**It’s an amazing piece of technology, the air conditioner. It was invented almost by accident at the turn of the 20th century by a 25 year-old experimental engineer called Willis Carrier.**

**Two consecutive New York summers of extreme heat and humidity had caused swelling pages and blurry prints that were threatening the reputation of a high-quality printing business in Brooklyn called Sackett-Wilhelms Lithographic and Publishing Company.**

[**Carrier**](https://en.wikipedia.org/wiki/Willis_Carrier) **was dispatched by his employer to see if he could solve the problem, and what he came up with was a contraption that used an industrial fan to blow air over metal coils filled with cold water, forcing the excess moisture in the air to condense onto the surface of the cold coils.**

**That very effectively solved the printing problem, but it also made the ambient air cooler as well, which meant all the print workers felt more comfortable too. Carrier was a sharp cookie, and he could see that he was on to something, so he continued tinkering with the technology and by 1922 he’d created a device called the Centrifugal Refrigeration Compressor - a technology that would completely disrupt the existing North American ice cooling industry.**

**Following the second world war, Carrier’s invention became so popular in the United States that today a typical US household is more likely to have an air conditioning unit than a dishwasher.**

**In fact, air conditioners have come to play a vital role in protecting people’s health and well-being in hot countries all over the planet, which is a very good thing. What’s not so good is their impact on the climate. AC units now account for about 20% of all electricity used in buildings around the world. According to the International Energy Agency or IEA, only 8% of people living in the hotter, mid latitude regions actually own an AC unit, but as atmospheric temperatures continue to rise and those developing nations continue to raise the standard of living for their populations, the number of units in use around the world is expected to triple by 2050.**

**And that means it’s become a top priority to find technologies that can radically improve the efficiency of these machines in order to minimise energy use and CO2 emissions.**

**Now a European company called Magtor say they’ve found a way to achieve just that by fundamentally rethinking one of the most energy hungry components of the air conditioning system.**

**So, could we have another genuine market disruptor on our hands?**

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

**The principles of an air conditioner haven’t really changed all that much since Willis Carrier first started marketing the technology nearly a hundred years ago.**

**In very basic terms a refrigerant fluid flows through a continuous circuit of copper pipe that includes an interior coil called an evaporator, and an exterior coil called a condenser, with a compressor and an expansion valve sitting between them. Inside the room, the warm ambient air is passed over the copper pipes in the evaporator. At this stage, the refrigerant gas in those pipes is at a much lower temperature than the surrounding air. That means that heat energy from the air can pass into the refrigerant gas, which then continues onto the compressor outside. As the name suggests, the compressor compresses the gas, and that makes it very hot indeed – far hotter than the surrounding air.**

**That very hot gas then goes into the condenser which is basically a fan assisted heat exchanger that allows the heat in the gas to escape out to fresh air. As the gas loses its heat energy it condenses and changes state into a liquid, just like the moisture in the air condensing into water on the surface of the cold pipes in Willis Carrier’s original device. The LIQUID refrigerant then flows through the expansion valve which is specifically designed to restrict its flow. The effect of that restriction is to reduce the pressure and turn the liquid back into a very cold gas ready to be sent back into the internal evaporator once again. Exactly the same principles are in use in refrigerators, and by simply switching the hot and cold sides of the system you can also create a heat pump.**

**So, the main driving force for the whole process is really the compressor, which is the component that requires the most electrical energy.**

 **And that’s where Magtor’s technology comes in.**

**Most modern compressors and pumps use rotary motors to shove a fluid from A to B inside a chamber.**

**But rotary motors can lose as much as 30% of their output when they’re asked to convert their rotary motion into the linear motion required by compressors and pumps. That conversion is done by a crankshaft, and once a crankshaft is in the system you get some friction losses, but more importantly, you get diminished efficiency because you’re only getting maximum shove force in the middle of the piston stroke. The start and end of the stroke are both dead points where zero force is available to do any useful work. In a compression task you really want the maximum force to be applied at the end of the stroke, not the minimum force. Overcoming these inertia forces every time to motor starts up requires a big spike in power demand, which can be as much as five times the motor’s normal operating consumption.**

**The technology that Magtor have been quietly developing for over a decade now, is a magnetically driven linear motor that completely eliminates the need for a crankshaft and achieves far higher operating efficiency as a result.**

**Here’s how it works.**

**A fixed electromagnetic stator sits at the centre of the motor. On either side of that are magnetic plates that are connected to each other via a shaft that runs through the middle of the stator. That connection effectively turns the two magnetic plates into a single moving part.**

**As a voltage is applied across the electromagnet, its polarity attracts the magnetic plate at one end and repels the magnetic plate at the other end. But because it’s an electromagnet, it’s polarity is changing fifty or sixty times a second as a result of the alternating current flowing through the copper windings. That means that once every fiftieth or sixtieth of a second the magnetic plate that was being repelled is now being attracted, and vice versa. If you then attach a piston to both of the magnetic plates and combine that with a pump or compression chamber, you effectively get compressive or pumping movement in both directions instead of the single direction that rotary motors achieve. Those two movements can be used either to do two different bits of work, or combined through a common outlet to deliver a single higher flow output for an application such as an air compressor.**

**So, that’s a good start.**

**But you also avoid that costly power spike at start up as well. Because there’s negligible mechanical inertia to overcome, as soon as an electrical current is applied, the movement caused by magnetic attraction and repulsion can get going instantaneously.**

**And on top of all that, Magtor have developed a very smart additional element that optimises the motive power provided by the magnetic flux of the system.**

**Normally, the fluxes created at each pole of a magnet loop out through open air, and a lot of the force is lost completely.**

**By placing another set of magnetic guides at the top and bottom of the electromagnetic stator, Magtor are able to channel those magnetic fluxes back into the system. The result is that for the same electrical excitation field, the magnetisation levels of the stator and the interaction surfaces are significantly increased. And in layman’s terms that means an extra boost to the system’s overall efficiency.**

**In this working example, a Magtopressor is connected to a 5-litre tank of air. Magtor’s tests have shown that their device, which is smaller and lighter than a traditional reciprocating-piston air compressor, can pressurise the cylinder 38% faster while consuming 33% less electricity. And as a bit of extra icing on the metaphorical cake, the magnetic linear motor doesn’t need any of the lubrication that rotary motors require, which means significantly less down time and maintenance costs.**

**Magtor say their Magtopressor and Magtopump models are designed to be easy drop-in replacements for existing units, not just in your home or office air conditioning unit, but in your car’s climate control system and thousands of other everyday devices including pressure washers, compressed air tools, domestic and commercial refrigeration, and all sorts of pumping applications.**

**The company already has more than 50 patents in place in 41 countries covering about 85% of the world’s GDP.**

**You won’t find a Magtopressor or Magtopump on the shelf of your local Home Depot, B&Q or Bunnings though. Magtor won’t be marketing their technology to individual consumers. Instead, their devices will join the phalanx of transformative technologies performing crucial energy saving functions as key components within larger machines and apparatus. You may one day have a Magtopressor inside your air conditioning system or in the back of your fridge. You probably won’t even know it’s there, but your energy bills and carbon footprint will be benefiting none the less.**

**A well accepted gauge of any new technology’s development progress is the nine step Technology Readiness Level, or TRL ladder developed by NASA in the 1970’s.**

**As of August 2021, Magtor are at level six on the ladder, and they’ve now reached the stage of development where they’re ready to work with mass production partners to get their Magtopressors and Magtopumps deployed worldwide.**

**Most folks nowadays are starting to understand the enormity and urgency of the decarbonisation challenge facing our civilisation in the coming decades. Not every solution will be a headline grabber like, say, General Electric’s Haliade X wind turbine or Tesla’s battery installation at Hornsdale in Australia. But technologies like Magtor’s are precisely the kind of market disruptors that our world will need if we’re to stand any chance of keeping atmospheric warming to levels that humans and other species can live with.**

**No doubt you’ll have a view on this technology, or perhaps you work in related industries and you can share your experience and knowledge of existing systems. If so, then why not jump down to the comments section below and leave your thoughts there**

**That’s it for this week though.**

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