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Pneumatic Gear System

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Abstract - *Gear shifting mechanism was designed & applied to make the shifting process faster and less destructible for the driver. The new device must be reliable with small dimensions and maintenance cost. Main aim of this project is to improve gear shifting process quickly by using devices such as a manual four speed gear box, single pneumatic double acting cylinders, single pneumatic two position five ways directional control valves, an electrical motor, a belt, two pulleys, push button, compressor. According to gear shifting method, the driver can do select transmission gear ratio without moving his/her hands from the steering wheel by putting the gear shifting push buttons on the steering wheel.*

Keywords- *Automation, Pneumatics, Gear Shifting, Direction Control Valve, Automobile.*

I. INTRODUCTION

At present due to the extended difficulties in manual operations, the technology has shifted from manual to automatic; few of them include ABS system, active steering system etc., in order to increase passenger safety and comfort. In an environment where movement, component and every assembly operation must be immediately and automatically recorded, checked and documented for maximum efficiency.

Gasoline engines develop useful torque over a limited engine-speed range. To be able to use thee available torque over the range of vehicle speed, gears are needed to reduce or increase the engine speed accordingly. The conventional manual transmission uses a driver-operated clutch, typically operated by a pedal or lever, for regulating torque transfer from the internal combustion engine to the transmission, and a gear stick, either operated by hand (as in a car) or by foot (as on a motorcycle). It enables the driver to select any gear ratio ("gear") at any time. But in case of the motorcycles and some types of racing cars, it only allows the driver to select the next-higher or next-lower gear. This type of transmission is called a sequential manual transmission. Sequential transmissions are used in auto racing for their ability to make quick shifts.

Modern commercial gearboxes are synchromesh type which use ratcheting drums and shift forks to select different gears. An automatic gearbox is one type of motor vehicle transmission that can automatically change gear ratios as the vehicle moves, freeing the driver from having to shift gears manually. Most automatic transmissions have a defined set of gear ranges. Besides automatic, there are also other types of automated transmissions such as continuous variable transmissions (CVTs) and semi-automatic transmissions that free up the driver from having to shift gears manually by using the transmission's computer to change gear. These are usually actuated by manual linkages or hydraulic means. Performance vehicles on the other hand, use sequential gearboxes with dog clutches to engage gears. Turbo-boost is normally lost between gear changes in a manual whereas in an automatic the accelerator pedal can remain fully depressed. This however is still largely dependent upon the number and optimal spacing of gear ratios for each unit. A new technology called automatically actuated manual transmission, bridges the gap between automatic and manual transmissions and provides benefits of both. There are significant benefits in shift times, torque, engine rpm, clutch actuation and vehicle acceleration over traditional manual actuation. Methods of actuation range from solenoid actuators to pneumatic or hydraulic systems. All transmission designs had one goal in common- to make shifting easier. The driver gear shifting strategy influences significantly in the vehicle dynamic behavior, performance and fuel consumption because it changes the transmission system inertia and the engine speed. This effect becomes even more pronounced in performance or competition driving. The time during which the power delivery from the engine to the wheels is interrupted due to a gear change being actuated is referred to as the "shift time". More time a vehicle loses in completing gearshifts, greater is the final lap time. The typical autocross vehicle incorporates a six speed gearbox, yet reaches a (course- limited) top speed in competition of only about 110 kph. Selecting a final drive for this top speed would result in 5 gearshifts in less than 4 seconds. As a result, final drive ratio is very sensitive to shift delay time. Although vehicle mass, engine performance and traction still play a major role, typical vehicle acceleration is significantly limited by the time it takes to complete a gearshift. The time taken to complete a gearshift is dependent on the following parameters:

1. Time of driver's reaction
2. Time of clutch operation
3. Time of gearshift mechanism operation
4. Time based on gearbox design.

Automated mechanical gearboxes are the logical choice for improving the shift time of a fixed-ratio gearbox. Integration of the clutching and the gear-shifting mechanisms seamlessly is the major advantage of this type of gearboxes. After the actuation command by the driver, the Gear Control Unit(GCU) cuts engine power(through ignition and fuel cut), disengages the clutch, actuates the gearshift mechanism and re-engages the clutch, all in a few hundredths of a second. Also, the shift rpm can be easily controlled and the drop in the engine rpm during a gear shift can be matched with the shift time to keep the engine in the maximum torque band at all times. Furthermore, an automated manual gearbox can control the "launch RPM" and can shift automatically for drag strip or acceleration events. Thus, the engine can be kept in the power band for virtually all of the time. An Automated gear-shifting mechanism can be quicker than the manual during an autocross, since the driver no longer needs to take care of the clutch or the throttle while shifting, allowing him to tackle the track more confidently and quickly. Pneumatic shifting systems have been designed previously but usually involve heavy components, complex electronics and limited functionality. The proposed system aims to be a performance-oriented, easy-to-customize replacement for multiple types of vehicles.

II. CONSTRUCTION DETAILS

The two solenoid valves are connected to a compressor with the help of hoses of Ø6mm from which pressurized air is extracted. The solenoid valves are followed by two pneumatic cylinders with the help of air hoses. The cylinders are followed by a clutch pedal. Next to the clutch pedal gear box and a motor arrangement is present. It also includes a proximity sensor which senses the speed of the wheel. The precise signals are sent to the solenoid valves by the control unit through the relays. Therefore the input is speed of the wheel sensed by a sensor and the output is shifting of gear accordingly. The power to the control unit is supplied from the 12V battery. The fig. explains briefly about the construction of the pneumatic gear changer incorporated in induction motors.

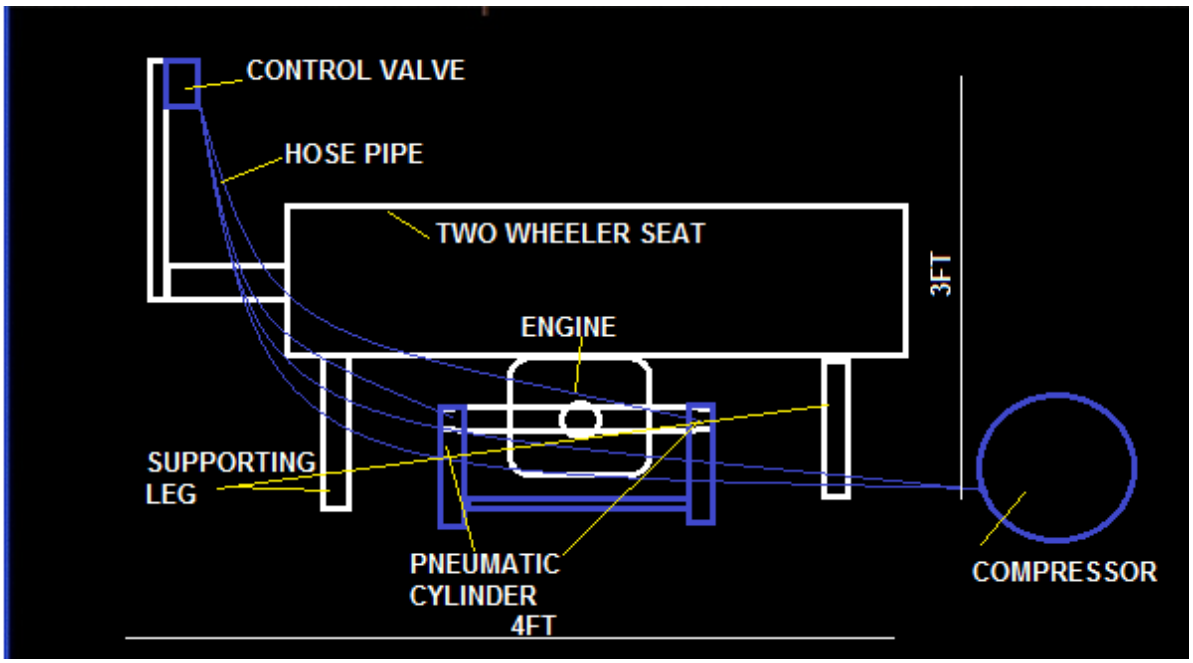

Figure 1 Block Diagram of pneumatic gear changer

III. WORKING PROCEDURE:

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 compressor and it is controlled by a control unit (micro controller). This microcontroller is pre-programmed for working of the system. The 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. Instead of using clutch as in case of conventional Gear Shifting Mechanism, we used Compressed Air. With the help of compressed air, we actuate double acting cylinder which in turn helps to shift the gears by using Direction Control Valve. The operation becomes quite easy and requires less time to operate. Driver does not need to remove his hand from steering in order to operate the lever as in case of conventional gear shifting mechanism. The two solenoid valves are connected to a compressor with the help of hoses of Ø6mm from which pressurized air is extracted. The solenoid valves are followed by two pneumatic cylinders with the help of air hoses. The cylinders are followed by a clutch pedal. Next to the clutch pedal gear box and a motor arrangement is present. The power to the control unit is supplied from the 12V battery. When we pressed forward button, lever will change gear in forward direction and when we apply reverse button gear will change in reverse direction.

IV. COMPONENT DETAILS

4.1 Compressor

The system includes a base having a mounting structure for engaging a complementary mounting structure of the wheel, such as lug nuts. A compressor assembly is mounted to the base and rotates about the axis of rotation of the wheel when the vehicle is moving. The compressor assembly includes a reciprocating member such as for instance a piston or a diaphragm that is connected to a crankshaft aligned with the axis of rotation of the wheel. A counterweight is fixedly mounted on one end of the crankshaft, which under the influence of gravity acting on the counterweight results in torque being transferred to the crankshaft to prevent rotation thereof. Resulting relative motion between the compressor and the crankshaft pumps air into the tire via an air conduit.

Figure 2 Compressor

4.1.1 Technical Data Features:

A. 12 V DC Powered
B. Rotary Type
C. High Power Model has a Extra High Power Motor for Better Inflation power + Stronger Outer Body + Long air Pipe
D. Simply use this for fast & easy inflation for compressed air
E. No strength required for pumping air as it is all electronic & is powered directly from battery
F. Time Saving as compared to mechanical pump
G. Quick Operation
H. Pressure gauge that reads in lb./in and kg/cm bar

4.2 Battery

In order to choose the most convenient 12V battery. The characteristics that were taken into consideration in this decision were: price, amp hours, size, weight and energy density. For the batteries with less than 15Ahs, the distribution of weights was given taking into consideration that 2 batteries would be used instead of one in order to provide the required power. A rechargeable battery, storage battery, secondary cell, or accumulator is a type of electrical battery

which can be charged, discharged into a load, and recharged many times, while a non-rechargeable or primary battery is supplied fully charged, and discarded once discharged. It is composed of one or more electrochemical cells. Several different combinations of electrode materials and electrolytes are used, including lead–acid, nickel cadmium (NiCd), nickel metal hydride (NiMH), lithium ion (Li-ion), and lithium ion polymer (Li-ion polymer).

Figure 3. Battery

4.3 Double Acting Cylinder

A cylinder is a hydraulic actuator that is constructed of a piston or plunger that operates in a cylindrical housing by the action of liquid under pressure. Fig shows the basic parts of a cylinder. Cylinder housing is a tube in which a plunger (piston) operates. In a ram-type cylinder, a ram actuates a load directly. In a piston cylinder, a piston rod is connected to a piston to actuate a load. A cylinder in which air pressure may be alternately applied to the piston to drive it in either direction.

Figure 4 Double Acting Cylinder

4.3.1 Technical Data And Specification

- **A.** Pneumatic cylinder: double acting
- **B.** Diameter of cylinder: 40 mm
- **C.** Diameter of rod: 8mm
- **D.** Stroke length: 50mm
- **E.** Material: The material used for a pneumatic cylinder is nickel-plated brass to aluminum and even steel and stainless steel depending upon the level of load, humidity temperature, and stroke length specified appropriate material selected.

4.4 Hose Line

The Teflon tube having 8mm diameter is used for a pressure line or return line. The waterline is connected with valve with a knob or pneumatic connector. The water pressure line having 5/2 directional control valve which actuate the pneumatic cylinder.

Figure 5. Hose Line

Figure 6. Direction Control Valve

4.5 Dirction Control Valve

To change the direction of airflow to and from the cylinder, we use a directional control valve. The moving part in a directional control valve will connect and disconnect internal flow passages within the valve body. This action results in a control of airflow direction. The typical directional control valve consists of a valve body with four internal flow passages within the valve body and a sliding spool. 5/2-Way single solenoid valve, in the normal position, port 1 is connected to port2; port 4 is connected to port5, and port 3 is blocked. When rated voltage is applied to the coil 14, the valve is actuated through an internal pilot valve. In this position, port 1 is connected to port 4, port 2 is connected to port 5 is blocked. The valve returns to the normal position when the voltage to the coil is removed.

V. CONCLUSION

The project presented has involved the development and implementation of automatic transmissions for automobile. The motivation of this work is to implement this idea in clutch featured automobile with a suitable clutch control. The automatic transmission can be also used in 5 and 6 speed versions by altering few changes in the program. Therefore from the above calculations it is evident that the forces exerted by the cylinders are optimum to move the shifting levers (pedals). According to the achieved results, the suggested mechanism is realizable & workable. Using the simplest and required hardware enables to convert the old traditional gear shifting mechanism to semiautomatic one. The application of this mechanism leads to make the driving process simple and reduces the risk of destabilizing the automobile, the lap/stage time, and the chance of miss shifting.

REFERENCES

[1] A.A. Shingavi[1], Tagad Sham Annasaheb[2], Pagare Sagar Balasaheb[3], Pawar Prashant Jayram[4], Khose Satish Bhau[5] “Electro-Pneumatic Gear Shifter”. IJSRD - International Journal for Scientific Research & Development, Vol. 4, Issue 01, 2016.

[2] S. Vijay Kumar[1], P. Nithesh Reddy[2], P. Masoom basha[3] “Fabrication of pneumatic gear changer”. IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), Volume 11, Issue 3 Ver. V (May- Jun. 2014), PP 53-63.

[3] Mankar N.A.[1], Keshar S. D.[2], Minde R.R.[3], Khaja Abulfaiz A. H.[4], Barhe S. E.[5] .”Electro-pneumatic Gear Shifting Mechanism”. International Research Journal of Engineering and Technology (IRJET), Volume: 03 Issue: 03, Mar-2016.

[4] Muntaser Momani[1], Mohammed Abuzalata[2], Igried Al-Khawaldeh[3], Hisham Al-Mujafet[4] "Pneumatic, PLC Controlled, Automotive Gear Shifting Mechanism". Research Journal of Applied Sciences. Submitted Date: March 10, 2010. Accepted Date: March 30, 2010. Published Date: May 10, 2010.

[5] Vishnu P R[1], Vishnu R[2], Rathish.R[3] and Vinoth Kumar.G[4]. "Pneumatic Gear Transmission for Two Wheeler". International Journal of Emerging Technology in Computer Science & Electronics (IJETCSE) ISSN: 0976-1353 Volume 21 Issue 1 –APRIL 2016.

[6] Siddharth Dahiya, Adithya Asok Sharma, Rahul Srinivasan, Ritesh Tekriwal, Kamalkishore Vora, B Ashok and C Kavitha. "Electro-Pneumatic Shifting System and Gear Control Unit for a Sequential Gearbox," SAE Technical Paper 2016-28-0175, Published 02/01/2016.

