**If I had to guess, then I would say that most of us probably haven’t given a great deal of thought to the inner workings of compressors, have we? I mean what even is a compressor and why am I taking up any of your time talking about them?**

**Exactly!**

**Well, this is a very simple example of a compressor, and what I’m demonstrating now is perhaps one of the stupidest things you can do with a compressor.**

**Ouch!**

**Thankfully history is littered with people much smarter than me, who understood the far more useful potential that these sorts of devices hold. Not just for pushing air into bicycle tyres, which is of course what this thing is really designed for, but for a multitude of applications ranging from basic pumps to sophisticated air conditioning systems and all sorts of other devices that have become the indispensable drivers of our modern society.**

**They all need a power source though, of course. We wouldn’t get much done if we relied on hand powered devices like this to keep our homes cool for example. And it’s a lot of power. The Carbon Trust recently calculated that air compressors of one form or another account for more than ten percent of total industrial energy consumption. And a lot of that energy is wasted in leakages and heat generation.**

**So finding ways to make compressors work better is definitely a very good idea, not just to save money during the current global energy crisis, but perhaps more importantly in the long term to reduce the amount of energy we use in the first place.**

**A now there’s a new compressor design on the market that is not just potentially revolutionary but actually literally revolutionary.**

**Let me show you what I mean…**

**Hello and welcome to Just Have a Think.**

**It’s easy to think of compressors as being a fairly modern invention. But in fact, they date back to at least 1588, when an Italian engineer called Agostino Ramelli came up with what we would now call a ‘positive displacement compressor’ which he intended to be used to pump water up from underground wells.**

**In 1860, Ramelli’s design was significantly improved by two American brothers with the fantastic names of Francis Marion Roots and Philander Higley Roots. Their device caught the eye of the superintendent of a local iron foundry who realised that he could use it to blast air into his furnaces much more efficiently than his existing bellows. The Roots brothers were smart enough to patent their design, and within ten years they’d built a monster 48-tonne version of their ‘Roots Blower’ with enough power to shove a train carrying 22 people through a tunnel. So, you know, eat your heart out Hyperloop! These guys had nailed it a hundred and sixty years ago!**

**And just to conform to nationalistic stereotyping, it took a German engineer to optimise the design. His name was Heinrich Krigar and in 1878 he twisted the blades of the Roots Blower to produce a design that he successfully patented as the Schraubengebläse – or “screw blower”.**

**Then in 1935 a Swedish inventor by the name of Alf Lysholm took the concept a step further with his Twin Screw Supercharger, which led to the development of the Lysholm Compressor design that is still widely used in all sorts of industrial applications today.**

**One of the challenges faced by all compressor designs is leakage. Most designs rely on extremely accurate machining to achieve very fine tolerances between the compressing elements and the chamber that houses them. It’s what’s known in the business as a ‘clearance gap’. A gap is essential to avoid inefficiencies from friction, and costly maintenance from wear and tear. But you want that gap to be as small as possible so that only a very tiny amount of fluid is lost.**

**We’ll come back to that challenge in a moment, but what about this new compressor design that I mentioned earlier on?**

**Well, it’s called the Lontra Blade Compressor and its manufactured here in the UK by a company that is, unsurprisingly, called Lontra.**

**To understand how it works, I caught up with the company’s CEO, Steve Lindsey, via Zoom recently.**

**Steve explained that the basic principle of the design is essentially just my old bicycle pump bent round into a circle, and he was kind enough to lend me this scaled down model to help show the inner workings of the device.**

**Inside this sealed metal chamber there are two elements rotating perpendicular to each other.**

**The vertically rotating element has a blade attached to it that draws in a parcel of air via a large, permanently open inlet at the bottom of the chamber. As the blade continues to rotate, air fills up the entire chamber until the blade reaches this point.**

**So, that’s pretty much exactly what happens as I pull open the handle of my bicycle pump. I’ve now got a full chamber of air in here.**

**Now, here’s where we get some clever geometry going on. As the blade reaches the top point, it’s able to pass through this very precisely engineered slot in the perpendicular rotating disc, but crucially because the shape of the blade is such that it slides very snuggly through the slot, the air that’s been drawn in behind it is not able to pass through, so it’s now captured in the chamber.**

**Because the unit is in a perpetually rotating motion, the blade now sweeps back around through the lower half of the circle where it does two things. It draws more air in behind it, via the large, lower intake port, AND it squeezes the air that it captured during the previous revolution, which is precisely what happens as I push the handle of my bicycle pump back down again. And, just like a bicycle pump, that squeezed air is now at a nice high pressure.**

**You’ll notice there are some holes drilled into the wall of the rotating chamber. Those holes are sealed in by the outer wall until they reach this part of the rotation where they meet a large external opening through which the compressed air is able to escape. Again, the basic principle is not dissimilar to my bicycle pump. In my case the pump puts air into my bicycle tyres, and in the case of the Lontra Blade Compressor it provides compressed air for whatever application it’s bolted onto. And that’s really all there is to this beautifully simple design.**

**The two perpendicular rotating components are mechanically linked through a gearing system so that once everything has been correctly calibrated to ensure the blade arrives at the slot at precisely the right moment, it will always arrive at that point, at that moment, in all subsequent revolutions. There’s no back-and-forth motion like you get in a reciprocating piston set up, which means there’s very little wear and tear to worry about during the operational lifetime of the compressor.**

**An ideal pump, or compressor or piston, would have a very long stroke or distance of travel but with a very small diameter in order to minimise leakage, which brings us nicely back to that clearance gap that I mentioned earlier. The trouble is, if you make the piston and rods very slender and long, you tend to get all sorts of wobbliness going on that can quite quickly lead to poor tolerances and breakage.**

**Because the Lontra compressor is essentially a bicycle pump wrapped around into a circle, it allows you to have that highly desirable very long stroke, but without the wobbliness, because all the forces are constantly being translated around the circle, which as I’m sure you know is one of nature’s strongest geometric shapes.**

**Now of course there is existing technology, like rotary compressors and screw compressors, that are engineered to partially overcome the leakage problem, and they’re in use in their millions all over the planet for myriad different applications. But all of them rely on a clearance gap that only reaches its tightest point at a very narrow intersection, at the very apex of a fin or lobe. You can see that on either side of the apex, the gap drops quickly away and widens significantly. That means you have to have extremely tight tolerances at that very small point where you’re actually achieving a seal, which makes that part of existing compressors a relatively expensive component to manufacture. By contrast, the geometry of the Lontra Blade Compressor means that the radius at the edge of the rotating disc is concentric to the housing that it’s rotating within. That means there’s a much wider surface area for the clearance gap to seal against, which in turn means you get a much better seal with a much less expensive piece of machining.**

**That might not sound like a pedantic detail, but it makes a massive difference to the overall efficiency of the compressor.**

**Lontra’s technology has already achieved energy savings of 21% at a Severn Trent water treatment facility where it performs the crucial function of water aeration.**

**Even greater efficiency improvements of around 34% have been achieved in industrial pneumatic conveying applications, by which I mean blowing commodities through a network of pipes in a factory. All sorts of products, from pasta and beans to confectionary and powders, and even pharmaceutical tablets, are all far more easily transported around a production facility inside enclosed plastic or metal tubes than they would be via a conveyor belt. Imagine trying to convince all your dried cannelloni to go around a corner without falling off the belt!**

**Nightmare!**

**If you can chuck it all in a plastic tube and blow it around using compressed air instead, then you’ve got yourself zero wastage and a much more sterile and hygienic environment to boot.**

**And of course, the Lontra system is not limited just to those applications either. There are countless different scenarios where the efficiency of their compressor geometry would offer very significant savings. According to Our World In Data, energy use in industry represents more than 24% of global anthropogenic CO2 emissions, and we established earlier that compressed air accounts for about 10% of that energy use. So, if efficiency improvements of 34% could be achieved in all industrial compressed air applications, then just that one measure alone could potentially reduce overall carbon dioxide equivalent emissions by more than 400 million tonnes every year.**

**Food for thought, isn’t it?**

**No doubt you’ve got your own views on the subject, and you may even be working in the development of technologies like this and therefore have some useful insights that you could share. If you do, then why not jump down to the comments section below and leave your thoughts there.**

**That’s it for this week though. A huge thank you, as always to the fantastic team of channel supporters over at Patreon who enable me to keep these videos free of ads and sponsorship messages and who provide me with information and feedback to keep the content as accurate as possible. And I must just give a quick shout out to some folks who’ve joined recently with pledges of ten dollars or more. They are…**

**Zvi Miller**

**David Heraud**

**Colin Matthews**

**Alan Baker**

**Brad Cleavenger [CLEvenja]**

**Jay & Betty Crater**

**Johannes Geyer**

**Steve Potter**

**Florin Bostina**

**And of course, a huge thank you to everyone else whose joined since last time too.**

**You can get exclusive early access to every new video that I produce, plus regular exclusive extra content from me, AND the chance to influence the video topics we chose via monthly content polls by visiting patreon dot com forward slash just have a think.**

**And of course, if you found this video useful and informative, then you can help the channel absolutely for free by clicking the ‘subscribe all’ option in YouTube’s drop down menu. That really does make a massive difference to how well we get noticed by YouTube’s algorithms, and it’ll ensure you get notified whenever a new video comes out.**

**As always, thanks very much for watching, have a great week, and remember to Just Have a Think.**

**See you next week.**