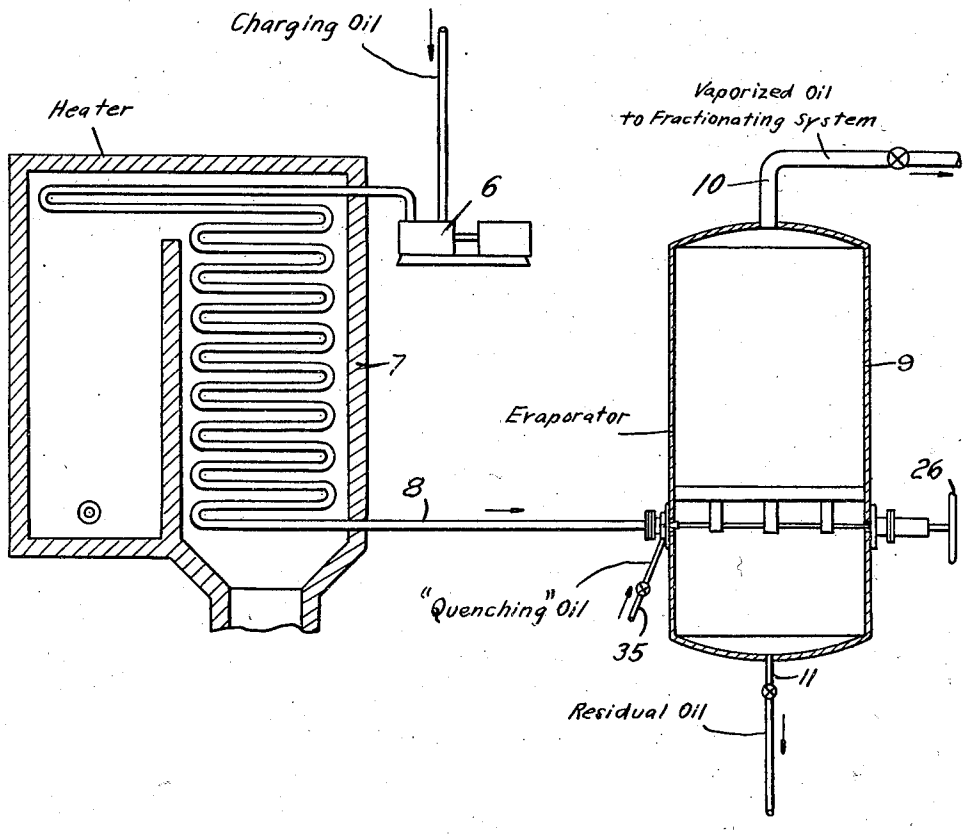
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Fig. 3.



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UNITED STATES PATENT OFFICE

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ART OF CRACKING HYDROCARBONS

Application filed August 1, 1931. Serial No. 554,393.

This invention relates to improvements in apparatus for cracking higher boiling oils such as gas oil and topped crude oil to produce lower boiling oils such as gasoline. The invention relates particularly to improvements in oil cracking apparatus comprising a heater in which oil is heated to a cracking temperature under superatmospheric pressure and an evaporator in which the hot oil products discharged from the heater are separated into a vaporized fraction and a residual fraction under a lower pressure.

In one aspect this invention relates to improvements in the apparatus described in the application of William V. Ischie filed August 15, 1931 Serial Number 557,249.

The reduction of the pressure on the hot oil products discharged from the heater into the evaporator involves a number of difficulties peculiar to cracking operations carried out in this type of apparatus, particularly where the oil is heated to a high cracking temperature, upwards of 900° F., for example, in the heater. The expansion of the hot oil products, upon pressure reduction, involves a tendency toward the formation of solid or semi-solid carbonaceous aggregates immediately in the region of expansion. The tendency is accentuated, particularly if the oil is heated to a high cracking temperature in the heater, by any abrupt changes in direction or velocity of flow of the stream or of parts of the stream of hot oil products discharged from the heater into the evaporator. These aggregates deposit and accumulate on the low pressure side of conventional reducing valves, or in the connections between conventional reducing valves and the evaporator, with a consequent tendency to choke the apparatus at this point rendering the operation irregular and uncertain and frequently compelling termination of the operation. These and related difficulties are largely eliminated in the improved apparatus of the present invention.

In the oil cracking apparatus of this invention difficulties due to deposition of solid or semi-solid carbonaceous aggregates adjacent the low pressure side of the pressure reducing valve are substantially eliminated. The apparatus provides for continuously smooth and undisturbed flow of the hot oil products constituting the heater discharge from the heater into the evaporator and for introduction of relatively cool oil directly into the region of expansion. Operation of the apparatus is regular and certain. The apparatus further embodies peculiar advantages of accessibility.

The improved apparatus of the present invention comprises, in combination with such oil cracking apparatus, a tubular member opening into the evaporator through an aperture in the wall of the evaporator the inner end of which tubular member forms a valve seat, a valve plug positioned with respect to this valve seat by an operating extension extending across the evaporator and through the wall of the evaporator opposite this aperture, means for discharging relatively cool oil directly into the region of expansion between the valve seat and the valve plug, and means for conducting the heater discharge into the evaporator through this tubular member. This tubular member is advantageously secured in position by means arranged outside of the evaporator to be removable from the outside of the evaporator. That part of the operating extension positioning the valve plug which is within the evaporator is advantageously stiffened and supported by a frame arranged within the evaporator carrying a plurality of supports for this operating extension. The operating parts of the pressure reducing valve within the system including the means employed to prevent escape of hot oil products along the operating extension, are thus arranged entirely within the region of lower pressure. Easy access to the cooperating parts of the pressure reducing valve is provided. Continued cracking in the evaporator of the hot oil products discharged from the heater is limited by the introduction of the relatively cool oil. This limitation of further cracking of the hot oil products discharged from the heater is sometimes designated "quenching". This operation may or may not involve cracking, in the evaporator, of the oil introduced

for this purpose, depending upon the character of this oil and the conditions prevailing in the evaporator. The continuously smooth and undisturbed flow of the heater discharge up to the point of expansion and the introduction of relatively cool oil into the region of expansion prevents the deposition of solid or semi-solid carbonaceous aggregates adjacent the pressure reducing valve. Within the evaporator itself sufficient volume to accommodate any solid or semi-solid carbonaceous aggregates formed in any reasonable period of operation is easily provided.

The apparatus of the invention will be further described in connection with the accompanying drawings which illustrate, diagrammatically and conventionally, an embodiment of the invention. In the accompanying drawings, Fig. 1 is a section of an evaporator in apparatus embodying the invention, Fig. 2 is a section on line 2—2 of Fig. 1, and Fig. 3 is an elevation, partly in section and with parts broken away, of an apparatus embodying the invention.

In the apparatus illustrated in Fig. 3, charging oil is forced, by means of pump 6, through the heater 7, in the heater 7 this oil is heated to a cracking temperature, 850–950° F. for example, and the hot oil products are discharged through connection 8 under a superatmospheric pressure, 400–800 pounds per square inch for example, into the evaporator 9 in which a lower pressure is maintained, 10–50 pounds per square inch for example, relatively cool oil, which however may be at elevated temperature, 600–650° F. for example, is introduced through connection 35, the vaporized fraction separated in the evaporator 9 is discharged through connection 10, to a fractionating system for example, and residual oil is discharged through connection 11. The charging oil, and the relatively cool oil, may comprise raw oil or one or more higher boiling fractions separated in such fractionating system or a mixture of raw oil and one or more such higher boiling fractions. The reduction in the pressure on the oil between the heater 7 and the evaporator 9 in this system illustrates the reduction of pressure involving the difficulties to which reference has been made. In the apparatus of this invention the connections between the heater and the evaporator provide for continuously smooth and undisturbed flow of the heater discharge up to the point of pressure reduction or expansion which point is located within the evaporator and for the introduction of relatively cool oil immediately at this point.

The heater discharge is conducted into the evaporator, in the apparatus illustrated, through the tubular member 12. The inner end of this tubular member forms a valve seat 13. A valve plug 14 is positioned with respect to this valve seat by an operating extension 15 extending across the evaporator 9 and through the wall of the evaporator opposite the aperture 16. The valve plug 14 itself is the first and only obstruction the heater discharge meets until expansion to the pressure prevailing in the evaporator has been completed. The tubular member 12 and the flange 17 are integral. The tubular member 12 slides through a corresponding bore in the flange fitting 29. The tubular member 12 comprising the valve seat 13 is secured in position by means of the flange 17 (see Fig. 1). Thus by unbolting this flange the tubular member 12 can be removed from the outside of the evaporator. The operating extension 15 carrying the valve plug 14 slides through a plurality of supporting blocks 19, 20 and 21 carried by a frame 22 (see Figs. 1 and 2) arranged within the evaporator 9. Rotation of the operating extension 15 may be prevented by a key 23 as illustrated. The operating extension 15 extends through the aperture 24, opposite the aperture 16, and through a stuffing box 25 to an appropriate mechanism, corresponding for example to the mechanism for operating a geared gate valve, operated by the hand wheel 26 for accurately positioning and fixing the position of the valve plug 14 with respect to the valve seat 13. The flange fitting 29 comprises an annular passage 31 communicating with a connection 35 through which relatively cool oil is supplied opening into the region of expansion between the valve seat 13 and the valve plug 14 through an annular orifice 33. A series of annularly arranged orifices may be substituted for the single annular orifice 33 although the single annular orifice appears to be more advantageous.

Referring particularly to Figs. 1 and 3, it will be apparent that, in the apparatus of this invention, any solid or semi-solid carbonaceous aggregates formed or separated as a result of the expansion of the hot oil products discharged from the heater as they pass between the valve seat and the valve plug are afforded no opportunity to deposit in the region adjacent cooperating parts of the valve but on the contrary are flushed from this region by the introduced relatively cool oil and, of course, since the valve seat is in effect within the evaporator there is no opportunity for such aggregates to deposit in any connection between the valve and the evaporator. Any aggregate so formed may deposit in the lower end of the evaporator, but since adequate volume is easily provided at this point to accommodate such material this is at most of but minor consequence. The tubular member of which the valve seat is part is easily removed for inspection, repair or replacement. Such removal involves but a minimum disturbance of the apparatus and does not involve entrance into the evaporator. The several features of the apparatus cooperate to

make possible uniform operation over long periods of time.

I claim:

In combination in oil cracking apparatus comprising a heater in which oil is heated to a cracking temperature under superatmospheric pressure and an evaporator in which the hot oil products discharged from the heater are separated into a vaporized fraction and a residual fraction under a lower pressure, a tubular member opening into the evaporator through an aperture in the wall of the evaporator the inner end of which forms a valve seat, a valve plug positioned with respect to said valve seat by an operating extension extending across the evaporator and through the wall of the evaporator opposite said aperture, means for discharging relatively cool oil into the region between said valve seat and said valve plug, and means for conducting the heater discharge into the evaporator through said tubular member.

In testimony whereof I affix my signature.

THOMAS DE COLON TIFFT.