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Semi-Automatic Gear Shifter Based On Pneumatic

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Abstract: *Gear shifting mechanism was applied to make the shifting process faster and less disturbance for the driver. The new device must be reliable with small dimensions, low construction and maintenance cost. This papers aims to improve gear shifting process using devices such as a manual four speed gear box, two pneumatic double acting cylinders, two pneumatic two position five ways DCV (Direction Control Valve) According to suggested gear shifting method the driver can select the transmission gear ratio without moving his hands from the steering wheel by putting the gear shifting push buttons on the steering wheel. This method leaves to the driver an excitement of choosing the shifting moment. The standing mechanism is achieved by reciprocating the double acting cylinder which controlled by 5/2 way DCV. This actuated through the dash board panel in front of driver through the buttons. Our idea is to convert manual gear shifting to semi-automatic gear shiftin.*
Keywords: *Gear shifting, Speed gear box, manual gear shifting.*

I. Introductions

In the recent years the development in automobile sector is well known to everyone. Researchers are continuously finding the solution for customer requirement and improve the product efficiency also to consider the fuel used which is going to be vanished. To increase efficiency it is proposed that as the frictional resistance is reduces the efficiency can be increased as the more power is consumed to overcome the frictional resistance. Therefore by taking gearbox we have tried to limit the frictional force by changing gear shifting mechanism from manual shifting to automatic shifting which works on pneumatic. The pneumatic system is selected as the compressed air can easily be generated by utilizing engine power and it is required in recent vehicles for the application such as pneumatic braking system, turbo charging, air suspension etc. therefore by utilizing the same energy i.e. pneumatic energy the gear can be shifted during the engine working which shifts the gear comparatively smooth as that of mechanical system. The pneumatic gear shifter has the pneumatic actuator which directly connected with the shifter mechanism of gear box which after sliding shifts the gear. At another side it is provided with pneumatic tubing connections by which the compressed air is supplied for its working. The actuator receives the signal from DCV which is a direction control valve which supplies the compressed air in both the direction i.e. when it is required to shift the gears in forward as well as reversed direction. The DCV is directly connected to the pressure line coming out through the compressor.

II. Components And Methods

Table no 1: Shows components of gear shifter

S.NO	COMPONENTS	QUANTITY
1	DOUBLE ACTING CYLINDERS	2
2	5/2 WAY DIRECTION CONTROL VALVE	2
3	VALVE CONNECTORS	5
4	HOUSING UNIT	1
5	GEAR LEVER	1
6	COMPRESSOR	1
7	GEAR ARRANGEMENT	1

III. Components Description

In this pneumatic gear changer we use some mechanical components. The components we used here are

- Double Acting Cylinder
- 5/2 Push button operateddirection control valve
- Air compressors
- Gear Lever
- Pneumatic fittings

1. Double acting cylinder

It consists of a piston inside a cylindrical housing called a barrel. Attached to one end of the piston is a rod which the rod end has one port. This rod end port is used for entrance of air and extends outside one end of the cylinder. At another end is a port for exit of air. Double acting cylinder can be extended and retracted pneumatically. The smallest bore size of a double acting cylinder is 1 1/8 inch. The piston, which is made of ductile Iron, contains ucup packing to seal against leakage between the piston and barrel. The ports are located in the end caps, which are secured to the barrel by bolts and nuts.

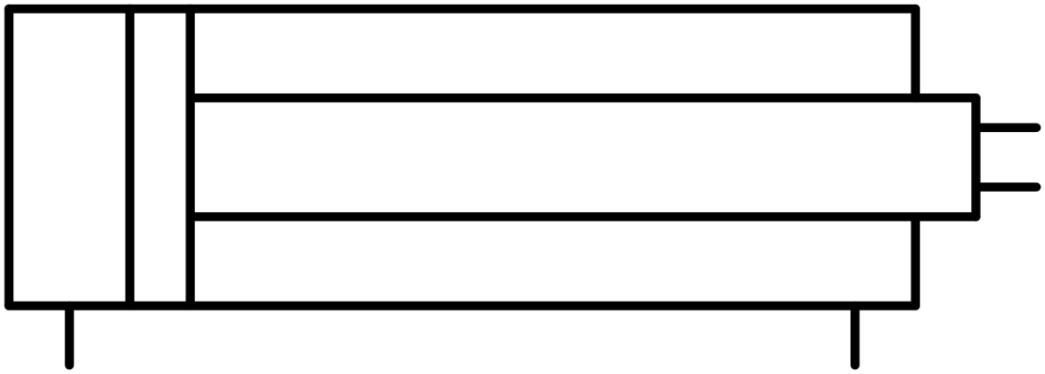

Fig. 1: Double acting cylinder

2. DIRECTION CONTROL VALVES

A direction control valve is used to change the direction of airflow as and when required by the system for reversing the machine tool devices. A direction control valve may be classified, according to the construction of the internal moving parts, as

1. Rotary spool Type.
2. Sliding Spool Type.
3. Push button operated direction control valve.

2.1. Push button operated valves

Push button operated valves are mechanical device. A push button operated valve is used to obtain mechanical movement in machinery by utilizing fluid or air pressure. The fluid or air pressure is applied to the cylinder piston through a valve operated by a hand. The push button operated valve is thus another important mechanical device used in control of machines. Push button operated valves are of two types,

1. Single Push button operated valve (5/2)
2. DoublePush button operated valve

Fig. 2 push button operated direction control valve

3. AIR COMPRESSOR

An air compressor is a device that converts power (using an electric motor, diesel or gasoline engine, etc.) into potential energy stored in pressurized air (i.e., compressed air). By one of several methods, an air compressor forces more and more air into a storage tank, increasing the pressure. When tank pressure reaches its upper limit the air compressor shuts off. The compressed air, then, is held in the tank until called into use. The energy contained in the compressed air can be used for a variety of applications, utilizing the kinetic energy of

the air as it is released and the tank depressurizes. When tank pressure reaches its lower limit, the air compressor turns on again and re-pressurizes the tank

3.1 COMPRESSOR MAY BE CLASSIFIED IN TWO GENERAL TYPES.

1. Positive displacement compressor
2. Turbo compressor

Positive displacement compressors are most frequently employed for Compressed air plant and have proved highly successful and supply air for pneumatic control application. The types of positive compressor

1. Reciprocating type compressor
2. Rotary type compressor

Fig. 3 Positive displacement compressor

4. GEAR LEVER

It is component used to shift gears in an automobile so it can be easily shift between gears at ease. In this setup we have used the gear rod of maruthi Omni so that it is of less cost and affordable one. A gear stick or gear lever or gearshift is a metal lever attached to the shift assembly in a manual transmission-equipped automobile and is used to change gears. In an automatic transmission-equipped vehicle, a similar device is known as a gear selector. A gear stick will normally be used to change gear whilst depressing the clutch pedal with the left foot to disengage the engine from the drive train and wheels. Automatic transmission vehicles, semi-automatic transmissions, and those with continuously variable transmission gear boxes do not require a clutch pedal.

Fig. 4 Gear lever or selector

5. PNEUMATIC FITTINGS

There are no nuts to tighten the tube to the fittings as in the conventional type of metallic fittings. The tube is connected to the fitting by a simple bush ensuring leak proof connection and can be released by pressing the cap and does not require any special tooling like spanner to connect (or) disconnect the tube from the fitting.

IV. Working Methodology

The gear shifting operation is start when lever is turned in the control valve. When the push button operated lever is turned, the 5/2 way directional controlled valve supplies pressurized air to the air cylinder in the pneumatic cylinder unit. The piston rod pushes the yoke in the gear changer .thus gear drive changes to next speed.Then the gear shifting operation is performed in ease so the devise works perfectly using the principle followed. In this construction there are two pneumatic cylinders consisting of pistons on either side of the vehicle pedal for engaging the gear. The cylinders are operated with the help of a pressurized air coming from compressorThe role of two pneumatic cylinders is one for increasing the gear speed and for decreasing the gear speed. For the forward motion one cylinder is actuated & for the reverse motion second cylinder is actuated.
When the DCV is operated the compressed air passes from DCV to actuator and actuator extends. During the actuation of the actuator it slides the shifter gear and allow the meshing of shifter gear to the smaller gear. as the gear meshes the power is transmitted from driving to driven shaft. And the speed of output shaft is depends on the gear ratio of driving and driven gear as below

N1= Speed of driving shaft = 750 rpm
N2= speed of driven shaft = ?
T1= Number of teeths of driving gear = 26
T2= Number of teeths of driven gear = 35

Therefore by gear ratio

$$\frac{N2}{N1} = \frac{T1}{T2}$$

$$N2 = \frac{N1*T1}{T2}$$

$$= \frac{750 * 26}{35}$$

N2= 558 rpm

This speed of driven gear is when the slider gear meshes to the first gear.

Now, in second position of DCV when lever is operated the direction of compressed air changes i.e. flow of air will be reversed and the actuator get retract. During the retraction of actuator again the slider gear slides and first it disengage the gear with low number of teeth and meshes with the gear having more number of teeth i.e. the big gear. As the meshing action takes place the power is start transmitting from driving to driven shaft. And the speed obtained is depends on the gear ratio of two meshing gears.

N1= Speed of driving shaft = 750rpm
N2= speed of driven shaft = ?
T1= Number of teeth of driving gear = 35
T2= Number of teeth of driven gear = 26

Therefore by gear ratio

$$\frac{N2}{N1} = \frac{T1}{T2}$$

$$N2 = \frac{N1*T1}{T2}$$

$$= \frac{750 * 35}{26}$$

N2=1010 rpm

Therefore the two speeds can be obtained by changing the gear but the changing action is done with the help of actuator which is operated on pneumatics hence it is called pneumatic gear shifter.

V. Result

The main objective of the project was to reduce the time required for shifting gears. Manual shifting required 2 to 3 seconds for shifting. Now, by implementing pneumatic shifting mechanism, time required for shifting I reduced to 0.5 to 0.7 seconds.

Table No.2 Comparison

Sr No	Criteria	Manual shifting	Pneumatic operated shifting
1	Shifting time	2 to 3 seconds	0.5 to 0.7 seconds
2	Precision	Good	Better than manual
3	Control	Relatively less, as the hands get engaged in gear shifting	Relatively more, as button for shifting gears are mounted on the steering itself
4	Effort	More effort	Less effort
5	Comfort	Less comfort	More comfort

VI. Discussion

Gear lever is the main or the most vital part for the transmission of a light vehicle. It helps the vehicle to translate the movement of up and down of the rider's hand into kinetic energy which will then either engage or disengage a gear. An experiment was conducted in order to find out the exact value of pressure and force required to be exerted by any rider in order to change gear of the light vehicle itself. In addition, the data obtained also will help this research with giving an insight for how much pressure does an actuator need to be able carry out the same task as the rider does. The system used a gear lever that helps to translate the human input into mechanical movement which will then engaging or disengaging the light vehicle transmission depending on the human input. Upward movement is for shifting while downward movement is for downshifting. The amount of force required to be exerted by the riders depend on the speed of his hand, The engagement and disengagement of gear n mean shifting from gear n-1 to gear n or from gear n+1 to gear n. it can be seen that based on all 20 data taken for each gear shifting, the amount of force required remain in the range of 45 N to 55 N. This value change significantly depending on how fast the user exerted the force onto the gear lever. The faster the movement of the rider hand, the less amount of force required to engage and disengage the transmission system. Yet, different light vehicle uses different kind of tools for the construction of the transmission system, the stiffness of the transmission spring inside the system will be different for different vehicle.

VII. Conclusion

The design of control architecture was an important aspect of study because a strong interaction between the many different parts was needed. We know that the pneumatic gear shifter developed by us cannot be directly used on the vehicles because of some limitations. But we have provided the option for working of the shifter as the compressed air production in the running vehicles is not a big deal. So by using the generated compressed air (generated for pneumatic brakes, air suspension, etc) we can use same for the shifting mechanism of gears.

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