

Study on Hydraulic Regenerative Braking System Used in Hybrid

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Abstract : The consumption of fossil fuels is one of the biggest problems being faced by humankind presently. With the increase in the demand of fuel, as increasing productivity is the prime concern in day to day life, the natural resources are getting depleted at a faster pace and hence there arises the necessity to develop and innovate novel environmental friendly methods and technology that employs alternative energy source to power heavy moving vehicles and off road machineries which are being employed in different terrains. Hydraulic Regenerative braking system is one of the most researched and progressive area currently being applied in various machineries to address the issue of energy regeneration during braking. It is an eminent branch of hybrid hydraulic technology, having vantage of maximum power density and the potentiality to accept the high frequencies of charging and discharging. Relatively lower energy density and complicated coordinating operation between two power source required a special energy, control strategy to maximize the fuel saving potential. This paper takes into account the scope, advantage, limitation and application of hydraulic hybrids regenerative braking system of hydraulic hybrids regenerative braking system.

Keyword : Hydraulic hybrid, regenerative braking.

1. INTRODUCTION

The elementary idea of a Hydraulic regenerative braking system is that when the vehicle decelerate or braking is applied, the kinetic energy is converted into hydraulic energy, through a gear box connect a hydraulic variable

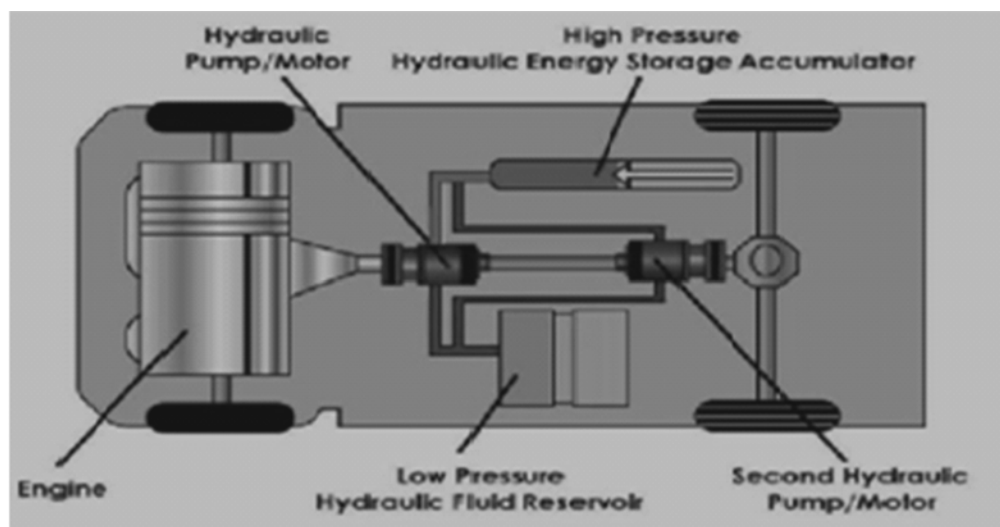


Fig. 1. Hydraulic regenerative braking system

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axial piston unit to the mechanical driven shaft .The axial variable piston unit operates as a pump and convert kinematic energy to hydraulic energy by loading a hydraulic bladder accumulator with hydraulic fluid and brakes the vehicles. During acceleration the entire process is reversed. The pressurized fluid is discharged in a controlled manner from the accumulator and flows back through the variable axial piston unit. The latter is driven by the fluid flow and acting as a motor, gives up its energy to the mechanical driven shaft and relieves the existing combustion engine. When the pressure is released the system become idle and the desired speed is achieved while accumulator is empty in order to maintain constant speed, the engine will engage , or to accelerate the vehicle beyond what the capacity of the accumulator was capable of. Fig 1 shows the primary construction of it [1,2].

1.2. Objectives

The main objective of this topic is to authenticate that a Hydraulic regenerative braking system can boost fuel efficiency of a vehicle by 32% during stop and go by ill waste of braking energy.

2. HYBRID BACKGROUND

2.1. Types of Hybrids

Hybrid vehicles are becoming more and more common in the auto industry. A hybrid hydraulics vehicle can be operated by using a primary engine and secondary energy storage device. While the most familiar vehicles are electric hybrid vehicles and have been commercially produced, for better hybrid option hydraulic regenerative braking system technology is being introduced. Parker Hannifin Corporation and Eaton Corporation such company can introduce the hydraulic regenerative braking vehicles introduced into the industry. Hydraulic regenerative braking systems are of two different types: parallel and series. In a parallel hydraulic hybrid drive, simply connects the hybrids components to a conventional transmission and drive shaft as shown in fig 3.this allow the system to assist the engine in acceleration only, it doesn't allow the engine to shut off when the vehicles is not in motion. Its means the vehicles is always burning the fuel. Thus the fuel efficiency increase by 25% . On other side Series hydraulic hybrid drive doesn't use a conventional transmission but transmit power directly to the wheels as shown in fig 4. As this drive itself turning the wheels, not uses a regular transmission of the vehicles, so that gasoline engine can be shut off, resulting in more fuel saving and ability to shut off the gasoline engine, it is capable to improve fuel efficiency by 60 to 70 % [5,6].

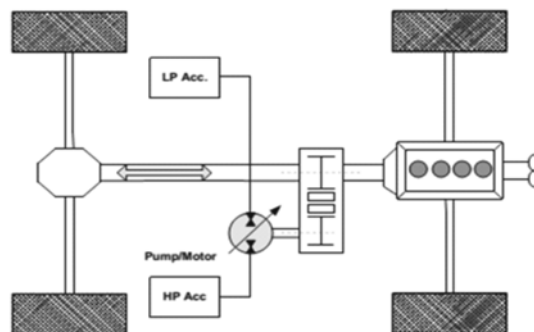


Fig. 3. Parallel hybrid hydraulic.

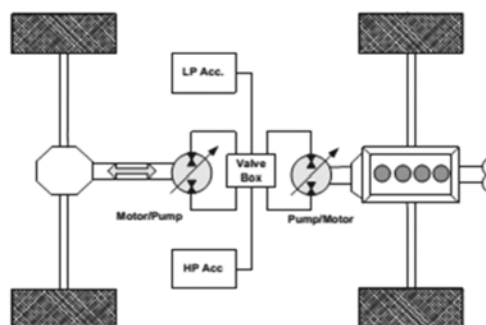


Fig. 4. Series hybrid hydraulic

2.2. Hydraulic regenerative braking system

The series hybrid hydraulic consists of directional selector valve having forward and reverse direction, regenerative braking using check valve, accelerator control and brake control which operated by hydraulic control valve. [3]. The pressure of the hybrid hydraulic is generally controlled through high pressure relief valve for safety purpose.

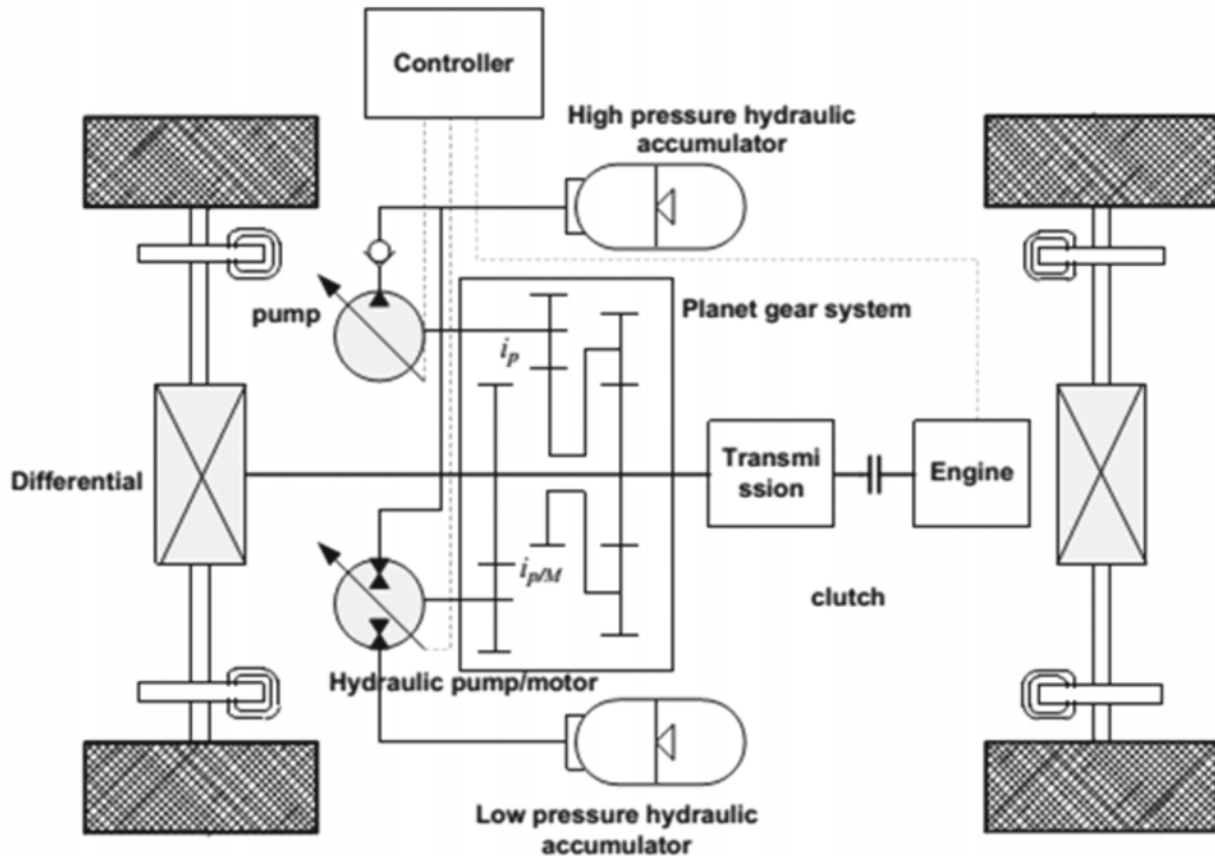


Fig. 5. New configuration of hydraulic regenerative braking for parallel system.

The hybrid regenerative braking system which shows in fig5 having clutch, differential, transmission, tank of low pressure, a high pressurized accumulator, variable displacement hydraulic pump/motor and an engine. The hydraulic pump and hydraulic motor are coupled to the propeller shaft through gear system. During retardation, the hydraulic pump/motor decelerates the vehicle while operating as a pump to store the energy normally lost due to friction brakes in a conventional vehicle. During braking, the vehicle's kinetic energy drives the pump/motor as a pump, transferring hydraulic fluid from the low pressure reservoir to the high pressure accumulator. The fluid compresses nitrogen gas in the accumulator and pressurizes the system. The high pressure hydraulic fluid is used by the hydraulic pump/motor unit to generate torque during the next vehicle acceleration. It is designed and sized to store braking energy from normal, moderate braking events and is supplemented by friction brakes for aggressive braking. Cruise conditions, the function of the hydraulic pump is to charge the hydraulic accumulator, meantime, adjust the engine working point onto the optimal fuel consumption region. When the hydraulic accumulator pressure reaches the highest initial charging pressure value, the vehicle is driven by the hydraulic accumulator and hydraulic pump/motor. The introduction of hydraulic pump minimizes the lower energy density disadvantage of the accumulator and makes the engine work in a high efficiency region through the initial charging function.

3. ADVANTAGE OF REGENERATIVE BRAKING SYSTEM

1. Emission of carbon dioxide is reduced in the environment.
2. Overall performance of the system is increased.

3. During braking most of the thermal energy is converted into useful mechanical energy.
4. Engine life enhances.
5. Wear of engine is reduced.
6. Due to reduction in brake wear, the life span of the friction braking system increases.

4. LIMITATION OF THE REGENERATIVE BRAKING SYSTEM

1. Regenerative braking system is more complexes.
2. Overall weight of the vehicles increases due to assemble of extra component.
3. Higher maintenances are required.
4. For safety purpose friction brake is necessary, in the case of failure of regenerative brake system.
5. The size of energy stores mainly depend upon size of vehicles.

5. APPLICATION OF REGENERATIVE BRAKING SYSTEM

1. Most of the kinematic energy is converted to useful work which lost during braking in the form of thermal energy.
2. Regenerative braking system is used generally in crane hoist motor and elevator.
3. On road vehicles like taxis, buses, delivery vans have high potential for regenerative braking.
4. Regenerative braking system is used in manufacturing industries where conveyer belt are used and frequently start and stop

6. CONCLUSION

When vehicles are driving in urban areas its goes through frequently stop and go due to traffic condition, a significant amount of thermal energy is consumed by frequently braking, which results in reduces the efficiency and increase in fuel consumption. Regenerative braking system is able to reduce consumption of fuel in hybrid vehicles and lower the environment pollution.

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