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Multiball Disc Variable Speed Drive

SHELKE MANGESH[1], TUWAR MEGHRAJ[2], SHINDE NIKHIL[3] BADAKH RAHUL[4]
Prof. THAKARE VISHAL[5]
1(Student, Department of Mechanical Engineering SNDCOE YEOLA, Maharashtra, India)
2(Asso.Professor Department of Mechanical Engineering SNDCOE YEOLA, Maharashtra, India,)

Abstract

The primary function of a transmission system is to transmit mechanical power from a power source to some form of useful power. Since the invention of the internal combustion engine in 1769, it has been the goal of transmission designers to develop more efficient methods of coupling the output of an engine to a load while allowing the engine to operate in its most efficient according to the need, that is the vehicle requires less power while running on the plane road during which the efficiency is higher. A continuously variable transmission is a type of transmission, however, that allows a variable speed or torque ratio change within a finite range, thereby allowing the engine to continuously operate in its most efficient or highest performance range .While the transmission provides a continuously variable output to the vehicle at the all load conditions. The development of modern variable transmission drive has generally focused on frictional driven devices, such as those commonly used in off-road recreational vehicles and recently in some automobiles. While these devices allow for the selection of a continuous range of transmission ratios

Keyword- *cvt,*

I.INTRODUCTION

The primary function of a transmission system is to transmit mechanical power from a power source to some form of useful power. Since the invention of the internal combustion engine in 1769, it has been the goal of transmission designers to develop more efficient methods of coupling the output of an engine to a load while allowing the engine to operate in its most efficient according to the need, that is the vehicle requires less power while running on the plane road during which the efficiency is higher.
Whereas while riding the hill or curve roads the vehicle requires more power and the speed required is less. Conventional transmissions allow for the selection of gear ratios but not continuously, thus limiting the engine to providing maximum power according to need. Because the engine is forced to adjust its speed to provide continuously variable output from the transmission to the load, it operates much of the time in low power and low efficiency regimes.

A continuously variable transmission is a type of transmission, however, that allows a variable speed or torque ratio change within a finite range, thereby allowing the engine to continuously operate in its most efficient or highest performance range .While the transmission provides a continuously variable output to the vehicle at the all load conditions. The development of modern variable transmission drive has generally focused on frictional driven devices, such as those commonly used in off-road recreational vehicles and recently in some automobiles. While these devices allow for the selection of a continuous range of transmission ratios, they are obvious inefficient. The reliance on friction to transmit power from the power source to the load is a source of power loss because some slipping is possible. This slipping is also a major contributor to wear, which occurs in these devices. To overcome the limitations occurring in the current continuous variable transmission employing frictional positive engagement Engineer's has been proposed for investigation Brigham Young University.

II NEED OF PROJECT

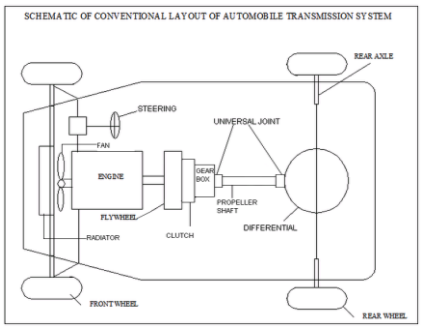

Fig 1.1 SCHEMATIC OF CONVENTIONAL LAYOUT OF AUTOMOBILE TRANSMISSION SYSTEM

Conventional transmission system uses single plate clutch , efficiency of this clutch is less than 70%

Manual transmission gear box has gears namely 0-1-2-3-4-5 hence in order to move to top gear one has to move form 0 (i.e., neutral to 1) in which the following operations have to be performed

- **A.** Disengage clutch
- **B.** Change gear
- **C.** Gradually engage clutch

Thus three operations are to be performed while moving from one gear to another, hence in all 15 operations are performed to move to the top gear, So also, In 1st gear speed cannot exceed 20 km.ph, where as in 5th gear vehicle cannot be tracked from stand still condition (e.g. At traffic signal).

To add to the problems the transmission system utilizes complete engine speed range where as engine gives best efficiency over a fixed range of speed.

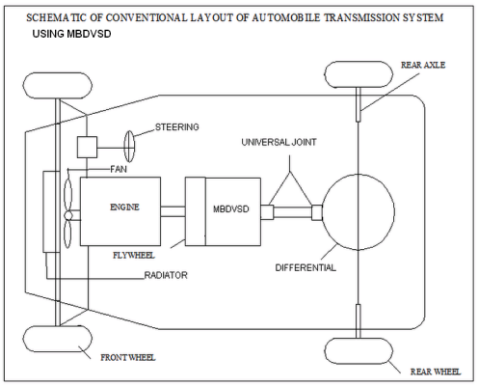

Fig 2.2 CONVENTIONAL LAYOUT OF AUTOMOBILE TRANSMISSION SYSTEM USING MULTI-BALL DISK VARIABLE SPEED DRIVE

To solve above problem the MULTI-BALL DISK VARIABLE SPEED DRIVE is designed which offers the following advantages,

- Acts like clutch as well as gear box.
- Efficiency of transmission more than 90%

- More than gear ratios of 35 possible, (engine can always be operated in maximum efficiency zone)
- Entire speed range of gear ratios 35 is controlled by single operating lever that can be directly connected to accelerator lever.
- No disengagement of clutch required while moving from one gear ratio to another, hence almost 11 operations of the conventional system are completely avoided.
- As engine is operated in maximum efficiency zone of speed range better fuel economy is achieved.
- Lower pollution as engine operates at maximum efficiency.
- Maximum operator convenience as no selection of gear ratios is to be done.
- Vehicular control by foot is reduced from three to two as only the accelerator pedal and brake pedal are to be operated by driver.
- Lower cost of productions.

Less investment for mass production as conventional machines are required for production

III LITERATURE SURVEY

Continuously variable transmissions have been in use for many years. Near the beginning of the twentieth century, cars like the Sturtevant, Cartercar, and Lambert featured friction dependent CVTs (Puttré, 1991).These friction drive CVTs were common in automotive use until engines capable of producing higher torques became common and necessitated the move to geared, fixed-ratio transmissions capable of high torque transfer and having better wear characteristics than friction dependent CVTs. Only in the past few years, with the advent of advanced materials and technology, have friction dependent CVTs returned to commercial application in the automotive industry.

To provide a foundation and motivation for the research presented, this chapter first presents a definition of a continuously variable transmission. For background purposes, a review of the current literature on CVTs is included. The families in which various embodiments can be classified are presented, along with a description of the operating principles in each family. A new family of embodiments of the positive engagement classification is also presented, along with the principles governing this new classification. This research focuses most heavily on embodiments in the final classification.

A transmission is a device which allows the transmission of power from a rotating power source to a rotating load. Conventional transmissions allow for the selection of discrete gear ratios, thus limiting the engine to providing maximum power or efficiency for limited ranges of transmission output speed. A continuously variable transmission, however, is a type of transmission that allows an infinitely variable ratio change within a finite range, thereby allowing the engine to continuously operate in its most efficient or highest performance range. Beachley and Frank, 1979, present a sub-classification of the continuously variable transmission called the infinitely variable transmission (IVT). While the two terms are often used interchangeably, there is a distinct difference between them. While a CVT allows an infinitely variable ratio change within a finite range, an IVT must be capable of producing an output speed of zero for any input speed, thus giving an infinite speed ratio

. **IV COMPONENTS**

The Multi-Ball disk Variable speed drive consists of the following parts

1. Motor

Motor is a single phase AC commutator motor, 50 watt power and speed variable from 0 to 9000 rpm. Speed variations are achieved by means of an electronic speed variator which changes the current supplied to motor and thereby the power. Motor shaft carries the motor pulley (1.5 inch diameter).

2. Belt

Belt is an FZ section rubber V-belt, which connects the input reduction pulley and motor pulley in the open belt drive used as the input transmission drive.

3. Input reduction pulley

Input reduction pulley is an 3 inch diameter aluminium FZ section single groove pulley mounted and fastened to the input shaft of the drive.

4. Input shaft

Input shaft is an high grade steel (EN24) component housed in ball bearings 6004zz and 6003zz in input bearing housing at the left hand end, and bearing 6201 at the right hand end . The input shaft is integral with the left hand input disk where as the right hand input disk is keyed to the input shaft. Right hand input disk is moveable towards the left hand to maintain the contact pressure thereby the torque is adjusted. To ensure the contact pressure an helical compression spring is installed and an locknut is carried on the threaded end of input shaft (M16 x 2 pitch) which ensures the contact pressure.

5. Input bearing housing

Input bearing housing houses ball bearings 6004zz and 6003zz which hold the input shaft at the left hand end. Input bearing housing is held in and vertical structural member i.e. the left hand casing.

6. Driver disks:

The left hand driver disk is integral with the input shaft and the right hand driver disk is keyed to the input shaft. The driver disks together drive the top and bottom set of balls.

7. Balls (4 no's)

Balls of the multi ball disk drive are high grade steel elements (EN24) , due ground and lapped with hardness up to 63 HRC. These balls are held in ball holders. Balls transmit the power from the driver disk to the intermediate planet disks

8. Ball holder ((4 no's)

Balls holders are structural steel (EN9) members that receive the balls at one end and are mounted on the tilt shafts on the other end. The ball holders are means of speed variation as they change the radii of contact between the driver disks and the planet driven disks.

9. Planet Driven disks (2 no's)

Planet disks are integral with the shafts and are mounted in ball bearings 6201zz on left hand side, and bearing 6004zz on the right hand side. These bearings are supported in the intermediate bearing housings. Planet driven disk shafts carry the driver planet gears which are keyed to the right hand end of the shafts.

10. Planet Driver gears (2 no's)

Planet driver gears are high grade steel (EN24) gears of 2 module and 22 teeth. These planet gears are keyed to the right hand end of the planet driven disk shafts which together drive the central sun driven gear.

11. Central Sun driven gear

Central Sun driven gear is high grade steel (EN24) gear of 2 module and 58 teeth. The planet gears keyed to the right hand end of the planet driven disk shafts together drive the central sun driven gear. The central sun driven gear is mounted on the output hub.

12. Output hub

The output hub is the driven output member that carries the central sun driven gear. It houses the ball bearing 6007zz held in position by means of an internal circlip on the output bearing housing.

13. Output shaft

Output shaft is the output member integral with the output shaft, provisions of central drill are made on the output shaft for output speed measurement.

14. Intermediate bearing housing (4no's)

Intermediate bearing housings on left hand side are structural steel parts that house ball bearing 6201zz and that on the right hand side house bearings 6004zz. These bearings together hold the planed driven disk shafts. Intermediate bearing housings are mounted in the left and right hand side casing plates.

15. Gear sector (2 no's)

Gear sectors are elements that connect the tilt shafts on which the ball holders are mounted. Gear sectors are partial gears with 2 module and 40 teeth arrangement. The gears facilitate simultaneous motion of the two tilt shafts in opposite direction and thereby changing the radii of contact equally on both sides of the mean. Gear sectors are mounted on the right hand end of the tilt shafts.

16. Tilt shafts

Tilt shafts are plain carbon steel (EN9) elements held in tilt shaft bushes mounted on the casing plates, these shafts carry the ball holders, handle and gear sectors. These shafts effect the speed change of the device.

17. Handle

Handle is of plain carbon steel (EN9) mounted on the tilt shaft, rotating the handle in either clockwise or counter-clockwise direction will effect the speed change. Handle is made of three pats that is the boss mounted on tilt shaft, M8 stud and the 25 mm round knob.

18. Clamp nut

Clamp nut is carried on the threaded end of input shaft (M16 x 2pitch) it ensures the contact pressure between the driver disks, balls and the planet driven disks.

19. Casing

Casing is in the form of the left hand and right hand mild steel casing plates, two support plates and the base legs. Casing plates house the input and output bearing housings, intermediate bearing housings and the tilt shaft bushes.

V WORKING

The balls and disks are brought into engagement by the helical compression spring arrangement, whose tension is adjusted by the Clamp nut. Motor drives the input pulley mounted on the input shaft. Also, the Driver disk mounted on the input shaft rotates at the same speed. Driver disks drive the four balls placed in the ball holders .Thus, this balls causes the rotation of the driven disk mounted on the output shaft. The shaft transmits the torque to the respective planet gears which are in mesh with the sun gear. The planet gears mounted on the driven disk shafts drive the central gear mounted on the driven hub thus power is transmitted to the output shaft.

Various speeds (35 gear ratios) are achieved by operating the handle connected to the ball holders, which are interlinked by two gear sectors. The movement of the ball holders gives the range of speeds as explained above, and the speed changes are achieved without de-clutching action.

VI. ADVANTAGES

1. Acts like clutch as well as gear box.
2. Proper balanced power transmission and Efficiency of transmission more than 90%
3. No disengagement of clutch required while moving from one gear ratio to another, hence almost 11 operations of the conventional system are completely avoided.
4. As engine is operated in maximum efficiency zone of speed range better fuel economy is achieved.
5. Lower pollution as engine operates at maximum efficiency.
6. Maximum operator convenience as no selection of gear ratios is to be done.
7. Vehicular control by foot is reduced from three to two as only the accelerator pedal and brake pedal are to be operated by driver.
8. Lower cost of productions.
9. Less investment for mass production as conventional machines are required for production.

Easy to maintain proper pressure between the contact surfaces thereby resulting in trouble-free operation

VII. APPLICATIONS

Light electric vehicles (LEVs)

1. Automobiles
2. Low speed vehicles (lawn tractors and golf carts)
3. Agricultural equipment
4. Speed drives for machine tool spindles.

CONCLUSION

The concept of group project was included in our engineering syllabus with the View toinculcate within us the application ability of the theoretical concept of design and production engineering to practical problems. So also to help us to learn to Work more as a team rather than an individual. In completing our project titled 'MULTI-BALL DISC VARIABLE SPEED DRIVE' as per our time estimate gives us immense pleasure and afeeling of achievement. During the course of project we encountered numerous problemswhich we overcame with the able guidance of our project guide.

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