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Design and Simulation of Alternate of Pneumatic Failure System

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Abstract: *Brake failure in heavy commercial vehicles remains a major contributor to severe road accidents, financial loss, and fatalities worldwide. Conventional braking systems, primarily pneumatic or hydraulic, are prone to failure due to mechanical wear, fluid leakage, pressure loss, or system malfunction. To address this critical safety concern, this paper presents the design and analysis of an Alternative Braking System utilizing a Wheel Packing Mechanism as a mechanically independent fail-safe solution. The proposed system features a robust stopper mounted above the wheel, which, upon activation triggered either manually or automatically by brake system failure detection, engages the tire's outer surface to create direct frictional resistance, thereby decelerating the vehicle. Unlike conventional systems, this design eliminates dependency on electronic, pneumatic, or hydraulic subsystems, ensuring high reliability during emergencies. The system's components, including the fender support, friction pads, hydraulics, and stopping mechanism, are carefully designed for high strength, heat resistance, and durability. Structural and stress analysis using CAD and finite element analysis (FEA) tools validate the system's capability to withstand operational loads and stresses. While intended for emergency use to avoid collisions during total brake failure scenarios, this Wheel Packing Mechanism offers a practical, cost-effective, and retrofittable safety solution that enhances the overall braking safety of heavy-duty commercial vehicles.*

Keywords: Brake Failure, Alternative Braking System, Wheel Packing Mechanism, Heavy Commercial Vehicles, Emergency Brake Safety

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