Aug. 8, 1933. B. N. BROIDO 1,921,602

PROCESS FOR HEATING OIL

Filed Oct. 23, 1926 2 Sheets-Sheet 1

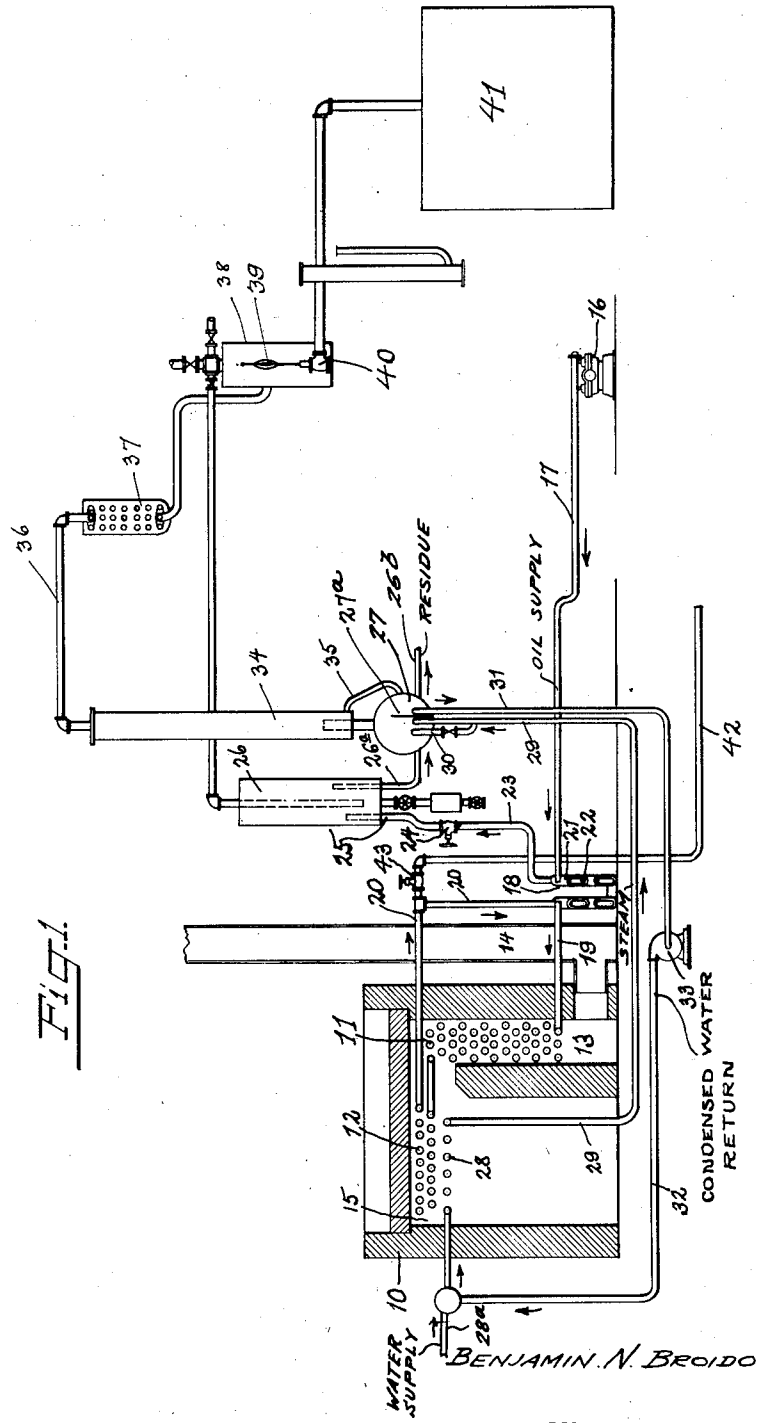

Fig. 1.

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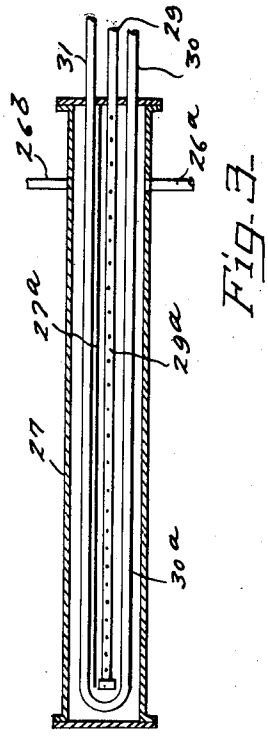

Fig. 3.

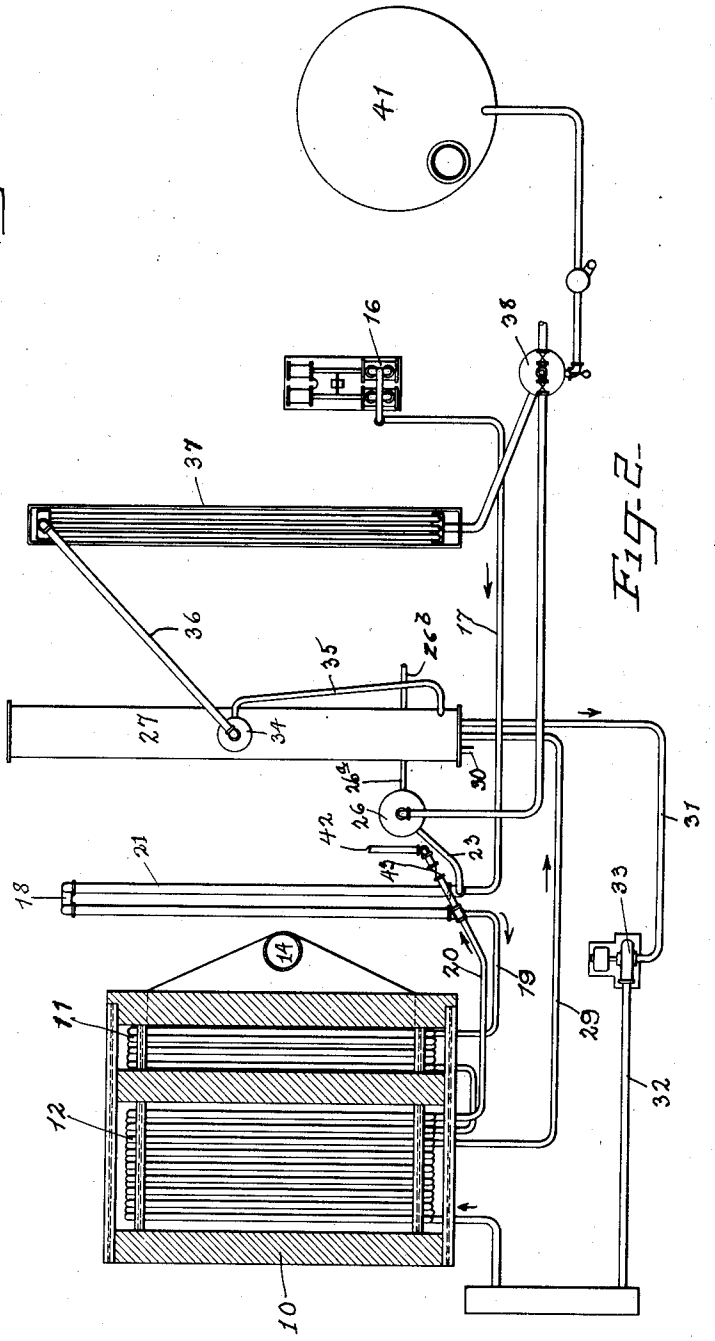

Fig. 2.

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UNITED STATES PATENT OFFICE

1,921,602

PROCESS FOR HEATING OIL

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Application October 23, 1926. Serial No. 143,715

2 Claims. (Cl. 196—116)

This invention relates to a continuous oil heating and cracking process.

The principal object of the invention is to provide process of this character of marked simplicity, high thermal efficiency of operation and by means of which a greater yield of the lighter hydrocarbons may be obtained from any given crude oil.

The invention depends in a great measure upon the following principles: In the operation of oil stills it has been found that the temperature of the furnace gases which sweep over the still tubes should not exceed 1500 or 1600 degrees, because if higher temperatures are permitted, such high temperatures cause the oil in the tubes to be converted to carbon, thus not only clogging the tubes, but in addition, reducing the yield of commercially valuable constituents obtained from the distillation process. As the temperature of the furnace gases ordinarily would reach a much higher degree than the figure above stated, it has heretofore been the practice, in order to prevent such higher figure from being reached, to operate the still with a very high percentage of excess air for the purpose of cooling the furnace gases. Such a procedure is wasteful and as a result the thermal efficiency of a still so operated is comparatively low. It has further been found that if steam is caused to bubble through a tank containing oil, hydrocarbons are evaporated and liberated at a temperature lower than their boiling point. The reason for this phenomenon is not entirely clear but it is believed that the light hydrocarbons evaporate at a pressure lower than normal because of the reduced partial pressure of the oil in the mixed body of oil and steam.

Briefly stated, the present invention contemplates heating the oil in a tube or pipe still to a cracking temperature and temporarily maintaining the oil so heated under sufficient pressure to prevent evaporation of the lighter hydrocarbons. The heated oil under such pressure is passed through a heat exchanger in counterflow relation with the cold incoming oil, thus serving to preheat the incoming oil and to cool the heated oil below a temperature at which the lighter fractions will vaporize. The cracked oil is then passed through a pressure reducing device and into a vaporizer wherein it is heated by steam supplied from any suitable source and preferably from a water screen or coil interposed between the first oil containing tubes of the tube or pipe still and the furnace, a considerable portion of the steam so supplied being permitted to bubble through the oil to heat the oil and to secure the liberation of the lighter hydrocarbons, as described above. Due to the reduction of the pressure in this vaporizer, and the reheating of the oil therein, the light hydrocarbons formed by the cracking process are evaporated, and the vapors therefore liberated. After being liberated in the vaporizer, the lighter hydrocarbons are passed through a fractionating tower and condenser and to a collecting tank in the usual manner.

By using a water screen or coil between the furnace and the oil tubes of the pipe still, I secure the important advantage of cooling the furnace gases before they reach the oil tubes, thereby not only protecting the oil tubes, but also preventing the formation or baking of excessive carbon in these tubes. In addition, the use of the water screen avoids the necessity for the introduction of excessive air into the still for cooling the furnace gases. Furthermore, by employing the water screen to generate steam, which is used later on in the process to heat the cracked oil in the vaporizer, a very high thermal efficiency of the entire apparatus and process, is secured.

I am aware that it is not broadly new to heat the oil in a pipe still to the cracking temperature and to maintain it under sufficient pressure in its passage through a heat exchanger, in which the temperature of the oil is reduced to a degree below which the lighter hydrocarbons will vaporize, and then to reduce the pressure to slightly above atmospheric and reheat the oil to liberate the lighter hydrocarbon formed at the cracking temperature, as disclosed, for example, in the patent to Richey et al. #1,530,091, granted March 17, 1925. In the Richey process, the reheating of the oil, after its pressure is reduced, is done by means of the hot oil which passes from the pipe still, and as a result, it is necessary to employ a plurality of vaporizers which are maintained at different temperatures to produce a fractional distillation, this being necessary in the process of the patent in order to avoid heating the lighter hydrocarbon to the same temperature as the heavier ones. In addition, in the process of the patent, the pipe still employed is the usual one in which it is necessary to introduce an excess of air to prevent the temperature of the furnace gases from exceeding a degree above which carbon would be formed in the oil in the pipe still tubes.

A suitable constructional example of an apparatus embodying the principles of the present invention is shown in the accompanying drawings, in which Fig. 1 is a somewhat diagrammatic side elevation of a complete installation, parts of which are shown in section. Fig. 2 is a plan view of the installation shown in Fig. 1 and also showing parts of the apparatus in section, and Fig. 3 is a longitudinal section of one portion of the apparatus.

As shown in the drawings, the numeral 10

indicates a furnace having therein two sets or banks of oil tubes 11 and 12, the tubes 11 being located in a second gas pass 13 forming a heating chamber communicating with the stack 14 and the tubes 12 being located in a first gas pass 15 situated above the furnace. The oil to be treated is pumped from any suitable source of supply by means of the pump 16 through the pipe 17 to a heat exchanger 18 from which it passes through the pipe 19 to the second bank of oil tubes 11 of the pipe still 10 and flows in series through these tubes and thence in series to the bank of tubes 12. The oil is heated in the pipe still to a temperature of about 900° F. and then passes through the pipe line 20 to the heat exchanger 18.

The temperature to which the oil is heated will vary with different oils, and the pressure ordinarily of the order of 600 lbs. per square inch will also vary, as whatever pressure necessary to keep the oil in liquid phase will be employed and this pressure will be determined by the character of the oil treated.

The heat exchanger 18 consists of the pipes 21 and 22, the latter being arranged concentrically within the pipes 21 and the two concentrically arranged pipes forming a tortuous coil through which the oil passes, the heated oil from the pipe still flowing counter to the cool oil supplied to the heat exchanger through the pipe 17. In its passage through the heat exchanger, the cracked oil from the pipe still is cooled to a temperature of about 300°, while the cool oil supplied through the pipe 17 is preheated to approximately the same temperature. During its passage through the tubes of the pipe still and the heat exchanger, the oil is maintained above a pressure sufficient to keep it in a liquid condition and prevent liberation of the lighter hydrocarbons. The cracked oil leaves the heat exchanger by the pipe 23 and passes through a pressure reducing valve 24. In its passage through the pressure reducing valve, the pressure of the cracked oil is reduced to slightly above atmospheric, the oil then passing, by means of the pipe 25, to a settling tank 26, in which any carbon, which may have been formed in the oil in the pipe still and is carried over in suspension, is deposited. The low pressure oil is then carried by the pipe 26a to a vaporizer 27 in which the cracked lighter hydrocarbons are vaporized. The vaporizer 27 is provided with a suitable baffle 27a which forces the oil entering the vaporizer to follow a tortuous path to the discharge pipe 26b which carries off the residuum to any suitable point of storage or disposal.

Interposed between the furnace of the pipe still 10 and the bank of tubes 12 is a row of water tubes 28, over which the furnace gases sweep before reaching the oil tubes 12 and 11, thus cooling the furnace gases to the desired temperature. Steam generated in the water tubes 28 is led by the pipe 29 to the vaporizer 27, a considerable portion of the steam being permitted to bubble up through the oil within the vaporizer from the perforated pipe 29a and another portion of such steam being circulated through a closed coil 30a to heat the oil in the vaporizer to the desired temperature. The closed coil is supplied through a pipe 30 which branches from the pipe 29. Condensate from the closed coil is circulated back to the water tubes 28, by means of the pipes 31, 32, and a pump 33. Water to replace that discharged in the form of steam through the pipe 29a is supplied to the system including the water tubes 28 through the supply line 28a from any desired source (not shown) under whatever pressure may be necessary to overcome the pressure existing in the water circulating and steam generating system. This pressure obviously may vary in different cases.

Located above the vaporizer 27 is a bubble or fractionating tower 34 having a return pipe 35 connected with the vaporizer 27.

The hydrocarbons which pass through the tower 34 are led through the pipe 36 to a condenser 37 of the usual construction, from which the product passes through the usual chamber 38, provided with a float control 39 and outlet valve 40, and thence to a storage tank 41.

A drain pipe 42, provided with a shutoff valve 43, is provided for permitting the system to be drained when desired.

The method of operation and the process performed by the apparatus will be readily understood from the above description, as the functioning of the apparatus has been set forth in connection with the description of the various parts of the apparatus. It will be seen that the process and apparatus are very simple, that the provision of the water tubes ahead of the oil tubes, in which water tubes steam is generated, which steam is used for reheating the oil by causing the steam to bubble through the oil, results in securing a process and apparatus of high thermal efficiency and a low operating and installation cost.

While I have shown and described an apparatus in which the steam generated in the water tubes is employed for the reheating of the oil in the vaporizer it will be apparent that the principles of the invention are not limited to the specific apparatus and arrangement shown, the vaporizer shown being merely an illustrative example of a heating device which could obviously be employed for any purpose or process work.

I claim:

1. The method of conserving heat in an oil cracking furnace which comprises burning fuel in the furnace with small excess of air, passing heat-absorbing fluid through passages within the furnace for cooling the gases before they reach the oil to be cracked, the heat absorbing fluid being different and separate from the oil to be cracked, and allowing the gases to pass, after passing said first mentioned passages, around passages through which the oil to be cracked is passing.

2. The method of conserving heat in an oil cracking furnace which comprises burning fuel in the furnace with small excess of air, passing liquid water fluid through passages within the furnace for cooling the gases before they reach the oil to be cracked, the liquid water fluid being maintained separate from the oil to be cracked, and allowing the gases to pass, after passing said first mentioned passages around passages through which the oil to be cracked is passing.

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