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METHOD FOR THE PRODUCTION OF CORROSION-PROOF AND HEAT-PROOF CHROMIUM COATINGS

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In order to render corrosion- and heat-proof the surface of articles of iron and steel, the surface has already been enriched in chromium by thermic diffusion. This is effected according to known methods, for instance in that the pieces at temperatures from 900–1100° C are exposed for several hours to a gaseous chromium-chloride compound, the chromium constituent of which replacing the iron in the surface layer of the treated articles. In this manner iron-chromium alloys with up to 35% of chromium are produced in the surface. Corrosion- and heat-proof surfaces on articles consisting of iron or steel can also be produced by applying on them galvanic chromium coatings. Such chromium coatings, however, do not adhere very solidly on the base metal and they burst off already at comparatively low mechanical stressing of the work piece. It has already been proposed to obviate these inconveniences by heating the galvanically covered pieces in neutral atmosphere to higher temperature and by diffusing the metals the one into the other. As also this method was not yet absolutely satisfactory, that is because it did not result in a sufficient adhering of the chromium coatings produced by galvanic method on the base metal, the proposal has been made in the German Patent No. 563,882, to galvanically coat with chromium the base metal after applying to them a layer of nickel or cobalt as intermediate layer, and to then diffuse the metals the one into the other by heating in neutral atmosphere to temperatures at which a melting of the intermediate layer does not occur.

Whereas, therefore, up to the present the inconvenience inherent to the corrosion- and heat-proof chromium coatings produced by galvanic method with subsequent thermic diffusion were looked for in first instance in the constitution of the protecting layers themselves and consequently the proposals for avoiding them were directed exclusively to an influencing of the layers themselves, it has now been found, that for the adhering capability, that is the connection of the chromium coatings produced by galvanic method and subsequently treated thermically and their quality the quality of the base metal is chiefly decisive on which the layers have to be applied. Experiments have shown, that the galvanically applied chromium at the subsequent thermic treatment diffuses much easier and deeper into the surface of the articles consisting of iron or steel, if these articles do not consist of unalloyed iron or steel, but of iron-carbon alloys, which contain as alloying elements also titanium, vanadium, tantalum, niobium, chromium, molybdenum, manganese, aluminium and silicium, these substances singly or several of them. It is material, that the effect of these elements with regard to favouring the chromium-diffusion is realised not only on higher carburised iron or steel but also on iron-carbon alloys with very low carbon contents. Whether then the effect, for instance of the titanium, tantalum, niobium and vanadium is due to the premature tying off of the α range, or as regards the diffusion still other effects play a role, has not yet been cleared up at present. In iron- and steel qualities with higher carbon content the above mentioned alloying elements avoided evidently a wandering of the carbon in the cross section of the pieces to be coated, which occurs even then, if the carbon content in percents is very low, for instance is below 0.1%, but the wall thickness of the articles to be treated is comparatively thick, for instance 10 mm thick. At such a wandering of carbon surface layers rich in carbon result which render it difficult for the chromium to penetrate or even prevent the penetration of chromium.

For the galvanic chroming with subsequent thermic diffusion the following iron-carbon alloys have to be used according to the invention:

		Per cent
(1)	Carbon	0.02–0.4
	Titanium, niobium or tantalum	Up to 3
(2)	Carbon	0.02–0.4
	Manganese	2 –6
(3)	Carbon	0.02–0.4
	Aluminium	Up to 2

Iron-carbon alloys with 0.02–0.4% carbon have also proved to be very useful, the alloys containing at the same time titanium and molybdenum, the content in titanium corresponding to 1 to 4 times, preferably twice the content of carbon, and the content of molybdenum amounting to 0.2–3% preferably 0.5 to 1.5%. Good results were further obtained with alloys having 0.02 to 0.4% carbon, 2 to 3% chromium and 0.5 to 2% vanadium. In the remainder of all the alloys are present iron and the usual companions of the iron, and it has further shown that a phosphorus content higher than the usual amount up to 0.3% influences diffusion in a favourable sense. The same favourable influence is exerted by a silicon content of up to 2%.

The production of the articles with the galvanic chromium coatings from the alloys as stated is not only favourable when the chromium coating is applied directly on to the base metal, but also when intermediated layers are employed, for instance such of nickel or cobalt and the whole is then submitted to a thermic subsequent treatment.

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