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DUAL DRIVE MODES IN BIKE

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Abstract - *In the past few years, the rise of two-wheeler in the automobile industry has been on a high. The most common used two-wheelers are bikes. The transmission system of a bike is conventionally manual. The main objective of this paper is to automate the transmission system of a bike without interrupting the manual system. Thus, the rider has the freedom to choose to drive the bike either by manually changing the gear for transmission or by an automatic transmission. For this purpose, we have enacted a new mechanism of a variator has driven auto-clutch system (VDA). We have implemented this system on a bike without interrupting the inbuilt system of the bike. This paper shows the design and implementation of VDA in bikes for comfortable riding. This system has been tested and functioning successfully. As this mechanism is flexible and of low cost, so it can be implemented in any bike available in the market.*

Key Words: transmission system, manual, automatic, VDA system

1. INTRODUCTION

The invention of the motorcycle has shown a great impact in the automobile industry. It has enabled comfortable, cheaper and quick mode of transportation. Till date, many modifications have been done to the initial model of bike in every aspect. And still many research works are ongoing to make bikes more comfortable and efficient. From last 6-7 years, the increase in the number of gearless scooters indicates the preference of riders to eliminate the trouble of shifting gears time to time. But still, many people prefer the conventional manual mode of transmission in bikes. So there a problem arises for the rider to choose between these two modes of transmission.

The solution of such a problem has already been solved in cars and other heavy vehicles. So for that AMT is used in cars. But for bikes, a proper solution has not been found. So in this paper, the discussion about the design and analysis of such a system which is successfully implemented on a bike has been done.

2. WORKING PRINCIPLE

The system here used to enable dual drive modes in a bike is named as VDA system. VDA stands for a variator driven auto-clutch system. As per the name suggests this additional system is a combination of variator and auto-clutch system. The variator gets the power from the engine that drives the auto-clutch system. The auto-clutch system consists of a centrifugal clutch and 3 gears of varying size to transmit power to the chain. This system enables to drive in gearless mode.

3. LITERATURE REVIEW

R. Hembree [1] has taken a patent on semi-automatic gear shifting apparatus for use in shifting gears in gearboxes of motorcycles and the like gearboxes wherein gears are shifted by rotating spindles which are connected to the ratchet type gear shifting means. Here the shifting apparatus consists of a lever arm, one end of which is connected to the spindle and the other end is connected to the toe pedal. Also, an actuating rod is connected to the toe pedal, the rod is reciprocated to move the lever and in turn the spindle. This spindle is actuated by a pair of push-button switches mounted on the handlebar.

U. M. Friedrich Raff [2] in his paper, explained the use of an actuator with a tachometer for the fore-aft movement of the gears is used. The gear shifting mechanism also includes a solenoid and pivotal mounting to provide movement of the actuator assembly in the second direction. In this patent, the invention of automated driver system for a manual transmission vehicle includes a gear shifting mechanism under control of a microprocessor. The gear shifting mechanism includes a gear shift actuator, DC Motor, Tachometer with a lead screw assembly and also a linear displacement transducer is used.

David G. Funk [3] in his paper has said that a solenoid actuated transmission shifting apparatus is provided for temporary and permanent installation is automobiles with convention motorcycle transmission. The shifting apparatus allows for shifting and downshifting through the transmission gears by pressing pushbuttons mounted on the handlebar. It is an object of this invention to provide a pushbutton solenoid shifter that incorporates the use of electronic solenoids to actuate the shifting of gears in manual transmission of the motorcycle.

P. Alexander M.E[4] in his paper, has mentioned that the transmission gears and clutch shifting apparatus for automatic operation of manual shift mechanism in an automotive vehicle include gear and clutch actuation mechanisms mounted on the bar of the vehicle and coupled by the cables to the control actuation mechanisms mounted off the vehicle board. The onboard gear shift actuator includes two intersecting movable slots for causing movement of the shift lever. In this invention, electrical control and actuation mechanism are mounted outside the

vehicle. A relatively small gear and clutches are mounted on the vehicle, cables are used to connect these actuators with each other.

Oliver J. Tysver [5] in his paper, has explained that a multi-speed automatic transmission for automobiles having parallel input and output shafts includes two parallel gear sets and constant meshing gear wheels, which provide two fixed speed ratios. The first power path uses the first speed ratio which includes a first control clutch and a second control clutch. The second power path uses the second speed ratio which is higher than the first speed ratio, which includes a third control clutch. This also has a double planetary gear set, a first and second control brake. Alternatively, either the input or output shafts are in alignment and one the two-speed ratios are used. This transmission features six forward speeds, a braked neutral and a reverse drive.

Francis G. King [6] from his paper, gives us a brief introduction to shifting schedule of gears to save energy and improve fuel economy. Since there is no perfect automatic shift technology for engineering vehicles, this theory is implemented to improve the ordinary vehicle transmission. The author predicts that automatic gear transmission vehicle chooses the best shift rule based upon driver's information of manipulation .the author also claims that the rule of shift decision changes the traditional shift mechanism to intelligent shift decision

Robert E. LaWrie [7] in his paper, has specified that automatic transmission is a key technology to improve the performance of vehicles. With the synthesized application of mechatronics technology, computer technology, auto control technology on vehicles, development of modern vehicles is leading to an intelligent gear shifting mechanism. Gear shifting strategy as explained in the journal is the core of intelligent control system of an automatic transmission that improves vehicle's performance and fuel efficiency. The gear shift strategy is the rule of changing the time of automatic shifting between gears with respect to rear wheel revolution.

Pierre A. G. Lepelletier [8] in his paper, has provided the solution for power loss in manual gear transmission system. The main objective is to create a mechanism to reduce the inconvenience caused in manual gear vehicles. The shifting of gears is done automatically as well as manually. In automatic gear shifting mechanism, the gears are shifted in accordance with the speed of the vehicle. The wheel revolutions are sensed and the signal is transferred to the microcontroller which shifts the gear with respect to the implemented C program.

Luigi Glielmo [9] in his paper, has shared an information, that the production of the manual transmission is reduced by fifty percent and automated manual transmission (AMT) production is increased. The AMT's are used in racing cars and in modern hybrid electric vehicles.

From the review of the journals and papers, we have understood that the automatic transmission vehicles are more in demand but less fuel efficient. So, automation of manual vehicles can smoothen the driving and improve efficiency. The vehicle can be provided with two modes of driving, manual and automated mode. This technology can be implemented in an auto-clutch bike as well as in clutch featured bike.

4. COMPONENTS OF VDA

1. Engine
2. Variator
3. Auto-clutch system
4. Gear
5. V-belt
6. Chain tensioner

5. DESIGN AND ANALYSIS

The use of some devices that are not generally used in a bike has been taken for implementing a gearless mode of driving. They are,

1. Variator
2. Centrifugal clutch
3. 3 gears of varying diameter
4. Chain tensor

A Variator Driven Auto-clutch system operates by varying the working diameter of two main pulleys in the transmission. One pulley is kept fixed, and the other one is movable, operated using a variator. The variator does the function of increasing or decreasing the amount of space between the two sides of the pulley. This makes the belt to ride lower or higher along the inner walls of the pulley, depending on driving conditions, thereby changing the gear ratio. Thus, VDA can maintain the engine at its optimum rpm range without interfering the efficiency and mileage of the bike. The use of chain tensor is to eliminate chain sag or slackness and maintain the chain tension.

For analyzing the efficiency of VDA system, the rpm transmitted to the rear tyre through VDA system at different speed intervals are to be calculated. Here, the speed is taken in the range of km/h. To find the rpm of the tyre the formula given below is used.

N_t = V/ (3.14*D)

Here, N = speed attained by the rear tyre in rpm

V = speed in m/s

D = diameter of tyre = 0.62 m

Now, to find the N for a speed of 1 km/h, the tyre rpm will be, N = N_t/V = 8.562

The output gear reduction is taken as 8.04 (calculated by using the output shaft diameter and the teeth on the rear to front sprockets for Hero Honda CD 100SS)

So from here, calculate the speed of output shaft in rpm by using the following equation.

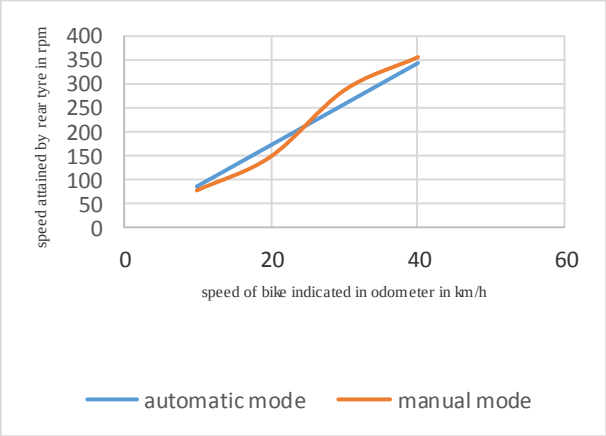
N_o = N*8.04*V

Sl. No.	Speed of bike in km/h	Speed attained by the rear tyre in rpm	Speed of output shaft in rpm
1	10	85.62	688.34
2	20	171.25	1376.44
3	30	256.88	2064.67
4	40	342.51	2752.89
5	50	428.81	3441.12

The above table shows the speed attained by the tyre as well as the output shaft when riding in automatic mode.

Similarly, a table mentioning the values of speed attained by tyre for corresponding speed in manual mode at varying gears is shown below.

Sl. No.	Gear position	Speed of bike in km/h	Speed attained by the rear tyre in rpm
1	1st	10	78
2	2nd	20	148
3	3rd	30	286
4	4th	40	355



Graph: – speed of bike Vs rear tyre rotation speed

Speed of bike Vs speed attained by rear tyre graph for both manual and automatic mode is plotted.

Thus, the graph indicates the speed of rear tyre at different speed intervals. At initial gear position i.e. at 1st and 2nd, the transmission of torque from the engine to the rear tyre is lesser as compared to automatic mode at the same speed. In a similar way, the transmission of torque from the engine to rear wheel is more for manual mode at higher gears i.e. at 3rd and 4th as compared to auto mode in corresponding speed.

6. CONCLUSION

The implementation of dual drive modes in bike using VDA is working with satisfactory conditions. We are able to understand the difficulties in maintaining the tolerances and also the quality. As per this work, the rider has the utmost comfort of riding the bike with dual modes such as manual mode i.e. by shifting gears, or automatic mode i.e. gearless mode. It enables to choose single vehicle even for travelling large distance or even in traffic situations. This work also eliminates the loss of torque while transmission in lower gears i.e. at 1st and 2nd gears. Thus it results in a decrease in pollution. By using more advanced techniques, this can be modified and be used by the manufacturers for manufacturing such bikes as per customer's demand. Thus, it will play a significant role in the revolution of two-wheeler industry.

7. FUTURE SCOPE

In future, this type of vehicles can further be modified and good sale can be obtained from the manufacturer. This will be a better solution to overcome wastage of money and fuel. The jerking of the shaft can be avoided by changing the internal shaft of the engine with the same of an extended size. The working of neutral gear can be utilized by using a lever mechanism to shift from manual to auto mode and vice versa. Thus, the manufacturers by implementing these basics can make a bike of such advantages with low cost and high efficiency as per the demands of the customer.

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