ABSTRACT

Vehicle designers continually strive to optimise engine and transmission system. The manual drive and then automatic systems have naturally been developed into providing a continuously-variable transmission system.

The CVT is new/old technology and its burgeoning rise in the automotive world

CVT’s promise, both as a boon of fuel economy and as a low cost alternative to conventional transmissions.

We felt now is a good time to take a closer look at this innovative and time-tested technology.
INTRODUCTION

CVT has been around for more than a 100 years, but has only recently begun to find its way into production automobiles. However, until recently it was reserved for industrial applications - running lathes or light duty drill presses, for instance. With the introduction of improved materials, such as high density belts, advanced hydraulics and more recently, high speed sensors and microprocessors, the stage was set for CVT’s rise in the automobiles.

CVT rely on pulleys, wheels and / or cones offering infinitely variable “gear ratios” within limit. The CVT is easily adapted to manual or automatic operation and can also adapted for use as a constant speed drive.

This transmission is infinitely variable between its maximum and minimum ratio range. It has wide variety of applications in any industry.
What is CVT? and Why it is?

A continuously or infinitely variable Transmission (CVT) is the “Holy Grail” of Mechanical Engineering. It is a gearbox, which instead of having fixed step changes in gearing ratio, has an infinite number of gear ratio, which can be selected and altered continuously.

Why use a CVT rather than conventional automatic or manual transmission? The answer is efficiency; engine efficiency of CVT, the engine goes from an idle to a pre-programmed rpm immediately so the engine input is constant and then varies the output speed for smooth, seamless acceleration.

Other reason for using CVT’s include simplicity of design power application without any jerk to the ground.

It consists of very few components

1. a high power/density belt
2. a hydraulically operated driving pulley.
3. A mechanical torque sensing driving pulley
4. Microprocessors and sensors.
Continuous Variable Transmission

How it works?

Working Principle:-

Although there are different variations on the CVT theme, most passenger car’s use a similar set up.

Essentially a CVT transmission operator by varying the working diameter of the two main pulleys in the transmission.

The pulley have V-shaped groove in which the on connecting belt rides. One side of pulley is fixed; the other side is moveable, actuated by a hydraulic cylinder. When actuated, the cylinder can increase or reduce the amount of space between two sides of the pulley. This allows the belt to ride lower or higher along the walls of the pulley, depending on driving conditions, thereby changing the gear ratio, this action is infinitely variable with no “steps” between.

The “step-less” nature of its design is CVT’s biggest draw for automotive engineers. Because of this a CVT can work to keep the engine in its optimum power range, thereby increasing efficiency and gas mileage.

With this advantages, it’s easy to understand why manufacturers of high-mileage vehicles often incorporate CVT technology into their drive-trains.
CVT OPERATION AND MECHANISM

The CVT transmission consists of an oil–pressure variable input and output pulley and a metal belt that connects the two. With an oil system clutch on the “driven” side the multimatic acts as an automatic transmission.

The power output from the engine goes through:

Front / Back switch mechanism → Driving pulley → Metal belt → Driven pulley → clutch.

The two pulleys widths, adjusted by oil pressure, react to the position of throttle, speed, and other conditions. For instance, when the accelerator is depressed, the driving pulley width increases. At the same time driven pulley width decreases the two combining for a “lower gear” effect.

By making such adjustment, we have full control over the entire gear range previously available to automatic transmissions from LOW to OVER DRIVE and everything in-between. In addition metal belt is highly flexible, and easily accommodates the ever-changing width of the pulleys and transfer power efficiently without any slippage.

This difficult task of adjusting oil pressure and adjusting to variable driving conditions is handled completely by the ECU and allows the transmission to extract the maximum performance out of an engine – making this revolutionary.
CVT MECHANISM

The unique feature of the Honda-multimatic that, it doesn’t use a torque converter but uses a newly designed multi-layered clutch. Additionally to obtained smooth acceleration various proprietary equipment's were added to make a step-less transmission with highly reliability and durability.

CVT Characteristics:-

1. No exotic materials
2. Readily available components used.
3. High efficiency.
4. Few moving parts
5. Compact.
6. Ratio change under load.
7. Adaptable to various applications.
USES:

- General
- Automotive industry
- Material handling
- Garden machinery
- Farm machinery
- Electrical power generation – land
- Electrical power generation – aircraft
- Electrical power generation – automobiles
SPECIFIC:

- Bicycles
- Winches
- Hoists
- Machine Tools
  - Lathes
  - Milling machine
  - Winding Machine
  - Snowmobiles
  - All terrain vehicles
CVT DESIGN ADVANTAGES

It caters for all drive train requirements in one simple engineering principle.

It incorporates an infinitely and continuously variable mechanical gear range from infinity to about 3:1 without any interposing gears.

It eliminates the need for a clutch or any similar slippage device totally.

It is capable of high torque.

It makes the need for separate gearbox and clutch arrangement obsolete.

It generates no heat due to slippage because no frictional slippage takes place under load in the operation of the device.

The technology is simple, effective and easy to manufacture.

The technology operates by gripping and not slipping.

It has high mechanical efficiency throughout its operating range regardless of the instantaneous ratio selected.

It can easily be torque controlled by means of a programmable controller.

It will provide for the manufacture of simpler, more efficient and cheaper Vehicle drive systems.
DRAWBACKS OF CVT

As CVT uses steel metal belt, which have less torque transmitting capacity and thus its use is limited over small cars or sporty car’s only.

Slipping or belts over a pulley may occur due to transmission of high torque continuously and thus vehicle may creep sometimes. The effect called “rubber band effect” or “slipping clutch syndrome” which is common source of criticism on CVT’s are thus definitively banished.

CVT’s uses hydraulic torque converter to handle the task of pulling away – inevitable incurring come degree of loss in the slip phase.

CONTROL OF CVT’s BY MULTITRONIC

Full electronic control in order to attain its goals of a smooth ride and excellent fuel economy. This is largely separated into three section

- Gear ratio control
- Acceleration control
- Side pressure control
Advances in CVT’s: Multitronic CVT’s

In the guise of the new multitronic, it developed a step-less transmission that finally overcomes all the drawbacks of this principle and capitalizes on the benefits of this systems optimized gearshift strategies. Newly developed multitronic represents a radically new departure in that it has better acceleration uses less fuel and provides a more comfortable ride than a comparable car with 5 – speed manual gearbox. The multitronic sets itself apart from the CVT systems currently on markets through its numerous modifications improvement and newly developed features such as have modified the variator of the continuous variable transmission by adopting a new transmission element known as the link-plate chain to handle the high forces and torque’s that are developed constantly by the six-cylinder engine with a peak torque of 280 Newton-meters. The scope for using continuous variable transmission has thus been significantly broadened. The MCVT’s uses oil-cooled multi-plate clutch, which not only avoids the typical transmission losses of the torque converter, but also implements a variety of starting strategic.

The rubber band effect is avoided by electronically controlled engine speed tracking, producing driving properties in conjunction with a reassuringly familiar pattern of sound and advantage of the multitronic compared with modern torque converter transmissions is that the gearshifts entirely jolt-free.

The electronics in addition include the DRP dynamic control program, which monitors both the driver and driving conditions.
CONSTRUCTION DETAIL

The plate-link chain is the heart of revolutionary multitronic step-less automatic. The structures of the link plate chain is similar to that of other chain, except that it has several layers side by side, making it much stronger. The link plates are connected by pins, the face ends of which press against the tapered surface in the variator. The link-plate chain moreover has the advantage that it can run round even tighter radii than other link type belts. It is able to transmit maximum forces and torques when running at this minimum diameter.

One fundamental advantage of the variator in the multironic is the high spread of ratios. All of the power can be optimally transferred in a more sporty and economic manner than with a manual transmission and with more comfort than conventional automatic.
CONCLUSION

The multitronic is one of the new continuously variable transmissions (CVT’s) that promise to render the current crop of automatics obsolete. Use of link plate chain to offer an almost infinite number of ratios, completely eliminating internal gears.

Whatever the compromises made in the name of addressing the conservative tastes of the American consumer, the multitronic CVT’s is an absolute revelation, indeed a revolution.

Because of the smooth transition in gear ratios provided by the CVT transmission, the CVT insight provides constant, step-less acceleration from a stop all the way up to cruising speed. This contrasts with the jerk of gear changes experienced with a typical automatic transmission.

And of course, Multitronic is one of the new continuously variable transmission (CVT’s) that promise to render the current crop of automatics obsolete.

All of the power can be optimally transferred in a more sporty and economic manner than with a manual transmission and with more comfort than conventional automatic.
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Continuous Variable Transmission

Diameter Increases

Cones more inward

Diameter Decreases

Cones more outward

Thin, High-Strength Metal

Ring

Metal Belt Design Layout
Continuous Variable Transmission

Honda Multimatic Step Gear Ratio Mechanism

- Pulley Groove Wide
- Transfer Pitch Small

- Pulley Groove Narrow
- Transfer Pitch Large

In LOW "gear"

In Overdrive "gear"

Acceleration Clutch Location Comparison

Honda Multimatic

- Driving Pulley
- Forward/Reverse Box
- Metal Belt
- Driven Pulley
- Multi-Plated Acceleration Clutch

Standard CVT

- Driving Pulley
- Belt
- Driven Pulley
- Electro-Magnetic Acceleration Clutch

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