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APPARATUS FOR CRACKING HYDROCARBONS

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2 Claims. (Cl. 196—133)

It has been the practice in processes for cracking hydrocarbon liquids to employ high pressures and temperatures with a view to secure high yields of the products of cracking and to ensure economy. The temperatures employed in such cracking processes are partly above the scaling limit of ordinary materials employed for those parts of cracking apparatus subjected to high pressures and temperatures, such as soft carbon steels. There is thus a need for great resistance to deterioration of the metal used for such parts of cracking apparatus.

Furthermore the material employed must be highly resistant to chemicals, as both crude oils and tarry residues commonly contain sulphur compounds (in relatively large quantities) to which some steels are highly sensitive.

In order to reach the degree of resistance required in the parts of apparatus that are subjected to high pressures and temperatures, alloyed steels are employed, among them being chromium-nickel-steel. Steels containing nickel have however proved to be sensitive to sulphur and they exhibit more particularly at high pressures and temperatures, phenomena of brittleness which may result in the fracture of the cracking tubes. Moreover nickel is known to favour the undue production of soft carbon in such and similar apparatus.

Experiments carried out by the applicant have demonstrated that the parts of apparatus used for cracking hydrocarbon liquids, when made of steel alloys are suitable when the metal contains a substantial proportion of chromium and is substantially free from nickel. The invention thus comprises the use of such steel alloys for the purpose.

For the purpose moreover the chromium content in such steel alloys may advantageously be as high as 7%, and in special cases even up to 13%. If still smaller quantities of aluminium be added to the chromium alloys the resistance to the action of sulphur and sulphur compounds is increased. The aluminium content necessary to produce this result lies between 0.3% and 4.0%. A further improvement in the quality of the steel is obtained by the addition of elements, such as silicon, molybdenum, vanadium, titanium, beryllium, in quantities about 0.1% to 2%. Silicon may be added in order to improve the metallurgic manufacture in regard to the deoxydation and the degasifying of the steel. Molybdenum and vanadium are able to raise the resistance to deterioration in hot state. Titanium is added for improving the structure of the grain and beryllium for raising the resistance to corrosion. The following steel alloys are given as samples combined according to the invention:

Steel No.	C	Mn	Cr	Al	Si	Mo	V Ti Be
1	0,1	0,3	4	0,5	0,2	0,3	0,1 V
2	0,06	0,4	6	0,8	0,5	0,6	
3	0,12	0,3	8	1,5	1,2	0,8	0,2 Ti
4	0,12	0,5	12	2,6	0,8	1,2	
5	0,15	0,3	10	0,8	1,2	0,5	0,1 Be

When temperatures are employed which lie above the scaling limit it is not necessary to consider not only a high hot tensile limit, but also to take into account the necessary resistance to scaling. It has been found by the applicant that the alloys that satisfy these requirements are those whose chromium content lies between 5% and 8%, and whose aluminium content lies between 0.3% and 2%, and which furthermore contain small quantities of silicon and molybdenum. Such alloys are resistant to scaling up to about 900° C., they have a high hot tensile limit, and they are highly resistant to sulphur. If the process be carried out at temperatures which lie below the scaling limit the quantities of chromium used may be reduced to about 2%.

Thus according to the invention the cracking of hydrocarbon liquids is effected in an apparatus in which the parts subjected to high temperatures and pressures are made of steel alloys which while they contain chromium do not contain nickel.

The invention comprises the use of a process in which the steel alloys employed for the parts of the apparatus have a chromium content up to 8% and at the most 13%.

The invention also comprises a small addition of aluminium to the material so employed, and the additions of other substances as hereinbefore indicated, and an apparatus whose parts are made of steel alloys having the characteristics indicated.

It will be understood that the invention is broadly applicable to processes for cracking hydrocarbon liquids, either in the liquid or vapour phase, or partly in the liquid and partly in the vapour phase, it being understood that the parts of the cracking or reaction tubes, or the reactors, or reaction, receiving, expansion or other vessels through which the hydrocarbon liquids or vapours pass at high pressures and high temperatures or otherwise while subject to the conditions of the

treatment, are made of a steel alloy of the composition and for the purpose hereinbefore described.

What I claim and desire to secure by Letters Patent of the United States is:

1. A steel adapted in the cracking of hydrocarbons, to come in intimate contact with the hydrocarbons, said steel being free from nickel and containing chromium in amounts between about 5% and 8%, aluminium in amounts between about 0.3% and 4%, and further additions of silicon 0.2% to 2%, molybdenum 0.3% to 2%, beryllium 0.1% to 2%, the balance substantially iron.

2. Apparatus for cracking liquid hydrocarbons comprising a part of tubular form, means for supplying hydrocarbons thereto, and imparting heat at cracking temperature, the said part consisting of a steel alloy free from nickel and containing chromium 5% to 13%, aluminum 0.3% to 4%, beryllium 0.1% to 2%, silicon 0.2% to 2%, molybdenum 0.3% to 2% and the balance substantially iron.

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