

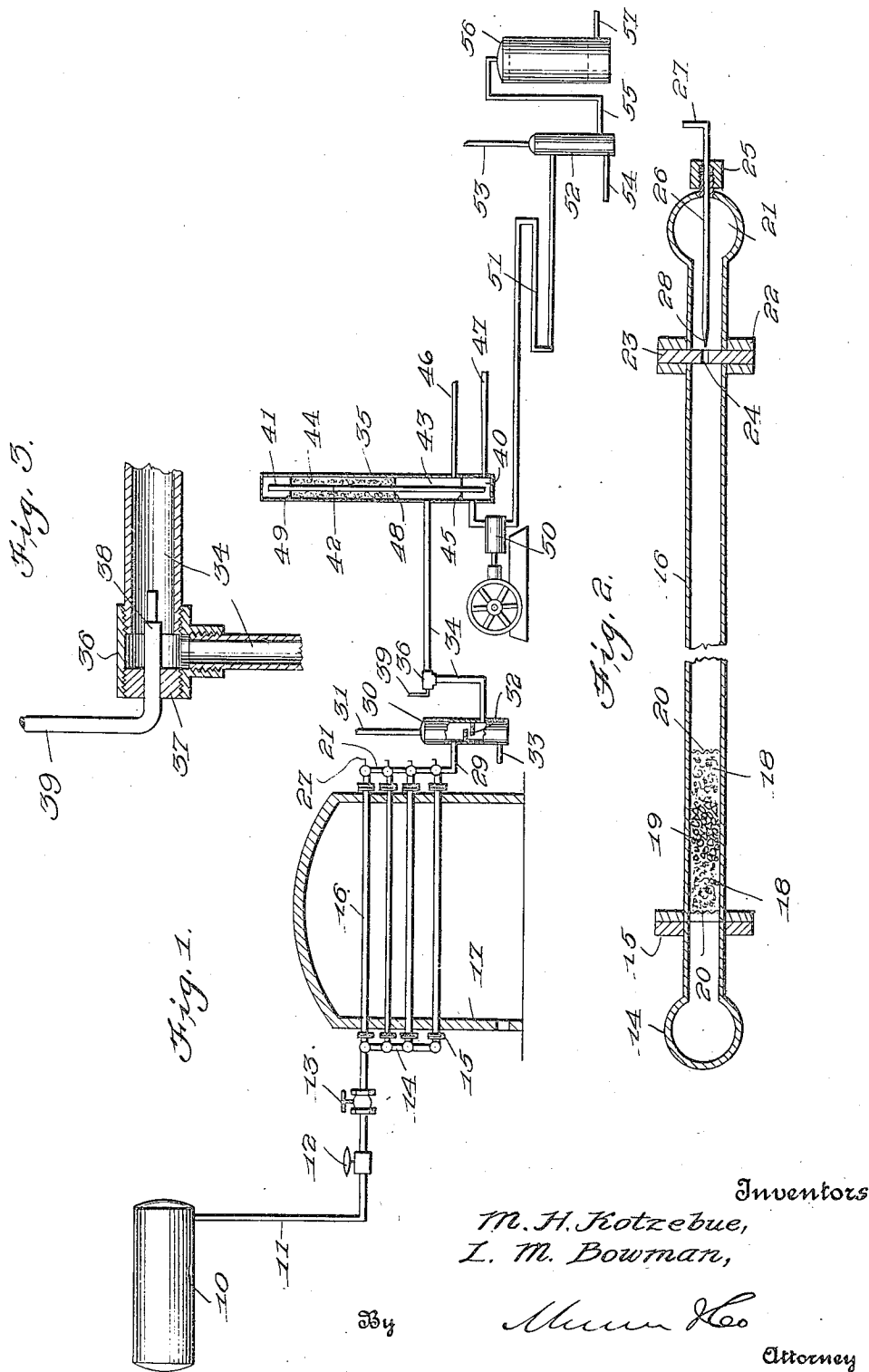
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APPARATUS FOR CRACKING HYDROCARBONS AND RECOVERING GASOLINE

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APPARATUS FOR CRACKING HYDROCARBONS AND RECOVERING GASOLINE.

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To all whom it may concern:

Be it known that we, MEINHARD H. KOTZEBUE and LEVI M. BOWMAN, citizens of the United States, and residents of Tulsa, in the county of Tulsa and State of Oklahoma, have invented certain new and useful Improvements in Apparatus for Cracking Hydrocarbons and Recovering Gasoline, of which the following is a specification.

Our present invention relates generally to the manufacture of a motor fuel adapted for use in internal combustion engines and is more particularly an improved method of and apparatus for cracking petroleum hydrocarbons and recovering gasoline from gases.

One of the objects of the invention is to provide an improved method and apparatus permitting of cracking high boiling petroleum distillates and other hydrocarbon oils and their distillates and the derivatives in order to produce the large yield of light hydrocarbon liquids suitable for use in internal combustion engines and a further object is the provision of an apparatus which will be safe, efficient, and free from the trouble of accumulation of carbon and the losses experienced in apparatus of this character now in use.

Another object is the provision of a method and apparatus permitting of the blending cracked hydrocarbon vapors with gas containing pentane, and other forms of "wild" gasoline vapors, as well as the compressing and cooling of the cracked vapors and gases together in such way that a light gasoline substitute will be produced of a nature superior to blended products now obtained, without the losses usually experienced in its manufacture.

Other objects and advantages will be obvious from the specification and from the fact that we propose to take heavy hydrocarbon oil or heavy petroleum distillate and conduct it to highly heated cracking tubes having means by which the fluids are vaporized before they reach the cracking chamber of the tube or tubes and are subsequently cracked by virtue of being under the proper pressure and heated to the proper temperature in the cracking chambers of the tubes. The vapors are then released from the cracking tubes through orifices whose size determines the pressure and rate of operation. The cracked vapors are then collected and from this point may be handled according

to the practice now in use although our invention contemplates the conduction of the cracked vapors to a chamber where they are mixed with cold casinghead gases. The sudden cooling thus brought about in the mixing chamber will cause the heavier hydrocarbons, mostly of the paraffin series, to condense and the gasoline vapors in the gas to blend with the remaining cracked vapors which are conducted in their blended state to a knockout tower or dephlegmator. In the course of the passage of the blended vapors to this tower, steam is injected into the same for the purpose of washing the vapors so that the final product will have a good odor and color, as well as for the purpose of raising pressure and thus assisting in condensing or knocking out the heavier hydrocarbons in the tower. The remaining vapors are compressed and cooled, the dry gas separated, and the liquid accumulated filtered and conducted to storage.

In the accompanying drawing in which we have illustrated the best form of apparatus so far devised for the purpose of carrying out our improved method, and which forms a part of this specification,

Figure 1 is a diagram of the apparatus complete, certain parts being broken away and in section for better identification and understanding,

Figure 2 is an enlarged horizontal section through the apparatus along the axial line of one of the cracking tubes, and

Figure 3 is an enlarged detail section through another portion of the apparatus adjacent to the point of injection of the steam.

Referring now to these figures we have shown an elevated storage tank 10 which feeds through a line 11, although any suitable pump may be substituted for the elevated tank. In the line 11 is a pressure regulator 12, and beyond the pressure regulator is a cut off valve 13. With the valve 13 open and the pressure regulator properly set, the desired feed of heavy hydrocarbon or heavy petroleum distillate takes place into a header 14 with which the feed line 11 connects, this header being connected by a series of flanged unions as at 15, with the receiving ends of a series of cracking tubes 16 within a furnace or other heater.

In each of the cracking tubes 16, one of which is shown in detail in Figure 2 we form an equalization point between the liquid

hydrocarbons and the vapors thereof, located at one side of the furnace or other heater 17, by means of wads of steel wool 18 at opposite sides of a section thereof filled with gravel 19 and in turn confined between reticulate disks or partitions 20. The liquid hydrocarbon is vaporized at this equalization point and the vapors alone pass through that portion of the bore or chamber of each cracking tube extending within the heating chamber.

At their discharge ends, the several cracking tubes 16 connect with a discharge header 21 at the opposite side of the furnace or heater 17 with respect to the feed header 14, the connection being completed by flanged unions 22 between which a discharge plate 23 is secured having a discharge orifice 24 axially of the discharge end of the cracking tube.

Extending inwardly through stuffing boxes 25 at vertically spaced points of the discharge header 21 in axial alinement with the several discharge orifices 24, are lengthwise shiftable cleaning rods 26, preferably having outer angular ends 27 forming handles and inner pointed ends 28 which may be shifted inwardly through the orifices 24 for cleaning the latter.

From the header 21 the cracked vapors are in further accordance with our invention led through a pipe 29 to a mixing chamber 30, although they may from this point be handled in a manner similar to that usually employed in handling cracked vapors in the ordinary gasoline forming processes.

According to our invention the mixing chamber 30 has a gas feed line 31 connected therewith by means of which casing head and like gases containing gasoline may be fed to the mixing chamber. Intermixing of the cracked vapors and the cold gas is assured by the provision of baffles 32 in the chamber and by virtue of this fact the heavier hydrocarbons, mostly of the paraffin series, are condensed and drained from the lower portion of the mixing chamber through a drain pipe 33.

The remaining lighter and intimately mixed hydrocarbons are discharged from the mixing chamber through a pipe 34, to a knockout tower or dephlegmator 35, pipe 34 being preferably in sections disposed at an angle with respect to one another as seen particularly in Figure 3, and connected by a T-coupling 36, one leg of which is closed by a plug 37 carried by the inwardly projecting nozzle 38 of a steam feed pipe 39. Steam is thus introduced whereby its force increases the pressure in the knockout tower 35, the further function of the steam being the thorough cleaning of the blended vapors to insure good odor and color.

The knockout tower 35 has lower and upper chambers 40 and 41 connected by a pipe

42 forming a means of communication there-through and extending axially of the tower from its intermediate vertically spaced chambers 43 and 44, with the former of which the pipe 34 communicates. Chamber 43 is separated from the lower chamber 40 by an imperforate partition 45, immediately above which a drain pipe 46 leads away from the top. The drain pipe 47 also leads from the lower portion of the lower chamber 40. The intermediate chambers 43 and 44 are separated by a horizontal perforate or reticulate partition 48 and chamber 44 is likewise separated from the upper chamber 41 by a perforate or reticulate partition 49 so that the blended vapors taken into chamber 43 pass upwardly through the chambers 43 and 44, the latter of which is filled with steel shavings, broken tiling or some similar material. The vapors, minus such condensation as is drained off through pipe 46, pass upwardly into the upper chamber 41 and from this chamber downwardly to the lower chamber 40, it being observed that little loss of heat need be experienced in this air passage in view of the fact of location of communicating pipe 42 axially of and within the tower 35.

The blended vapors and gas pass from the lower chamber 40, minus condensation withdrawn from the drain pipe 47, to a compressor 50 of any suitable type capable of handling wet vapors and gas, and the compressed vapors and gas are forced through cooling coils 51 to an accumulator tank 52 where the gas separates from the liquid and passes outwardly through a gas discharge pipe 53 leading from the upper end of the accumulator. The condensed steam is withdrawn through a pipe 54 at the lower portion of the accumulator and the liquid hydrocarbon is carried by a pipe 55 to a filter 56 having any suitable filtering means therein. The filtered hydrocarbon finally passes from the filter 56 through a pipe 57 to any suitable point of storage.

This apparatus while adapted to the carrying out of our improved method in an effective efficient manner may be varied to a considerable extent and it is to be understood that any suitable apparatus is contemplated by our invention. As the apparatus is described, we utilize the same in the carrying out of our improved method by supplying heavy hydrocarbon products such as are obtained from the treatment of crude petroleum, especially such inexpensive hydrocarbons that have a boiling point higher than 350° F., to the receiving header 14 under pressure. This pressure may range from 5 to 150 pounds per square inch, depending on the product utilized and the result desired. The header 14 distributes the liquid hydrocarbon to the equalization or vaporizing points of the several cracking tubes as

previously described, where the liquid hydrocarbon is vaporized, the pressures in the several tubes holding back the liquids to such an extent that only the vapors pass through the cracking chambers of the tubes. For this purpose the discharge orifices 24 of the cracking tubes find an important function and to insure any congestion of these orifices, the cleaning rods 26 should be thrust inwardly through the orifices at least once in every twenty-four hours of continuous operation. In view of the fact that the vapors only are exposed to the high cracking temperatures, only a very small amount of carbon is formed and this is in the nature of a dust which passes out freely with the vapors through the discharge orifices. The vapors are collected in the discharge header 21 and have at this point a temperature ranging from 550 to 900° F.

The intensely heated vapors meet the cold gas in the mixing chamber 30, and the sudden cooling of the vapors causes the heavier hydrocarbons, mostly of the paraffin series, to condense, these being drawn off from time to time through the drain pipe 33. The vapors and gases pass from the mixing chamber and after the injection of steam for the purpose of cleaning and increasing the pressure, these gases and vapors enter the knockout tower 35 and pass outwardly through the steel shavings or other material 44. This tower is air cooled and the shavings of similar material absorb the heat from the vapors and cause the high boiling hydrocarbons to condense, these being drawn off through the drain pipe 46. The light vapors accumulate in the upper chamber 41 and pass downwardly to the lower chamber 40, but little loss of temperature being occasioned by this transfer due to the construction of the parts including the particular arrangement of the pipe 42 as previously described. Any condensation during this

transfer and also any condensation in the lower chamber 40, may be withdrawn through the drain pipe 47, and the products from this drain pipe as well as the drain pipe 46 can of course be rerun or, to some extent at least blended with the final product.

The compressor 50 receives the vapors and gases from the lower chamber 40 of the tower and forces the same at an increased pressure through the cooling coils 51. The pressure in the lower chamber 40 usually varies from atmospheric to 50 pounds and the temperature from 100 to 300° F., depending upon the gravity and boiling point desired in the final product. With American kerosene and wet casinghead gas to produce a product having a gravity of 60 to 75° Bé., we maintain a pressure of about 10 pounds and a temperature of 250° F. in the chamber 40 and operate the compressor 50 so as to maintain a pressure of 200 to 250 pounds in the cooling coils 28.

In the accumulator tank 52, the residue gas passes out through the upper pipe 53, the condensed steam is withdrawn through drain pipe 54, and the light hydrocarbons pass out through filter 56 and from there to storage.

We claim:

In an apparatus of the character described, a heater, a cracking tube extending through the heater, spaced sections of steel wool within said tube adjacent to its intake end and at one side of the heater, gravel between said sections of steel wool, reticulate disks within the tube to confine said steel wool and gravel in place, said tube having an apertured outlet plate therein adjacent to its outlet end and having an otherwise unobstructed internal passage within and across the heater.

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