PATENT SPECIFICATION 906,569

DRAWINGS ATTACHED.

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COMPLETE SPECIFICATION.

Improvements in and relating to the Catalytic Cracking of Paraffin Hydrocarbons for the Production of Gas Containing Carbon Monoxide and Hydrogen.

We, SIMON-CARVES LIMITED, a British Company of Bird Hall Lane, Cheadle Heath, Stockport, County of Chester, and DR. C. OTTO AND COMP. G.m.b.H., a Company organised under the Laws of Germany, of Bochum, Federal Republic of Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the catalytic cracking of paraffin hydrocarbons for the production of ignitable gas in a process using pure oxygen or air, the heat required being provided by the oxidation of a catalyst.

Processes of this general nature, having for their objective the production of town gas or synthesis gas, are already known in the art and in a three-stage process as at present practised the catalyst is oxidised in the first stage by air passed from the bottom to the top of a cracking column. In the second stage, the catalyst is reduced by hydrocarbon or other gases passed from the top to the bottom of the column. In the third stage, the cracking takes place from the bottom to the top of the column. Reducing gases introduced during the reduction of the oxidised catalyst are burned thereon into carbon di-oxide and water, and the waste gases are passed out into the atmosphere, thus resulting in a considerable heat loss.

It has also been previously attempted to carry out the process in two stages, in the first of which the catalyst was oxidised and in the secind of which cracking took place without previous reduction. Incomplete cracking of the hydrocarbons took place and there was a formation of soot.

These are cyclic processes such as the known Onia-Gegi and Segar processes.

The present invention has for its object a process wherein the above disadvantages are eliminated.

According to the present invention, a process for the catalytic cracking of paraffin hydrocarbons for the production of gas containing carbon monoxide and hydrogen, comprises the steps of initially oxdidising a nickel catalyst with oxygen, mixing a waste gas with the oxygen and passing said mixture through the catalyst to increase the heated zone thereof, interrupting the flow of the waste gas/oxygen mixture through the catalyst and passing a mixture of said hydrocarbons and steam through said catalyst in the opposite direction to the flow of said waste gas/oxygen mixture therethrough to produce said gas containing carbon monoxide and hydrogen.

The term "waste gas" as used herein is intended to refer only to the gas produced by the oxidation of the catalyst as herein described.

A better understanding of the invention may be obtained from the following description when this is read with reference to the accompanying drawings, of which:—

Figure 1 is a diagrammatic view of a cracking column for a two-stage process operated in accordance with the known prior art; and

Figure 2 is a similar view of a cracking column for a two-stage process, according to the present invention.

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According to the prior art, as shown in Figure 1, a catalyst 1 is disposed between heat accumulators 2 and 3 within a column 14. Air for oxidation of the catalyst 1 is blown into the column 14 by a blower 4 through a pipe 5 and rises to the top of the column, passing upwards through the accumulator 3, catalyst 1 and accumulator 2. Waste gas leaves through the pipe 6 and valve 11 to the atmoshpere. The hydrocarbons and oxygen-containing gases (e.g. steam) are introduced through pipes 7 and 8 into the upper portion of the column 14 and the gas produced leaves at its base through the pipe 9.

Air introduced in the first stage of the process, through the pipe 5, is preheated in the accumulator 3 and contacts the lower surface of the catalyst 1 to oxidise this surface and cause its temperature to increase. Only sufficient heat is necessary to make up for heat loss, and it is thus not necessary to oxidise the whole of the catalyst 1, but only so much of its lower surface as will recoup the heat loss. The lowest surface of the catalyst attains the higher temperature.

Waste gas from the oxidation flows through the remainder of the catalyst, through the heat accumulator 2 and thence through the pipe 6 and valve 11 to atmosphere.

The heating of the catalyst 1 above its lower surface is so small that hydrocarbons introduced from above, as previously described, are not cracked. The lowest zone of the catalyst, though possessing the required temperature, is not active, but is partly reduced, with simultaneous soot formation, by the hydrocarbons which have passed through the insufficiently heated upper portions of the catalyst. Correct catalytic cracking cannot, therefore, be obtained by the above, known, two-stage process.

Attempts have been made to move the hot layer of the catalyst 1 from its lower to its upper surface by increasing the flow of air from the blower 4. This results in the oxidation of a greater proportion of the catalyst and the production of more heat, more heat being freed than can be used. The result of this has been that during cracking, the catalyst temperature has been initially too low but has been increased so rapidly and to such an extent that the material of the column 14 could not withstand the great heat produced and the column 14 itself was damaged.

In accordance with the present invention, however, the two stages of operation are carried out in such a manner that correct carcking is obtained without damage to the cracking column; the inert waste gas formed during oxidation of the catalyst being conveyed wholly, or in part, back into the process during the oxidation stage. The oxidation and cracking are carried out in opposite directions of flow as in the prior art described hereabove.

It has been found that by this mode of operation it is possible to distribute the heat required for cracking the hydrocarbons evenly throughout the whole depth of the catalyst without it being necessary to oxidise the whole of the catalyst. There is thus a greater exchange of heat to the accumulator on the upstream side of the hydrocarbon flow to the catalyst and the hydrocarbons are thus preheated before they reach the catalyst, when immediate cracking takes place.

In Figure 2 is illustrated a modification of the installation of Figure 1 to enable the present process to be carried out.

As in the above prior art, air is introduced into the base of the column 14, through a pipe 15 and waste gas is drawn off from the top of the column through a pipe 6 and valve 11. On its way through the column 14 the air passes through a heat accumulator 3, the nickel catalyst 1 and a further heat accumulator 2. Paraffin hydrocarbons and oxygen-containing gas (e.g. steam) for cracking are fed into the column through pipes 7 and 8, as in Figure 1, and the cracked gases are removed fom the base of the column through the pipe 9; the reaction being basiscally $C_n H_m + H_2O \rightarrow CO + H_2$.

The waste gas pipe 6 is connected to the air inlet pipe 5 by a by-pass pipe 12 which has a branch 13 leading to atmosphere and a further branch 15, equipped with a valve 16, leading to the source of oxidising air. The pipe 12 has a blower 4 inserted between the pipes 15 and 5 and an adjustable valve 18 inserted between the pipes 6 and 13 and the pipe 15. Waste gases from the upper portion of the column 14 are passed through the valve 11 and pipes 6 and 13 to atmosphere and air for oxidation of the catalyst 1 is drawn in by the bolwer 4 through the pipe 15 and passed through the pipe 5 and valve 10 into the base of the column 14. By suitable adjustment of the valve 18 a portion of the waste gases from the pipes 6 and 13 can be drawn into the pipe 12 to mix with the air drawn in by the blower 4 from the pipe 15, and by suitable adjustment of the valves 18 and 16 the correct proportions of waste gas and air for carrying out the invention can be obtained.

In the operation of the invention, the valves 10, 16 and 18, are initially so adjusted that only pure air is drawn into the base of the column 14. As the oxidation of the nickel catalyst proceeds and the column begins to heat up, the valves 16 and 18 are adjusted so that a proportion of waste, or inert, gas is drawn into mixture with the air and the catalyst begins to heat upwardly throughout its depth. Subsequently, the air may be com-

pletely shut off or only the waste, or inert, gas be circulated. When the required temperature and depth of heating has been reached in the catalyst, the valves 10 and 11 are closed and paraffin hydrocarbon gases and steam are allowed to enter from the pipes 7 and 8 through valves 19 and 20; the cracked gases leaving through the pipe 9 and a valve 21.

As the catalyst 1 begins to cool, the valves 19, 20 and 21 are closed and the valves 10 and 11 are opened and initially air and then air and waste gases are again circulated upwardly through the column 14 to re-oxidise the catalyst to the required temperature and depth.

The valves 10, 16, 18, 19, 20 and 21 may all be, and perferably are, automatically operated, perferably by temperature control means of any suitable known type, so that once the required catalyst condition has been achieved the cracking and oxidation stages follow each other in automatic succession.

WHAT WE CLAIM IS:—

1. A process for the catalytic cracking of paraffin hydrocarbons for the production of gas containing carbon monoxide and hydrogen, comprising the steps of initially oxidising a nickel catalyst with oxygen, mixing a waste gas with the oxygen and passing said mixture through the catalyst to increase the heated zone thereof, interrupting the flow of the waste gas/oxygen mixture through the catalyst and passing a mixture of said hydrocarbons and steam through said catalyst in the opposite direction to the flow of said waste gas/oxygen mixture therethrough to produce said gas containing carbon monoxide and hydrogen.

2. A process according to Claim 1, wherein the oxygen is added in the form of atmospheric air.

3. A process for the catalytic cracking of paraffin hydrocarbons for the production of gas containing carbon monoxide and hydrogen substantially as herein described with reference to Figure 2 of the accompanying drawings.

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906,569 COMPLETE SPECIFICATION
1 SHEET

This drawing is a reproduction of the Original on a reduced scale.

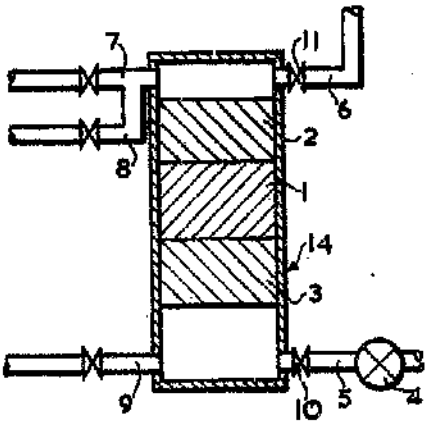

FIG. 1.

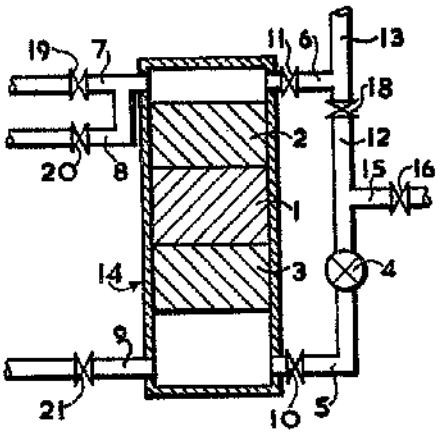

FIG. 2.