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ART OF CRACKING HYDROCARBONS

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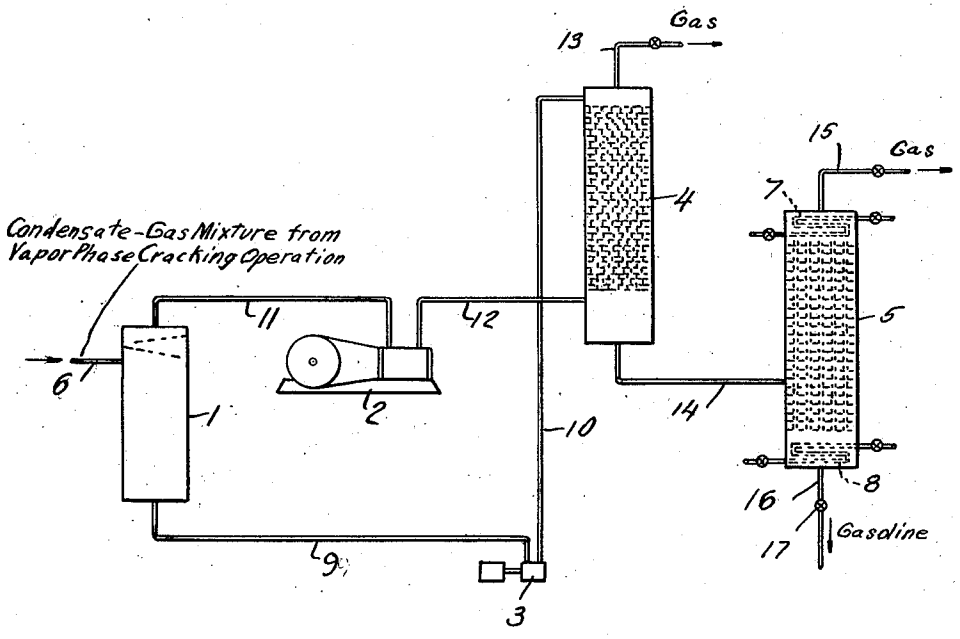

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UNITED STATES PATENT OFFICE

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ART OF CRACKING HYDROCARBONS

Application filed December 16, 1929. Serial No. 414,419.

This invention relates to improvements in the manufacture of gasoline by cracking operations producing a mixture including a gasoline condensate and a large volume of hydrocarbon gases and vapors; the invention relates, more particularly, to the separation and recovery of gasoline condensates from such mixtures.

The invention is of special value in conjunction with vapor phase cracking operations, such, for example, as are described in an application filed June 13th, 1927, Serial Number 198,621, by Harry L. Pelzer, but the invention is also useful in conjunction with other types of cracking operations producing a large volume of hydrocarbon gases and vapors together with the gasoline condensate from which the gasoline condensate must be separated.

In conventional pressure distillation cracking operations in which the oil undergoing pressure distillation is heated to a cracking temperature in the general range of 775–850° F., the gas-vapor mixture produced, incondensable at ordinary atmospheric temperatures and pressures, may approximate in volume, for example, 7–15 cubic feet per gallon of the gasoline condensate produced.

In vapor phase cracking operations, as currently practiced, the gas-vapor mixture produced may approximate in volume, by way of contrast, for example, 60–90 cubic feet per gallon of the gasoline condensate produced. The foregoing figures are not inclusive of all operations of either class, but they represent fairly the enormously increased production of gases and vapors incondensable at ordinary atmospheric temperatures and pressures usually encountered in vapor phase cracking operations as compared with pressure distillation cracking operations. This increased production of such gases and vapors involves a number of peculiar problems.

Conditions of temperature and pressure remaining the same, two units of volume of such a gas-vapor mixture require for saturation the presence of twice as much of any condensable vapor as one unit of volume. As a consequence, this increased production of gas and vapor incondensable at ordinary atmospheric temperatures and pressures tends to involve a correspondingly increased loss of gasoline constituents required to saturate the gas-vapor mixture. In conventional practice, separation of the gas-vapor mixture from the gasoline condensate in a receiver, or successive receivers, following a condenser, this loss corresponds approximately to the volume of the gas-vapor mixture produced.

Loss of condensable constituents of the gasoline condensate through the operation of this property of such gas-vapor mixtures is, of course, encountered in conventional pressure distillation cracking operations, for example, and a number of expedients have been adopted to avoid or minimize this loss. For example, following separation of the gasoline condensate and the gas-vapor mixture, the gas-vapor mixture has been subjected to scrubbing operations with various scrubbing media from which scrubbing media absorbed condensable constituents have been subsequently recovered. It will be apparent that this scheme involves a number of difficulties in application to operations in which the volume of the gas-vapor mixture is increased, for example, ten times.

It has also been proposed to compress together the gasoline condensate and the large volume of gases and vapors produced by severe cracking operations to absorb in the gasoline condensate itself condensable constituents entrained in the gases and vapors, but in practical operation, even though an improved equilibrium is obtained under the imposed pressure, much the same loss is encountered when the pressure on the gasoline condensate is subsequently reduced to normal.

This invention provides an improved method for separating the gasoline condensate from such condensate-gas-vapor mixtures with a high ultimate recovery of condensable constituents in the separated gasoline condensate, with a low inclusion of non-gasoline constituents in the separated gasoline condensate, and with a low loss of condensable gasoline constituents in the separated gas mixtures.

In carrying out the present invention, the

gasoline condensate is initially separated from the uncondensed vapors and gases under relatively low pressure, in the conventional receiver for example, the separated gases and vapors are then compressed and the compressed gases and vapors are subjected to a scrubbing operation with the initially separated gasoline condensate under relatively high pressure, the scrubbed gas mixture and the condensate mixture including absorbed constituents are separately taken off from the scrubbing operation, the condensate mixture from the scrubbing operation is subjected to a rectifying operation under relatively high pressure and a gas mixture and a rectified gasoline condensate are separately taken off from the rectifying operation, and the pressure on the rectified condensate is reduced to normal.

The mixture of uncondensed vapors and gases initially separated from the gasoline condensate includes a substantial proportion of gasoline constituents, and the initially separated gasoline condensate may similarly include a substantial proportion of constituents condensable at ordinary atmospheric temperature and pressure but dissolved or otherwise entrained in the separated condensate. Under the high pressure prevailing in the scrubbing operation, the gas mixture is stripped of condensable gasoline constituents. The resulting condensate mixture, however, includes a substantial proportion of constituents incondensable at ordinary atmospheric temperature and pressure. In the following rectifying operation, this condensate mixture is accurately fractionated to produce a final gasoline condensate including a maximum of condensable constituents yet free from any such proportion of constituents incondensable at ordinary atmospheric temperatures and pressures as would involve, under normal conditions, excessive evaporation losses from the condensate. A high ultimate recovery of a stable gasoline condensate is thus obtained.

The invention will be further described in connection with the accompanying drawings, which illustrate, diagrammatically and conventionally, one form of apparatus adapted for carrying out the process of the invention.

Referring to the drawings, the apparatus illustrated comprises a receiver 1, a compressor 2, a pump 3, a scrubbing tower 4 and a rectifying tower 5.

The receiver 1 is connected to the condenser of the apparatus in which the cracking operation is carried out, in which the gasoline vapors produced are condensed, through connection 6. For example, the receiver 1 may correspond to the receiver "93" connected to the condenser "84" in the apparatus illustrated in application Serial Number 198,621, mentioned above.

The scrubbing tower 4 may be of any conventional type provided with means for promoting intimate contact between down flowing liquid and up flowing vapors and gases. The rectifying tower 5 may be of any conventional type, for example, it may consist of an appropriate number of "bubble" sections. The rectifying tower 5 is shown as provided with a cooling coil 7 and a heating coil 8 for purposes of control.

In carrying out the invention in the apparatus illustrated, the condensate-gas-vapor mixture from the cracking operation is discharged into the receiver 1 through connection 6. An initial separation of condensate from uncondensed vapors and gases is effected in this receiver. The receiver may be operated, for example, with a pressure approximating 0–35 pounds per square inch. The condensate separated in the receiver 1 is pumped through connections 9 and 10 by means of pump 3 into the upper end of the scrubbing tower 4, and the gas mixture separated in receiver 1 is forced into the lower end of scrubbing tower 4 through connections 11 and 12 by means of compressor 2. The scrubbing tower 4 may be operated, for example, under a pressure approximating 200–300 pounds per square inch. The stripped gas mixture is discharged from the upper end of the scrubbing tower 4 through connection 13. The condensate mixture including constituents absorbed from the gas mixture in the scrubbing tower 4 is discharged through connection 14 to the rectifying tower 5. The rectifying tower 5 may be operated under a pressure approximating that prevailing in the scrubbing tower 4. A gas mixture substantially free from condensable gasoline constituents is discharged from the upper end of the rectifying tower 5 through connection 15. The rectified gasoline condensate is discharged from the lower end of the rectifying tower 5 through connection 16 and valve 17, the pressure on the rectified gasoline condensate being reduced to normal as it passes valve 17.

By operating the scrubbing tower 4 at a relatively higher pressure, a substantial proportion of very low boiling unsaturated hydrocarbons, such as butylene and propylene, may be delivered to the rectifying tower 5 with the condensate mixture from the scrubbing tower 4. These unsaturated hydrocarbons may then be recovered as constituents of the gas mixture separated in the rectifying tower 5 in concentration sufficient to permit their utilization in the manufacture of synthetic alcohols. A compounded alcohol product may be so produced from this gas mixture, by conventional methods, and incorporated in the gasoline condensate where it is intended for use as motor fuel.

Relatively lower pressure may be used in the scrubbing tower 4 if no recovery of such

very low boiling unsaturated hydrocarbons is desired.

I claim:

In the manufacture of gasoline by cracking operations producing a mixture including a gasoline condensate and a large volume of hydrocarbon gases and vapors, the improvement which comprises effecting an initial separation of the condensate and the gases and vapors under relatively low pressure, compressing the separated gases and vapors and subjecting the compressed gases and vapors to a scrubbing operation with the separated condensate under relatively high pressure, taking off a scrubbed gas mixture from the scrubbing operation, separately taking off a condensate mixture including absorbed constituents from the scrubbing operation and subjecting this condensate mixture to a rectifying operation under relatively high pressure, taking off a gas mixture from the rectifying operation, and taking off from the rectifying operation and reducing to normal the pressure on a rectified gasoline condensate.

In testimony whereof I affix my signature.

EUGENE C. HERTHEL.