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UNITED STATES PATENT OFFICE.

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PROCESS AND APPARATUS FOR THERMALLY DECOMPOSING HYDROCARBONS.

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In a patent issued on October 18, 1927, to G. O. Curme, Jr., No. 1,646,349, there is disclosed a process of thermally decomposing hydrocarbons by exposing them to high temperatures (usually of the order of 900–1000° C.) while in contact with an alloy consisting predominantly of iron and chromium, a preferred composition for the purpose being a workable iron-chromium alloy containing upward of 20% of chromium. As pointed out in said application such alloy is workable in the sense that it can be fabricated into tubes, either seamless or made of fusion-welded sheet; it is highly resistant to heat and to oxidation; and in contra-distinction to iron it is practically devoid of that type of catalytic effect upon the hydrocarbon vapors which leads to serious deposition of carbon. Such carbon deposits or residues as may form on the interior surfaces of the tube are readily removed by periodically passing air through the tube while heating it to a sufficient temperature to oxidize the carbon.

It has been found that iron-chromium alloys of the type above mentioned may under some conditions of use develop a certain brittleness: and further investigations have shown that a characteristic brittleness is developed in iron-chromium alloys containing about 20–35% of chromium when the alloys are held for some time at temperatures in the neighborhood of 400–500° C., as may occur in slowly cooling apparatus made from such alloys through this particular temperature range. Furthermore fusion-welding of such alloys, and others of even lower chromium content, often produces a zone of brittleness adjacent the weld.

My present invention relates to the thermal decomposition of hydrocarbons in accordance with the Curme process, and comprises an improved process and apparatus for accomplishing the essential result of decomposing the hydrocarbons (preferably but not necessarily in gas or vapor phase), without excesssive deposition of carbon, while avoiding in substantial measure the difficulties arising from brittleness of the tubes, irrespective of whether such brittleness is due to their subjection in use to an embrittling temperature range or to their subjection to fusion-welding. I accomplish the above results by certain modifications in the composition of the iron-chromium alloy.

It has been found that a suitable addition of nickel between 2%–15% has the effect of inhibiting the embrittling action of temperatures of the order of 400–500° C., and it also increases the tensile strength and improves other of the mechanical properties of the alloy. The nickel has an undesirable effect, however, in that it renders the alloy more susceptible to corrosion by certain agents, for example, sulfur and sulfur-containing gases.

I have found that a suitable addition of silicon with the nickel has a beneficial effect on the alloy, and in particular, that it overcomes the tendency of the nickel to lower the resistance of the alloy to corrosive influences. I have also found that the silicon, especially in conjunction with the addition of manganese, obviates the brittleness produced by fusion-welding, and gives an alloy which is admirably adapted in all respects for use in the thermal decomposition of hydrocarbons.

The proportions of the constituents of the alloy are:

Chromium	15% to 40%
Nickel	2% to 15%
Silicon	0.7% to 3%
Manganese	0.7% to 3%

with the balance principally iron. Alloys of the foregoing composition are readily forged, rolled, and otherwise worked when the carbon content is sufficiently low. The carbon content should not exceed 1.0% and is preferably at a value below 0.30%, for example at about 0.15%. Because of its workability and its excellent behavior when welded the material is admirably adapted to be rolled into sheet from which to fabricate, preferably by welding, tanks and other vessels for the carrying out of chemical processes wherein severe corrosive conditions are present including the cracking of oils and oil vapors, and the thermal decomposition of hydrocarbons in general. The high strength of the alloy and the soundness of the welds which can be made in it adapt it

as material for pressure vessels, even where the corrosive action of the material under the treatment is augmented by the use of elevated temperatures.

I claim:

1. Apparatus for thermally decomposing hydrocarbons comprising a tubular member, and means for supplying hydrocarbons thereto and heating them to a cracking temperature, said tubular member consisting of an alloy containing chromium 15%–40%, nickel 2% to 15%, silicon 0.7% to 3.0%, manganese 0.7% to 3.0% and carbon not more than 1.0%, the balance principally iron.

2. The process which comprises thermally decomposing hydrocarbons while the latter are in contact with an alloy containing chromium 15%–40%, nickel 2% to 15%, silicon 0.7% to 3.0%, manganese 0.7% to 3.0% and carbon not more than 1.0%, the balance principally iron.

In testimony whereof, I affix my signature.

STANLEY M. NORWOOD.