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A Study of Two Wheel Drive Motorcycle

Patil Sahil[1], Gorde Aniket[1], Yadav Omkar[1], Pardeshi Nikhil[1], Shaikh Tauseef[2]
[1]Students, Vishwatmak Om Gurudev College of Engineering, Mohili, Maharashtra, India
[2]Professor, Vishwatmak Om Gurudev College of Engineering, Mohili, Maharashtra, India

ABSTRACT

Nowadays people concentrate more and more on the comfort and operability of automobiles. Four wheel-drives in cars have become popular and are in demand in the automotive sector. But the advancement in two wheelers was limited. The concept of two wheel drive motorcycles was not successfully and economically implemented. Two wheel drive motorcycle is desirable in situations where there is rough terrain and high inclination roads which are tiresome and difficult to drive with the conventional rear wheel driven motorcycles. The two wheel drive bikes are apt for farmers, military applications, desert drive etc. The proposed design provide economical and user friendly two wheel drive. The use of chain drive and sprockets help in reduction of power loss during transmission of power from the engine to front and rear wheels. The lightweight 'all-mechanical system' is used to obtain two wheel-drive. Under optimum traction conditions, the rear wheel is actually driving faster than the front wheel and the one-way clutch within the system allow the front wheel to freewheel under these conditions. At this point, the two wheel drive system is effectively passive. Though the front drive system is turning, it is not actually transferring power to the front wheel. When the rear wheel loses traction, the drive ratio, relative to your forward speed, changes. The two wheel drive system engages transferring power to the front wheel until traction is re-established at the rear wheel.

Keywords : Two Wheel Drive, Front Wheel Drive, Bikes For Farmland, Military Bikes, Adventure Bike, Handling, Stability, Control System

I. INTRODUCTION

The automobile companies are bringing out many two wheeler models every year around the world. Nowadays importance is given more to function and performance than the beauty of the vehicle. Motorcycles for instant are preferred for transport as well as adventure riding and other applications. The conventional rear wheel drive motorcycle uses chains to transmit power from the engine to the rear wheel. But their applications are limited. The load carrying capacity is limited. The climbing capacity is also limited as there is torque only at the rear wheel. If the rear wheel slips, the vehicle does not move. This concludes that the conventional motorcycles cannot be used at ease in climbing high inclination roads, driving along muddy roads, desert roads, farm lands, mountains etc. These motorcycles are also not suited in off roads and adverse terrains.

The new all-wheel drive control system (new VTD control; Variable Torque Distribution) has been developed to improve stability and handling performance under various road/operating conditions. This system use sensor signals for braking force control system (VDC; Vehicle Dynamics Control) which improves stability of vehicle, and includes cooperative controls with ABS, TCS and VDC to optimize the control performance for an all-wheel drive vehicle.

In this paper, the estimation technology to detect the coefficient of road friction which is the core of the new VTD control, and experimental results of vehicle equipped with this control system are presented.

An all-wheel drive vehicle (AWD vehicle) is one with a power-train capable of providing power to all its wheels, whether full-time or on-demand.

As vehicles became more sophisticated and tires gave better winter performance in the 1960s there was an interest in giving the benefits of all-wheel drive to conventional cars; not for off-road use but for winter use in snow or on wet roads. Now days Automobile industries in INDIA are Developing Technologies and mechanism to increase vehicles functions and performance as well as trying to make it more comfortable and compatible for Indian roads. Speaking of Indian roads other than highways they are no lesser then rough terrain and high inclination roads which are tiresome and difficult to drive especially in climate conditions like heavy rains. This is where AWD has its Advantages.

II. PREVIOUS DESIGNS

Many companies have designed two wheel drive bikes. Some of them are already in production and are available in the market. Of which the companies Rokon, Yamaha, Christini are of more importance.

Rokon: Rokon is a company with several models of two wheel drive bikes in the market. The models are bulky in size and heavy. The bikes have big tires and a big frame to support it. The company set out to build the ultimate off road vehicle in the 1950s. It had to go anywhere and be a rugged workhorse. With this in mind a two-wheel drive vehicle with hollow wheels was designed and produced. Some call it a bike but the name Moto Two Wheel Drive Motorcycle www.iosrjournals.org tractor more closely identifies it. This is because of its huge size. Power to both wheels in a lightweight yet strong frame design gave riders nimble and versatile traction off road.

Christini: Christini Motors is one of the leading manufacturers of two wheel drive bikes in the world. Chistini's patented mechanical all wheel drive system delivers power from the motorcycle transmission to the front wheel through a series of chains and shafts. There is no energy robbing hydraulics involved. The lightweight all-mechanical system works similar to that of AWD systems found on four wheeled vehicles.

III. DRAWBACKS OF AVAILABLE DESIGNS

The current available designs have several disadvantages. The cheapest one among them costs above $8000 and common people cannot afford it. Also the transmission systems employed in such designs are more complex. The current designs available are using hydraulic transmissions, which thus have high power loss. The very big size of these bikes makes them suitable only for limited uses like race events etc.

One of the available designs is ROKON 2WD bike, which have got a full time two wheel drive system employed. The full time two wheel drive mechanism has considerably less fuel economy. And also the size of these bikes is very high which limits the use. Another design available is YAMAHA YZ250, which is a production bike by the famous two wheel manufacturers, YAMAHA. These bikes are used only for mountain races and are equipped with high capacity engines. Also the cost of the above two designs are very high. CHRISTINI BIKES, one of the leading companies in manufacturing two wheel drive bike, they are manufacturing 2WD bikes with medium capacity engines. Even they are manufacturing medium capacity bikes, the cost is still very high. The transmission used by CHRISTINI BIKES is a combination of chain drives and shaft drives and therefore the transmission losses are less compared to other designs

IV. DESIGN

The front wheel should be given a higher sprocket ratio than the rear that is the front wheel rotates at a lower speed than the rear. This condition is given to have a differential effect when the bike is taking a turn. When a bike takes a turn the bike turns with respect to a point on the ground. Thus the front wheel will be turned at an angle to the bike and the rear wheel will be in line with the bike. If the front wheels drives faster than the rear, the vehicle will experience a pulling effect. This will make uncomfortable for the rider to make correct balance at turns. A faster rear wheel will also give directional stability while cruising at high speeds.

Since the front wheel is at a lower speed, to avoid slip a free wheel should be used. A free wheel is a one-way clutch which transfers power only in one direction. Thus under optimum traction conditions, the rear wheel is actually driving faster than the front AWD system. One-way clutches within the front hub allow the front wheel to freewheel under these conditions. At this point, the AWD system is effectively passive and no power will be transmitted to the front. Thus the bike will act as a RWD vehicle. Thus the fuel consumption will not increase.

The way the automatic engagement works is like pedaling a bicycle downhill. You are pedaling, but because of gravity (acting like the rear drive) the bike is travelling faster than you are delivering power. When you get to the bottom of the hill and slow down (similar to what happens when the rear wheel spins), you will begin to power the bike again. Thus only when the rear wheel loses traction on the road (the rear wheel spinning simply without moving the vehicle) the front wheel should engage and should drive the vehicle. Thus the AWD system engages only when required.

Also it should be cheap and should give the required angle of turn corresponding to the handle. The front wheel Two Wheel Drive Motorcycle www.iosrjournals.org should have a sprocket to receive the power from the engine. A chain having the corresponding pitch and thickness is required.

4.1 Vehicle selected

The selected vehicle is a Pulser 150 motorcycle. It has a 150cc two stroke engine, a centrifugal clutch, the clutch output is connected to a pulley through belt transmission and a sprocket is connected to a sprocket which drives the rear wheel through a chain drive in the ratio 4:1. It has a simple tubular frame. Thus it is easy to incorporate the two wheel drive system in this motorcycle. Moreover the cost is less. Thus for reducing the cost, for the ease of fabrication and simple design we have chosen India's first two seater moped: Pulser 150

Specifications:

weight = 130 kg

Turning radius = 2.0 m

Gear ratio = 5:1

Figure 1

4.2 Design process

To take power to the front:

A chain drive is taken from the pulley to a position below the handle.

The end of this chain drive is coupled to one side of a tripod Universal joint.

A sprocket is fitted at the right end of the Universal joint.

A chain drive is taken from this sprocket to the sprocket at the front wheel.

The length of the pulley axis is increased.
An extra sprocket (number of teeth: 16) is added to the end of the pulley.

The Universal joint is positioned below the handle so that the two shafts of the UNIVERSAL joint meet exactly on the axis of steering.

A free wheel (number of teeth: 18) is attached to the left shaft of the UNIVERSAL joint. A free wheel is a one way clutch which transmits power in only one direction, and in opposite direction there will be no power transmission. It is commonly used as the sprocket at the rear wheel of bicycles.

At the other end of the UNIVERSAL joint another sprocket (number of teeth: 13), with greater pitch, is fixed. The front wheel of the motorcycle is replaced by the rear wheel of the similar motorcycle having the rear sprocket (number of teeth: 52).

A chain drive is taken from the right side sprocket of the Universal joint to the sprocket at the front wheel.

V. PROBLEMS ENCOUNTERED

During the progress of the project many problems were encountered. Some of them are:

The vehicle was not turning the required angle due to offset of the CV joint turning axis and vehicle axis.
Heavy Vibration.

Failure of chain drive at higher speeds.

Increased turning radius of the motorcycle because of restriction provided by the CV joint rubber bushing .
Chain drive failure due to chain slackening at rough terrain travel.
Bulkey design and less efficiency.

VI. SOLUTIONS

To reduce the offset in the CV joint axis and steering axis, CV joint was shortened in length (excess length removed) and found successful.

To reduce vibration additional bearing was introduced at the input shaft of CV joint and found successful.

To obtain rigidity extra support was welded to the support assembly.

Misalignment of the chain was rectified.
Bushing was removed and low resistance bushing was incorporated.

VII. CONCLUSION

The rear wheel drive motorcycle which we initially started with was successfully converted into a two wheel drive motorcycle with automatic engagement within the given span of time. Automatic engagement of the front wheel was made possible by using a free wheel. At optimum running condition the vehicle behaves same as a rear wheel drive vehicle and do not produce any problems. The turning radius of the vehicle is found to be 2.5 meter, with an increase of only 0.5 meter from the initial condition. Since we made simple design the weight of the vehicle increased by only 6kg and hence there is no much variation in the fuel efficiency of the motorcycle.

As we used chain drive, the power loss is very less when compared to the older designs by Yamaha, Rokon etc. The motorcycle effectively negotiates steep inclination which it couldn't make up in the normal rear wheel drive and moreover, it navigates with minimum effort in muddy and slippery condition. The load carrying capacity of the motorcycle has also increased slightly.

We obtained a higher sprocket ratio at the front wheel than that of the back wheel and hence the front wheel rotates at a lower rpm than the rear

wheel. During normal run by the action of the free wheel, no power is utilized by the front wheel and only during the slip of rear wheel the front wheel drive engage its action. So we could effectively create an automatic engagement of the front wheel drive.

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