To all whom it may concern:

Be it known that I, John W. Coast, Jr., a citizen of the United States of America, a resident of Tulsa, in the county of Tulsa, State of Oklahoma, have invented certain new and useful improvements in Apparatus for Treating Hydrocarbons, of which the following is a full, clear, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to improvements in apparatus for treating hydrocarbons, and more particularly to means for condensing the high boiling point hydrocarbons passing from a still. The main object of the invention is to provide a simple means whereby air can be very effectively utilized as a cooling medium for the vapor.

In the preferred form of the invention, air is conducted through a collection of tubes in an air cooled condenser, so as to heat the air and create an induced draft in the tubes. The vapor is admitted to the condenser at a point near the hot discharge ends of the air tubes, and then deflected back and forth across the outer faces of the tubes, the low boiling point hydrocarbons being discharged, preferably in the form of vapor, from the relatively cool portion of the condenser.

Figure I is a diagrammatical view of a cracking apparatus embodying the features of my invention.

Fig. II is an enlarged longitudinal section of the air cooled condenser.

Fig. III is an end view of the condenser.

To illustrate the invention, I have shown a cracking still 1 arranged above a heating chamber 2 and provided with a vapor pipe 3 leading to an air cooled condenser A, wherein the high boiling point fractions are condensed. 4 designates a vapor pipe leading to a water cooled condensing coil 5, from which the low boiling point product is recovered.

The apparatus I have shown is particularly adapted for use in cracking high boiling point products of distillation, such, for example, as distillates or residues resulting from the distillation of crude petroleum. The substances to be treated are introduced into the still in any suitable manner, and any desired pressure can be obtained by regulating a valve 6 in the vapor pipe 4. The pressure in the still 1 and condenser A is preferably greater than 50 pounds per square inch, and the temperature of the contents of the still preferably ranges from about 600° F. to 800° F. The low boiling point fractions passing from the still flow through the vapor pipe 3, condenser A, vapor pipe 4 and then into the main condenser 5. The relatively high boiling point fractions are condensed in the condenser A, such fractions being either recovered as separate products, or returned to the still for further treatment, as will be presently described.

The condenser A comprises a large air-cooled drum provided with a series of baffles 7, 8, 9, 10, 11 and 12, whereby it is divided into a series of condensing chambers. The baffles 8, 10 and 12 extend from the top to points near the bottom of the 75 drum, and the baffles 9 and 11 extend from the bottom to points near the top of the drum. A primary condensing chamber 13 is formed between the baffle 9 and one end of the large drum; an intermediate condensing chamber 14 is formed between the baffles 9 and 11, a final condensing chamber 15 being formed between said baffle 11 and an end wall of the drum.

16 designates horizontal air conducting tubes extending from one end of the drum to the other and passing through the different baffles. A hot air flue 17, extending upwardly from one end of the condensing drum, is arranged to receive the heated air passing from the discharge ends of the tubes 16. The draft may be regulated by adjusting a damper 18 in the hot air flue 17. At atmospheric temperature, enters the tubes 16 as indicated by unfeathered arrows at the right hand end of Fig. II, and this air is heated as it flows through the horizontal tubes, the hot air being discharged into the flue 17 where it rises so as to create an induced draft in the horizontal tubes.

My object is to circulate the vapor back and forth across the outer faces of the horizontal air conducting tubes and at the same time conduct the vapor from the hottest portion of the condenser to the relatively cool end thereof where the fresh air is admitted to the horizontal tubes. The vapor passing from the pipe 3 enters the primary condensing chamber 13 near the hot discharge ends of the horizontal tubes 16, and flows...
in the directions indicated by the feathered arrows in Fig. II. In the primary condensing chamber 13, the vapor flows upwardly and over the upper edge of the baffle 7, downwardly between the baffles 7 and 8, and then upwardly between the baffles 8 and 9. The vapor then escapes from the primary condensing chamber by passing over the upper edge of the baffle 9, flowing downwardly between the baffles 9 and 10, and then upwardly between the baffles 10 and 11. The vapor passing over the upper edge of the baffle 11 flows downwardly between the baffles 11 and 12 and then upwardly to the vapor pipe 2 leading to the main condenser.

The horizontal air tubes are preferably staggered, as shown in Fig. III, and they serve as baffles for the vapor which must flow back and forth across these tubes in passing through the condensing drum. The vapor is thus brought into contact with the air tubes a number of times and thoroughly subjected to the cooling action of the air currents. The vapor circulates back and forth in the drum, but its general direction of movement is opposite to the direction of the air currents in the tubes 16. In other words, the vapor enters the drum near the discharge ends of the air tubes and passes from the drum near the intake ends of the air tubes. As a consequence, the vapor is first subjected to the cooling action of the preheated air near the discharge ends of the tubes, and finally to the relatively cool portion of the condenser near the intake ends of said tubes. The last mentioned portion of the condenser is never subjected to the maximum vapor temperature, and it is constantly cooled by the incoming air currents at the intake ends of the tubes.

Several desirable results are obtained by condensing the high boiling point fractions in this manner. A very effective induced draft is created in the horizontal tubes by the rising current of hot air in the flue 17. By deflecting the vapor back and forth across the outer faces of the staggered horizontal tubes, all of the vapor is repeatedly brought into intimate contact with the tubes and such contact is maintained for a considerable period of time. It is also an advantage to maintain the discharge end of the condenser in a relatively cool condition, as previously pointed out. The different condensing chambers are maintained at different temperatures, and the high boiling point fractions are condensed, either in the primary or intermediate condensing chambers 13 and 14 or in the relatively cool final condensing chamber 15, near the intake ends of the air cooled tubes. These high boiling point fractions cannot escape to the vapor pipe leading from the relatively cool condensing chamber 15.

The staggered tubes 16 are preferably arranged close to each other as shown in Fig. III, and since the cylindrical wall of the drum is constantly subjected to the cooling action of the surrounding atmosphere, relatively wide vapor spaces may be formed between the collection of tubes and the sides of the drum. The condensate formed on the tubes in the upper portion of the drum, will drop from one tube to another, and fall onto the bottom of the drum. The baffles 9 and 11 prevent this condensate from flowing from one condensing chamber to another.

The different fractions condensed in the air cooled chambers 13, 14 and 15 will have a close range of boiling points, i.e., the gravity of the condensate in one condensing chamber will not be greatly different from the gravity of the condensate in the next adjacent condensing chamber. For example, condensate having a gravity of 34° B. may be recovered from the primary condensing chamber 13, while the condensate flowing from the condensing chambers 14 and 15 will be 40° B. and 50° B. respectively.

A discharge pipe 13', leading from the bottom of the primary condensing chamber 13, is connected to pipes 20, 21 and 22. 14' designates a discharge pipe leading from the intermediate condensing chamber 14 and connected to the pipes 20, 21 and 22. The discharge pipe 15' leading from the final condensing chamber 15 is also connected to the pipes 20, 21 and 22. Valves 23, 24 and 25 may be regulated to control the flow of condensate from the pipes 13', 14' and 15' to the pipes 20, 21 and 22. The pipe 20 leads to the still and the high boiling point condensate may be returned through this pipe for further treatment. The pipes 21 and 22 lead to water cooled coils 26 and 27. The condensate may be discharged through these cooling coils and recovered as a separate product or products. A study of Fig. I will show that the valves 23, 24 and 25 and the pipes associated therewith are so arranged that any of the fractions condensed in the condenser A can be either returned to the still, or discharged through one of the water cooled coils and recovered as a separate product. When the apparatus is in service, some of the valves are closed and the open valves are regulated to maintain the desired high pressure in the condenser A and still 1.

I claim:

1. An air cooled fractional condenser comprising a drum provided with baffles extending from the top to points near the bottom of the drum, baffles extending from the bottom to the high boiling point fractions leading from the relatively cool condensing chamber 15.
the respective condensing chambers, a collection of approximately horizontal air conducting tubes passing through said baffles and extending from one end of the drum to the other to serve as baffles for the vapor in all of said condensing chambers, the condensing chamber near the discharge ends of said air conducting tubes having a vapor inlet for the admission of vapor to the drum, the condensing chamber near the inlet ends of said air conducting tubes having a vapor outlet for the discharge of vapor from the drum, said parts being so arranged that vapor passing through said vapor inlet will flow back and forth across the outer faces of the air conducting tubes and at the same time flow from one end of the drum to the other in a general direction opposite to the direction of the air currents in said tubes, and a hot air flue arranged to receive the heated air passing from said tubes, said hot air flue being extended upwardly so that the hot air rising therein will create an induced draft in said air conducting tubes.

2. An air-cooled condenser comprising a drum provided with baffles extending from the top to points near the bottom of the drum, baffles extending from the bottom to points near the top of the drum so as to divide the drum into a series of successive fractional condensing chambers, individual condensate conductors extending downwardly from the bottom of said drum and communicating with the respective condensing chambers, so as to separately deliver the different fractions from said drum, a collection of approximately horizontal staggered air conducting tubes passing through said baffles and extending from one end of the drum to the other to serve as staggered baffles for the vapor in all of said condensing chambers, said tubes being close to each other and relatively wide vapor spaces being formed between the collection of tubes and the sides of the drum, the condensing chamber near the discharge ends of said air conducting tubes having a vapor inlet for the admission of vapor to the drum, the condensing chamber near the inlet ends of said air conducting tubes having a vapor outlet for the discharge of vapor from the drum, said parts being so arranged that vapor passing through said vapor inlet will flow back and forth across the outer faces of the air conducting tubes and at the same time flow from one end of the drum to the other in a general direction opposite to the direction of the air currents in said tubes, a hot air flue arranged to receive the heated air passing from the discharge ends of said tubes, said hot air flue being extended upwardly from an end of the drum so that the hot air rising in the flue will create an induced draft in the approximately horizontal air conducting tubes, and a damper for regulating the draft in said hot air flue.

In testimony that I claim the foregoing I hereunto affix my signature.

JOHN W. COAST, Jr.