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PROCESS AND APPARATUS FOR MAKING CALCIUM CARBIDE

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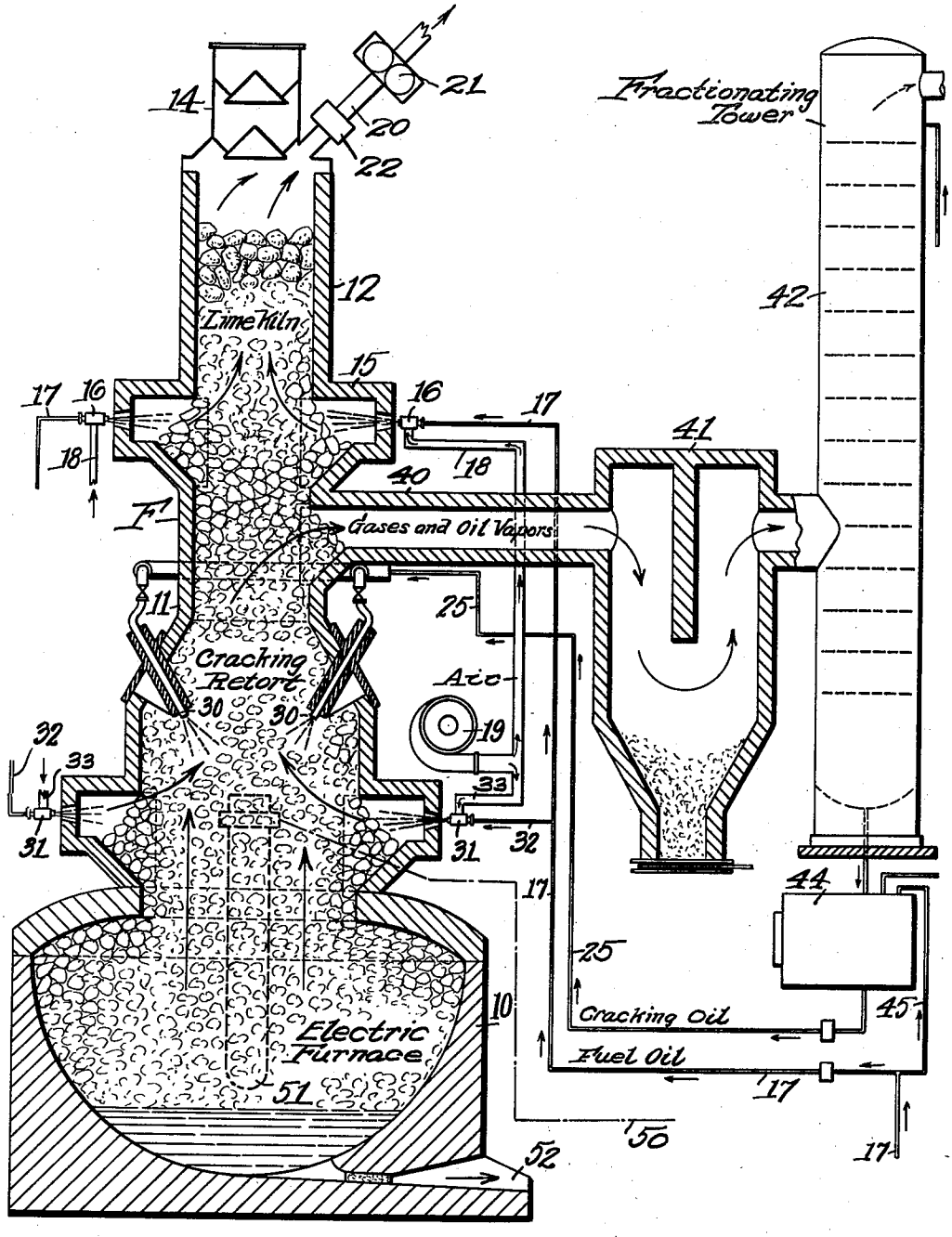

Inventor
Lewis W. Riggs.
By Attorney
Edwin T. Hawley

Witness
C. F. Wenn

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PROCESS AND APPARATUS FOR MAKING CALCIUM CARBIDE

Lewis W. Riggs, Watertown, Mass., assignor to Hydrocarbons Research Co., Boston, Mass., a corporation of Massachusetts

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11 Claims. (Cl. 23—208)

This invention relates to the production of calcium carbide by a continuous process direct from raw limestone and heavy hydrocarbon oil.

It is a general object of my invention to provide an improved process for the manufacture of calcium carbide, such that the entire operation may be carried out by the thermal energy of combustion, except as electricity is used in the carbide reaction in accordance with common practice.

A further object of the invention is to provide an improved and continuous process for manufacturing calcium carbide direct from limestone and hydrocarbon oil, with simultaneous production of substantial amounts of fuel gas, gasoline and heavier oils as by-products.

I also provide a process by which carbide is produced by the reaction of lime with carbon deposited on said lime in a preceding oil-cracking operation.

A further feature of the invention relates to the provision of improved apparatus especially adapted to the carrying out of my improved process.

My invention further relates to certain arrangements and combinations of parts and to certain ordered procedure which will be hereinafter described and more particularly pointed out in the appended claims.

The drawing is a sectional side elevation of a preferred form of apparatus well adapted to the purposes of my improved process.

Referring to the drawing, I have shown a vertically extended stack or furnace F, comprising a lower or carbide-producing portion 10, an intermediate portion or oil-cracking retort 11, and an upper portion or lime kiln 12.

Limestone in its natural state is fed to the upper end of the lime kiln 12 through any usual charging device 14, by which escape of gas during charging is substantially avoided.

Below the portion 12, I provide a heating section 15 provided with oil burners 16 which are supplied with oil through an oil feed pipe 17 and with air through an air feed pipe 18 connected to a fan 19. Heat from these oil burners 16 changes the limestone charged to the kiln into lime or calcium oxide. The combustion gases, together with carbon dioxide generated by decomposition of the limestone, are drawn off through a pipe 20 by an exhauster 21 and are discharged to a stack or otherwise disposed of.

A carbon-monoxide indicator 22 may be provided in the pipe 20, which indicator will show whether or not the apparatus is operating economically. If any substantial amount of carbon-monoxide is shown in the waste gases, a decrease in speed of the exhauster 21 is indicated.

The hot lime thus produced feeds downward automatically to the cracking retort 11, where heavy hydrocarbon oil, such as crude petroleum or fractions thereof, is introduced through a separate oil feed pipe 25 and nozzles 30. Heat for the cracking process is supplied in part by additional oil burners 31, receiving oil through branch pipes 32 connected to the oil feed pipe 17, and receiving air through branch pipes 33 connected to the air feed pipe 18.

The gases and oil vapors generated in the cracking process, mixed with products of combustion from the burners 31 and with gases resulting from the carbide-making reaction in the electric furnace, pass upward through the hot lime to a discharge pipe 40, leaving oil carbon largely in the form of soot or oil coke deposited on or mixed with the lime. The mixed gases are drawn off by a suitable exhauster to a dust-collector 41 and fractionating tower 42 or to other suitable separating and purifying apparatus where fuel gas and low boiling oils such as gasoline and kerosene are recovered separately from the heavy residual oil fractions which are returned to the cracking retort and yield large amounts of oil carbon when re-cracked.

The heavier oils may be collected in a receptacle 44, from which they are returned through the oil feed pipe 25 to the nozzles 30 in the cracking retort.

A branch connection 45 from the oil feed pipe 17 provides for the introduction of additional fresh oil to offset the gas and gasoline or light oils removed by cracking, thus maintaining the necessary oil supply for the cracking operation.

The hot lime, now well charged with soot or carbon deposited thereon or mixed therewith from the cracking operation, feeds downward automatically to the electric furnace portion 10 of the apparatus, where electricity is introduced through wires 50 and electrodes 51 of the usual type, and where liquid calcium carbide is produced at high temperature, which carbide may be drawn off through the usual drainage passage 52.

The oil used is preferably of such composition that it will yield a considerable percentage of carbon in the form of soot, which adheres to or remains in the mass of hot lime as the lime moves downward to the electric furnace. The amount of limestone charged and oil cracked will be relatively adjusted so that the resulting mix-

ture of lime and carbon will be in the correct proportion for effecting production of calcium carbide. Carbon in the form of deposited soot is particularly desirable for the carbide reaction, as it is substantially free from ash, and a high quality carbide is produced.

The electricity used in the carbide reaction may conveniently be produced by power generated from the residual gases remaining after the gasoline and heavier oils are separated therefrom.

Assuming that the process is well under way and that the apparatus is in continuous operation, a high temperature will be generated in the furnace portion 10. The very hot carbon monoxide from the carbide reaction will pass upward to the cracking retort 11, preheating the electric furnace charge and providing sensible heat for the cracking operation. A part of the hot carbon monoxide will react with any excess air supplied to the burners 31, so that the oil cracking operation will take place in a substantially non-oxidizing atmosphere.

The oil and air injected will be regulated as indicated by heat requirements. Under certain circumstances it may be desirable to shut off the oil at 31 and to allow the air to burn the carbon monoxide and a part of the oil introduced at 30 to produce the required cracking heat.

The heated gases and oil vapors produced by the cracking process, together with the uncombined carbon monoxide, are drawn off as previously described through the pipe 40. The heat required to burn the limestone is commonly supplied through the burners 16.

The operation may be briefly described as vapor-phase cracking in a body of hot lime and in an atmosphere of products of combustion and gases resulting from a carbide reaction, with resultant deposition of carbon on or in the lime, and production of fuel gases and oil vapors, later condensed and recovered as gasoline and heavier oils. Lime is a catalyst which under certain conditions will favorably effect the reaction.

It will thus appear that my new process is continuous and economical and that the heat generated in the carbide reaction is largely and effectively used in the preliminary steps of the cracking process, so that very little heat is wasted. Also, the gases generated in the electric furnace are substantially recovered, and may be used as fuel gas for generating the electricity used in the carbide reaction.

All parts of the operation are carried out at relatively low pressure, so that the oil cracking is performed under most favorable conditions. In fact, the pressure in the upper portion or lime kiln 12 is quite commonly below atmospheric.

Having thus described my invention and the advantages thereof, I do not wish to be limited to the details herein disclosed, otherwise than as set forth in the claims, but what I claim is:

1. The process of making calcium carbide which comprises providing a furnace having a kiln at the top and an oil-cracking retort below said kiln, charging limestone to the top of the kiln, burning the limestone to produce lime, delivering the hot lime direct to the oil cracking retort, injecting hydrocarbon oil into said lime in said retort, supplying heat for cracking said oil and thereby depositing oil carbon on and in said lime, removing gases and oil vapors from said furnace between the cracking retort and the lime-forming kiln, delivering said mixture of lime and deposited carbon direct to an electric furnace, and producing calcium carbide from said mixture in said electric furnace.

2. The process of making calcium carbide which comprises providing a furnace having a kiln at the top and an oil-cracking retort below said kiln, charging limestone to the top of the kiln, burning the limestone to produce lime, delivering the hot lime direct to the oil cracking retort, injecting hydrocarbon oil into said lime in said retort, supplying heat for cracking said oil and thereby depositing oil carbon on and in said lime, removing gases and oil vapors from said furnace between the cracking retort and the lime-forming kiln, delivering said mixture of lime and deposited carbon direct to an electric furnace, and producing calcium carbide from said mixture in said electric furnace, the heat for reducing the limestone and for cracking the oil being derived in part from the carbide reaction and in part from auxiliary heating devices.

3. The process of making calcium carbide which comprises providing a furnace having a kiln at the top and an oil-cracking retort below said kiln, charging limestones to the top of the kiln, burning the limestone to produce lime, delivering the hot lime direct to the oil cracking retort, injecting hydrocarbon oil into said lime in said retort, supplying heat for cracking said oil and thereby depositing oil carbon on and in said lime, removing gases and oil vapors from said furnace before they are mixed with combustion gases from said lime kiln, delivering said mixture of lime and deposited carbon direct to an electric furnace, so proportioning the limestone and cracking oil that correct proportions of lime and carbon for the carbide reaction will be delivered to the electric furnace, and producing calcium carbide from said mixture in said electric furnace.

4. The process of making calcium carbide which comprises providing a furnace having a kiln at the top and an oil-cracking retort below said kiln, charging limestone to the top of the kiln, introducing heat from an external source, burning the limestone to produce lime, delivering the hot lime by gravity to the oil cracking retort directly under said kiln and in open communication therewith, injecting hydrocarbon oil into said lime in said retort, supplying heat in part from the lower part of said furnace and in part from an external source for cracking said oil to yield gases and oil vapors and to deposit oil carbon on and in said lime, removing said gases and oil vapors from said furnace between the cracking retort and the lime-forming kiln, delivering said mixture of lime and deposited carbon by gravity to an electric furnace directly under said retort and in open communication therewith, and producing calcium carbide from said mixture in said electric furnace.

5. Apparatus for making calcium carbide comprising an electric furnace, an oil cracking retort directly superposed in said furnace and in open communication therewith, and a line kiln mounted directly above said retort and in open communication therewith, whereby all solid materials charged to or produced in said apparatus move freely downward by gravity to said electric furnace.

6. Apparatus for making calcium carbide comprising an electric furnace, an oil cracking retort directly superposed in said furnace and in open communication therewith, a lime kiln mounted directly above said retort and in open communication therewith, whereby all solid materials charged to or produced in said apparatus move freely downward by gravity to said

electric furnace, means to charge limestone to said kiln, means to charge hydrocarbon oil to said retort, and auxiliary means to supply additional heat to said furnace just below said retort and also just below said kiln.

7. Apparatus for making calcium carbide comprising an electric furnace, an oil cracking retort superposed in said furnace and in open communication therewith, a lime kiln mounted directly above said retort and in open communication therewith, whereby all solid materials charged to or produced in said apparatus move freely downward by gravity to said electric furnace, means to charge limestone to said kiln, means to charge hydrocarbon oil to said retort, auxiliary means to supply adidtional heat to said furnace just below said retort and also just below said kiln, and means to remove gases and oil vapors from said furnace at a point between the cracking retort and the lime kiln.

8. The process of making calcium carbide which comprises providing a furnace having a kiln at the top and an oil-cracking retort below said kiln charging limestone to the top of the kiln, burning the limestone to produce lime, delivering the hot lime direct to the oil cracking retort, injecting hydrocarbon oil into said lime in said retort, supplying heat for cracking said oil and thereby depositing oil carbon on and in said lime, removing gases and oil vapors from said furnace, delivering said mixture of lime and carbon direct to an electric furnace, producing calcium carbide from said mixture in said electric furnace, condensing the oils in said gases and vapors, separating the heavy oil fractions from the lighter oil fractions and returning said heavy fractions to the cracking retort, and recracking said heavy fractions, thereby substantially increasing the amount of carbon deposited on and in the lime.

9. The process of making calcium carbide which comprises providing a furnace having a kiln at the top and an oil-cracking retort below said kiln charging limestone to the top of the kiln, burning the limestone to produce lime, delivering the hot lime direct to the oil cracking retort, injecting hydrocarbon oil into said lime in said retort, supplying heat for cracking said oil and thereby depositing oil carbon on and in said lime, removing gases and oil vapors from said furnace, delivering said mixture of lime and carbon direct to an electric furnace, producing calcium carbide from said mixture in said electric furnace, and utilizing a portion of the carbon monoxide from the carbide reaction to reduce all excess air entering the furnace to a non-oxidizing condition, whereby said oil is cracked in a non-oxidizing atmosphere.

10. That improvement in the process of making calcium carbide as set forth in claim 1, which comprises supplying additional heat for the cracking operation by introducing air to combine with the carbon monoxide gases and a part of the deposited carbon above the electric furnace but below the cracking retort.

11. That improvement in the process of making calcium carbide as set forth in claim 1, which comprises supplying additional heat for the cracking operation by introducing air to combine with the carbon monoxide gases, a part of the deposited carbon and a portion of the hydrocarbon cracking oil at a point above the electric furnace and below the cracking retort.

LEWIS W. RIGGS.