A BRAKING SYSTEM AND METHOD FOR EMERGENCY BRAKING

IITM Technology Available for Licensing

Problem Statement

- **Reliable emergency braking systems** reduce accidents and are essential for vehicle safety, in **heavy-duty and industrial vehicles.**
- **Conventional systems** such as pneumatic, hydraulic, electronic, and regenerative brakes provide effective braking. However, these systems **require regular maintenance and are prone to failures like leaks or software glitches.**
- Further, Pneumatic and hydraulic brakes suffer from complexity, **slow response times, and maintenance challenges**. Whereas, advanced systems like regenerative and electronic brakes **increase costs and introduce new failure risks.**
- There is a need for **a mechanical emergency braking system** that **improves reliability, reduces maintenance costs**, and offers a quicker, cost-effective, and efficient alternative to traditional systems.

Intellectual Property

- IITM IDF Ref 2909
- **IN 202441046447 Patent Application**

TRL (Technology Readiness Level)

TRL 7 System prototype demonstration in operational environment

Technology Category/ Market

Category- Automobile & Transportation

Industry Classification:

Automotive and Transportation; Electric Vehicle (EV) and Hybrid Systems; Railroad Equipment Manufacturing; Industrial Machinery

Applications:

Suitable for heavy-duty vehicles such as trucks and buses; braking applications in rail systems; challenging environments where pneumatic or hydraulic systems may be unreliable due to extreme conditions; vehicles with space constraints as system integrates directly into the axle, optimizing space utilization.

Market report:

The global automatic emergency braking market was valued at USD 74.68 billion in 2025 and is projected to grow to USD 134.41 billion by 2034 with a CAGR of 6.72%

Research Lab

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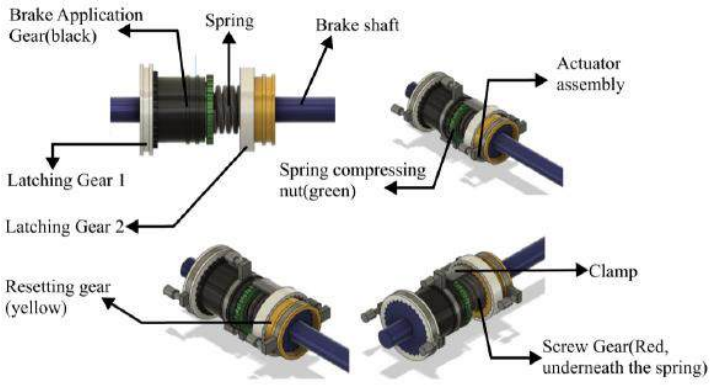

Figure: Diagram of the whole braking system

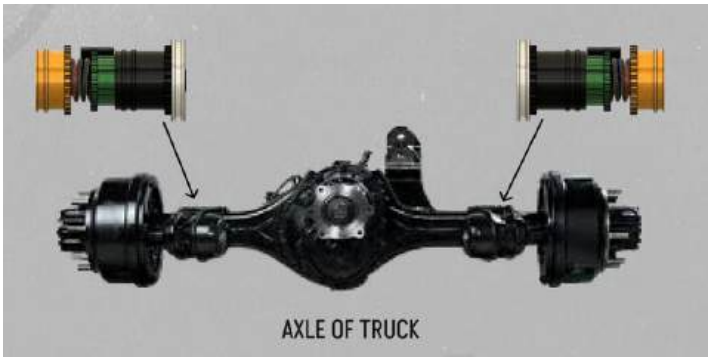

Figure: The position of the braking system on the axle of a truck

providing at least one brake shaft, replacing at least one axle shaft and connecting a differential to a wheel, ensuring coordinated movement and efficient force transfer during both braking and resetting phases

mounting a brake application gear on the brake shaft, initiating rotation upon brake application and transferring rotation from the brake shaft to a brake application gear.

connecting a spring compressor to the brake application gear through one or more grooves that enable linear motion.

fixing a screw gear on the brake shaft, placing a spring, and enabling for its compression when the spring compressor rotates

engaging at least one latching gear during the braking and resetting phases, respectively

engaging a resetting gear with the screw gear and the brake shaft during the resetting phase, enabling repositioning of the spring compressor and the screw gear to their initial positions after braking.

positioning an actuator assembly at critical points such as the latching gears and resetting gear, controlling the engagement and disengagement of these gears to initiate and complete the braking and resetting processes.

Figure: A method for implementing the braking system

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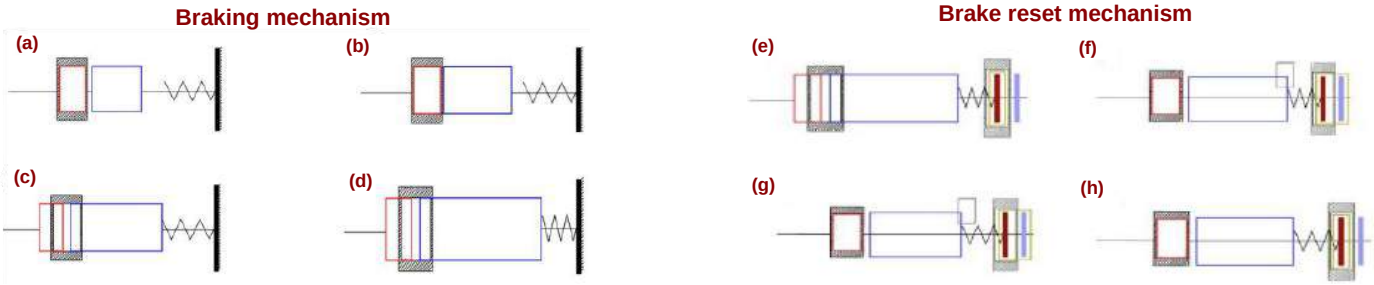

Figure: Kinematic analysis of the proposed mechanism:

When Brake is applied

(a) Initially, the system (all the parts) will be inactivated with the axle and the locking gear (Black) will always rotate at the same speed as the main wheel axle.
(b) When the brake is applied, the actuators will push the clutch gear (Red) toward the axle gear (part of the axle) which has a friction plate (Blue), that will rotate the clutch gear at the same speed as that of the axle.
(c) Then the locking gear will lock these two to make sure both will rotate together. Since the clutch gear and the spring compressor are connected (through inner groves) the spring compressor will also start to rotate
(d) The spring compressor (Blue) is on the screw gear, which will convert the rotational motion to linear motion, and as the spring compressor moves forward it will press the spring in order to stop the motion.

When Brake is reset

(e) The reset locking gear will be connected with the screw gear (which is kind of fixed) and the silver casing.
(f) After the axle starts rotating when the engine starts, the reset locking gear (Right Silver) will connect the screw gear and the axle gear. At the same time, the locking gear (Left Black) will decouple from the clutch gear.
(g) The clamp is pressed on the spring compressor to prevent the rotation motion that will unscrew the spring compressor
(h) At last, the reset locking gear and clamp will go into their initial positions

Technology

- Utilizes purely mechanical components (e.g., brake shafts, gears, springs) for reliable emergency braking, eliminating dependence on pneumatic or hydraulic systems prone to leaks or maintenance issues.
- **Converts rotational motion into linear force via a spring compressor and screw gear. Stops vehicles in 3.6–4.6 seconds, faster than traditional brakes.**
- Includes a resetting gear and actuators that restore components to their original state without external force, ensuring seamless reuse.
- Directly integrated with the axle, optimizing space utilization and reducing the complexity of installation in vehicles or machinery.
- Spring length: 165.3 cm, gear diameters: 7–23 cm, system components aligned for safety and efficiency, designed for heavy-duty vehicles, industrial equipment, and extreme conditions.

Key Features / Value Proposition

- Unlike pneumatic and hydraulic systems prone to leaks or air bubbles, the purely mechanical design eliminates these risks, ensuring consistent and dependable braking performance.
- The system avoids complex components like compressors and reservoirs, reducing maintenance frequency and costs compared to traditional pneumatic or hydraulic brakes.
- Immediate mechanical engagement upon activation ensures quicker braking compared to the pressure build-up required in pneumatic and hydraulic systems.
- Compact, axle-mounted integration minimizes complexity and costs, making it more economical than electronic braking systems, which involve sophisticated software and hardware.
- Operates entirely on mechanical principles, avoiding software glitches or electrical failures that can affect electronic braking systems. The system is ready for repeated use without manual reset intervention.

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