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PRODUCTION OF HYDROCARBONS

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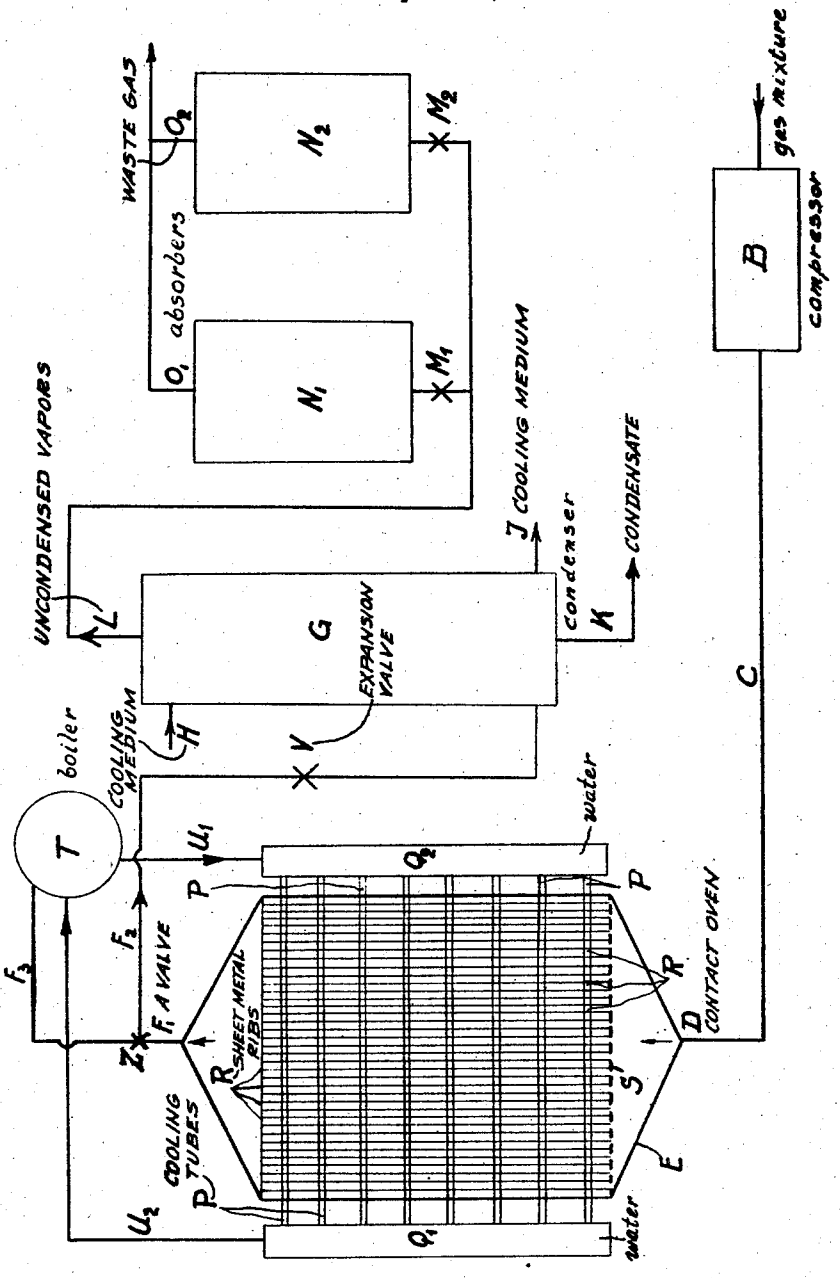

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PRODUCTION OF HYDROCARBONS

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3 Claims. (Cl. 260—449)

My invention relates to the production of hydrocarbons by catalytic reaction of carbon monoxide with hydrogen. It has particular reference to means whereby this reaction can be carried through in a particularly economical manner.

It is well known to those skilled in the art that the hydrogenation of carbon monoxide for the production of hydrocarbons requires operation within a narrow range of temperatures and that therefore care must be taken to absorb the heat energy liberated in this exothermic reaction. It has therefore been suggested to carry through the reaction in apparatus comprising a system of cooling tubes, on which are mounted heat abducting sheet metal ribs spaced some millimeters from each other, the tubes being traversed for instance by hot water under a pressure sufficiently above normal to prevent boiling. The process based on the hydrogenation of carbon monoxide is disclosed in a general way in U. S. patent to Fischer and Tropsch No. 1,746,464.

If, in this process, the pressure in the reaction zone differs from the pressure in the cooling tubes, tubes of pressure-resistive material, for instance a steel alloy containing chrome or nickel must be used, which commands a high price.

I have now found that the process can be carried through in a more economical manner in apparatus fitted with cooling tubes of some low priced material such as iron, if the reaction is carried through under a pressure, which approximately corresponds to the vapor pressure of the cooling medium (water) at the reaction temperature. This simple expedient enables me to dispense with pressure-resistive cooling tubes and to thus greatly reduce the first costs of the apparatus.

When using water as cooling medium, I carry through the reaction under the pressure acting on the water at the temperature at which the reaction occurs. If this temperature is for instance 160° C. the reaction is carried through under a pressure, in the reaction zone, of about 6 atmospheres, since under this pressure water boils at 160° C. At a temperature, in the reaction zone, of 220° C. the pressure in this zone should be 23 atmospheres, since under this pressure water boils at 220° C.

Pressures ranging between about 2 and 50 atmospheres may be maintained in the reaction zone.

For safety's sake an equalization of pressure should be provided for between the space traversed by the cooling medium and the reaction space, for instance by establishing a communication between the two vapor spaces.

In carrying through this process I may for instance proceed as follows: The gas mixture containing carbon monoxide and hydrogen, for instance in the proportion of $1CO:2H_2$, is conducted through a contact chamber traversed by rows of cooling tubes, on which are arranged sheet metal plates which serve to lead away the heat and which are spaced about 10 mms. from each other, the interstices between the cooling tubes and the sheet metal plates being filled with the contact mass inducing the catalytic reaction. In the cooling tubes flows hot water placed under high pressure, for instance 11 atmospheres, and in that case having a temperature of about 186° C. The heat energy developed in the reaction is absorbed by the cooling medium to such an extent that the temperature in the reaction zone does not exceed about 187° C. The gas mixture, which has previously been carefully freed from sulfur compounds, is introduced from below into the contact chamber under a pressure of for instance 11 atmospheres, and after having passed through the chamber, is cooled down in order to condense the condensable reaction products such as water, benzines and oils. The gas is thereafter treated with activated carbon for the extraction of the low boiling benzines and hydrocarbons of the gasoline type.

When using for instance a cobalt catalyst activated with thorium, one cubic meter of the gas mixture yields about 120–130 grams benzines and oils.

The flow sheet annexed to this specification and forming part thereof illustrates the process in a diagrammatic manner by way of example. The gas mixture containing CO and H_2 first enters a compressor B, in which it is placed under the desired pressure, and then flows through pipe C to the inlet D of the contact chamber E, escaping from same at F_1 and flowing through pipe F_2 and an expansion valve V into the condenser G fitted with an inlet H and exhaust J for a cooling medium. The condensate is withdrawn at K, while the not condensed gases and vapors escape at the top through pipe L and, after passing the valves M_1 and M_2 enter the absorbers N_1 and N_2, respectively, which are arranged in parallel and are filled with activated carbon serving to extract the not-condensed hydrocarbons. The waste gas escapes from the absorbers at O_1 and O_2, respectively.

The contact chamber E is traversed by a system of horizontal cooling tubes P, on which are mounted ribs R formed of plain sheet metal plates, each plate being traversed by all the tubes. These plates are arranged in closely spaced relation.

The ends of the cooling tubes are connected to collector chambers Q_1, Q_2, filled with cooling medium, for instance water placed under pressure, which flows from the condenser T through pipe U_1 into the chamber Q_2 and, after having traversed the cooling tubes P, enters the chamber Q_1, returning to the condenser T through pipe U_2.

In order to provide for an equalization of pressure between the reaction zone and the vapor space of the boiler T, these two spaces are connected with each other by the pipes F_1 and F_3 with valve Z which prevents the gaseous products of reaction from passing in substantial quantities into condenser T.

The interstices between the cooling ribs or plates R and the cooling tubes P are filled with the body of catalyst, which rests on the perforated bottom S.

Various changes may be made in the details disclosed in the foregoing specification without departing from the invention or sacrificing the advantages thereof.

I claim:

1. In the process of producing hydrocarbons by reacting carbon monoxide with hydrogen in the presence of a hydrogenation catalyst, in which the temperature in the reaction zone is controlled by means of a boiling cooling medium conducted in tubes across the reaction zone, the step of carrying the reaction through under a pressure and at a temperature which approximately correspond to the pressure and the temperature under which the boiling cooling medium passes through the cooling tubes.

2. The process of claim 1, in which the boiling cooling medium is water placed under a pressure of about 11 atmospheres, and the gas mixture is passed through the reaction zone under a similar pressure and at a temperature of about 186° C.

3. The process of claim 1, in which the pressures in the reaction zone and the vapor zone of the cooling system are equalized by establishing communication between said zones.

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