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Rebuilding Routes of Rolling Using a Specialized Installation by Build-up of Welding

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Abstract

This article presents a specialized facility, automatic loading related to rebuilding over large distances, tens of meters, running routes used both in industry, technology bridges of industrial halls and those used for passenger transport, tram rails, or train. In addition to these issues are shown and drawn from: the type of track and place of wear.

Key words: *reconditioning, rails, mechanized installation*

Introduction

The present article refers to the conception of some feasible technologies and to the achievement of a mechanized installation, designed for reconditioning by build-up welding of the rails used in the railway transport, local urban transport, the cranes' railways, overhead cranes or of any other installations that move on rails.

The installation presentation is taken from the Invention Patent no. 117836 of 23.07.2001, "Automatic installation for rebuilding by welding of rails used", by Gârleanu Gabriel, Măzăreanu Gheorghiță and Dedu Ion.

With the help of this automate welding installation it is possible to revamp not only the grooved rails, made up of a bottom rail base and a vertical rail web, but also those made up of a rolling head and a guiding head having in between the rail's ditch.

Requirements – Technical Problem:
inexistence of a specialized automated device for reconditioning by build-up welding on long worn parts of different types of rails, without sequential interruption of the welding process (the process is interrupted only when the filling material ends – of wire – or accidentally), applicable especially for rails in a curve. As the bogie is fix (it cannot turn), when the direction of motion of the train or tram is changed, the rail is subject to friction by the bogie wheels on the inside part of the rail. When the weariness is so high that the traffic is endangered, the rail is usually reconditioned or replaced. Replacing a rail entails certain disadvantages.

The welding tractor for circular and linear welding is well known and with this installation the adjustment of the parameters is achieved through a control panel. The technical problem solved by this installation is that of achieving an automate installation for reconditioning the worn out rails by build-up welding, which would assure the welding seam continuity according to the rails' geometric configuration modification or to the weariness degree.

The rolling railways are subject to different mechanic stress types such as: compression, shock, abrasion, fatigue, bending stress, etc. Due to such stress, within 1-5 years the rail weariness occurs, which leads to the necessity to replace the rail. Depending on the place the rail is going to be used and the maximum stress degree, a certain type of rail is chosen.

As far as the geometrical configuration of the rail cross section is concerned, the following main rail types are distinguished:

- grooved rails – are rails with rolling head (double headed rail), a guiding head, having in between the rail's ditch, and which have in their profile competence rail web and rail base – it is generally used with the crane runway.
- rails without ditch - are rails that have only a rolling head (double headed rail) rail web and rail base – they are generally used for the crane or overhead crane runway and for the train railways. A few types of rails currently used are: S49, S54, R65, A65, S700, S800, S900.

Generally, depending on their employment, the following types of rail weariness could occur that can be reconditioned by build-up welding:

- lateral weariness
- vertical weariness: - general – continuous
- local (dish)

The effect is even more obvious in the rail joint area where besides the redundant stress there is also a quite intense shock stress that in time leads to dishes occurrence (rail dishes).

In order to solve this problem it is recommended to use materials with a chemical composition and such mechanical properties that would restrain the occurrence of the above-mentioned effect. From this point of view, the most reliable steel is the manganese steel, especially the austenitic manganese steel that assures the following properties:

- increased hardness, especially after cold hardening – approximately 400 HB;
- steel structure anchorage based on the chromium carbide and manganese carbide formation which restrain the carbon migration from the superficial layer;
- high tenacity, meaning increase of mechanical shock resistance- especially favourable to rail joints;
- assuring a high impact resistance value, removing this way fine rail breaks;
- abrasive wear resistance increase, due to steel scuffing, effect that occurs especially due to wheels skidding on the rolling railway, when starting/stopping or changing direction;

Due to economic saving strategy most of the railways parts are manufactured of carbon steel or low alloyed steel, with or without thermal treatment except some special parts such as rail tongues, frogs, etc that can be manufactured of high alloyed steels (austenitic manganese steel).

As it can be observed the steel used for the manufacture of the rolling railway components has a very high carbon content, which, together with the manganese content, leads to a mechanical resistance and the hardness necessary for these parts.

The optimal solution is to manufacture the rails of carbon steel of common type as far as the chemical composition is concerned, and to build up the contact stressed areas using austenitic manganese material.

The solution is even more efficient as the rail is built up with welding after wearing. Thus the lifetime will increase approximately 3-4 times.

Current State

Currently this reconditioning is achieved by build-up welding using the following methods: welding with coated electrode, semi-automatic welding MIG/MAG, with tubular wire and SAF, the use of some devices that perform the build-up welding, but on relatively short lengths (maximum 2-3 mm) in the case of semi-automatic welding.

Disadvantages:
- low productivity (0.5 – 1 ml repairs/hour) by one team: 1 welder + 1 locksmith,
- high probability in the occurrence of method's specific flaws; the quality of the work depends on the welder's skill and his physical and psychical state;
- the surface resulted after welding presents numerous geometric discontinuities, buffing works being necessary in order to obtain the corresponding geometrical configuration;
- numerous geometric and structural discontinuities occurrence at the joint sequence between 2 adjacent reconditioned areas (due to short welding seams);
- high degree of welders' physical and psychical stress, continuous monitoring and adjustment of process being necessary;
- ample and costly labour protection measurements;
- supplementary measures in order to maintain the additional material quality (electrodes calcinations, material holding in drying cabinets, use of hydro-isolating coats)
- supplementary costs occur due to the use of protection gases (storage, handling and consumption).

Results - The Installation

The installation is made up of a movable carriage that moves on the railways with the help of a driving mechanism, on the movable carriage being mounted: an electronic device for automate adjustment of the working parameters, a control board, the welding equipment as well as a device for continuous positioning and adjustment of the burning head (see figure 1).

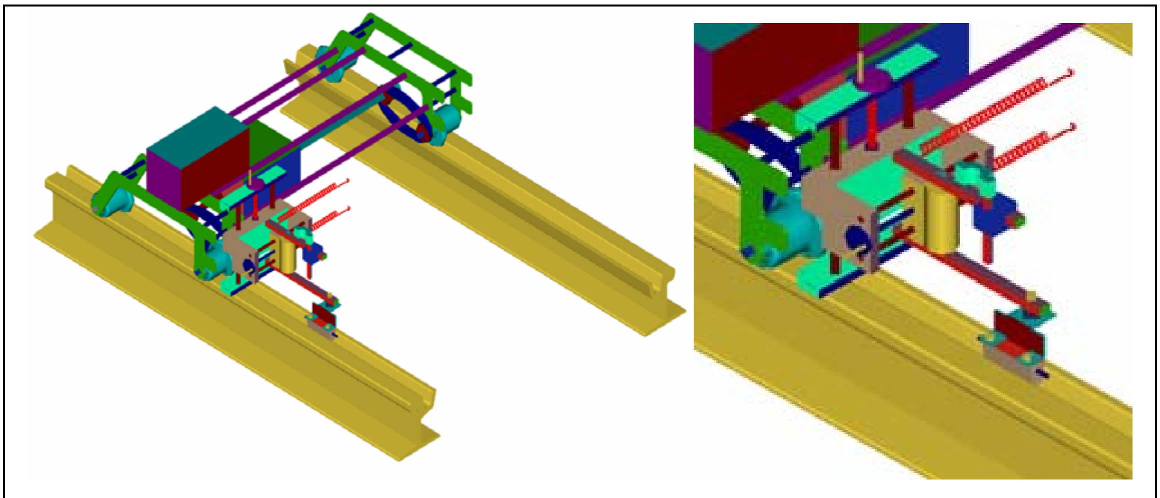

Fig.1. The installation by build-up of welding

The continuous positioning and adjustment device, which can be positioned both vertically and horizontally, consists of a roll – a forked lever that sustains two arms, upper and lower, on which the burning head and the proximity sensor can be positioned and also a crosshead slipper for sustaining the melted steel bath and for tracking the rolling rail that is being reconditioned, and which assures the continuous positioning of the burning head. (See figure 2)

Moves parts of the device are shown schematically in figure 3 and Position welding torch and copper patina inside the track channel can be seen in figure 4

For the welding process several types of welding material have been used; they were all tubular wires with self-protection.

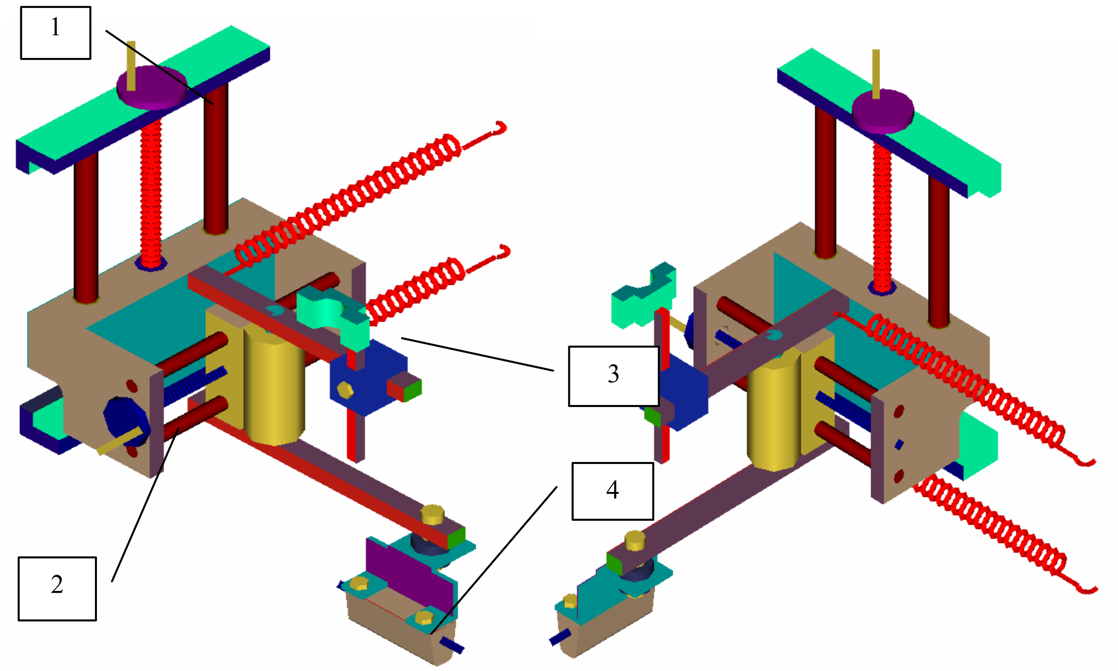

Fig. 2. Positioning and adjustment device
1 - Clamp for vertical positioning of the torch, 2 - Clamp for horizontal positioning of the torch
3 - Catch member for the torch, 4 - Copper guide track

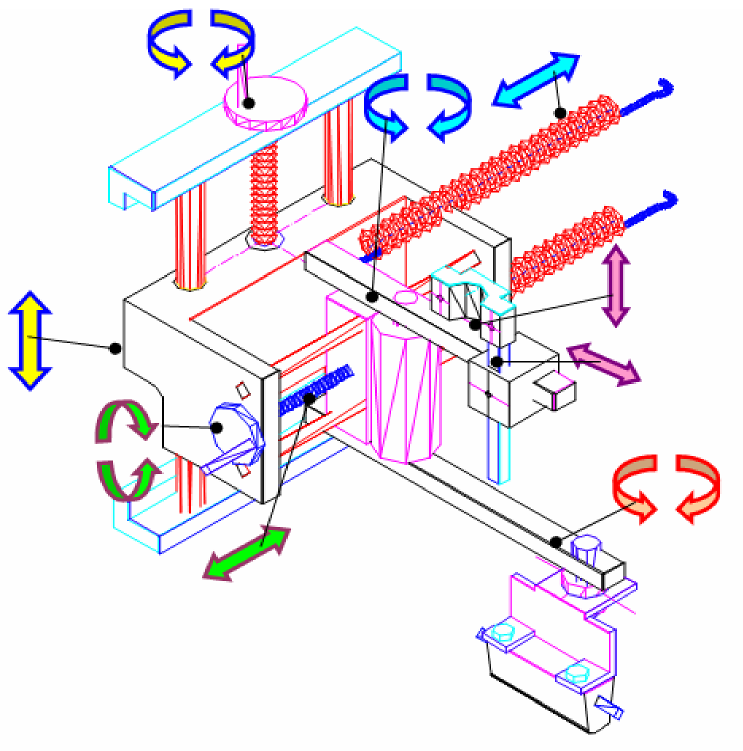

Fig. 3. Moves parts of the device

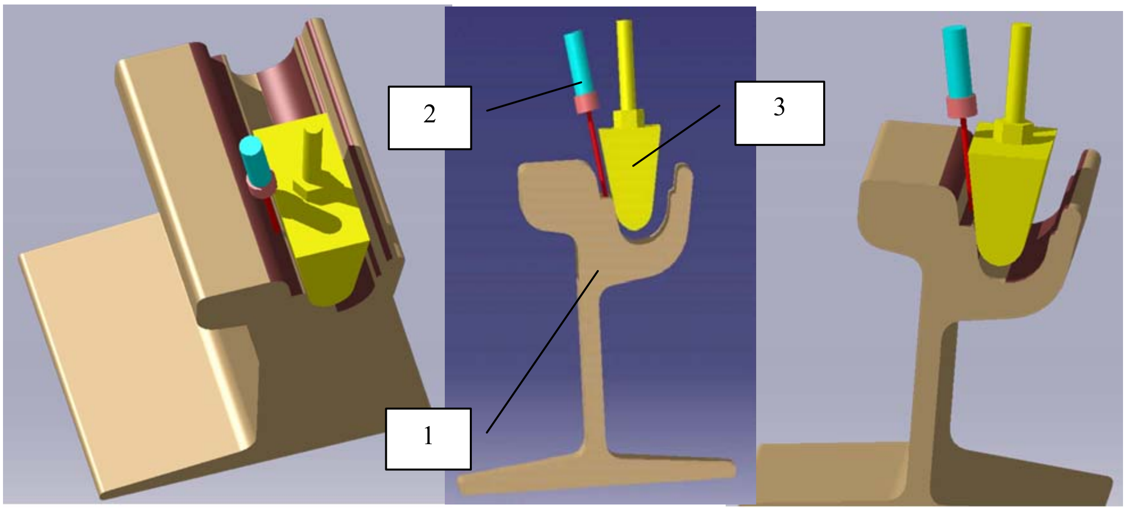

Fig.4. Position welding torch and copper patina inside the rail channel
1 - Rail, 2 - Welding torch, 3 - Copper guide track

The advantages of the device are:

- high productivity, the process being limited only by the degree of adding laying material and of the used process;
- the quality of execution doesn't depend on the welders' skill and his physical and psychical state;
- in case of reconditioning the lateral weariness, by using the bath sustaining crosshead slipper, a corresponding geometry of the reconditioned area is assured, only a superficial polishing being necessary;
- high efficiency of the additional material use;
- the possibility of reconditioning on long distances, actually limited only by the length of the area to be reconditioned or the existing quantity of additional material on the installation when beginning the operation;
- being a completely automate method, welders' supervision is being made at intervals, no adjusting being necessary during the welding process, in this way decreasing welder's stress degree;
- the number of labour protection measurements is decreased;
- the installation has a solid construction, its movement is achieved only on the rails that are being reconditioned, presenting no shock risks that could affect its good operation;
- the risk of professional diseases decreases due to the intermittent supervision of the process, as the operator is at a corresponding distance;
- the possibility of having automate welding mode parameters adjustment depending on the weariness value variation on the rail length, obtaining this way the corresponding geometric configuration and productivity increase.

A grooved rail, the worn out area and the laid material are presented in figure 5 below.

Figure 6 presents 2 grooved rails, a worn out rail, before reconditioning (left) and one after reconditioning (right).

The welded samples were tested in an authorized lab and the results were more than satisfactory, resulting a special material quality with metallic structures that behave very well at steel-to-steel scuffing and don't present flaws (pits, cracks, lack of melting).

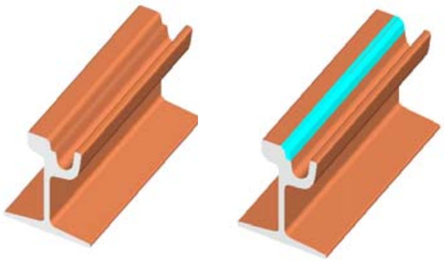

Fig. 5. A grooved rail, the worn out area and the laid material

Fig. 6. A worn out rail, before reconditioning and one after reconditioning

Conclusion

With the help of this technology rails in curves can be reconditioned very conveniently – a cost saving method, the costs ranging between 25 and 40% as compared to those implied by replacing the rail. The metal layer is more resistant than a new rail and reconditioning can take place several times. The lifetime of a rail may be increased 2, even 3 times after a reconditioning process and the costs for achieving the welding equipment are quite low.

Using this type of equipment and this technology, over 50 km of tram rail have been reconditioned since 1999 in Bucharest.

Recondiționarea căilor de rulare utilizănd o instalație specializată de încărcare prin sudare

Rezumat

Articolul prezintă o instalatie specializată, automată, de încărcare prin sudare pentru reconditionarea pe distanțe mari, zeci de metrii, a căilor de rulare utilizate atât în industrie, podurile tehnologice din hale industriale, cât şi a celor utilizate pentru transportul de călători, şine de tramvai, sau tren. Pe lingă acestea sunt aratate şi problematicile desprinse din: tipul şinei şi locul uzurii.