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Modeling and Prototyping of Automatic Clutch System for Light Vehicles

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Abstract. Nowadays, recycling or regenerating the waste in to something useful is appreciated all around the globe. It reduces greenhouse gas emissions that contribute to global climate change. This study deals with provision of the automatic clutch mechanism in vehicles to facilitate the smooth changing of gears. This study proposed to use the exhaust gases which are normally expelled out as a waste from the turbocharger to actuate the clutch mechanism in vehicles to facilitate the smooth changing of gears. At present, clutches are operated automatically by using an air compressor in the four wheelers. In this study, a conceptual design is proposed in which the clutch is operated by the exhaust gas from the turbocharger and this will remove the usage of air compressor in the existing system. With this system, usage of air compressor is eliminated and the riders need not to operate the clutch manually. This work involved in development, analysation and validation of the conceptual design through simulation software. Then the developed conceptual design of an automatic pneumatic clutch system is tested with proto type.

1.Introduction

Many of automobile manufacturing industries are producing both automatic and manual transmission car. A transmission basically transfers the power from a car's engine to drive shaft and the wheels. Clutch is a device which is used in automobiles, to transmit power from engine to gear box transmission system. In a car, the use of clutch is very essential, because the engine spins all the time, but the car's wheels do not. In order to stop the car without killing the engine, the wheels need to be disconnected from the engine somehow. The clutch is used to engage the spinning engine very smoothly with the non-spinning transmission by controlling the slippage between them [1,2].

2.Research Methodology

At present, clutches are operated automatically by using an air compressor in the four wheelers. It requires more power to operate the clutch. It incurs more running and maintenance cost. Due to the provision of air compressor, the weight of the vehicle also increases and thus the mileage is reduced. Previous studies conducted on automatic clutch system. Aleksandr Blokhin et al. [3] developed a new

technical solution for creation of mechanisms of the friction clutch automatic control for potential heavy-duty trucks and buses. Min Wu and Ze Rong Tang [4] developed automobile intelligent electronic control automatic clutch systems, use the electromagnet controlled by circuit to replace the clutch pedal of manual car. Prasanth et al. developed the semi automatic clutch system with proportional control valve and the actuation by a double acting cylinder[5]. After reviewing the various studies on automatic clutch, it is found that the clutch can also be actuated without the help of air compressors [6] – [9]. This can be done by effective use of the exhaust gas coming out from the turbocharger. By this method the air compressor can be removed from the system and thereby decreasing the weight of the vehicle and increasing the mileage also.

The first stage of the work deals with identification and design of components required for the clutch operating system. In the second stage, the conceptual design is developed and analysed by using ANSYS software. Optimal design is arrived from the analysis which can be generated and drafted by using CATIA software. The final stage of the work involved in making and validating the prototype of the clutch operating system.

In this system, there is one proximity sensor provided with the gear lever to have a smooth operation of clutch. The gear changing lever is connected with relay switch to facilitate the operation of clutch automatically by means of pneumatic cylinder which is powered by existing battery. The clutch shaft is connected with vacuum cylinder. There is an unloader valve fitted in the line before the reservoir and whenever the pressure reaches the maximum, the unloader valve releases and diverts exhaust gas to the catalytic converter. Whenever the gear is changed, the relay switch operates a pneumatic cylinder which causes the air coming out of turbo charger to be sucked, compressed and sent to the vacuum cylinder. This causes the piston moves inside the vacuum cylinder and thus the clutch disengages. The automatic clutch with pneumatic cylinder relates to an automatic transmission more particularly, the invention describes a transmission for producing an automatic movement for light-weight vehicles, such as cars and other type of four wheelers.

3. Construction and working

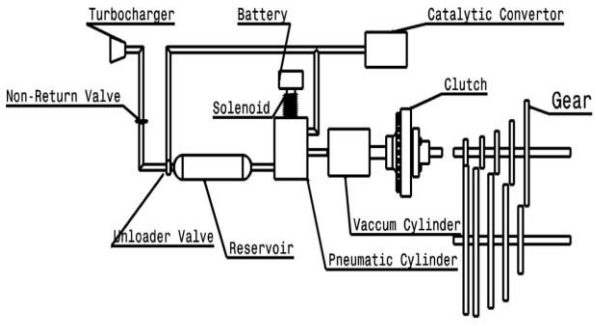

Figure 1. Schematic diagram of automatic clutch system.

Figure.1 shows the schematic diagram of automatic clutch with pneumatic cylinder. This system is working by the exhaust gas coming out from the turbocharger which is sent to the reservoir. From the reservoir, the exhaust gas is sent to the pneumatic cylinder in which the exhaust gas is compressed and the clutch is operated. In the pneumatic cylinder, when the piston moves from top dead centre (TDC) to bottom dead centre (BDC), the exhaust gas from the reservoir is injected and compressed inside the pneumatic cylinder and then sent to the vacuum cylinder. The piston in the vacuum cylinder is

attached to the clutch. The exhaust gas moves the piston and thus the gear is engaged smoothly through the clutch. When the piston moves from BDC to TDC, vacuum is created in the cylinder which causes the compressed gas from the vacuum cylinder is sucked into the pneumatic cylinder. From the pneumatic cylinder, the exhaust gas is sent out to the catalytic convertor. There is an unloader valve present in the reservoir. When the reservoir is full the unloader valve opens and the remaining exhaust gas is sent to the catalytic convertor through separate line.

4. Modeling of conceptual design

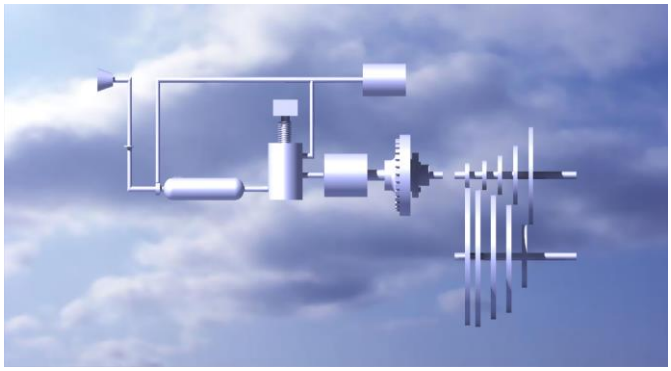

Figure 2. 3D Modelling in CATIA.

Figure 2 shows the 3D model of the proposed clutch system which is developed by using CATIA.

5.Prototyping

The prototype model of the automatic clutch operating system shown in figure 3 consists of non-return valve, unloader valve, solenoid, pneumatic cylinder and vacuum cylinder.

Figure 3. Prototype model.

All the components are assembled as shown in figure 3 and tested for feasibility and effectiveness.

6.Conclusion

Clutch is a mechanism for connecting and disconnecting the engine with the transmission system in a vehicle, or the working parts of any machine. Turbo Charger is a supercharger, driven by a turbine powered by the engine's exhaust gases. The exhaust gas from the turbocharger is used to activate the clutch system which facilitates smooth changing of gears. This work involved in development, analysation and validation of the conceptual design through simulation software. Then the developed conceptual design of an automatic pneumatic clutch system is tested with proto type. With this system, usage of air compressor is eliminated and the riders need not want to operate the clutch manually. As there is no limit for making improvements in any kind of work, this automatic clutch operating system may also be further improved with reducing the wear and tear of parts by filtering the exhaust gas and reducing the weight of the system by using the parts made by composite materials.

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