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Research Paper

ALTERNATIVE TRANSMISSION SYSTEM FOR 4 WHEELER

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A transmission system in automobile consists of a gear box and differential. A differential is a component used to distribute torque and helps while turning. It also provides better drivability. In this project we are going to use a component that can transmit torque from the engine without a differential and act as automatic transmission. The purpose of this is to overcome the short coming of differential and provide automatic transmission for better drivability. For this, we have developed a component that will be connected through a gear array. It will act as automatic transmission. Presently the front wheels can move only up to 45°. We are also developing a smart parking system which will be completely mechanical and can be easy installed in present cars. For the parking system we are using flexible shaft and a new type of steering mechanism which can turn the wheel to 90°.

Keywords: Hartnell governor transmission, 4 wheeler, Smart parking system

INTRODUCTION

A differential is an array of gear that helps in division of torque. A conventional differential splits torque in equal ratio. In certain adverse condition one wheel requires more torque than the other which cannot be given by differential. Both the wheels are dependent as they are connected to a single differential component. By the component we have designed it will serve the purpose of differential and also overcome the short coming of differential.

Automatic transmission are better to operate, better in handling and are very powerful. Presently most of cars use manual transmission instead of automatic. One of the main reasons of this is the cost of the automatic transmission is very high compared to that of manual transmission. By using our component in the transmission system we can cut down cost to great extent as this component eliminates the need of differential and gives an automatic transmission.

There are numerous situations in our daily lives when we need to park the vehicle but we are not able to do so because of the limited turning of the wheels. There are new systems

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being developed using which all the wheels can be turned to 90° all this system use motor to turn the wheels. Moreover this is not popular because of its high cost and its feasibility. We have designed a new steering mechanism which can turn the front wheels to 90° due to steering and back wheels can be turned to 90° by using a lever .Thus vehicle can move in different a direction which was not previously possible.

LITERATURE SURVEY

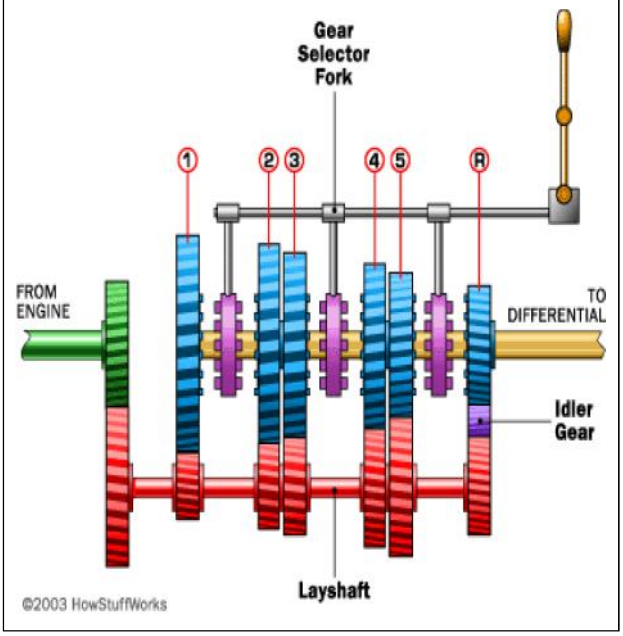
Manual Transmission

A manual transmission, also known as a manual gearbox, stick shift (for vehicles with hand-lever shifters) or standard transmission is a type of transmission used in motor vehicle applications. It uses a driver-operated clutch engaged and disen-gaged by a foot pedal (automobile) or hand lever (motorcycle), for regulating torque transfer from the engine to the transmission; and a gear stick operated by foot (motorcycle) or by hand (automobile).

Manual transmission often feature a driver operated clutch and moveable gear stick. Most automobile manual transmission allow the driver to select any forward gear ratio at any time.

The way a manual transmission works is that the flywheel isattached to the engine, the clutch disk is in between the preesure plate and the flywheel.when running, the clutch disk spins with the flywheel.As the clutch is depressed the throw out bearing is pushes in, which makes the preesure plate stop applying preesure to the clutch disk. This makes it stop receiving power from the engine so that the gear can be shifted.

Figure 1: Gear Transmission



Without damaging the transmission.When the clutch pedal is released,the clutch disk is allowed to start receiving power from engine.

Manual transmission are characterized by gear ratios that are selectable gear pairs to the output shaft inside the transmission.

Automatic Transmission

An automatic transmission is atype of motor vehicle transmission that can automatically changegear ratios as the vehicle moves, freeing the driver to have shift geras manually. Most automatic transmission have defined set of gear ranges, often with parking pawl feature that locks the output shaft of the transmission stroke face to keep the vehicle from rolling either forward or backward.

The planetary gear arrangement helps to achieve the automatic transmission.

Continusly Variable Transmission

A Continuously Variable Transmission (CVT) is a transmission that can change seamlessly

Figure 2: Planetary Gear System

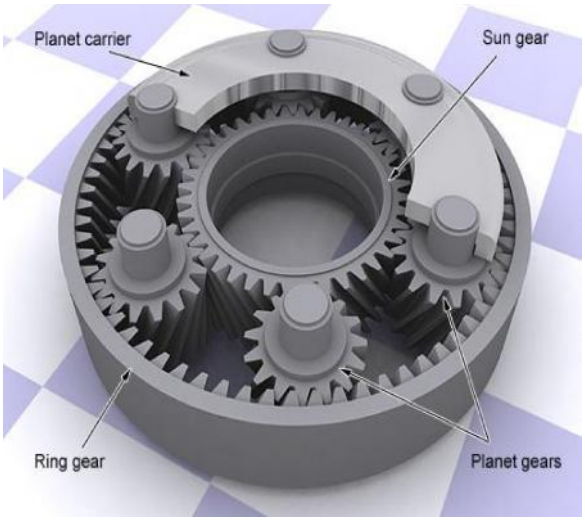
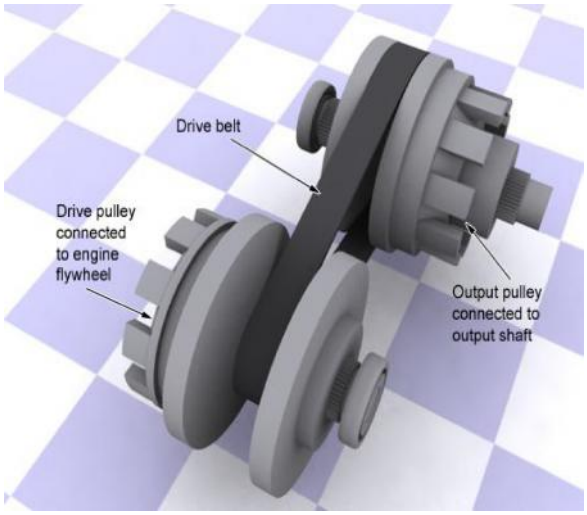


Figure 3: CVT Transmission

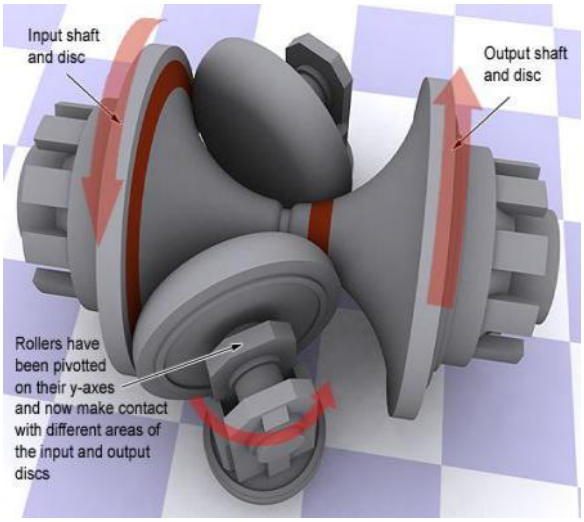


through an infinite number of effective gear between maximum and minimum values. This contrasts with other mechanical transmissions that offer a fixed number of gear ratios. The flexibility of a CVT allows the input shaft to maintain a constant angular velocity.

Toroidal CVT

Toroidal cvts are made up of discs and rollers that transmit power between the discs the

Figure 4: Torroidal Transmission

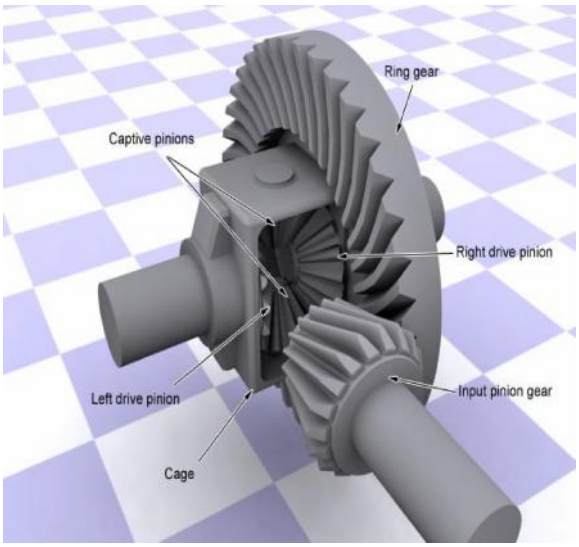


discs. The discs can be pictured as two almost conical parts, point to point, with the sides dished such that the two parts could fill the central hole of torus.One disc is the input , and other is the output. Between the discs are rollers which vary the ratio and which transfer power from one side to the other. When the roller's axis is perpendicular to the axis of the near-conical parts, it contacts the near-conical parts at same-diameter locations and thus gives a 1:1 gear ratio. The roller can be moved along the axis of the near-conical parts, changing angle as needed to maintain contact.

Differential

A differential is a particular type of simple planetary gear train that has the property that the angular velocity of its carrier is the average of the angular velocities of its sun and annular gears. This is accomplished by packaging the gear train so it has a fixed carrier train ratio R = –1, which means the gears corresponding to the sun and annular gears are the same size. This can be done by engaging the planet gears of two identical

Figure 5: Differential



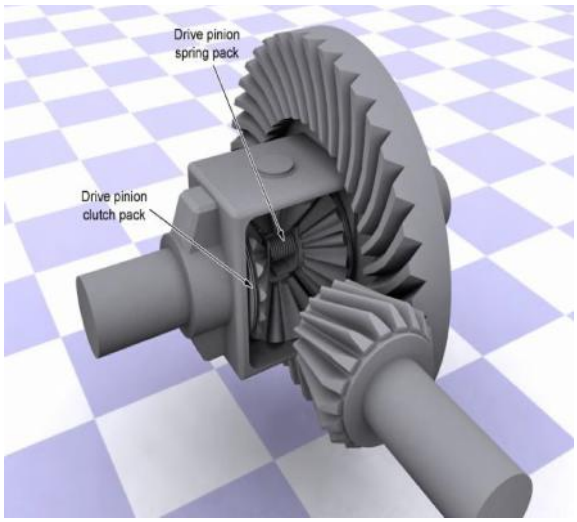
and coaxial epicyclic gear trains to form a spur gear differential.

In automobiles and other wheeled vehicles, a differential couples the drive shaft to half-shafts that connect to the rear driving wheels. The differential gearing allows the outer drive wheel to rotate faster than the inner drive wheel during a turn. This is necessary when the vehicle turns, making the wheel that is travelling around the outside of the turning curve roll farther and faster than the other. Average of the rotational speed of the two driving wheel equals the input rotational speed of the drive shaft. An increase in the speed of one wheel is balanced by a decrease in the speed of the other.

Limited Slip Differential

A Limited Slip Differential (LSD) or anti-spin is another type of traction aiding device that uses a mechanical system that activates under centrifugal force to positively lock the left and right spider gears together when one wheel spins a certain amount faster than the other. This type behaves as an open differential unless one wheel begins to spin and exceeds that threshold. While positraction units can be of varying strength, some of them with high enough friction to cause an inside tire to spin or outside tire to drag in turns like a spooled differential, the LSD will remain open unless enough torque is applied to cause one wheel to lose traction and spin, at which point it will engage. A LSD can use clutches like a posi when engaged, or may also be a solid mechanical connection like a locker or spool. It is called limited slip because it does just that; it limits the amount that one wheel can "slip" (spin).

Figure 6: Lock Differential



Lock Differential

A locking differential, such as ones using differential gears in normal use but using air or electrically controlled mechanical system, which when locked allow no difference in speed between the two wheels on the axle. They employ a mechanism for allowing the axles to be locked relative to each other, causing both wheels to turn at the same speed

regardless of which has more traction; this is equivalent to effectively bypassing the differential gears entirely. Other locking systems may not even use differential gears but instead drive one wheel or both depending on torque value and direction. Automatic mechanical lockers do allow for some differentiation under certain load conditions, while a selectable locker typically couples both axles with a solid mechanical connection like a spool when engaged.

Governor

A governor is a device used to measure and regulate the speed of a machine.

The six basic types of governors are as follows:

1. Mechanical centrifugal flyweight style that relies on a set of rotating flyweights and a control spring; used since the 5 inception of the diesel engine to control its speed.
2. Power-assisted servomechanical style that operates similar to the mechanical centrifugal flyweight but uses engine oil under pressure to move the operating linkage.
3. Hydraulic governor that relies on the movement of a pilot valve plunger to control pressurized oil flow to a power piston, which, in turn, moves the fuel control mechanism.
4. Pneumatic governor that is responsive to the air flow (vacuum) in the intake manifold of an engine. A diaphragm within the governor housing is connected to the fuel control linkage that changes its setting with increases or decreases in the vacuum.
5. Electromechanical governor uses a magnetic speed pickup sensor on an engine-driven component to monitor the rpm of the engine. The sensor sends a voltage signal to an electronic control unit that controls the current flow to a mechanical actuator connected to the fuel linkage.
6. Electronic governor uses magnetic speed sensor to monitor the rpm of the engine. The sensor continuously feeds information back to the Electronic Control Module (ECM).

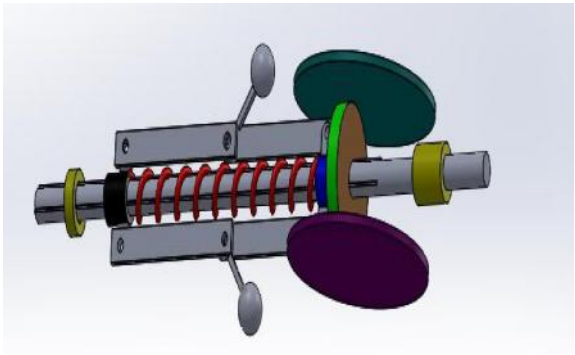
ALTERNATIVE TRANSMISSION COMPONENT

Description

The component consists of two circular discs one at the top and other at the bottom. There is a roller stacked in between these plates. The roller is mounted on the shaft such that the roller can slide over the shaft.

The cad design is shown in Figure 7.

Figure 7: Hartnell Governor



We have manufactured the roller. The roller is made from wood and stones. The stones are aligned in such a way that roller can move easy over the disc. For avoiding the stones movement the arrangement has been made. The disc on the top are having a gear profile both the gears are meshed. The surface below

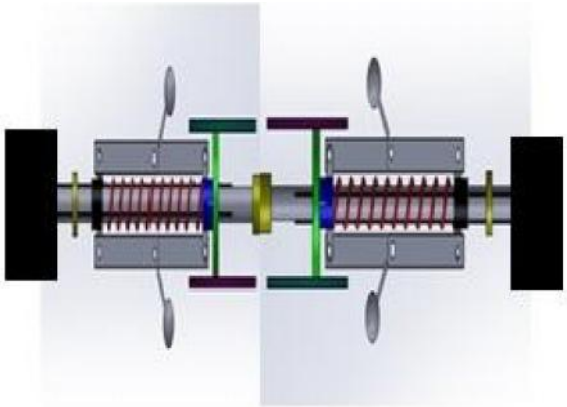
Figure 8: Rotor Component

Figure 9: Rotor

the gears has ceiling rubber. This used to provide more friction in our model.

The cad design of assembled view of the components with the wheels

Figure 10: Transmission Setup



The view of our design is as shown

Figure 11: Prototype Model

Working

The components which consists of gears on the top can be driven by a engine output or a motor. When the disc rotates this causes the roller to move. The important aspect is that for every point contact of the roller with the disc the roller will rotate with different speeds. The governor present helps in the motion of roller. This variable speed of the roller helps in achieving different speed of the wheels as this will be connected to both the wheels. Hence this component can function independently for both the wheels without any maximum limits as in the differential.

Implementation

To implement this component we have fabricated a chassis and implemented this component for both the wheels as shown the Figure 12.

This prototype will help to understand working of the chassis

Transmission Layout

The transmission layout for the design is shown in Figure 13.

Figure 12: Prototype

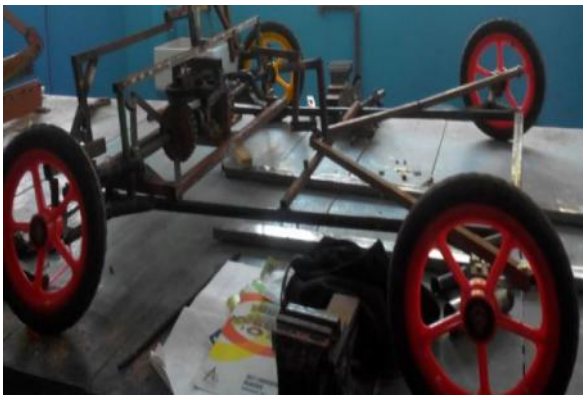
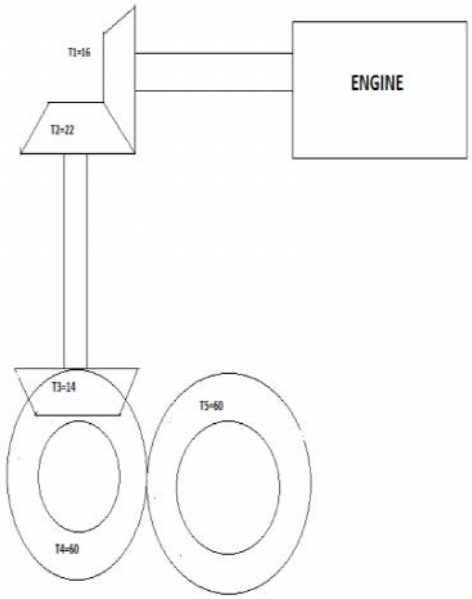


Figure 13: Transmission Layout



In this system power can be transmitted from the engine as shown. In 7 our fabricated model the vehicle will be powered using a hand lever.

CALCULATIONS

We have taken values of Tata nano for the calculating tor

Maximum speed and Torque of the proposed component. The gear reduction are done to achieve the output

Gear Ratio Calculations

1st Gear reduction = T_2/T_1 = 22/16 = 1.375

2nd Gear reduction = T_4/T_3 = 60/14 = 4.286

Gear reduction between discs

= T_5/T_4 = 60/60 = 1

Calculation Of Disc and Roller Gear Ratio

Let

D_1 = Disc diameter when the roller is in initial position

D_2 = Disc diameter when roller is in extreme position

D_R = Roller diameter

To obtain above calculated gear reduction, we have assumed the diameter of disc and roller

D_1 = 406 mm

D_2 = 175 mm

D_R = 140 mm

Let

C_{D1} = Circumference of Disc 1

C_{D2} = Circumference of Disc 2

C_R = Circumference of roller

C_{D1} = 2 *-®-* r1 = 203 * 2 * 3.14 = 127.505

C_{D2} = 2 *®-* r2 = 375 * 2 * 3.14 = 549.78

C_{DR} = 2 *®-* rR = 70 * 2 * 3.14 = 439.82

Maximum reduction = C_R/C_{D2} = 439.82/ 549.78 = 0.8

Maximum reduction

= C_R/C_{D1} = 439.82/127.5 = 3.452

Total Reduction at initial stage

1st reduction * 2nd reduction * max reduction of component

= 1.375 * 4.286 * 3.452

= 20.345

Total Reduction at final stage

= 1.375 * 4.286 * 0.8

= 4.715

Hence we can achieve variable gear ratio

Calculation of torque

Torque from engine = 50 N-m

Torque after 1st reduction = 50 * 1st gear ratio

= 50 * 1.375

= 68.75 N-m

Torque after 2nd reduction = 68.75 * 2nd gear ratio = 68.75 * 4.286

= 294.66 N-m

Initial torque at wheel to move the vehicle

= 294.66 * max gear reduction ratio = 294.66 * 3.452

= 1017.17 N-m

Torque at the wheels at maximum speed

= 294.66 * min gear reduction ratio = 294.66 * 0.8

= 235.73 N-m

Maximum Speed Calculation

Maximum rpm from engine = 5500

Maximum speed will be achieved by the vehicle at maximum gear ratio and minimum gear ratio

= Maximum rpm at wheels

= Engine rpm/min gear ratio

= 5500/4.716

= 1166.59

Maximum rpm attained by vehicle at 1166.59

= max rpm * 60 min * circumference of tires (m)/1000

= 1166.589 * 60 * 1.59/1000

= 111.29 km/hr

Hence we can achieve high speeds using proposed design

ADVANTAGES AND DISADVANTAGES OF TRANSMISSION SYSTEM

Advantages

- Independent system
- No traction loss
- Minimum slipping

Disadvantages

- Wear in the disc due to friction
- Component can be used only in passenger cars.

APPLICATIONS

Applications of Transmission System

- Used in passenger cars instead of differential
- Used in cars as an automatic transmission

SELECTION OF MATERIALS

Factors Determining the Choice of Materials

The various factors which determine the choice of material are discussed below.

Properties: The material selected must possess the necessary properties for the proposed application. The various requirements to be satisfied can be weight, surface finish, rigidity, ability to withstand environmental attack from chemicals, service life, reliability, etc.

The following four types of principle properties of materials decisively affect their selection

a. Physical

b. Mechanical

c. From manufacturing point of view

d. Chemical

The various physical properties concerned are melting point, thermal

Conductivity, specific heat, coefficient of thermal expansion, specific gravity, electrical conductivity, magnetic purposes etc.

The various Mechanical properties Concerned are strength in tensile, compressive shear, bending, torsional and buckling load, fatigue resistance, impact resistance, elastic limit, endurance limit, and modulus of elasticity, hardness, wear resistance and sliding properties.

The various properties concerned from the manufacturing point of view are:

- Cast ability
- Weld ability
- Forge ability
- Surface properties
- Shrinkage
- Deep drawing, etc.

Manufacturing Case: Sometimes the demand for lowest possible manufacturing cost or surface qualities obtainable by the application of suitable coating substances may demand the use of special materials.

Quality Required: This generally affects the manufacturing process and ultimately the material. For example, it would never be desirable to go casting of a less number of components which can be fabricated much more economically by welding or hand forging the steel.

Availability of Material: Some materials may be scarce or in short supply, it then becomes obligatory for the designer to use some other material which though may not be a perfect substitute for the material designed. The delivery of materials and the delivery date of product should also be kept in mind.

Space Consideration 9: Sometimes high strength materials have to be selected because the forces involved are high and space limitations are there.

Cost: As in any other problem, in selection of material the cost of material plays an important part and should not be ignored. Sometimes factors like scrap utilization, appearance, and non-maintenance of the designed part are involved in the selection of proper materials.

CONCLUSION

Hence, the alternate transmission component and the smart parking system is fabricated. Friction losses in the transmission component can be reduced by using oil which is used in cvt. The transmission component can be used in passenger cars. The smart parking system can be easily implemented in cars.

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