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Reconditioning by Mechanized MAG Welding of the Worm Gear Element Belonging to Mixers

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Abstract

Reconditioning by electric arc mechanized welding requires the use of specific procedures such as MIG-MAG welding, TIG welding or even SF welding. These processes allow mechanization of operation as well as the automation. Alongside with the material and geometry study it considers loadings the product to be reconditioned is subjected to.

The electric arc welding, in general and the MAG welding, particularly in mechanized regime are highly applied permitting the utilization of a diversified range of materials and products having generally a cylindrical geometry.

The features of the work and the contribution of authors consists in the special and pragmatic mode to achieve a technical cooperation between the device the component to be reconditioned is fixed on, the welding source and the operator.

Key words: worm gear *(Schaaf), coil mixer, MAG welding, reconditioning, treatment*

Motivation

Starting from the base material and the geometry of products, authors used a device in the endowment of TES Welding, a device that allows fixing and reaching welding speeds both for the worm gear and its stator, figure 1.

The paper presents results of reconditioning by welding only for the worm gear, which chemical composition and mechanical characteristics are illustrated in tables 1 and 2.

The datasheet elaborated by EUROPEAN FOOD company asks mechanical and resistance characteristics closed to that of some initial components, namely, hardness in the range 62-65 HRC and fine execution according to ISO 2768. It also imposes that the coil width does not exceed 0.5mm over the initial level after the final hardfacing, figure 2.

a. b.

Fig. 1. Products subjected to reconditioning:
a. worm gear; b. stator

Table 1. Chemical composition of C120 steel

Composition / Material	C [%]	Mn [%]	Si [%]	S_{max} [%]	P_{max} [%]	Cr [%]	Ni [%]	Observations
C120	1.8-2.20	0.15-0.45	0.15-0.35	0.025	0.030	11.0-13.0	Max. 0.35	Without other alloying elements Mo, W, V

Table 2. Mechanical characteristics and heat treatment for the C120 steel

Characterisics / Grade	Forging or rolling temperature	Soft annealing		Quenching			Annealing		Hardfacing by welding
	[°C]	[°C]	HB	[°C]	Cooling environment	HRC	[°C]	HRC	HRC
C120	1050-850	810-840	260	920-960	Oil, air	60	210-220	60-63	62-65
				950-980	Isothermal bath		420-440	54-50	

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Worm Gear (Schaaf)

The product subjected to reconditioning is used in the bread manufacture industry being loaded mechanically as well as subjected to wear. The MAG hardfacing by welding is performed for the worm gear worn coils; coils have been prepared, by mechanical processing, at 8mm level inferior to the initial one.

The worm gear, figure 2, is made out of C120 tool steel/STAS 3611-80 foreseen with two begining displaced with 180°. The coil step is 40mm, and its width is 4mm.

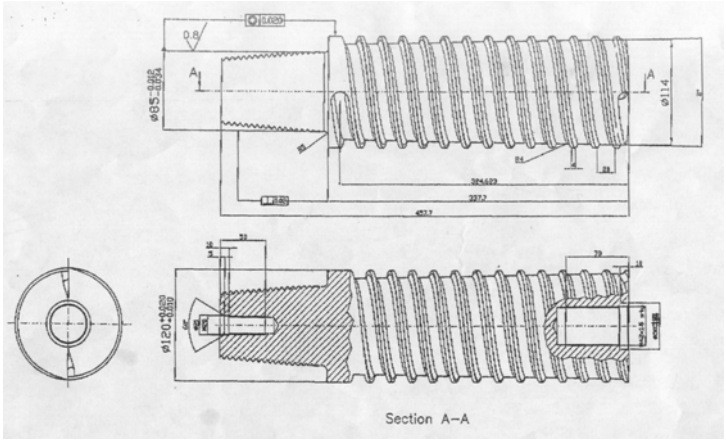
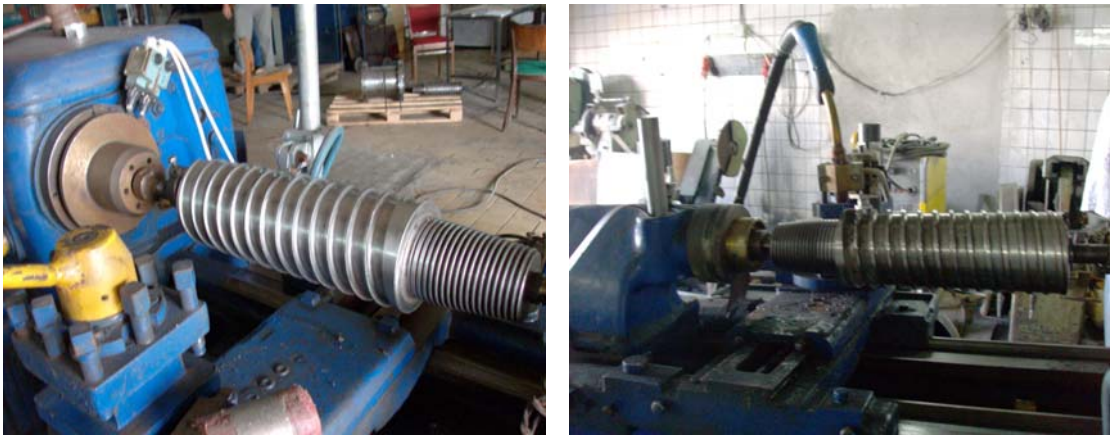


Fig. 2. Sizes of the worm gear

Reconditioning Equipment

Positioning and rotating device - DPR

The worm gear subjected to reconditioning is fixed in the lathe, special adapted for circular hardfacing by MIG-MAG welding of cylindrical components. The worm gear is fixed and centered between the equipment tips, figure 3, and the welding head is fixed in the knife bearing device of the lathe.



a. b.

Fig. 3. Positioning and rotating device
a. Worm gear fixing; b. Welding head fixing

The equipment assures the rotating of the worm gear at the welding speed that can be adjusted gradually, by the speed gear specially adapted, as well as continuously by an inverter type electronic scheme, which changes the rotation speed of the asynchronous three-phased motor assembled directly on the main shaft of the welding equipment, figure 4. The equipment also allows the continuous and gradual adjustment of the worm gear hardfacing auger.

The technical and functional characteristics of the welding equipment are presented in table 3.

It is worth mentioning that for left-right rotation the control box is used; this operation is assured automatically by the control panel or manually by the operator through the speed box of

the DPR equipment. In the same time the worm gear rotates the welding head advances with the necessary step so that the deposition form is a helicoidal one. The welding operation is interrupted by means of a limiting device (revolution counter) assembled on the lathe.

a. b.

Fig. 4. Welding equipment operation
a. Fixing the driving motor; b. Control panel

Table 3. Main technical and functional characteristics of the welding equipment

Characteristic	Welding speed [cm/min]	Auger deposition [mm]	Weight of the component [kg]	Length of the component [mm]	Lathe revolution [rpm]
Value range	10 - 80	0 - 90	300	1200	0,1 - 20

Welding equipment

The welding source CLOOS-400 type is equipped with special functions used to ignite the arc, to adjust the welding current dynamics and to limit the advance of the wire without current. The current can be adjusted in the range 40-400A and the arc voltage range is 15-35V.

Experimental Testing

Experimental testing was made on a cylindrical component identical from the material point of view and sizes with those of the worm gear in order to establish the hardfacing parameters for the first as well as the second layer. More depositions were performed using different welding regimes, figure 5.
The component subjected to reconditioning (worm gear) has been rectified at 106 mm diameter. Optimized reconditioning parameters are presented in table 4.

Table 4. Technological reconditioning parameters

Parameters / Layer no.	I_s [A]	U_a [V]	v_s [cm/min]	$T_{pr.}$ [°C]	Cooling environment	Coil width [mm]	Thickness of the deposited layer [mm]	Worm gear diameter [mm]
1	135-140	19.3-19.5	30	250	Aer	5	5	111
2	100-105	18.5-19	30	<300	Aer	4	3.5	114.5

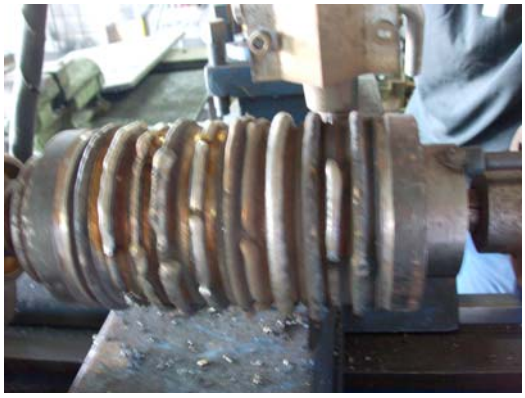


Fig. 5. Experimental establishment of the welding parameters

Filler material selection

The first and the second layer were performed with the same filler material A7111M (FONTARGEN); using a buffer layer between the base material and the first deposited layer seamed to be unnecessary. The hardness resulting after the second layer was in the range 62-63HRC. The chemical composition and the filler material hardness are presented in table 5.

Table 5. Chemical composition of the filler material

Chemical composition / Filler material	C [%]	Mn [%]	Si [%]	Cr [%]	Rockwell hardness- (Vickers hardness) on deposited metal (shielding gas: CO2)+20°C
FONTARGEN A 7111 M	0.50	0.50	2.50	8.00 – 9.00	56 – 62 HRC (650 – 775)
Obs.: Marking filler material: MSG 6 – 60/DIN 8555; Material no.: W1.4718 Recommendations: annealing temperature: 780-820°/maintenance 5h; T.T. quenching: 1020-1070°C/ oil quenching or compressed air quenching; pre-heating of the base metal susceptible to cracking at 200-300°C is recommended.					

Reconditioning technology

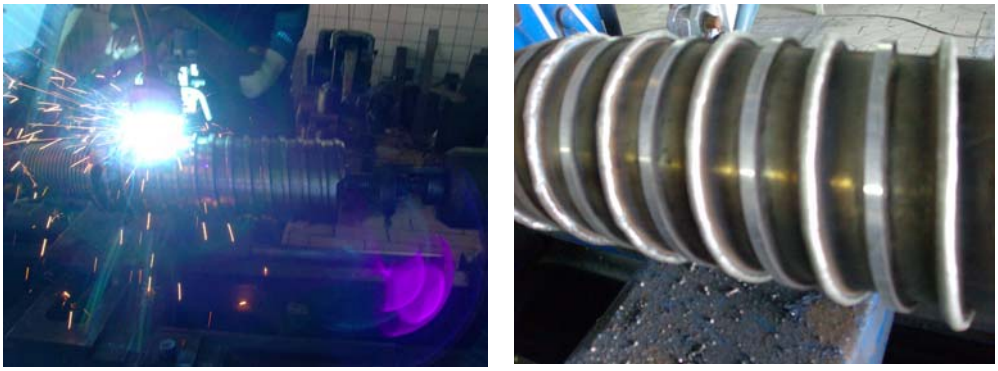
Parameters of the hardfacing process using MAG welding are those established in table 4 and they refer to the welding current, arc voltage, welding speed, pre-heating temperature and temperature between layers.

Reconditioning phases for the worm gear are presented in figures 6 and 7. After fixing the worm gear in the device, figure3 a and the precise establishment of the welding head step, the same with the coil one, there follows the pre-heating operation and then the performing the first layer for the first coil, figure 6 a, hardfacing is achieved in two passing, figure 6b.

Hardfacing the layer on the first coil, figure 6 b., as well as starting deposition on the second coil first layer, of the second layer, respectively, on the same coil are performed only after the interval of the working temperature is $< 300°C$.

Final image of the worm gear reconditioning operation as well as aspects during the reconditioning process are illustrated in figure 7.

Width of deposition after the second layer for both coils has to be in the range 4.0-4.5mm as the coil profile is not rectified.



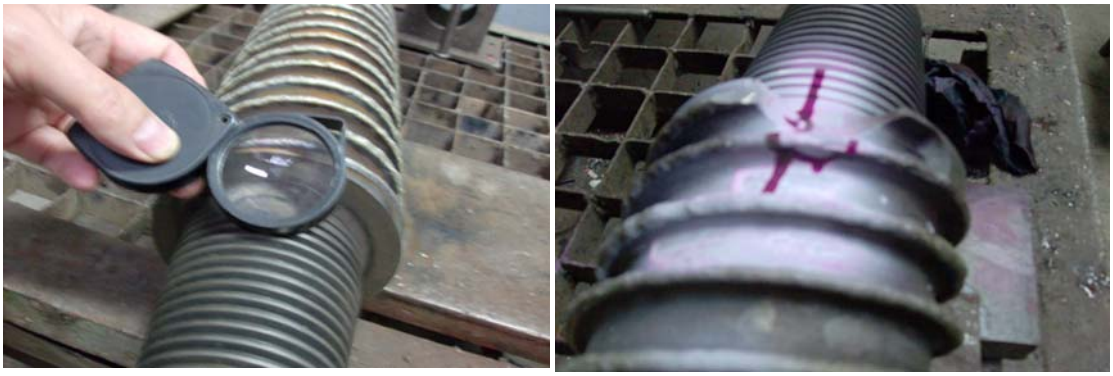
a. b.

Fig. 6. Hardfacing by MAG welding of the first coil:
a. Execution of the first layer; b. Final aspect after the second layer

a. b.

Fig. 7. Reconditioned worm gear:
a. Aspect of the reconditioned worm gear; b. Detail during hardfacing

Before and after the reconditioning operation it is recommended to visually examine the product using the penetrant liquid or magnetic particle examination method so that to be sure it has no unadmitted defects, such as cracks occurred during the service or after the heat treatment the product has been subjected to, figure 8.



a. b.

Fig. 8. Defects evincing
a. Visual examination; b. Liquid penetrant examination

Conclusions

În order to recondition the worm gear the mechanized MAG welding was proposed using a special positioning and rotating device existing in the endowment of the firm S.C. TES S.A. Timisoara. This device allows the reconditioning of the worm gear coil undet quality and reproductibility conditions.

The proposed filler material for welding permitted the proposed hardness imposed to worm gear coil without applying a buffer layer, without being necessary a post welding heat treatment for improvement, respectively.

The applied welding technology allows the rehabilitation of the worm gear with in time efficient effects at the beneficiary.

Premises are created to recondition, in the future, other same type components.

References

1. Burcă, M., Negoiţesu, S. – *Sudarea MIG/MAG*, Editia a 2-a, Editura Sudura, Timişoara, 2004.
2. Gliţa, Gh., Negoiţescu, S. – *Echipamente pentru sudare*, Editura Lux Libris, Braşov, 2008.
3. * * * – SR EN 439/96 - *Gaze de protecţie pentru sudare şi tăiere cu arc electric.*
4. * * * – STAS 3611-80 - *Oţeluri aliate pentru scule.*
5. * * * – *Catalog materiale de sudare*, FONTARGEN.

Recondiţionarea prin sudare mecanizată MAG a elementului ,,melc extruder'' de la malaxoare

Rezumat

Recondiţionarea prin sudare mecanizată cu arc electric necesită folosirea unor procedee specifice cum ar fi: sudarea MIG-MAG, sudarea WIG sau chiar sudarea SF. Aceste procedee permit atât mecanizarea operaţiilor cât şi automatizarea acestora. Pe lângă studiul de material, geometrie, se va avea în vedere şi solicitările la care este supus produsul ce se recondiţionează.

Sudarea cu arc electric în general şi în special cea în mediu de gaze protectoare MAG în regim mecanizat are un grad ridicat de aplicare permiţând utilizarea la o gamă diversificată de materiale şi de produse de regulă cu geometrie cilindrică.

Particularităţile lucrării şi contribuţia autorilor constă în modul special şi pragmatic de a realiza o conlucrare tehnică dintre dispozitivul pe care se fixează piesa supusă recondiţionării, sursa de sudare şi operatorul care coordonează această operaţie.