ASPECTS REGARDING CAR PARTS RECONDITIONING BY USING RENDERING PROCEDURE

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Abstract: *The research focused on analyzing the mechanic features of the car parts that are to be reconditioned, which was further used to select the suitable reconditioning methods and procedures according to the type, dimensions and loads to which the car parts are exposed.*

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1. Selecting the car parts and establishing the reconditioning method

The present research chose to focus on the loading reconditioning carried out by welding electrodes made up of different materials for the following reasons:

• it is a reconditioning method largely used for steel, iron cast and nonferrous metal parts which cannot be reconditioned to the repairing dimensions or which reached the final repairing stage. Likewise, the procedure allows, within certain limits, to recondition those parts whose wear and tear has already gone beyond the final repairing stage;

• compared to other reconditioning methods, it insures a relatively low price and a high productivity;

• the method may be applied several times to the same conjugated parts, processed to different repairing stages;

• it does not require any expensive mounting.

For the featured analysis, the piston pin and the crosshead were chosen as representative. This establishes the

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connection between the piston and the rod and carries the pressure force from the piston to the connecting rod (figure 1).

The piston pin works under high mechanical load conditions, being loaded by the gas pressure force and by the inertia developed by the piston. Bending, shock, fatigue, etc loads are applied on it. The piston pin connects the piston and the connecting rod by means of a bushing. The 15Cr08 steel characteristics are featured in table 1.

Fig.1 *The piston pin in a wearing state*

Table 1 The15Cr08 steel mechanical characteristics, composition and thermal treatments

<table>
<tr><th colspan="9">Mechanical characteristics</th></tr>
<tr><td colspan="2" rowspan="2">Rp_{0,2} [N/m²]</td><td rowspan="2">Rm [N/m²]</td><td colspan="2" rowspan="2">A₅ [%]</td><td rowspan="2">KCU Resilience 10⁴ [J/m²]</td><td colspan="3">Degree of hardness</td></tr>
<tr><td colspan="2">when annealed</td><td>after improvement</td></tr>
<tr><td colspan="2">460</td><td>905</td><td colspan="2">12</td><td>59</td><td colspan="2">174 HB</td><td>-</td></tr>
<tr><th colspan="9">Chemical composition [%]</th></tr>
<tr><td>C</td><td>Mn</td><td>Cr</td><td>S</td><td>P</td><td>Si</td><td>Al</td><td>Ni</td><td>Cu</td></tr>
<tr><td>0,16</td><td>0,60</td><td>0,85</td><td>0,30</td><td>0,30</td><td>-</td><td>-</td><td>0,20</td><td>0,20</td></tr>
<tr><th colspan="9">Thermal treatment (after cementing)</th></tr>
<tr><td colspan="5">Hardening at 900° C and oil cooling</td><td colspan="4">Low comeback at 180°C and water cooling</td></tr>
</table>

2. Manual welded loading using sheathed electrodes.

The procedure was adopted due to the relatively low carbon content of the car parts which are ready to be reconditioned. In order to analyze the influence of the electrodes which are used on the car parts hardness, several types of electrodes were taken into consideration during the first stage of the experimental research. There should also be mentioned that hard loading electrodes were not included in the analysis because the previous research showed that the processing of the laid-down layers was practically difficult, while the structural modifications in the basic material and the overall costs of the technological process were incompatible with the car parts and the area of research under consideration.

After carrying out the measurements, it was observed that the laid-down layer presents strong dimensional variations.

Fig. 2 *Welding loaded pin*

3. Processing of the welding loaded parts

Taking into consideration the high thickness of the laid-down layer and the lack of dimensional surface levelness, there had to be applied a rough turn followed by a smooth turn. After applying the surface hardening thermal treatments, the parts were readjusted and some of them even polished.

It was observed that if the technological process is repeated, the electrodes with the proper dimension are selected and if the adequate thermal treatment is applied to the basic material and to the working surface respectively, it can yield reconditioned parts whose endurance is at least as good as the one of a new part.

4. The endurance of the reconditioned parts surface

The endurance and the mechanical features of the laid-down layers largely depend on the input material, so we either had to choose high endurance materials which insure a good wear and tear resistance but are harder to process, or softer materials which insure good mechanical characteristics and are easy to process, but which have a low endurance not able to provide the adequate wear and tear endurance.

Even if the loading uses a material which is similar to the car part's basic material, the use of a superficial hardening procedure is required. In order to analyze the proper way to harden the surface of the reconditioned parts, thermal and thermo-chemical treatments were applied, followed by a superficial hardening by using high frequency currents for the car parts loaded by manual welding with E 51 B electrodes. In order to apply a superficial hardening procedure on the laid-over layer, the first action was to improve the chemical composition of the superficial layers by increasing their carbon content.

After cleaning the parts, the metallographic analysis and the measurements carried out yielded the following results:

• the hardness of parts' surface after the actual cementing was an average of 230 HB, which is insufficient to insure the needed wear and tear endurance;

• the chemical analyses carried out revealed the existence of certain concentration disparities (0, 02%) both in depth and in certain spots in the surface. Nevertheless these disparities do not have a significant impact on the hardness, as the value disparities between the different spots on the surface are irrelevant;

The welding loaded car parts finally underwent a superficial hardening by induction (table 2).

Table 2 Hardened parts – average measured values

Type of measured parts	Thermal treatment procedure	HRC Hardness	
		Nominal values	Measured values
Crosshead	CIF hardening	55-62	58...62
Piston pin	CIF hardening	59-65	60...62

After applying this superficial hardening treatment, we were able to draw the following conclusions:

• the procedure does not harm nor modify the adherence of the laid-down layer;

• the achieved hardness is the appropriate one, provided the required carbon percentage is insured in the superficial layer;

• the superficial layer, although hard, can be processed for finishing relatively well, following an adequate alignment system;

• the hardness achieved with this procedure is even on the parts surface;

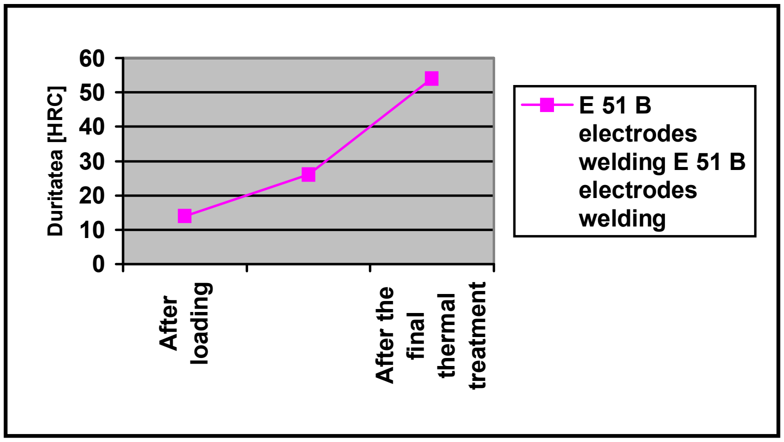


Fig. 3 *The increase of the superficial hardness after applying the thermal treatments*

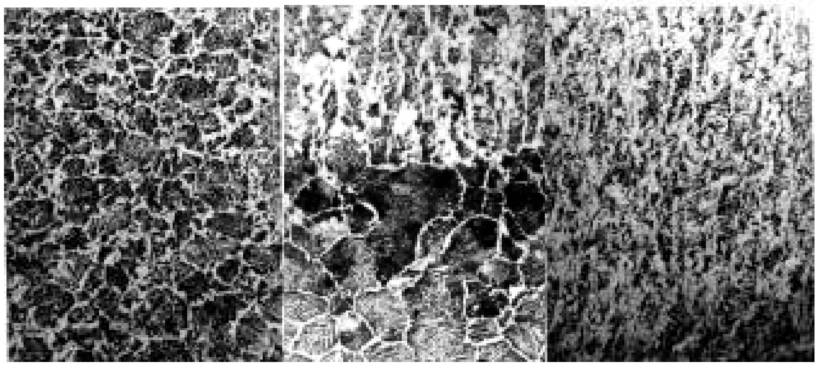
Upon testing the operational quality of the layers' surface, one can notice that those parts which have been reconditioned by welding followed by thermal/thermo-chemical treatment have better wear and tear endurance than the original parts, provided the proper mechanical endurance is insured.

5. Conclusions

• When choosing the procedure to be used for loading, one must bear in mind the complexity of the car part and the wear and tear degree, the amount of preparatory works or the necessary subsequent processing, and the physical-mechanical features the car part must have after reconditioning;

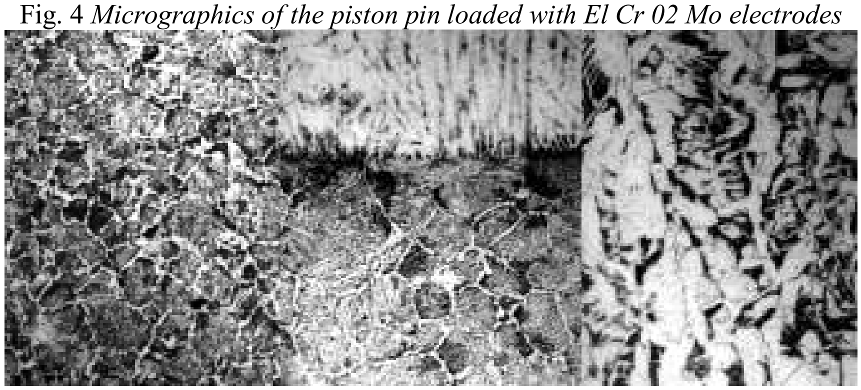
• the results yielded by certain experimental studies showed that as far as welded loading is concerned, an essential factor is the choice of the admixture material and the displacement method. For superficial layer hardness rates below 30 HRC it is required to use loading materials with a composition similar to the basic part and the hardness within the ranges imposed for the car part surface. When the parts require a higher degree of hardness, it is not recommended to use electrodes with a high hardness for loading as this renders the processing of the laid-down layer difficult. Even when using metallic carbide coated tools and a special cutting procedure (very low cutting feed and depth, under abundant cooling), they worn off very quickly and this led to a drastic decrease in the economical efficiency.

• when loading the parts by welding electrodes with a low carbon content, the characteristics of the basic material are thermally influenced during the loading procedure (figures 4 and 5) and during the cementing thermal treatment, which imposes the subsequent application of thermal treatments to restore the structure, and superficial hardening (accordingly). This allows the obtaining of hard surface parts, resistant to any type of wear and tear.



a) Basic material b) Interface area c) Laid-down layer

Fig. 4 *Micrographics of the piston pin loaded with El Cr 02 Mo electrodes*



a) Basic material b) Interface area c) Laid-down layer

Fig. 5 *Micrographies of the piston pin loaded with E 51 B electrodes*

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