

## **Semi Automatic Clutch in Heavy Vehicles**

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**ABSTRACT:** Automobiles are the major mode for the transportation, in this current era. Due to the technological advancements there were lot of new upgrades, new safety features available which comforts the driver and also the passengers. Many modern vehicles were introduced with new features like automatic door locking system, Temperature stabiliser, window closing systems, power steering system, Anti-lock Braking Systems, ESP's etc. Manual engagement of clutch while shifting between the gears in traffic areas is a hectic job for drivers. This project is proposed to avoid the necessity of pressing the clutch plates while changing gears. The semi-automatic clutch system comprises a switch in the gear rod knob. With this switch the driver controls the clutching operation. The controlling is done with a Proportional Control Valve and the actuation by a double acting cylinder. The positioning of the clutch is done by the pneumatics by using metering out circuit. Hence engaging of the clutch is done semi-automatically by this mechanism and the retraction of the pneumatic cylinder is achieved smoothly. Instead of pressing the clutch manually, the engagement and disengagement of the clutch is done semi automatically. Driver indeed will be experiencing more comfort in two pedal systems than in common three pedal systems. This project will be much comfortable for amputees who have the spirit of driving heavy vehicles.

**Keywords:** Proportional Control Valve, Gearrod setup, Clutch setup, Pneumatic source

### **DEMERITS OF THE EXISTING SYSTEM**

The above mentioned tri-pedal clutch system has some demerits with regards to its operation. Driver has to manage all three pedals with his two legs, which is way too complicated. Most of the drivers who are driving heavy vehicles were unaware of the improper engaging of the clutches; due to this there can be occurrences of friction between the gears and the life time factor of gearbox and transmission system is affected badly. We can see a driver shifting the gears without engaging the clutch; one can normally see this practice in their surroundings. If the driver regularly does this the gear tooth may subject to damage.

The second system is a two pedal system which eliminates the clutch pedal system <sup>[6]</sup>. This system is introduced based on the drawbacks of the first system but there were also some side effects created in the locomotive. The problem caused by the auto clutch system is reduction in mileage, locking of clutch with the main shaft and cost that matters a lot. These were considered to be de-merits of the existing system.

### **OBJECTIVE**

Automation which in the pure sense reduces the human effort and increases the reliability and accuracy of the process. The objective of the project is to design and implement a semi-automatic clutch system for automobiles, which provides a simplistic remedy for physically challenged.

### **PROBLEMS IDENTIFICATION**

Applying clutch manually at every instant, while changing gear is comfortless. In synchronizing, switch with clutch pedal. Physically challenges, people realize more difficulty in CBA pedal system <sup>[5]</sup>. During the rush hour of traffic; the driver should be able to shift the legs simultaneously to change the gears, but its' practically a hectic work for the driver to do so. Thus the amputees might also feel very discomfort when applying the clutch with their legs.

### **PROPOSED SYSTEM**

### **PROPOSED METHODOLOGY**

Pneumatic source is the crux of this project. A switch is connected to the gear rod which is directly coupled to the solenoid actuated 5/2 spring return Proportional Valve upon the signal from the switch 12 V supply is connected to

the directional control valve [8]. A double acting cylinder [7] is actuated by using the directional control valve. The compressor port is available in the heavy vehicles for the usage of air conditioners and also for air brakes. It generates the total pressure of 13 bar [7]; but 5 bar is sufficient for the cylinder to retract and extend. During the forward stroke of cylinder the piston extends with normal speed, this in-turn presses the pedal and disengaging operation takes place. Whereas during the retraction of the cylinder flow control valve or needle valve is introduced in order to reduce the speed of the retraction stroke. Hence the smooth engaging operation of the clutch takes place.

### FORCE CALCULATIONS

For engaging and disengaging of clutch practically needs some push or pull. A simple theoretical, force calculation was done and the cylinder was selected using working pressure as the major consideration.

During trial and error experimentation, the minimum pressure required for the process was found to be **5 bar**.

To calculate the force required:

The assumed constants;

- Working pressure  $P = 6 \text{ bar} = 6 \times 10^5 \text{ N/m}^2$
- Cylinder diameter  $d_1 = 50 \text{ mm} = 0.05 \text{ m}$
- Piston rod diameter  $d_2 = 20 \text{ mm} = 0.02 \text{ m}$
- Stroke length  $S = 150 \text{ mm}$

Therefore, the force generated by the double acting cylinder,

In retraction stroke,

$$\begin{aligned}
 F &= P \times A \\
 &= P \times \pi (d_1^2 - d_2^2) / 4 \\
 &= 6 \times 10^5 \times \pi (0.05^2 - 0.02^2) / 4 \\
 F &= \mathbf{989.6 \text{ N}}
 \end{aligned}
 \tag{2.1}$$

Thus, the retraction stroke of a cylinder produces **989.6 N**

In extension stroke,

$$\begin{aligned}
 F &= P \times A \\
 &= P \times \pi (d_1^2 - d_2^2) / 4 \\
 &= 6 \times 10^5 \times 3.14 \times (0.05^2 - 0.02^2) / 4 \\
 &= \mathbf{1178 \text{ N}}
 \end{aligned}$$

Thus, Extension of the cylinder produces **1178 N**

Force applied manually by the driver to the clutch pedal is 150 N (approx) [6].

### FEASIBILITY STUDY

#### ECONOMIC FEASIBILITY

Implementing this project will be economically feasible and hence it will be affordable for any kind of the manufacturers to implement this system in the automobiles. Hence source of this project is pneumatic supply which is used for actuation in which the compressor is readily available in vehicle itself therefore the cost of this project is reduced considerably. A cylinder attached with the links is used for the actuation of the clutch which is less cost and this project is much efficient and it is economically feasible.

Sl. No.	Components	Cost
1.	Pneumatic double acting cylinder	₹ 1,500.00
2.	5/2 solenoid operated, spring return DCV(Proportional)	₹ 1,400.00
3.	Pneumatic hoses	₹ 50.00
4.	NO switch (PB type)	₹ 7.00
5.	Mild steel frame	₹ 2,000.00
6.	Clutch pedal	₹ 300.00
7.	Gear rod	₹ 250.00
	<b>TOTAL</b>	<b>₹ 5,507.00</b>

*Cost feasibility study of total project*

## International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization, Volume3, Special Issue 4, April 2014

Second National Conference on Trends in Automotive Parts Systems and Applications (TAPSA-2014)

On 21<sup>st</sup> & 22<sup>nd</sup> March, Organized by

Sri Krishna College of Engineering & Technology, Kuniyamuthur, Coimbatore-641008, Tamilnadu, India

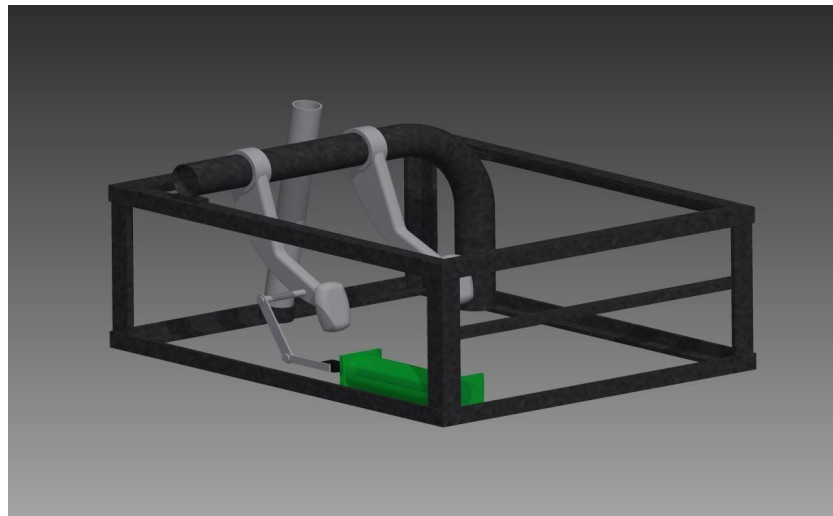
### OPERATIONAL FEASIBILITY

Operation of this project can be achieved by the actuation of the directional control valve. The signal from the battery is sent through the switch to energize the solenoid by which the movement of the spool in DCV is achieved and it allows the passage for the air to pass through it by which linear motion is obtained. This system can even be operated by illiterate person who haven't had knowledge about the system. This project is very simple to use and hence it is operationally feasible.

### TECHNICAL FEASIBILITY

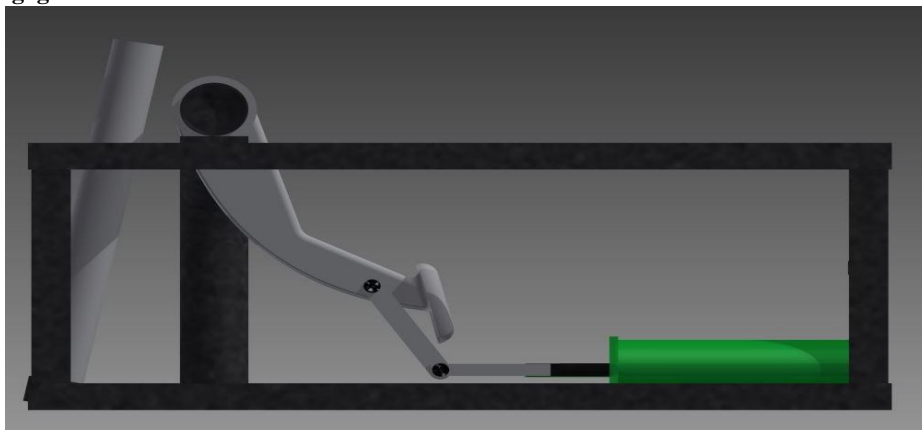
Technical success of this project relies upon the work expected from the different sections of this project. The actuation of the clutch pedal depends upon the signal from the DCV and the link mechanism is used for engaging and disengaging the clutch. Hence this project can be used in either automatic mode or in the manual mode in which the link mechanism can be removed out when not necessary in the hill stations where to remain the vehicles in Half-clutch. The entire process is controlled by using the directional control valve in which the retraction speed of the system is controlled by throttling valve or needle valve.

### ASSEMBLY VIEW OF THE SYSTEM



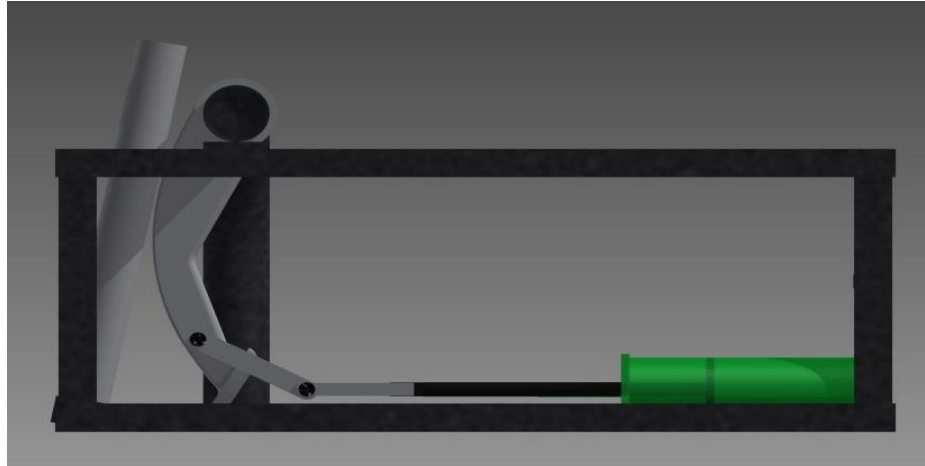
### MODES OF OPERATION1

Mode 1 – Plate engaged:



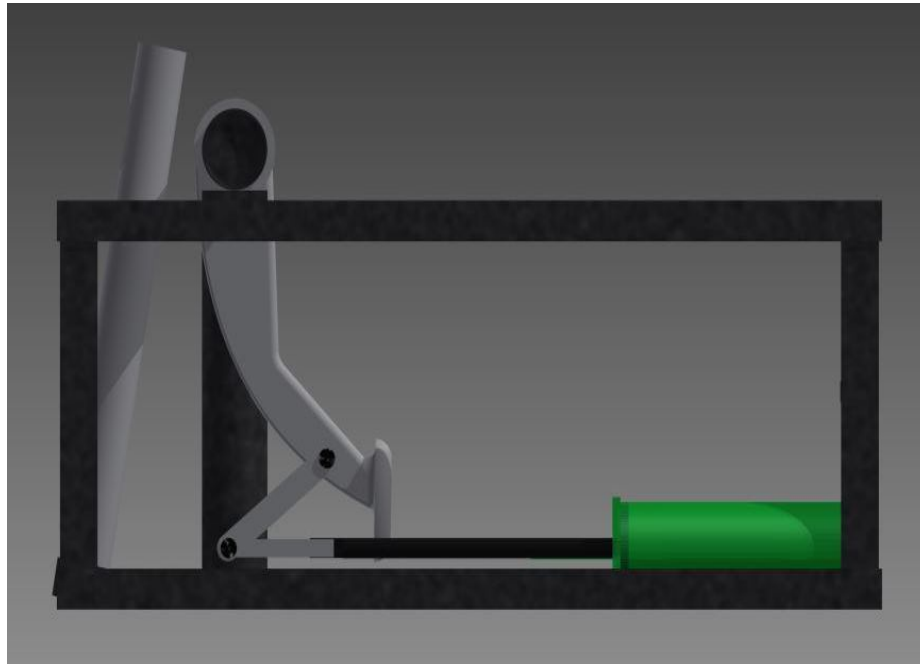
*Operation mode - 1*

**Mode 2 – Plate disengaged:**



*Operation mode - 2*

**Mode 3 – Half clutch:**



*Figure 8.3 (c): Operation mode - 3*

**Mode -1:** The clutch plate is engaged to fly wheel in this mode. Zero pressure is applied to the double acting cylinder. Figure 8.3 (a) illustrates this mode of operation.

**Mode – 2:** The clutch plate is disengaged from the flywheel. In this mode of operation DCV is actuated by giving a supply of 12 V. Figure 8.3 (b) shows the clutch pedal at the disengagement position. For continuous disengagement the switch has to be pressed for continuously.

**Mode – 3:** The clutch pedal is stopped in half way (i.e.; Half clutch mode is enabled). Figure 8.3 (c) illustrates this half clutch mode of operation.

### WORKING PRINCIPLE

Semi automatic clutch system consists of two parts integrated to gather and to provide smooth functioning of the system. Mechanical integrated with electronic system to form a mechatronics system which results in low cost automation.

A switch is connected to the gear rod in which one end of the switch is connected to the common terminal of the relay; the NO contact of the relay is connected to the solenoid coil which is integrated with the Proportional valve. A 12 V power supply is given to the relay coil by which the coil gets energised and output of the coil is connected to the solenoid valve which in turn actuates the spool in the directional control valve. Pneumatic source is used here for the actuation of the cylinder. A 5 bar pressure is applied to the DCV. The output of the DCV is connected to the double acting cylinder. The links are connected from x the rod end of the cylinder to the clutch pedal as shown in figure 8.1. When the cylinder actuates the engaging of the pedal is done smoothly, for slow retraction of the system the throttle valve is used hence the retraction of the cylinder is done smoothly and slowly as compared to the extension stroke of the cylinder.

### PHOTOGRAPHY OF THE SETUP (FABRICATED MODEL)

DESIGN VIEW



SIDE VIEW



### CONCLUSION

Thus, this project provides an alternative to the existing clutch applying system in heavy vehicles through semi automation with low cost system. Though, the project provides the desired output, the centre positioning of the cylinder is not achieved to bring the system in half clutch while starting and to synchronize with the gear rod. This modification is done in the future scope of this project.

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