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3,705,058

SOFT-NITRIDING PROCEDURE FOR STEEL
AND CAST IRON

Zoltan Kolozsvari and Endre Gal, Targu-Mures, Rumania,
assignors to Fabrica de Utilaje si Piese de Schimb
"Metalotehnica," Targu-Mures, Rumania
No Drawing. Filed July 7, 1971, Ser. No. 160,523
Claims priority, application Rumania, July 9, 1970,
63,864

Int. Cl. C23c 11/16, 11/18

U.S. Cl. 148—16.6

1 Claim

ABSTRACT OF THE DISCLOSURE

A method of increasing the nitrogen content of steel and cast iron wherein the body is maintained in an atmosphere of ammonia, methane and oxygen in a molar ratio of $\text{CH}_4:\text{NH}_3=1$ and $(\text{CH}_4+\text{NH}_3):\text{O}_2=25-30$ while maintaining the dissociation rate of the ammonia between 38 and 40%. The treatment time is 1 to 10 hours at a temperature of $570^\circ\text{C} \pm 10^\circ\text{C}$.

SUMMARY

The invention refers to a soft-nitriding procedure of steel and cast iron in a controlled atmosphere, in order to increase the resistance of machine parts to scuffing, wear and fatigue.

The treatment has to be performed in a gaseous media composed of methane, ammonia and oxygen at a temperature of $570 \pm 10^\circ\text{C}$. The atmosphere has a high nitriding capacity and it is easy to control by common methods. The ratio of gas components is as follows:



As a result of the treatment a compound layer of a thickness of 10–15 μm . is obtained, supported by a diffusion layer with a case depth depending on treating time and material composition.

The invention refers to a soft nitriding (low temperature carbonitriding) procedure of steel and cast iron in a controlled atmosphere.

Soft-nitriding of steel and cast iron machine parts is generally performed in a salt bath containing alkaline cyanides and cyanates. The active carbon and nitrogen appears as a result of decomposition of the above salts. The working temperature of the salt baths is of $570 \pm 10^\circ\text{C}$. (below of critical temperatures in Fe–N system). As result of the treatment a surface layer is to be obtained, composed of a compound (white) layer and a diffusion layer. The compound layer is responsible for the high resistance to wear and scuffing, the diffusion layer forms a support.

The above procedure presents disadvantages, because applying a salt bath with heavy toxic effect and by the other hand no continuous inspection and control of the bath characteristics is possible, the only inspection is by performing chemical analyses.

A soft-nitriding procedure in a gaseous media is also known, using Endo-gas and ammonia. Backdraw of this procedure is the use of gas generator and a low nitriding potential.

The procedure in conformity with the invention eliminates the above disadvantages, performing the nitriding in order to realize a controlled and uniform treatment, at $570 \pm 10^\circ\text{C}$., in an atmosphere composed of ammonia, methane and oxygen. The ratio of gas components is as

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follows: $\text{CH}_4/\text{NH}_3=1$ and $(\text{CH}_4+\text{NH}_3)/\text{O}_2=25-30$, with an ammonia dissociation rate of 38–40%, and a treating time of 1–10 hours.

An example of realizing the invention is given below, in order to soft-nitride pieces of OLC 35 (plain carbon steel with 0.35% C).

The treatment has been performed in a gaseous media of the following composition: $\text{NH}_3/\text{CH}_4=1$, adding oxygen in a ratio of $\text{CH}_4+\text{NH}_3/\text{O}_2=25-30$, at a treating temperature of $570 \pm 10^\circ\text{C}$. The ammonia flow-rate has to be adjusted for a dissociation degree of 35–40%.

A three hours treatment assures the following results:

Sample	Hardness					
	HB	HV1	HV3	HV5	HV10	HV30
Untreated.....	200–207					
Nitrided in salt bath.....		510	440	407	370	320
Gas-nitrided.....		490	430	400	380	340

Metallographic examination has shown the following data:

case depth (of diffusion layer): 0.35–0.40 mm.

depth of compound layer: 10–15 μm .

microhardness of compound layer: 870–920 MHV.

On the basis of experiments the parameters of the above treatment, in conformity with the invention, have been established, as follows:

(a) temperature: $570 \pm 10^\circ\text{C}$.

(b) ratio of the components: $\text{NH}_3/\text{CH}_4=1$ and
 $(\text{CH}_4+\text{NH}_3)/\text{O}_2=25-30$

(c) ammonia dissociation rate: 35–40%

(d) treating time can vary between 60 min. and 10 hours depending on parts to be treated and material.

Advantages of the procedure in conformity with the invention are:

a clean metal surface can be obtained

all the parameters of the procedure can be precisely checked and controlled.

What is claimed is:

1. A soft-nitriding procedure for increasing the nitrogen content of steel and cast iron articles, comprising heat treating said articles for 1 to 10 hours at a temperature of $570^\circ\text{C} \pm 10^\circ\text{C}$. in an atmosphere of ammonia, methane and oxygen while maintaining the dissociation rate of the ammonia between 38 and 40%, said atmosphere being characterized by having molar ratios of CH_4 to NH_3 of 1 and CH_4+NH_3 to O_2 of 25 to 30.

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CHARLES N. LOVELL, Primary Examiner

U.S. Cl. X.R.

148—16.5