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Wear Analysis of Pivot Pin Housing of Electric Locomotive

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Abstract:*Railway system in India plays a dynamic role in shipping. The demand of lengthen facility life and dependability of the various component are always mirrored as serious issue. The module of the study has been obtained from the Central Railway, Electric loco shade Bhusawal. In the current study the failure of Pivot Pin is explored. A study embraces failure of Pivot Pin. Pivot Pin are exposed to Tractive and Braking effort. Still the failure is owing to wearing amid the sleeve and housing of WAG-7 Electric Locomotive. Electric Locomotive WAG - 7 of Indian Railway used for goods carter and sustained at Bhusawal Loco Shed of Central Railway. There are many modules in the traction power system, from edge with effectiveness distribution network to associates with trains, and they are tangibly located along the rail line. Focus to usage, environment, and mature conditions of components worsen with time. Systematic maintenance has to be carried out to reinstate their conditions and check them from failure. However, the judgments on the suitable length of maintenance intermissions often lead railway operators to the problematic of reducing both risk of miscarriage and operation cost. In the previous 20 years, there has been a huge rushing in railway traction enlargement. This has run similar with the growth of power integrated circuit technology and microchips. By this explosion, we carry to you all the noticeable topographies and all main features of pivot pin and housing type Electric Locomotive (WAG-7).*

Keywords*: WAG-7, Locomotive, Pivot Pin Housing, sleeves.*

I. Introduction

Due to inadequacy of energies like coal, diesel and petrol and also due to growing conservational greenhouse gasses, electrification in the railways developed a necessity. By electrification the following benefits can be gained:

1. A pollution permitted environment,
2. Calm and economy maintenance,
3. Saving of critical fuels like coal, diesel etc.
4. Faster, closer and contented conveyances,
5. Charming starting and stopping.

The leading locomotive was developed by Cornish inventor Richard Trevithick in 1804& the style of locomotives started by vapour engines, in addition settled to diesel engines, which ruled the period for pretty long time. The diesel engines were identical and abundant flexible plus would have a significant hauling power related to the vapour ones. But a harsh change subjective the railways with the discovery of electrically functioned locomotives.These locomotives at the launch mandatory restriction to be rewarded, which remained to run electric power constantly existing for the locomotive. This grabbed interval and even a vast speculation to fix electric supply lines all over the zones and also offer adequate and precise amount of influence for the loco everywhere it goes. The railway also had to fix the sub-stations to enhancement up the muscle. Railways employed the agreement with state electricity boards, with approval of NTPC which would deliver railways a dependable and repeated clout [1]. After the constrictions stood satisfied, the developing power-driven locomotives came into requests. The new creation upgraded the effectiveness of the railway organization and furthermore decreases the effort of the individual driving the locomotive. Slender amendment ended the system additional and additional capable and elastic, which received massive incomes in the railway segments. Now, the railways have to exceed the need of entirely electrifying the system so that the locomotive can track all over.

The Locomotive is virtually the sole accountable for the flat consecutively of the entire rail vehicle. It‘s for the reason that all locomotive is being squared by loco shed section for each 45 days and the care is scheduled for certain stages. The primarily established locomotives used energy converters, which would transform the received AC control to DC control and feed to DC motors. The fresh microchip controlled

locomotives take the AC power and nourish the harsh AC induction motors by power adaptations norms these locomotives have exceeded all hardships and also administration smoothly as of now. It has been anticipated that the new locomotives would exchange the old ones with its benefit and relief for the driver[3].

Sneha V.Pawade 2014[1] studied that failure of one of the mechanisms of traction link (Pivot Housing). She presents theoretical and finite element analysis (FEA) results for the pivot housing assembly which predicts the failure load and determines ultimate failure strength.

Manoj A. Kumbhalkaret. al., [2] studied that, failure investigation of helical compression spring with the material analysis by experimentation for chemical composition for different failed specimen of springs using spectrometer. It is continued to the stress analysis with respect to the mechanical properties of material by analytical and finite element analysis at various loading conditions. The material and stress analysis revealed that the failure occurs due to design incompetency by increase of stresses at curvature and at maximum tractive efforts at various speed.

AmolY.Chaudhari, Prof.R. D.Patil[3] studied that ,Rail joint is the critical section where induced fatigue stresses are maximum due to the presence of bolt holes where the cross-sectional area is minimum. These holes may causea major source off atigue cracking when high shear load sare transferred through the joint.This makes the joint weak and ultimately the critical site for failure.The process introduces are gion of compressive residual stresses around the hole, which attenuates fatigue crack grow thrates by reducing the effectivestress. Mandrellizing expands the hole diameter by means of the radial interference pressure to all owradial plastic flow of material and some elastic recovery after the removal of mandrel. Thusit produces a large residual compressive zone around the hole.This zone acts as a barrier to crack growth thereby enhancing the service life of the structural components.

VivekkumarGupta [4] studied that,"Rail wheel interaction is a complex phenomenon and is fascinating the imagination of Railway Engineers and travelling public since inception of Railway. It requires more insights when complexities of diversion in form of curves or turnouts are superimposed. Not much basic work has been done in India in recent past on the issue resulting in ambiguous understanding of the concepts even to Railway P Way Engineers. This paper is meant to discuss basics of rail wheel interaction mechanism in context of negotiation of curves and turnouts by railway vehicles. The issue assumes greater importance in context of introduction of higher axle loads and requirement of negotiation of curves and turnouts at higher speeds.

II. Problems Identified In Pivot Housing

Since after introduction of WAG-7 locos, pivot pin wear cases due rubbing of steel sleeve of housing were noticed. To arrest them an additional steel sleeve over a pin modification was successfully implemented. Although the pin is get well protected thereafter, but the following perennial problems are still persist [6]-

1. Mutual rubbing wear between inner sleeve (of pivot pin) & outer sleeve (of rubber-metal ring of housing assembly.)
2. Bond breakage between rubber ring & steel sleeve, leading to dislodge from the housing.
3. Breakage of bolts of pin holding bottom plate.
4. Ageing/ cracking of rubber ring.
5. Dropping of housing in a bogie frame pivot cage due to above problems.

III. Analytical Analysis Of Pivot Pin Housing

Pivot Pin is used to hold the locomotive body and the frame together.The Pivot Pin is Located on the locomotive body & and Pivot Hosing is located on the frame. The material used for Pivot Housing is Steel. Rubber and Mn-Steel sleeves are used to implicit the gap between Pivot Pin & Housing. The Pivot Pin is subjected to Breaking & Tractive Effort. The material considered for Analysis of Pivot Pin Housing is Polyamide.

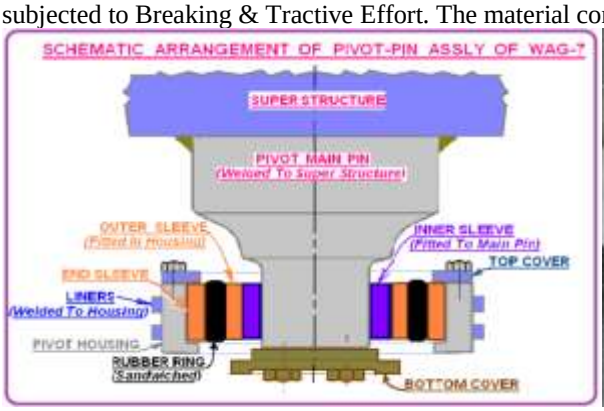

Fig.1: Actual Pivot Housing [5]

Fig.2: Schematic diag. of Pivot pin Housing[6]

Table 1: Diameter of sleeve [5]

Sleeves	Inner Dia. (mm)	Outer Dia. (mm)	Thickness (mm)	Height (mm)
Pin				141
Inner Sleeve	213	230	17	110
Outer Sleeve	230	245	15	100
Steel Support	245	265	20	120
Rubber	265	321	56	110
Outer support	321	334	26	115
Structure	334	361	27	156

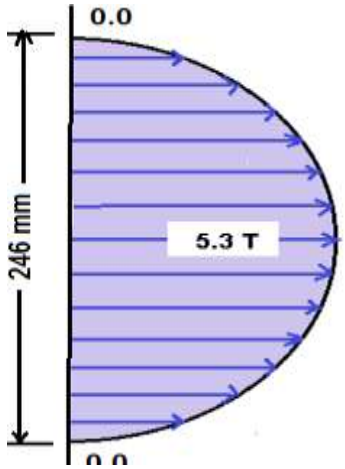

Fig. 3 Cut Cross-section of Pivot pin

Total load=AREA UDER CURVE
=TRATIVE EFFORT
=44T

Affected Area= $\pi * R^2/2$
R= 5.3T MAX LOAD

COMPRESSIVE STRESS AT MAXIMUM LOAD
=5.3*1000*9.81/65*100
=8N/mm^2

As limit of compressive strength for Polyamide Is 35N/mm^2[5]. The Polyamide material can withstand calculated compressive force due to tractive effort.

IV. Conclusion

From the above analytical study following are the conclusions to reduce wear of pivot pin housing sleeve:
1. Alternative material Polyamide is suggested on the basis of compressive properties.
2. Polyamide material sustain the maximum compressive load occurred due to tractive effort.

V. Future Scope

The loco has to tourism on the rails which have the joints and local abnormalities which carry the influence loads. Necessity of the design for propelling the loco on the curved track is also very dangerous. The same was authenticated using Analytical Analysis.It can be furthered analyzed by Finite Element Analysis.

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