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DESIGN AND ANALYSIS OF A NOVEL SLIP-POWER RECOVERY SCHEME FROM TRACTION MOTORS

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Abstract

The use of DC Series Motor as Traction Motor has been slowly phased out in the Indian Railways. The current technology is to make use of Three-Phase Squirrel Cage Induction Motor as Traction Motor as it has the advantages of ruggedness, high starting torque, better efficiency at higher speeds and easy method of speed control. At the same time, a Squirrel Cage machine requires high starting current for starting. A lot of power is also wasted in the Rotor Circuit because of 'Slip' as the machine does not run at Synchronous Speed. Comparatively, in a Slip-Ring Induction Motor, the Slip-Power can be harnessed to either drive Loads of lower ratings or fed back to the Supply resulting in savings of Power to a large extent. The use of Slip-Ring Motor as an alternative to the Squirrel Cage Motor is demonstrated in this paper.

Keywords: Efficiency, Electric Traction, Speed control, starting Torque, Squirrel Cage Induction Motor, Slip Ring Induction Motor, Slip-Power, static Kramer Drive.

Nomenclature: α = Acceleration in Kmph/ps; a = Constant representing mechanical resistance such as track resistance; b = constant to cover factors like flange resistance and internal friction of train; c = coefficient covering train resistance; D_w=Diameter of the Wheel im mm; F_a = Tractive Effort required for Acceleration; F_c = Tractive Effort to overcome Curve Resistance; F_g = Tractive Effort required to overcome Gravitational Pull; F_r = Tractive Effort to overcome Train Resistance; G = Gradient; G_r = Gear Ratio; HP – Horse Power; IGBT – Insulated Gate Bi-Polar Transistor; kW – Kilo Watt; *n*= no. Of Axles; r = train resistance in kg/tonne; R = Radius of Curvature in metres; s = Slip; t – time; *v* = Train speed in Kmph; W = Weight of the Locomotive; W_E = Effective Weight = 1.1 (W + W_T); Wt = Weight of the Trailing Load; WRIM – Wound Rotor Induction Machine;