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RESTORATION OF WORN OUT HOLES OF PIVOT JOURNALS OF TROLLEY – BUSES OF CITY ELECTRIC TRANSPORT

The efficient technology of restoration of wear surfaces aimed at prolongation of pivot journals of trolley-buses. Department of wear resistance enhancement and tool kit.

Key words: *pivot journals, overlaying, wear resistance, flaw, flaw detection, restoration technology, modernization of the equipment.*

Introduction

City electro transport is the backbone of transport system of the majority of cities of our country, providing the stability of passenger transportation. Its operation depends on reliability of units and components. In spite of constant renovation of transport facilities, greater part of trams and trolley – buses available at over transport companies have been used for decades. Naturally, many components exhausted their the limit of service life due to the wear of working surfaces.

Replacement of such components is, a rule, rather economically non- expedient, and in many cases, practically impossible, since they are not manufactured.

Optimum solution of the problem in such cases is the restoration of the worn out surfaces of the components.

Problem set - up

One of such elements is pivot journal of trolley-bus. Vinnytsia municipal company of transport put forward the task of restoration of this piece. This problem was successfully solved at the Department of wear resistance of Vinnytsia National Technical University Technological process of worn-out surface of pivot journal, restoration one of the main component of the mechanism of the steering system of the trolley – buses is developed and implemented in practical realization. The reliability of the technological process influences failure – free performace of the transport vehicle and provide safety of transportation of the passengers. Pivot journal is installed at the front beam of the trolley – buses across the pivot, which serves as its rotation axis. To decrease the effort, needed for change of wheels motion direction, two plain bearing and ball bearing are used. The material, the piece is made of – steel YOX GOST 4543 – 71, hardness HB 241 – 285.

In the process of the operation several flaws of journals surfaces, influencing safety of motion, value of wheels turning force and wear resistance of tyres emerge.

The most dangerous are damages of root thread, wear of necks for hub gland, wear of the holes for pivot bearing. Values of surfaces wear are measured by means of gauges and micrometers. The presence of flaws can be detected by means of ultrasonic flaw detector and magnetic – field flaw detector. The realization of the holes restoration for pivot bearings installation is the most difficult operation.

Technology of the holes surface restoration

After testing several variants of technological process, we have chosen the following technology of holes surfaces restoration: rough boring of surfaces being reconditioned; overlaying of the hole surface 1; (Fig 1); rough boring of reconditioned surface 1; overlaying of the hole surface 2; finishing of surfaces 1 and 2; quality control of the restorted layer. Rough boring is performed in order to eliminate surface flaws of the holes in the form of micro cracks, traces of corrosion and other types of wear. Such machining allows to restore regular geometric forms of surfaces, before applying coating, i.e. to eliminate conicity , etc.

Performing of such machining directly before applying coating using the method of overlaying

or plasma spraying allows to minimize the thickness of surface oxides on the surfaces being reconditioned, improve the characteristics of conversation zone between the coating and the blank, perform deoxidization of the welding bath. For this operation pivot journal is placed in special fixture (Fig 1) on the boring machine. The blank is installed on the pin prism. In this case holes for pin bearing are machined one by one, moving the blank and changing fixing elements.

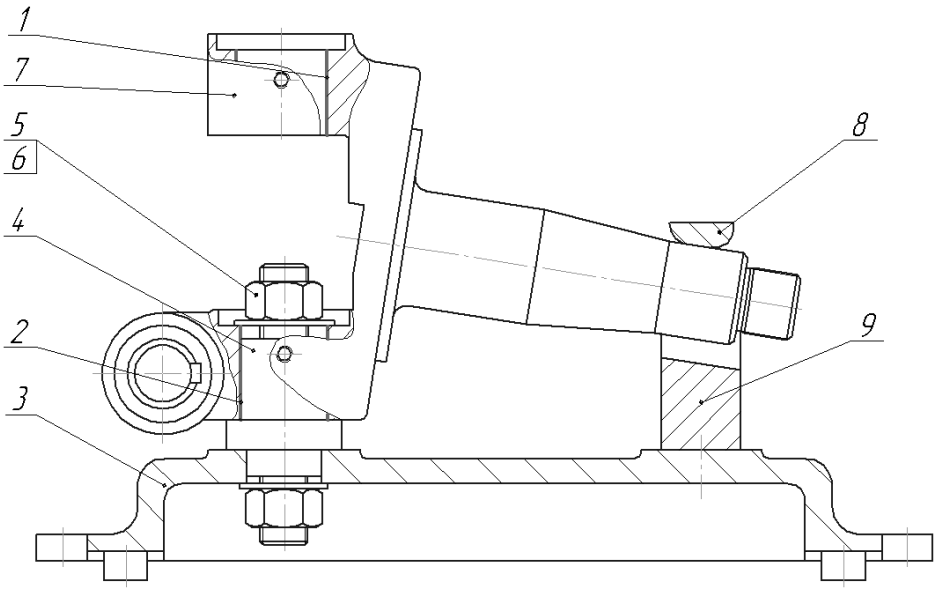

Fig 1 Technological attachments for pivot journal boring: 1,2 – holes being reconditioned; 3. plate of the fixture; 4. adjusting pin; 5. washer 6 nut; 7 pivot journal; 8. clamping plate; 9. supporting prism

Recondition of prepared surface is carried and using overlaying method in carbon dioxide environment. This method has advantage over the methods since in this case, there is no need to use flux or coated electrodes [1]. The arc between electrode wire and surface being reconditioned burns in the environment of the protective gas, which substitutes the air from overlaying zone and protects molten metal from harmful influence of atmospheric oxygen and nitrogen.

Automatic overlaying in carbon dioxide environment has the following advantages; lack of harmful emissions and solid slag; open arc allows to observe and make correction in the process of coating application; the process can be realized in any location of the overlaying surface. In order to adapt the existing equipment (BDY - 209 set) intended for overlaying of the worn out surfaces of the pivot journals holes, rotation unit 1 (Fig 2) with mandrel 2 for fixing blank, is installed; Overlaying head 9 for supply of electrode wire is modernized [2].

Set BDY – 300 is used as the source of power supply, also standard heating and protective gas supply system 4; ventilation system 5 are used.

Wire H n – 30XRCA is used for overlaying, the wire is supplied from the cassette 8 in overlaying zone across head 9.

The diameter of wire for overlaying operation is 1,2 mm. Overlaying is performed along helical line, provided by the rotation of the blank and longitudinal motion of the head: Fig 3 shows the general view of the overlaid surface of the hole.

After overlaying of the hole 1 surface its boring is performed. It allows to place the blank in the mandrel (see Fig 2) for overlaying the surface of the hole 2 and provides further alignment of the holes. Application of the coating on the surface of the hole 2 is performed similar to overlaying of the hole 1 surface.

Quality control of the of the applied coating is carried out during several stages. After overlaying operation and rough burning, visual control of surface flaws – cavities, cracks, pores, etc., is performed . The lack of the flaws in the metal layer is controlled by electromagnetic or

vibroacoustic methods [3].

Such types of control are performed for each of reconstructed surface of the lot of pieces. Additionally micro structural analysis of reconstructed surface is performed.

For this purpose, the faulty piece which cannot be reconstructed due to available cracks, chippings, etc., is taken from each lot. The process of the surface reconstruction of the holes applying the above – described technology is carried out, further reference micro section metallographic specimen, intended for micro structural analysis is manufactured. The analysis is carried out using electronic microscope РЭМ-106И

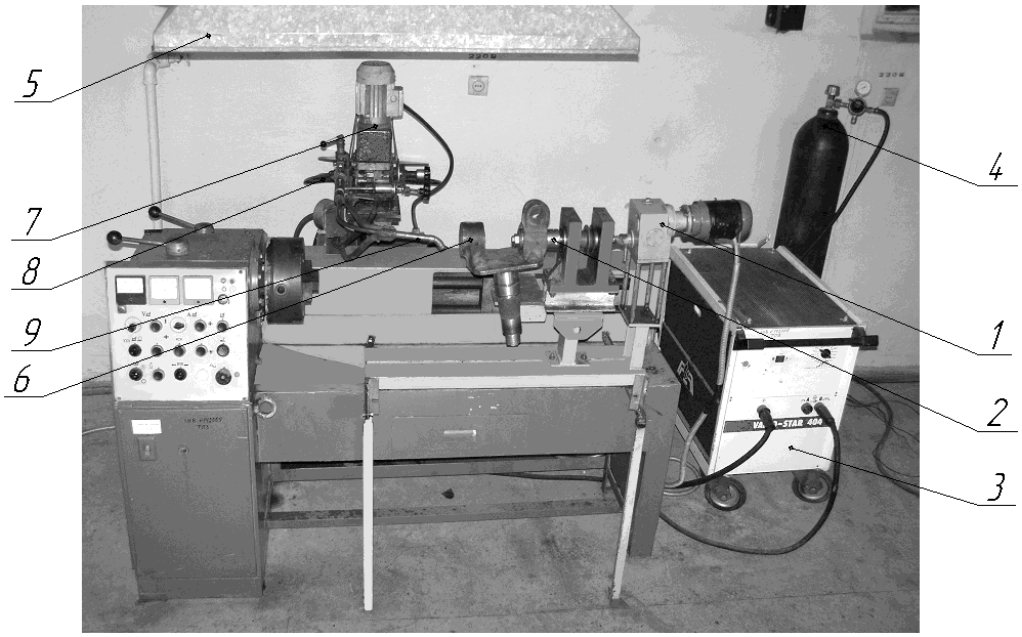

Fig 2 Installation for overlaying of the pivot journal holes of the trolley – bus
1.- rotator; 2. – mandrel for the blank placement; 3. – power supply; 4. – system of the heating and protection gas supply; 5. – ventilation system; 6. – reconstructed piece; 7. – electrode wire feeding system; 8. – feed reel; 9. – overlaying head.

Fig 3. Reconstructed holes G = 8 l / min

Pivot journal holes of ЗИУ-9 trolley – buses overlaying modes:

Thickness of the overlaying layer h = 3 mm on the side;

Strength of current I = 100 A;

Voltage U = 20V;

Overlaying step S = 4 mm;

Piece rotation speed V_p = 3 rpm.

Wire feed speed S_w = 136 m/ h.

Carbon dioxide consumption

The results of micro structural analysis are shown in Fig 4 and 5. General analysis of the micro hardness of the basic metal of reconstructed piece and its structural analysis (Fig 4) proves minimum thermal influence while its overlaying. The coating layer (Fig 5) has hardened fine grain structure with the hardness of 50 HRC, that provides the enhancement of wear resistance.

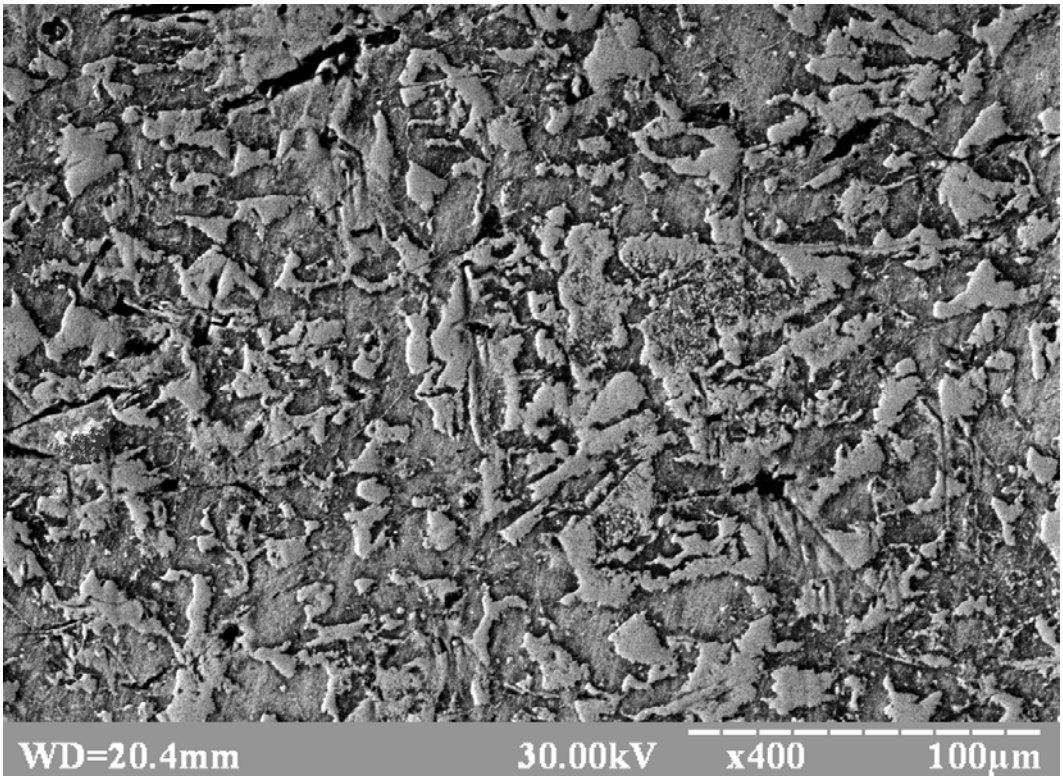

Fig 4. Microstructure of the blank metal.

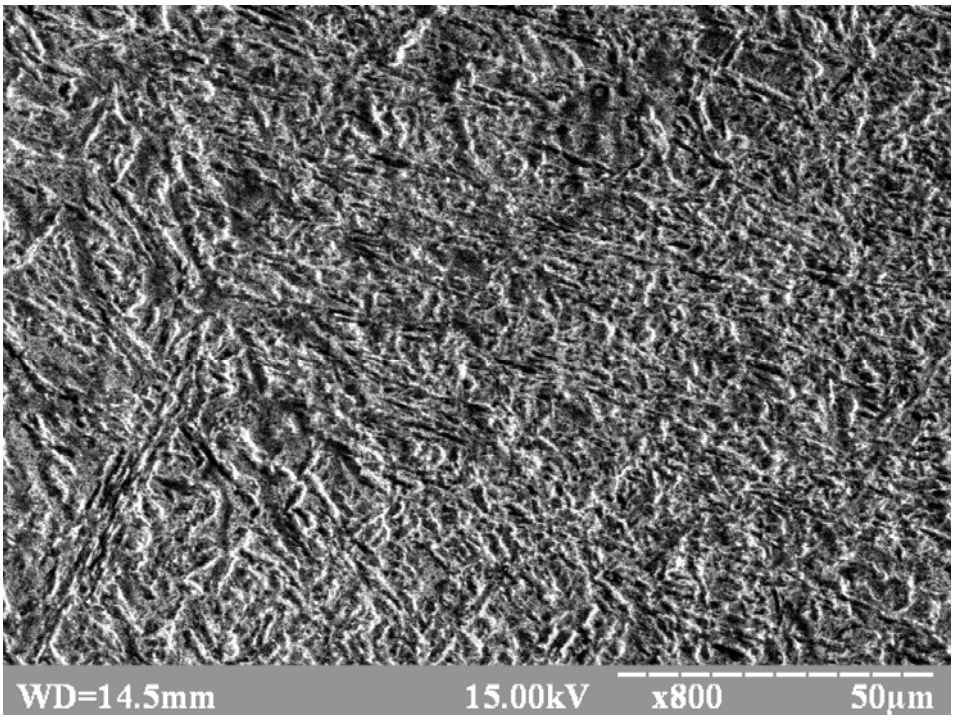

Fig 5. Micro structure of applied coating layer.

Conclusions

The result of the analyses: micro structural tests, hardness measurement test, electromagnetic, vibroacoustic, wear resistance tests showed the expedience of the usage of automatic overlaying in carbon dioxide environment for reconstruction of worn out surfaces of pivot journal holes of the trolley – buses of city transport.

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