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System for diagnosis of rolling profiles of the railway vehicles

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ABSTRACT

A computerized system for monitoring and diagnosis (*Profilograph*), which is capable to predict the wheel profile evolution, was developed. The S78 and UIC-ORE types of profiles were tested, for which the wear parameters are monitored. The main parameters that characterize the wear profiles were measured and analyzed: S_h—flange height, S_d—flange thickness and q_R—flange slope quota. The tests were executed on the basis of UIC norms and regulations. The diagnosis, gives technical information about the wheel profile, based on which, the following corrective mechanical actions should be taken: *re-profiling*, *invalidation* or *parts replacement* (in case of bandage wheel profile).

1. Introduction

Wheel and rail wear, is a fundamental problem in the railway field: the change of profile shape deeply affects the dynamic characteristics of railway vehicles, such as stability or passenger comfort and in the worst cases, can cause derailment of the train [1–6]. It is therefore of great economic relevance, to develop a system able to predict the wheel profile evolution, due to the wear process, since it could be used to effectively evaluate the wheel, at maintenance intervals, to optimize the wheel and rail profiles, with respect to wear and to optimize the railway vehicle's suspensions with new and worn wheel profiles.

Railway administrations have experienced with profiles of different coning for the rolling surface, with the objective to find an optimal solution, which guaranties the security of circulation and assures a good displacement quality of the vehicle. The most known conical profile, was the normal profile, UIC with standardized shape and dimensions on international plan, Fig. 1.

The unified wear profile, named UIC-ORE profile, is valid at any wheel diameter (between 330 mm and 1000 mm for trailing vehicles), and for any type of construction of the vehicle, with or without oriented axis. Other important wear profiles, realized in the European countries are: ORE C9 profile for UIC rails canted with 1:40; R-SNCF profile for UIC 60 rails canted with 1:25 – 1:20, introduced for motorized and towed vehicles; RD 6-BR profile for British rails towed at 1:20 [7]. Many countries, have adopted a part of this profiles, adapted to their own needs, other countries elaborated their own profiles. The special profile, S-78 profile, is used for wagon wheels, endowed with obligatory UIC flange, Fig. 2.

After several studies and tests, it was determined that the wear of the wheel, can be influenced by one of the following parameters associated to the vehicles, track characteristics, and service conditions: primary suspension stiffness, rail cant,

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0888-3270/

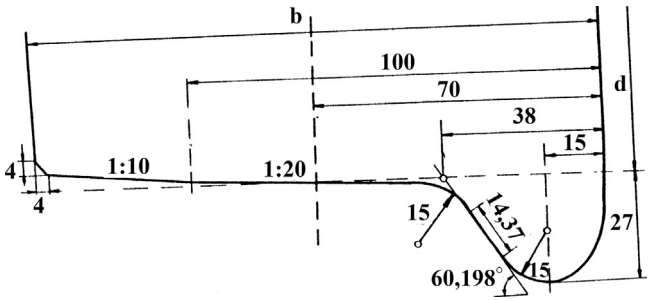

Fig. 1. UIC normal profile.

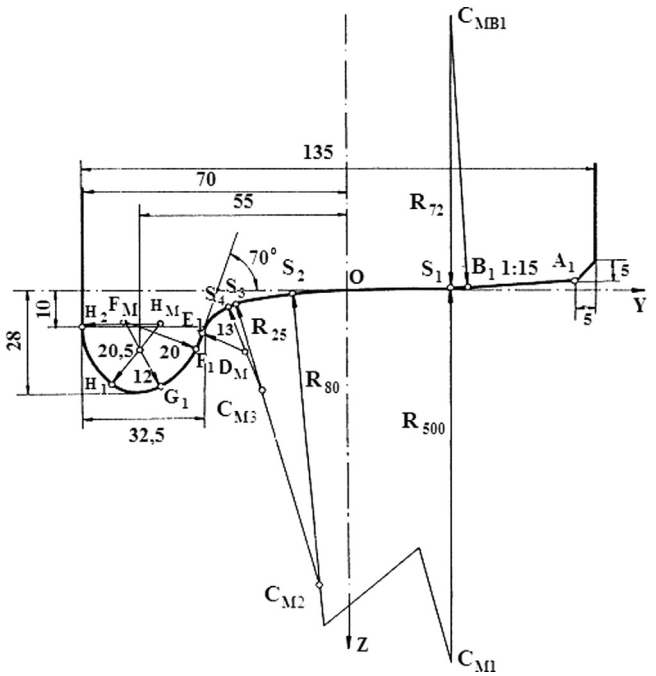

Fig. 2. S78 profile for wagon wheels with diameter between 760 mm and 1000 mm ($V_{max} = 160$ km/h) adapted to UIC 510 file.

traction/braking forces, velocity, train set design, track layout, friction conditions and wheel flange lubrication [1,2,9]. A common method for wheel wear geometric analysis is provided in the UIC 510-2 codes [10].

In the railway field are known different types of devices for the measurement and drawing of the rolling profiles, for the railway vehicles, which measure the wear, statically or dynamically.

In the following lines of the paper, are described the most used systems, in railway industry, that measure statically the wear profile parameters, similar to the computerized system Profilograph.

Therefore, exists a measurement and analysis system, which assures the measurement of the rolling profile of the wheel, by mechanical palpation of the profile. This type of system, assures a reduced measurement precision and due to the complexity of the palpation device, the profile measurement, can be realized only in the repairing shop (with difficulty on the mounted wheel—preferable on the wheel or bandage unassembled). The acquired data, is transmitted to a computing system and with the help of a dedicated software, draws and analyses the rolling profile [15,18].

Another type of system, uses as measurement device of the rolling profile, a high resolution video camera. In order to draw the rolling profile, the images received from the video camera, requires a complex processing and the price of the system is high. An advantage of this system, is the possibility to measure the rolling profile, in dynamic conditions (in the time of displacement of the railway vehicle) [14,16,17]. A measurement and analysis system of rolling profiles, similar to the computerized system Profilograph, presented in this paper, has as a measurement device a laser sensor. The system is portable and fixed on the lateral side of the wheel. For measurement, the sensor is rotated by hand, in order for the laser radius, to displace along the wheel width. The data acquired from the sensor, is transmitted to a computing system, where after processing, the measured rolling profile, is drawn and analyzed. It must be underlined, that this scanning method of the profile, introduces measurement errors, caused by the following factors: the reading is not linearly realized and because of the manual displacement of the sensor, the measurement is not repeatable [19].