Development of Reverse Gear Mechanism in Three Wheeler for Physically Challenged

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***Abstract*: In the fast-growing modern world, many types of vehicles are being innovated. But until now a major problem for the physically challenged people is to move the vehicle in the reverse direction. It is difficult for such people to move the vehicle backward even to a small distance. So to eliminate this problem I have implemented a reverse gear mechanism for a three-wheeler. This way the physically challenged people can easily reverse the vehicles without getting down from the vehicle by easily operating hand lever. The main objective of our project is to facilitate „comfortability and safety" to the physically challenged peoples. The reverse gear for handicap vehicle consists of the following components Vehicle, wheels, spur gear arrangements, and square tube arrangements to full fill the requirements of the complete operation of the reverse gear mechanism. When the need arises to reverse the vehicle or to require more torque to remove the vehicle from slopes they can engage the hand lever for reverse gear, hence the vehicle moves backward. This project will be useful for challenged people in society. This three-wheeled vehicle is so useful to the handicapped people to move in reverse direction easily and comfortably. It is based on the principle of meshing of gears. This project has also reduced the cost involved in the concern. The project has been designed to perform the required task taking minimumtime.**

Key words: Spur gear, Wheels, Shaft, Square Tube, Lever

1.0 INTRODUCTION

The main purpose of this concept is used to implement the reverse gear for handicapped vehicle. In this project we have fabricated the vehicle for the handicapped persons by using spur gear arrangements. These three wheel vehicle are so useful to the handicapped persons travel in reverse direction easily. Two stroke petrol engines for TVS XL vehicle is used in this project. The gear box unit is introducedbetween the engine output and chain drive mechanism.

The engine power output is connected to the input of gearbox unit. The gear box output is connected to sprocket wheel. From the sprocket two wheel the drive is transferred to rear wheel through the chain drive mechanism.

The physically challenged persons are one of the excluded sections of the society and also they face number of problems in their daily life.

In order to bring them in the mainstream both the central as well as the state governments are introducing many welfare measures and schemes. To avail these welfare measures and the schemes, first of all they must aware about the same. In motor vehicles, the transmission generally is connected to the engine crankshaft via a flywheel and or partly because inter combustion engines cannot runbelow a particular speed.

This vehicle requires the motor vehicle, lever, reverse gear box, v-belt, sprocketand other necessary parts. When need to reverse the vehicles they can engage the hand lever for reverse gear, the vehicle moves backwards.

This will be more useful for the challenged peoples in the society. Here introducing a reverse gear mechanism, with portable gear boxthat can be easily operated by hand.

Four gears are used for obtaining reverse motion of the vehicle. In this paper, proposes and designed a gear box which will be fitted into those vehicles without much altering the existing transmission system. The now common constant-mesh gearboxes, which can include non- synchronizer synchronized/synchromesh systems, where typically diagonal cut helical (or sometimes either straight-cut, or double-helical) gear sets are constantly "meshed" together, and a dogclutch is used for changing gears.

On synchromesh boxes, friction cones or synchronings are used in addition to the dog clutch to closely match the rotational speeds of the two sides of the (declutched) transmission before making a full mechanical engagement.

A simple but rugged sliding-mesh or unsynchronized / non-synchronous system, where straight-cut spur gear sets spin freely, and must be synchronized by the operator matching engine revs to road speed, to avoid noisy and damaging clashing of the gears The now common constant-mesh gearboxes, which can include non-synchronized or synchronized/synchromesh systems, where typically diagonal, cut helical (or sometimes either straight-cut, or double-helical) gear sets are constantly "meshed" together, and a dog clutch is used for changing gears.

1.1 PHYSICALLY CHALLENGED VEHICLE

People who have problem in their physics feel so difficult to move from one place to another. The introduction of some automobile vehicles with three wheels partially fulfills the requirement of physically challenged for their convenient driving in roadways. But

such types of vehicles also need a much range of high effort from challengers to ride in road ways. The main major drawback of such type of automobile vehicles is it can‟t be able to provide a suitable driving mechanism during turnings and parking. So it may result in more effort with skid. And also such types of vehicles are only suitable for specialized case persons whether they must have problem in only leg or ear. Those vehicles may also improve the shocking vibration to challengers which result in breakup of backbone of them. So we thing that the introduction of reverse gear mechanism two wheelers is the only solution for rectifying all the problems which is in above.

2.0 PROPOSED SYSTEM

To help physically challenged persons to move their vehicle in reverse without the help of others. It consists of three shafts with a keyway cutting and four spur gears. Driver shaft consists of compound gear arrangement. Gear 1 and Gear 2 are main gears, Gear 3 is idler gear which is to transmit power from gear 2 to gear 4 for forward motion and gear 4 is a driven gear that is mounted with driven shaft. The driven shaft consists of a sprocket that is connected with a chain arrangement that allows rear wheel to rotate. Lever is used in gear setup to change the gear in forward and reverse motion while supporting plate is used for mounting three shafts. Shifting of gears arrangement is provided to change the gear in forward and reverse motion. When the gear is shifted from right to left, it makes the vehicle move forward. When the gear is shifted from left to right, it moves the vehicle in a reverse direction. It is normally based on messing of gears.

3.0 METHODOLOGY

The implementation of the reverse gear mechanism is carried out with the TVS Excel 50. The specifications and other technicaldetails of the project are as follows.

3.1 SPECIFICATION OF THE VEHICLE

Bike Type:	Standard
Start Type:	Kick
Stroke :	42mm
Engine Displacement :	70cc
Ignition:	50w Electronic Ignition, Fly Wheel Magneto12v
No of Cylinders:	1
Max Power:	3.5 bhp @ 5000 rpm
Maximum Torque:	5 Nm @ 3750 rpm
Fuel Type:	Petrol
Tank Capacity :	3l
Gearbox Type:	Automatic
Clutch:	Centrifugal Wet Type
Brake Type:	Drum
Front Brake:	80
Rear Brake:	110
Top Speed :	50kmp/h
Front Suspension:	Telescopic Spring Type
Rear Suspension:	Swing Arm With Hydraulic Shocks
Wheel Size :	16 inches
Wheelbase :	1222mm
Dimensions:	750 X 2020 X 1110mm
Cooling System:	Air Cooled
Fuel Economy:	71
Transmission Type:	Belt Drive

3.2 CENTRIFUGAL TYPE CLUTCH

Centrifugal Clutch is a type of clutch in which centrifugal force is used to connect engine drive shaft with the shaft of transmission. It is placed in between the engine flywheel and transmission system. Its main function is to connect the engine shaft with the transmission shaft. It works more efficiently at higher speeds. The main parts of centrifugalclutch are

1. Shoes: The shoes are of sliding types which slides in the guide ways. It consists of friction lining at the end and this friction lining makes contact with the drum during engagement.

2. Spring: Spring is used to disengage the clutch when the engine rotates at lower speed.

3. Spider or guides: The spiders are mounted on the driver (engine) shaft or motor shaft. The spiders are equally spaced. Equally spaced means, if they are four guides than each guideis separated from each other by 90 degree. The sliding shoes are kept in between these guides and each guide is holding a spring.

4. Friction lining: The outer surface of sliding shoes has friction lining. It helps in making grip with the inner surface of the drum.

5. Drum: The drum of the clutch act as housing which encloses all the parts of the clutch that includes sliding shoes, guides, springs etc. It is connected to the driven shaft ofthe transmission system or chains or belt.

3.3 GEAR BOX USED

Figure - 1 GEAR BOX USED

As shown in the fig 1. two stroke petrol engines for TVS XL moped vehicle is used in this project. The gear box unit is introduced between the engine output and chain drive mechanism. The engine power output is connected to the input of gear box unit. The gear box output is connected to sprocket wheel. From the sprocket wheel the drive is transferred to rear wheel through the chain drive mechanism.

In this project, two stroke petrol engines for TVS XL model moped are used. The gear box unit is introduced between the engine output and chain drive mechanism. The engine power output is connected to the input of gear box unit. The gear box output is connected to sprocket wheel. From the sprocket wheel thedrive is transferred to rear wheel through the chain drive mechanism.

3.4 TWO STROKE ENGINE

A two-stroke (or two-cycle) engine is a type of internal combustion engine which completes a power cycle with two strokes (up and down movements) of the piston during only one crankshaft revolution. This is in contrast to a "four-stroke engine", which requires four strokes of the piston to complete a power cycle during two crankshaft revolutions. In a two-stroke engine, the end of the combustion stroke and the beginning of the compression stroke happen simultaneously, with the intake and exhaust (or scavenging) functions occurring at the same time.

Two-stroke engines often have a high power-to-weight ratio, power being available ina narrow range of rotational speeds called the "power band". Compared to four-stroke engines, two-stroke engines have a greatly reduced number of moving parts, and so can be more compact and significantly lighter.

4.0 WORKING PRINCIPLE

The two stroke petrol engines for TVS XL moped vehicle is used in this project. The gear box unit is introduced between the engine output and chain drive mechanism. The engine power output is connected to the input of gear box unit.

The gear box output is connected to sprocket wheel. From the sprocket wheel the drive is to rear wheel through the chain drive mechanism.

Figure 2 ENGINE OUTPUT

4.1 TWO WHEELER MECHANISMS

In this project, two stroke petrol engines for TVS XL model moped are used. The gear box unit is introduced between the engine output and chain drive mechanism. The engine power output is connected to the input of gear box unit. The gear box output is connected to sprocket wheel. From the sprocketwheel the drive is transferred to rear wheel through the chain drive mechanism.

4.2 GEAR BOX UNIT

This gear box unit consists of four spurgears. The gear 1 has 96 teeth of 120mm diameter gear 2 has 64 teeth of 80mm diameter gear3 has 24 teeth of 40mm diameter and gear 4has 56 teeth of 60mm diameter. The driver shafthas two gears which are assembled on a sliding bush. In this sliding gear, normally the mop would move forward and when the lever is engaged, the mop would move in the reverse direction. The sprocket shaft has two gear which receives the power from the main drive shaft as shown in figure 2, and for forward movement, the drive is transmitted to sprocket wheel shaft from the gear 1 to gear 4.

4.3 FORWARD MOTION

When gear 2, gear 3 and gear 4 are meshed, the vehicle moves in the forward direction. Gear 3 is idle gear which does not change the motion. From Gear 2, the power is transmitted to Gear 4 and to the sprocket. From sprocket, the drive is transmitted to rear wheel trough chain arrangement.

4.4 REVERSE MOTION

The lever is shifted to the right side. When Gear 1 and Gear 4 are meshed the vehicle moves in reverse direction. The power is transmitted from Gear 1 to Gear 4 and to the sprocket. From the sprocket, the drive is transmitted to rear wheel trough chain arrangement.

5.0 LIST OF MATERIALS FACTORS DETERMINING THECHOICE OF MATERIALS

5.1 PROPERTIES

The material selected must poses 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 Physical, Mechanical, manufacturing point of view, Chemical. The various physical properties concerned are melting point, thermal conductivity, specific heat, coefficient of thermal expansion, specific gravity, electricalconductivity, magnetic purposes etc.Thevarious 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
- Surface properties
- Shrinkage
- Deep drawing etc.

5.2 MANUFACTURING CASE

Sometimes the demand for lowest possible manufacturing cost or surface qualities obtainable by the application of suitable coatingsubstances may demand the use of special materials.

5.3 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.

5.4 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.

5.5 SPACE CONSIDERATION

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

5.6 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.

V1 / V2 = Torque at Engine / Torque at Torque at axle = 5 x 18.319 / 15

6.0 DESIGN AND CALCULA

6.1 GEAR TRAIN

In machines, rotary mo transmitted from one shaft to other. gears are employed to transmit moti main shaft of machine to various re elements. A combination of gears employed to transmit motion from one shaft to other(s) is called „Gear train". A combination of gears that is used for transmitting to another is known as a gear train; it may include various types of ears. One such gear train of bevel, spiral, and spur gears is shown in Fig. We shall consider two types of gear trains. In one type, referred to as a simple train, the axes of rotation of the gears are fixed in space as in the train shown in fig. In the other type, known as an epicyclic gear train, the gears revolve about axes that are not fixed in space. The term "epicyclic" comes from the facet that points on gears with moving axes of rotation will describe epicycloids paths.

motion from one shaft

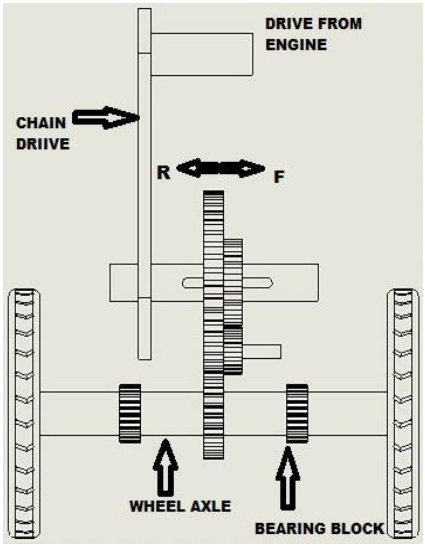

Figure 3 DESIGN SET UP

Table NO. 1 TABLE OF DATA

GEAR	DIAMETER	NO OF TE ET H	ID	PITCH	GEAR THIC KNES	MATERIAL 5Nm @
GEAR 1	80mm	66	15mm	3mm	12mm	SAE 1045 (H.T) 7.5TO R Torqu e
axle GEAR 2 TOIN	70mm	58	15m m	3mm	12mm	SAE 1045 (H.T)
GEA R 3 ion i s A set of	20mm	21	15m m	3mm	12mm	SAE 1045 (H.T)
GEA R on 4 from volvin g	20mm	18	15m m	3mm	12mm For	SAE 1045 Reverse:

6.2 BASIC CALCULATION

For Reverse:

Diameter=80mm

ID=15mm

No of teeth=66

No of teeth=66

Pitch=3mm

Thickness=12mm

Constant Gear:

Diameter=70mm

ID=15mm

No of teeth=58

Pitch=3mm

Thickness=12mm

For Forward gear:

Diameter=30mm

ID=15mm

No of teeth=21

Pitch=3mm

Thickness=12mm

Second Gear:

Diameter=30mm

ID=15mm

No of teeth=18

Pitch=3mm

Thickness=12mm

Gear Ratio for reverse=0.5

Gear ratio for forward=0.75

Vehicle Parameters:

3.5bhp @ 5000rpm

5Nm @ 3750rpm

7.5TORQUE CALCULATIONS

Torque at engine:

$P=2\pi NT / 60$

P=2 x 3.14 x 5000 x T / 60

T=3.5 x 60 / 2 x 3.14 x 5000

T=4.98Nm~5Nm

60 diameter gear = 56 teeth

120 diameter gear = 96 teeth

40 diameter gear = 24 teeth

80 diameter gear = 64 teeth

Torque at shaft:

F1 x R1 = T1

F1 x 30 = 5Nm

F1 = 5/30 N

F2 x R2 = T2

Law of conservation of momentum.

Since F2 = F1

F2 = 5/30N

T2 = 5/30 x 60

T2 = 10N

Force at wheel and shaft:

Torque at shaft = Shaft Radius x Force on shaft

T2 = 15 x F3

10 = 15 x F3

F3 = 10/15N

By Law of conservation of momentum.

Torque at wheel:

Torque at wheel = Force at wheels x Wheel Radius

Torque at wheel = 10/15 x 203mm

Torque at wheel = 133.98Nm

V1/V2 = Torque at Engine Sprocket / Torque at Axle Sprocket

$V1 = \pi DN/60$

V1 = 3.14 x 0.06 x 5000 / 60

V1 = 15.70 m/s

Fr = 96/56

Fr = 3.174

$V2 = \pi DN / 60xFr$

V2 = 3.14 x 0.12 x 5000 / 60 x 1.174

V2 = 18.319 m/s

Torque at axle =25.98 Nm $\sim 26Nm$

Figure 4 WORKING MODEL

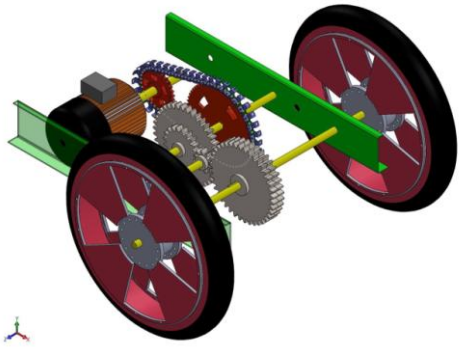

Figure 5 FINAL 3D DESIGN

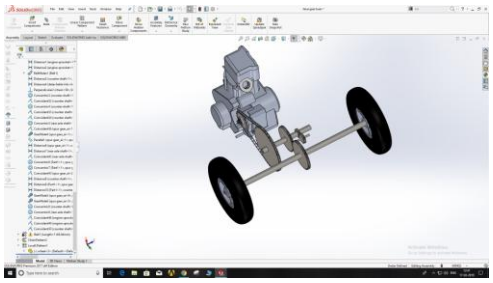

Figure 6.1 FINAL 3D DESIGN

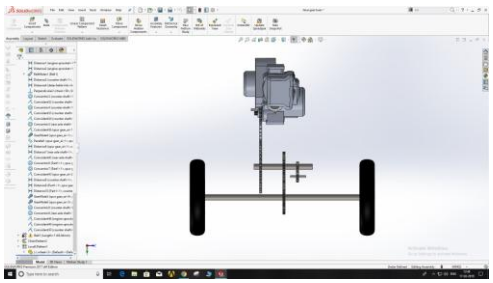

Figure 6.2 FINAL 3D DESIGN

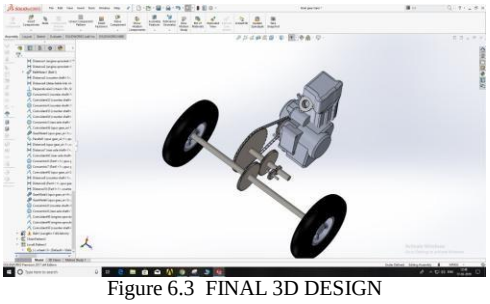

Figure 6.3 FINAL 3D DESIGN

7.0 CONCLUSION

The project "Development Of Reverse Gear Mechanism In Two Wheelers For The Physically Challenged " gave me a goodopportunity for multiple learning that involved problem solving.The operation of reverse gear using hand lever is easy and convenient way to engage the reverse gear .Having designed the mechanism for more torque during reverse motion the project has the advantage to move backward with minimum effort.

The use of the lever to engage the reverse gear is manual. It is very often affirmed by different academic and industrial experts that there should be no gap between method of learning in an institution and industrial processes, and we are trying to bridge the gap in our own small way through this paper. I feel that the project work is a good solution to bridge the gap between the institution and theindustries to serve the society better.

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