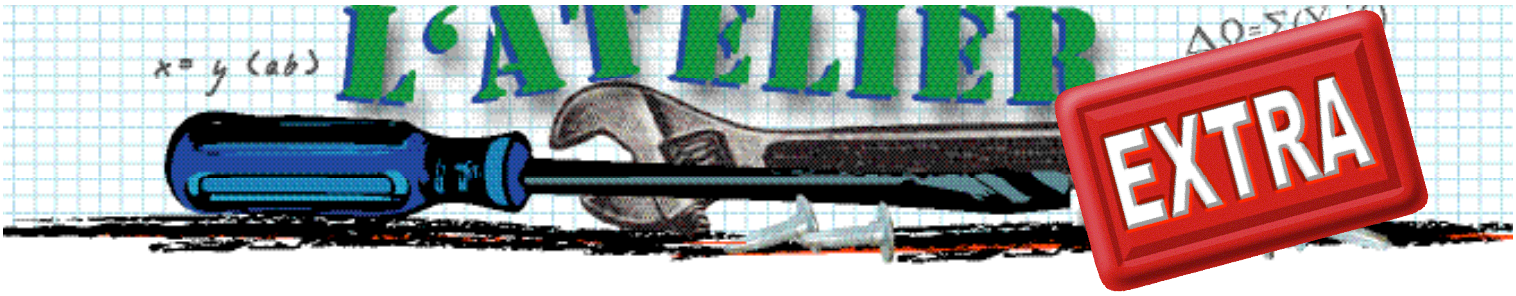
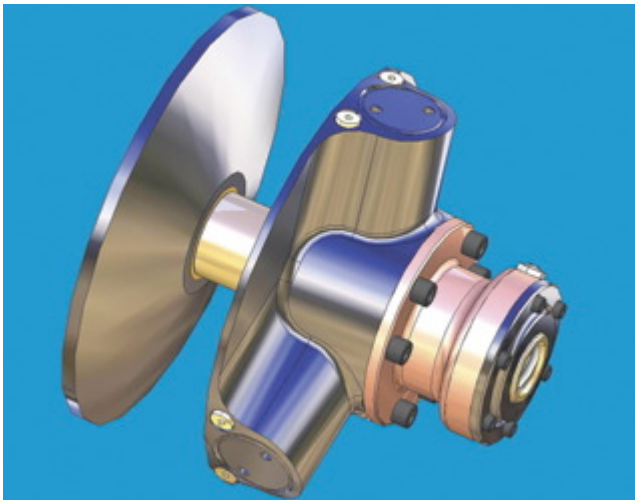


Inventium « *Hydradjust* » drive clutch: Let the revolution begin!

By Michel Garneau



The CVT as we know it

The constantly variable transmission (CVT) system used in modern snowmobiles is a model of simplicity and efficiency. In fact, despite prior failed attempts in certain other vehicles, this driveline system is currently in the midst of a revival into other forms of transportation such as ATV's and automobiles. The main strength of a properly tuned CVT system is that it will automatically set itself to the optimal ratio balancing the competing forces of engine torque and vehicle load.

Snowmobile clutches today are mechanical devices that come in two distinct but related types. The first, and oldest, is the fixed roller clutch such as those used with great success by Polaris, Arctic Cat and Yamaha. The other is a moveable roller design used by Ski-Doo and known as the Total Range Adjustable (or TRA) clutch. One interesting feature about the latter is the owner's ability to quickly alter the shift point (ie. Max rpm) of the clutch by changing the "clicker position" (which effectively raises or lowers the ramp inside the clutch thereby varying the load on the engine). Both systems have their proponents and detractors but in the end they have both proven to be effective at transferring power to the track.

In spite of all their inherent advantages, existing designs do have certain drawbacks, the first being noise. Present day mechanical CVTs all emit some degree of noise and reducing this would surely be a welcome development. The second relates to maintenance. It is a fact of life that bushings on the moveable weights or roller arms wear out and that springs lose their tension over time. The third is lost efficiency due to mechanical distortion. Although not visible to the naked eye, the manner in which the load is applied by the weights/rollers to the moveable clutch sheave (ie. On the outside extremities in three different planes) results in distortion of the moveable clutch face which in turn reduces the contact area with the belt. In other words, while in theory a full 50% of the clutch diameter is driving the belt, the distortion causes the contact area to fall to well below that resulting in lost "traction" and hence an increase in slippage and efficiency. Finally, there is lack of adjustability. While the TRA does address this to some extent, significant changes in either riding conditions or engine power typically require that the operator perform an overhaul of components (either spring or ramp/pin weight, or both) in order to achieve the desired characteristics.

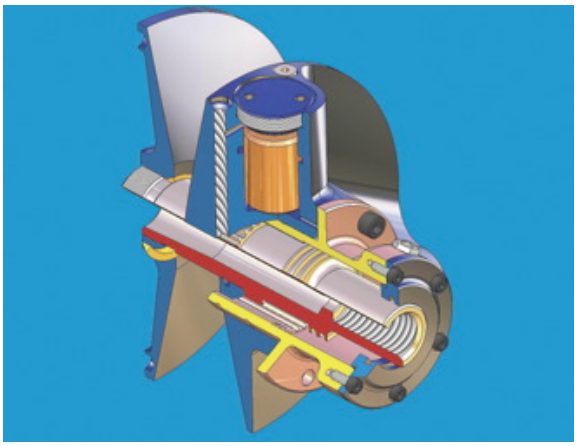
Introducing the Inventium way...

So, existing CVT designs are not perfect, but what alternatives do we have? Until now, virtually none, but all that is about to change. Enter the all-new (patent pending) Hydradjust drive clutch by Inventium International. Based out of Hébertville, Quebec, located in the heart of the Saguenay Lac St-Jean region, Inventium has developed what could be very well the greatest leap forward in clutching technology since the advent of the CVT itself.

Like existing designs, the Inventium clutch still relies on centrifugal force to generate the force necessary to squeeze the belt. The difference, however, lies in how it "converts" centrifugal force into the thrust required to get this done. Unlike conventional CVTs, the Inventium does not rely on purely mechanical means but rather uses hydraulic pressure to cause the moveable sheave to be displaced. How it does this is the key to the design and what offers so much potential for the future.

How it works

The Hydradjust clutch starts life as a solid piece of billet aluminium which is then CNC machined for exceptional accuracy. Three individual cylinders (1.375" diameter) are cut at 120 degree intervals (same as the ramp or weight interval on a conventional clutch) along with linked oil galleries (located at the upper end of the cylinders) leading to a sealed chamber in the hub (closest to the moveable sheave). Sliding pistons are then inserted into the cylinders, along with hydraulic oil and these are then sealed with removable caps. On the opposite side of the oil chamber, in a separate cavity, you will find pressurized nitrogen gas. This gas, usually stored at a pressure of 60 to 80 psi, acts as the spring in a traditional clutch. That is, it holds back the clutch



from engaging. Once the clutch begins to spin, centrifugal force acts on the mobile pistons and pushes them away from the center of rotation. In so doing, the pistons displace and pressurize the oil situated above them. This pressure is then transmitted (through the galleries) to the oil chamber mentioned previously. Once the hydraulic pressure developed by the moving pistons becomes greater than the gas pressure it is acting against (in the other chamber), the moveable sheave begins to slide causing the clutch to squeeze the belt and begin transmitting engine power. As the engine continues to speed up, the hydraulic pressure continues to increase resulting in typical clutching action. Total piston travel is 0.375" and at full-shift the pistons are in full contact with the top of the chamber. In terms of actual ratios, the clutch works within the same range as a standard Yamaha CVT, that is, going from 3:1 at engagement all the way to 1:1 at full shift. There is also a possibility of building in an "overdrive" feature such as what is found in the TRA (where the ratio climbs to 0.83:1).

Advantages

The main advantages of this clutch can be summarized in four words: quietness, efficiency, durability, and adjustability. As there are no external mechanical parts to generate noise, this clutch is extremely quiet. In terms of efficiency, as the forces causing the moveable sheave to displace come from the hub itself, they are applied evenly and centrally, in a distortion-free manner. In other words, this clutch fulfills the promise of 180 degree contact with the belt at all times. This, in turn, results in less belt slippage, cooler belt temperature for increased longevity, and more efficient power transfer. Durability is improved as there are no bushings on the ramps or arms to wear out and replace, along with no spring to fatigue.

What we are looking at, then, is an infinitely and easily adjustable power transfer unit. For example, changing the oil volume alters the slope of clutching curve. This allows the tuner to tailor the shifting curve for the engine's particular power characteristics. The precise engagement and maximum speed points can easily be set by altering the gas pressure. What this does, in essence, is cause a parallel shift (either up or down) of the clutching curve. Want a higher engagement point? Increase the gas pressure. So, by varying these two elements, one can fine-tune the clutch's behaviour to get exactly the desired traits at any given rpm. One final parameter of adjustability is provided by the piston weight. While the piston availability is limited to one model, the one offered is a hollow two-piece design that allows the owner to add or remove weight (simple bb's from an air gun can be used, for example) to customize total mass specifically for the application. Now, that, friends, is adjustability. Incidentally, the clutch is of a durable design with Inventium claiming that this clutch can safely handle sustained use on applications to 300 hp! As an added bonus, testing has shown the Inventium clutch to deliver excellent backshifting, a real asset for mountain and performance-minded riders.

Well worth the weight

So what does this wonderful unit weigh? Well, as it turns out, it weighs 3 lbs more than a stock Yamaha clutch. However, since the distribution of that weight is such that there is a greater proportion of it located closer to the center of rotation, it behaves the same (in terms of rotational inertia) as the Yamaha clutch at pre-engagement speeds. Of course, as the clutch spins faster and centrifugal forces push the pistons outward (away from the center of rotation), this begins to change. The fact that the pistons are heavier than the oil results in an outward shift in weight distribution which in turn increases the clutch's effective inertia.

The future is intelligent

While the present day version of the clutch is impressive, the best is yet to come. As you know, by altering one or both of the gas pressure and oil volume you can easily and totally transform the clutch's characteristics. Imagine, if you will, being able to change these two critical parameters on the fly. In speaking with the designer of the clutch, Inventium president Michel Lessard, he informed us that they intend to install rotary fittings which would allow adjustments to be made to these two parameters while the engine is in operation. To take it one step further, consider the possibility of hooking up the control of these two items to the engine's ECU and you have the makings of a fully adjustable "powertrain system". In other words, you can forget the present separation between engine and drivetrain and look at designing a fully adaptable powertrain that can be programmed for optimal fuel economy, performance, even traction control, at the flick of a switch. As we said at the beginning, this truly is about to rewrite the book on converting dead dinosaurs into forward motion. Quite the Inventium, wouldn't you agree?