Unzipping Zippers

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It's late November again, and most days are cold enough to really start bundling up. College students across the country take advantage of their Thanksgiving weekend to make the trek home and pick up their winter coats. As millions of cups of hot chocolate are prepared around the world, people are having another shared experience: stuck zippers.

While a stuck zipper is likely in the top ten most infuriating experiences everyone has, most of the time the humble zipper works flawlessly. Over the course of the past century and a half, the zipper was invented a couple times, but has not seen much in terms of revision. It is an overwhelmingly popular mechanism with a fairly intricate design and several varieties. Let's explore the zipper's history and unzip how it works.

Inventing the Zipper

When the industrial revolution spread across Great Britain in the second half of the 18^{th} Century, textile products were, for the first time in human history, able to be produced consistently at scale. Suddenly, there was a large gap between how fast fabric could be produced and shaped and how fast it could be sewed into finished products. On September 20^{th}, 1755, Charles Fredrick Weisenthal was granted a patent for a needle pointed on both

ends so it did not have to be turned around when sewing. This device inspired the first sewing machines invented in 1790 by Thomas Saint.

These machines had a critical problem, however. Rather than weaving back and forth through the fabric, a loops of thread were joined on the underside of the fabric. Called a "chain stitch", once the thread broke at any point, every loop made before it would pull out in rapid succession. This made machine stitched fabrics prone to coming apart, limiting the potential of early sewing machines.

In 1844, English inventor, John Fisher made the chain stitch obsolete by inventing a machine that used a second thread to lock the loops made by the first thread in place. This stitch was given the rather uncreative name, the "lock stitch". Several inventors would go on to refine this design. One man from Massachusetts, Elias Howe, invented a variation on the lock stitch sewing machine in which the fabric was held vertically rather than flat on a table.

Just a few years prior, in 1851, Elias Howe had received a patent for "Improvement in Fastenings for Garments". This design was the precursor to the zipper, although he never made much of an attempt to market it. The design consisted of sliding clips tied together by a string. The clips were able to slide along the edge of the fabric, and could be bunched up to open the seam or spread apart to close the seam.

Over four decades later, Whitcomb L. Judson invented a mechanism that functioned similar to modern zippers, the only difference being how the two sides connect. The same zipping motion is used, but used to quickly connect hooks to loops rather than using a zipper geometry. This design would evolve over the following decades into the modern zipper that gets its name from the iconic sound it makes.

How Zippers Zip

Zippers are devices that exhibit strength in compression, but can be pulled apart at an angle and rejoined at some point in the future. Importantly, zippers are quick to both unzip and rezip. There are three parts that are critical to the function of the zipper: the two sets of teeth, and the slider. Most zippers also include stops at the ends to keep the slider attached to the mechanism, but these components are not critical to how the zipper actually works. They come in several forms, but some of the more common types are metal molded zippers, plastic molded zippers, and coil zippers.

All three of these designs use identical slider geometry, usually molded from metal or plastic. The role of the slider is to join and separate the two sets of teeth. The slider has two channels at the top and a single, slightly wider channel at the bottom. As the slider travels up the zipper, the two sets of teeth are drawn into the two channels at the top, joined in the middle, and then exit the slider through the single channel at the bottom. Unzipping works in a similar way, but the geometry of the slider has one more trick. When transitioning from the lower channel to the upper two channels, the paths separate gradually, leaving a small spike of material in the middle at the top. This spike serves three purposes: dividing the two channels, pulling apart the zipper, and connecting the front and back of the slider.

Plastic and metal molded zippers have the same geometry, but are made from different materials. The cast teeth are crimped onto the fabric, and have a special shape such that they mesh together easily at an angle but rigid when the two strips are parallel. These zippers are fairly common on coats, jackets, and jeans.

Coil zippers, on the other hand, are made from a continuous coil of material, usually

nylon. The coil wraps around the edge of the zipper and is shaped on the inside to form small bumps on the top and bottom. These bumps interface with the inside of the coil above it, locking the zipper in place. These zippers are fairly common on book bags, pencil cases, and suitcases. They are also easily covered by another piece of fabric to create so called "invisible zippers".

That begs the question: what causes a stuck zipper? Zippers can get stuck for a whole host of reasons, but perhaps the most common are fabric getting caught under the slider causing it to be trapped between teeth and the teeth being damaged in the first place. While zipper repair does exist, it can be difficult, and usually a damaged zipper leads to the item being discarded.

Zippers are quite universal invention that most people overlook. Although they have only existed in their modern form for about a century, they have undoubtedly become a ubiquitous fastening mechanism for clothing around the world. It is safe to say that the zipper is here to stay.