

Electro-pneumatic Gear Shifting Mechanism

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Abstract - In this paper, a gear shifting mechanism was designed and applied to make the shifting process more expeditious and less destructible for the driver. The incipient contrivance must be reliable, has a diminutive dimensions, low construction and maintenance cost. This paper aims to gear shifting process utilizing contrivances as: a manual four speed gear box, two pneumatic double acting cylinders, , an electrical motor, limit switches, buttons, , a table (holder) and power supply. According to suggested gear shifting mechanism the control unit select optimum gear shifting ratio for an automobile without operating it manually (utilizing relays). Utilizing this method leaves to the driver the exhilaration of selecting the shifting moment.

Key Words: pneumatic cylinders, Solenoid valves, gear box, gear shifting mechanism, electric motor.

1. INTRODUCTION

In this project, a gear shifting mechanism is designed and applied to make the shifting process more expeditious and less destructible for the driver. The incipient contrivance must be reliable, with minute dimensions, low construction and maintenance cost. This project aims to ameliorate gear shifting process utilizing contrivances as: a manual four speed gear box, two pneumatic double acting cylinders, two pneumatic two position five ways directional control valves, , an electrical motor, a belt, two pulleys, limit switches, push buttons, bulbs, a table (holder) and power supply. According to suggested gear shifting mechanism the driver can cull the transmission gear ratio without moving his hands from the steering wheel by putting the gear shifting push buttons on the steering wheel. Utilizing this method leaves to the driver the exhilaration of culling the shifting moment.

This study describes in detail in a simple way to how to convert the traditional manually gear shifting mechanism to a semi-automated gear shifting mechanism. The development has concluded withal the gearbox, which became much smoother and engenders less noise. Gear shifting mechanism must be facile to utilize and workable, these authoritative ordinances are very paramount especially for minute cars utilized by special needs people. For some drivers, the gear shifting can cause some perplexing at driving specially at critical situations. A crowded road on a hill or a sudden detour makes an abundance of tension on the driver. One of the difficulties in

this situation is to operate the right reduction ratio and engaging it at the right time. This design avails the driver to increment his fixating on the road. Withal reduces the time needed to engage the required.

Reduction ratio, which increases the conveyances replication, this design may be considered as an inculcative model for gear shifting mechanism. So, we pointed to the following:

1. The opportune dimensions for the main components holder keeping in mind the integration of other part for enhancement and development.
2. A manual, 4-frontal speed gear box is utilized automobile drive is culled for this design because it is more facile to modify.
3. An electrical motor is utilized to engender mechanical power in lieu of an internal combustion engine, which is arduous to be placed there. It is additionally used to make the engagement process more facile. Motor is variable speed (0 to 9000 rpm)
4. A couple of pulleys and a belt are acclimated to transmit power from the electrical motor to the gear box.
5. To eschew binding in the input shaft caused by the radial force, we utilized a bearing fine-tuned on the holder.
6. We used two pneumatic, double acting cylinders, per pair of gear shifting.
7. Two (five ways, two positions) directional control valves are habituated to transmuted the compressed air direction. Every directional valve has 230V ac solenoid that converts electrical power to magnetic puissance, which magnetizes the spool inside the valve; this action transmutes the compressed air direction.

2. OBJECTIVE

The main objective of this system is to minimize the human errors in operating the gears with the avail of automatic technology. Other objectives include optimum gear ratios, reducing wear and tear of the gears, shifting the gear efficaciously, optimum performance of the gear box, optimum force exerted by the cylinders to move the shifting levers (pedals).

3. MODEL COMPONENTS

3.1 Base Frame

The base frame is a structural element that fortifies the entire gear box system. The frame carries the drive system at its lower end which comprises of the LH and RH rear bearing housings. The drive motor is mounted on the base frame.

3.2 Drive system

Drive system comprises of the single phase AC commutator motor with following designations

- Single phase AC motor
- Commutator motor
- Power = 1/15hp=50 watt
- Speed= 0-6000 rpm (variable)

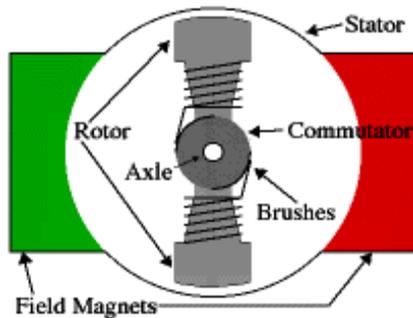


Fig -1: AC commutator Motor

3.3 Pneumatic linear actuator

The pneumatic linear actuator is an Standard cylinder SDA 20 x 15. This cylinder is a double acting cylinder that is operated by an pneumatic valve 5/2 way. The valve is supplied compressed air from the compressor by denotes of an AGB operates filter-regulator-lubricator (FRL) unit. This linear actuator is utilized in the following positions,

- 1st gear
- 2nd gear
- 3rd gear
- 4th gear

3.4 Shifter mechanism

The shifter mechanism is an assemblage of levers actuated by the linear actuator as mentioned above. This shifter is mundanely in neutral condition; it shifts the gears at commencement of cycle and releases it at cessation of cycle.

3.5 Position control system

The position system comprises of the following components;

- 5/2 ways, Solenoid operated, center off, and detent type
- Pneumatic cylinder DPNC connectors

The details of this relay system are given in the circuit diagram of the pneumatic system

4. CONSTRUCTION DETAILS

The two solenoid valves are connected to a compressor with the avail of hoses of Ø6mm from which pressurized air is extracted. The solenoid valves are followed by two pneumatic cylinders with the avail of air hoses. The cylinders are followed by a clutch pedal. Contiguous to the clutch pedal gear box and a motor arrangement is present. The construction withal includes a proximity sensor which senses the haste of the wheel. The precise signals are sent to

the solenoid valves by the control unit through the relays. Ergo the input is speed of the wheel sensed by a sensor and the output is shifting of gear accordingly. The puissance to the control unit is supplied from the 12V battery as well the shifting of gear monitored on an LCD. It withal consists of DC motor, ATMEGA Development board, speed regulator (expeditor), transformer etc.

5. WORKING PROCEDURE

The pneumatic circuit is as shown in fig.2, the motor is started to drive the main shaft by means of belt and pulley arrangement, initially the gear box is in neutral i.e., the output shaft is stationary condition. When the 5/2 way direction control valve -1 is operated the cylinder -1 operates the piston to move in the right hand direction thereby bringing the 3rd gear into engagement, and thus the output shaft starts to rotate thereby transmitting power from the input (motor/engine) to the output (differential).

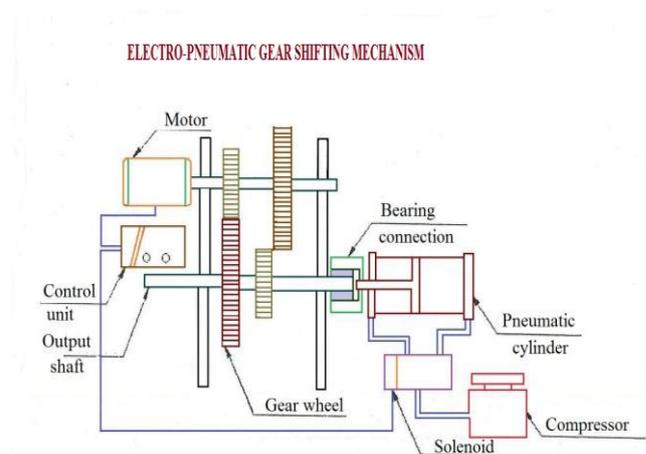


Fig -2: Electro-Pneumatic gear shifting mechanism

The flow control valve in the circuit governs the pressure which is of the order of 1.5 to 2 bars, hence the governed pressure causes the gradual push provided to the piston rod which brings about gradual engagement of the gears hence, (effect of gradual clutch release for smooth engagement is not required). When the 5/2 way direction control valve -2 is operated the cylinder -2 operates towards left as the piston rod is locked for movement left, hence first the fork shifter moves towards left bringing on the neutral position and then slides further left to bring the 1st gear into engagement. Similarly the circuit works for the 2nd and 4th gear.

Note: If both the valves i.e., 5/2 way direction control valve -1&2 are operated simultaneously, the system is arranged such that neutral position will be achieved, hence the system becomes fool proof.

6. CONCLUSION

The pneumatic gear changer was designed and checked for successful working. It was found to be running successfully under all the conditions.

By the results, the suggested mechanism is realizable and workable.

Using the simplest and required hardware enables to convert the old traditional gear shifting mechanism to semi-automatic one.

Using of this mechanism in vehicles leads to make the driving process easier, reduces the risk of destabilizing the car, the lap/stage time, and the chance of miss shifting.

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