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PROCESS FOR HARDENING STEEL ALLOYS.

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To all whom it may concern:

Be it known that I, ADOLF FRY, residing at Essen-Stadtwald, Germany, a citizen of the German Republic, have invented a certain new and useful Improvement in Processes for Hardening Steel Alloys, of which the following is a specification.

The present invention relates to the hardening of steel alloys by nitrogenization. It is already known to carry out the nitrogenization at such a high temperature that marginal layers are formed which consist principally of nitride of iron. Such marginal layers are however brittle, tend to peel off, and give, therefore, no surfaces able for parts which are subjected to severe strains. The object of this invention it to obviate this disadvantage.

In metallography, in addition to the generally known expressions "eutectic" and "peritectic" the expressions "eutectoid" and "peritectoid" are usual (see for example, Dr. W. Guertler, Metallographie, Berlin 1909, vol. 1, part 1, pages 308 and 334). By "peritectic" is understood the homogeneous crystalline mass which, at the cooling of alloy below certain temperature, inserts itself between the still existing molten mass and a type of crystal mixed with it, and surrounds the latter. By "peritectoid" is understood a structural element corresponding to the peritectic which is formed at a temperature lower than the temperature of solidification of a liquid alloy, in that at the expense of two already existing types of crystals a third type of crystal is formed which introduces itself as a separator between the other two and surrounds one of them. By "transformation" is generally understood the building up of a new type of crystal with a simultaneous breaking down of one or more others present. Hence, by "temperature of peritectoidal transformation" is to be understood that temperature (varying according to the type of alloy), at which the formation of the peritectoid occurs upon cooling.

The invention is based on the discovery that steel alloys which have absorbed nitrogen, undergo a peritectoidal transformation, which takes place at a temperature of about 580°. If the nitrogenization takes place below the peritectoidal transformation temperature, the concentration of the nitrogen remains below the limit at which the brittle layers of nitride are formed. In this case the steel receives the iron nitride in solid solution to a certain depth and not principally as nitride of iron only as in the known process. The marginal layer formed exhibits a texture which possesses the characteristic features of the hardening texture of the steel (of the martensite) and therefore acquires a high degree of hardness. The transition from the hard marginal layer to the core takes place quite gradually, and the marginal layer consequently has no tendency to peel off. The hardness diminishes slowly towards the core in proportion as the amount of nitrogen contained decreases.

The above described process is only suitable for alloyed steels; ordinary carbon steels do not acquire any great degree of hardness when they are subjected to the action of substances which give off nitrogen such as ammonia for example. The process has been found to be particularly suitable of application to such ternary and quaternary steel alloys which contain aluminium, chromium, manganese or silicon either separately or in any desired combination. A special increase in the hardness takes place already when one of the above elements is present to the extent of only a few per cent. Thus for example the Brinell hardness of an improved steel containing 0,39% C. and 2,88% Cr is increased by being heated in a current of ammonia at 500° from 282 to 471. The hardness of an improved steel containing 0.44% C., 1.07% Mn and 1.93% Cr was increased under the same treatment from 298 to 500.

Claims:

1. Process for hardening a steel alloy, consisting in subjecting the alloy to nitrogenization at a temperature below the temperature of peritectoidal transformation.

2. Process for hardening a steel alloy containing aluminium, chromium, manganese or silicon in any desired combination, consisting in subjecting the alloy, at a temperature below the temperature of peritectoidal transformation, to the action of a substance which gives off nitrogen.

The foregoing specification signed at Essen, Germany, this 29th day of September, 1921.

ADOLF FRY.