International Journal of Mechanical And Production Engineering, ISSN: 2320-2092, Volume- 5, Issue-3, Mar.-2017
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AUTOMATIC TRANSMISSION SYSTEM FOR MOTORCYCLES

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Abstract- It is observed that, in an automobile system the manual transmission is more difficult to learn and it requires frequent shift between gears especially while driving in cities. Each time it requires engaging and disengaging clutch while shifting gears. This is a tiresome task. In order to make this task easier, automatic transmission is evolved. Incorporating a lockup mechanism and start clutch for even more compactness and improved efficiency. As well as the automatic transmission system achieving some goals such as,

- Highly efficient torque transmission due to mechanical transmission in parallel with hydraulic transmission.
- Simple system configuration and high level of controllability.
- Compact unit increasing machine design freedom.

Index Terms- Automatic transmission, Swash plate, Distributor valve, ECU, Lockup mechanism, Start clutch.

I. INTRODUCTION

The main objective of our paper is to perform an automatic transmission system for motorcycle in an automobile. An automatic transmission system with a wide range of functions in a single unit, the system is a compact and highly efficient infinitely variable transmission system encompassing functions for starting, power transmission and shifting, all on a single shaft. The basic configuration of the system consists of an oil pump for converting engine power into hydraulic pressure, and an oil motor for converting the hydraulic pressure back into power for output. Both are made up of multiple pistons, a distributor valve and a swash plate for piston operation, while the cylinders are integrated into the output shaft. A swash plate plays an important role in this system; the angle of swash plate is varied to provide continuously gear ratios.
An Automatic transmission system also includes lockup mechanism and start clutch for an infinitely variable hydraulic mechanical transmission. When cruising, this lock up mechanism works to minimize transmission efficiency losses, contributing to improved fuel economy.

Automotive technology has been developed in many areas, like ABS system, active steering system and other safety systems, which implemented to increase the passenger safety and comfort. The development has concluded also the transmission, which become automatic without shifting any gear. This transmission system must be easy to use and workable, these demands are very important especially for motorcycle used special needs people. For some drivers, the gear shifting can cause confusing at driving specially at critical situation. A crowded road on hill or a sudden detour makes a lot of tension on the driver. One of the difficulties in this Situation can be minimise by automatic transmission system.

II. CONSTRUCTIONAL DETAILS

The automatic transmission system consist of an oil pump for converting engine power into hydraulic pressure, and an oil motor for converting the hydraulic pressure back into power for output.

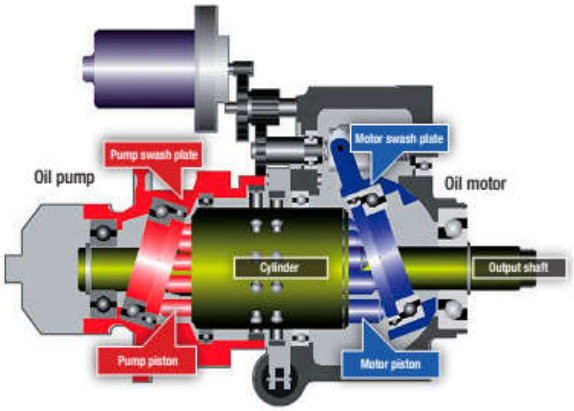

Fig-1: System components

The red area is the oil pump and the blue is the oil motor. The oil pump and motor each have swash plates and piston with a cylinder between the pump and the motor connected by the pistons. An output shaft is incorporated into the cylinder. The inclination of the pump swash plate is fixed, while motor swash plate inclination is variable.

III. WORKING DETAILS

The working of automatic transmission system comprises the following description:

3.1 Hydraulic Fluid Flow

- High - Pressure fluid flow :

The engine rotates the pump swash plate, which has gear mechanism. The rotating swash plate pushes the

pump pistons to increase the pressure on the fluid and feed it to high pressure annular chamber. The high – pressure fluid then fed to the oil motor piston chamber where it pushes the piston forward, which then pushes the motor swash plate.

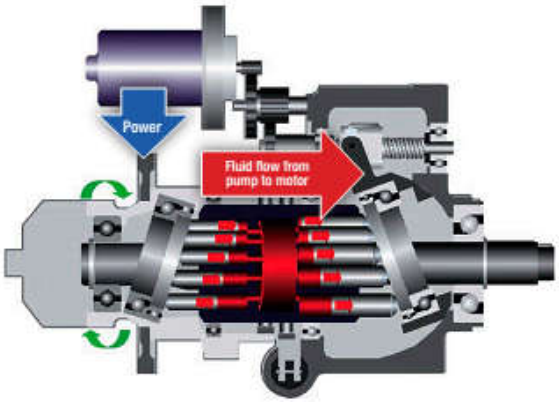

Fig-2: High-Pressure fluid flow

- Low - Pressure fluid flow :

The lower – pressure hydraulic fluid return to the pump through the low - pressure annular chamber. In this way, the fluid circulates between the pump and the motor.

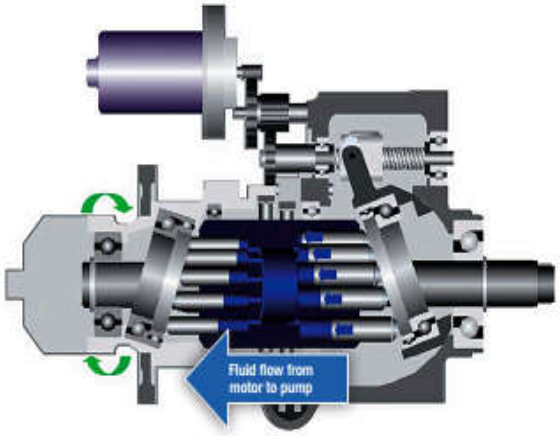

Fig-3: Low-Pressure fluid flow

3.2 Power Transmission

The distributor valves play an important role in fluid circulation. The valves are placed both in the oil pump and oil motor. When the piston moves through compression side, the valves connect the piston chamber and high - pressure chamber. When the pump pistons move to the expansion side, the valves allow a connection between the piston chamber and the low-pressure chamber. The valve in the oil motor moves opposite to its counterpart in the pump, ensuring the circulation of fluid within the system.

The distributor valves ensure constant conversion of the engine's output torque to high hydraulic pressure power. The reaction to the hydraulic power is then converted to torque that rotates the cylinder, while the movement of the distributor valves is regulated by an eccentric ring, for system simplicity and constant, stable operation.

When they are pressed through the swash plate, the oil pump pistons compress the hydraulic fluid to feed to the high-pressure chamber. The high-pressure fluid then generates pushing force which acts on the pump and motor pistons and each piston receives downward reactive force from the swash plate. With the pistons connected to the cylinder, the reactive force generates rotating force (torque) that drives the cylinder and the output shaft incorporated into the cylinder.

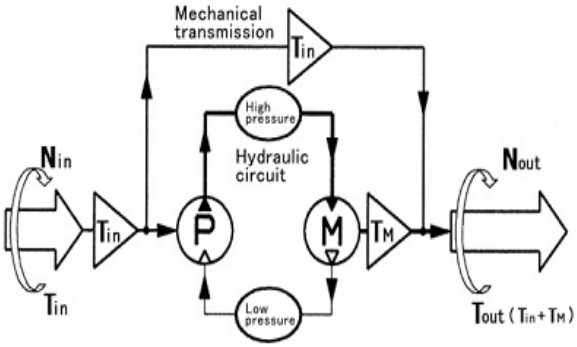

Fig-4: Torque Transmission and Gear Ratio

- Motor swash plate movement and torque transmission :

The torque available depends on the angle of the swash plate. The oil pump generates constant torque because the inclination of its swash plate is fixed. However, torque generation may be varied by altering the angle of the swash plate incorporated into the motor. The output torque is at a maximum when the motor swash plate is set at the maximum inclination. When the angle is decreased, the torque also decreases. With a perpendicular setup, the oil motor does not generate torque and the only available torque is that directly transmitted by the oil pump.

- Motor swash plate movement and gear ratio :

One function of the oil motor is varying the gear ratio by changing the inclination of the swash plate and the resultant amount of fluid required by the motor. The amount of fluid required by the oil motor side creates the difference in rotation between the pump swash plate and cylinder. When this difference is largest, the gear ratio is lowest. When there is no difference, the ratio is at its highest.

3.3 Electronics Shift Control

An electronic device was adopted for automatic transmission shift control. The electronic control unit (ECU) regulates control motor operation based on various information such as engine speed and throttle setting. The rotation of the control motor is converted

to a linear motion by a ball screw, varying the inclination of the motor swash plate.

To meet diversified rider needs, automatic transmission offers two fully automatic shifting modes D mode for ordinary riding and S mode for a sporty riding experience or the 6-speed manual mode, which gives riders the option of riding with a manual transmission feel. Riders can then switch among the three modes in accordance with their preferences.

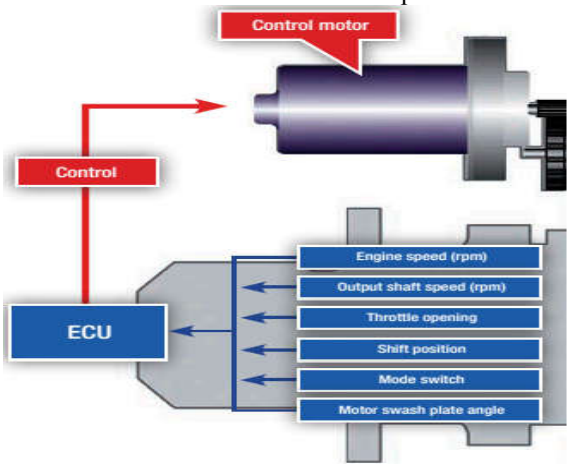

Fig-5: Electronic Control Unit

3.4 Lockup Mechanism

At the highest ratio, there is no torque transmission from the oil motor, but losses due to friction and fluid compression occur with circulation of the high-pressure hydraulic fluid. To minimize losses while improving transmission efficiency, the automatic transmission is equipped with a lockup mechanism. The structure is such that the mechanism begins to operate when it detects that the highest gear has been selected, and the distributor valve blocks the path of the high-pressure fluid to the oil motor piston chamber. When the lockup mechanism is idle, the distributor valve moves with the eccentric ring in the outer perimeter and switches between the piston and the high and low-pressure chambers. At the highest ratio, the hydraulic actuator cancels the eccentricity of the perimeter ring and the distributor valve blocks the fluid path between the high-pressure and piston chambers, causing lockup conditions.

The hydraulic actuator carrying out for the lockup function is controlled electronically. According to information on engine speed, output shaft speed and swash plate angle, the system ECU determines if the highest ratio has been engaged and allows fluid flow from the external oil pump to the solenoid valve to change the eccentric ring placement.

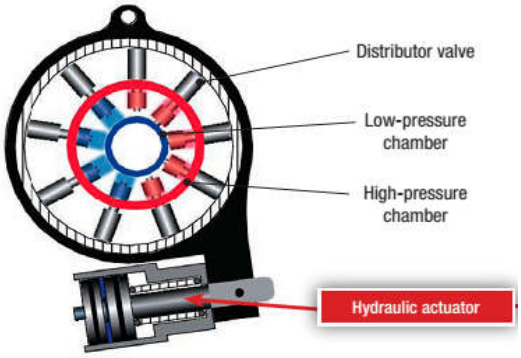

Fig-6: Lockup Mechanism

3.5 Start Clutch

Smooth starting and stopping, along with overall system compactness has been realized by combining a compact hydraulic start clutch with the automatic transmission.

The start clutch consists of:

1. A clutch valve connecting the high and low-pressure chambers.
2. A centrifugal governor that operates the clutch valve through engine rpm.

The centrifugal governor rotates with the oil pump swash plate. The weights inside the governor expand outward due to the centrifugal force resulting from the increased rotation of the pump swash plate, which pushes the connected clutch valve inward. When rotation decreases, spring force returns the clutch valve to its original position.

As the governor moves, the clutch valve moves inside the hollow shaft to connect and disconnect the high and low-pressure chambers. When the two chambers are connected, because fluid pressure is released into the low-pressure chamber, no torque is transmitted and the clutch remains disengaged. When the two chambers are disconnected, fluid pressure, torque is transmitted and the clutch is engaged. Since the clutch is operated by regulating hydraulic pressure, taking full advantage of the characteristics of the automatic transmission, start clutch operation is smooth.

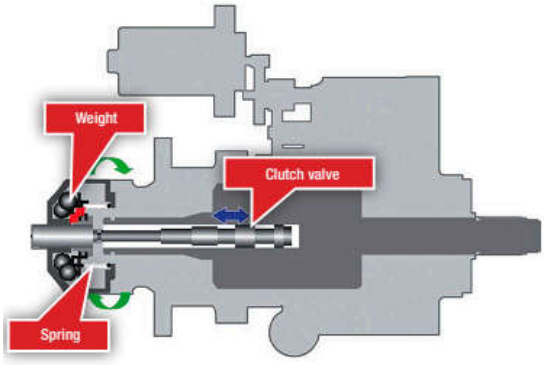

Fig-7: Start clutch

CONCLUSION

The project presented has involved development and implementation of transmission in motorcycle. The motivation of this work is to implement this idea in manual transmission with a suitable automatic highly torque transmission. By using some extra devices like use of swash plate, oil pump and motor, lockup mechanism, start clutch which minimise the engagement and disengagement of the gear in motorcycle and reduce the human effort and fuel consumption also. And after this invention inexperienced person also drive the vehicle easily because there is not required to shifting the gear, thus give better comfort ability to driver.

ACKNOWLEDGMENTS

First of all I would like to thanks to my teachers that they encouraged and give proper direction to me for doing this project. My colleagues that they helped me in attaining some basic knowledge in this project. I would like to thank the management of Jawaharlal Darda Engineering and technology, Yavatmal, India for their extensive support for completing this project work. This project of Automatic Transmission for Motorcycles is a new technique that I have elaborate.

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