

**A REMARKABLE AMERICAN, ROMANIAN-BORN INVENTOR.
A NOTE ON THE HISTORY OF A UBIQUITOUS ITEM**

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After 1939, numerous bright young people emigrated from Romania. Among them, a teenager who has not completed his studies, graduated high school in UK and then emigrated to US where he received an engineering degree from Harvard. That young man, Steven Ausnit, became a remarkable inventor and a very successful entrepreneur in US. His inventions are literally in every house today, yet he is insufficiently known as an inventor in Romania. This study represents an analysis of his inventions and entrepreneurship activities.

Keywords: invention, reclosable plastic bag, Ziploc[®], Romanian-born inventor, Ausnit, 20th century

1. INTRODUCTORY COMMENTS

The history of the Romanian technological development is rich in names and inventors who contributed to it; Romanian historians of the technology evolution have clarified well nation's involvement in the world technical progress. However, the task of identifying the Romanian-born inventors is often difficult, because many of them made their inventions abroad and sometimes definitively emigrated. Even when Romanian inventors are "discovered", their acceptance by Romanian researchers in science and technology history, by media, and by the larger public may be slow. One of the cases is that of Dragomir Hurmuzescu, inventor of several improved versions of the X-ray tube (one of them together with Benoit, another one named Chabaud-Hurmuzescu¹), of an improved coherer, of the celebrated "Hurmuzescu electrometer" – much appreciated by Marie Curie, and of many other electric and electronic devices – many of them, however, invented while in France and documented there only. While his inventions have been described after 1990²

¹ <https://www.emory.edu/X-RAYS/century.htm>. Accessed Aug. 22, 2021.

² Dragomir Hurmuzescu had various politically sensitive positions before 1944, including Director of the Romanian Radio Agency; as a consequence, he suffered injustices after 1947, including dismissal from the Romanian Academy. His works and merits have been shadowed for political reasons for a long period of time.

[1], Hurmuzescu is still missing from several lists of great Romanian inventors, including the popular lists of Wikipedia³ in Romanian and English, but he appears in another Romanian version of the list on Wikipedia⁴, although without reference to several inventions related to the X tube or to other discoveries. Unfortunately, the situation in the field of technology parallels that in culture where, according to Keith Arnold Hitchens in *Encyclopedia Britannica*⁵, “Romania in the 20th century produced several world-renowned intellectuals, including composer Georges Enesco, playwright Eugène Ionesco, philosopher Emil Cioran, religion historian Mircea Eliade” [2], not all enough known by the public.

We try to contribute to lessening the insufficient documented data on important Romanian-born inventors by drawing attention to one of them and by discussing his contributions.

2. INVENTIONS THAT WE CURRENTLY USE MAY PASS UNNOTICED

Inventions hardly ever represent an one-step ‘illumination’, an instantaneous revelation of an object or a method for doing things easier or better. Inventions typically represent a long process of gradual improvements and an entire ecologic system involving technical, economic and social aspects, and progresses in materials. Introducing a new object or method requires building the fundamental business structure that allows the manufacturing or application of the object or method and, more importantly, creates an educated public having the skill to use the object, and to understand the use and the benefit of such items and methods. Frequently, the public must be prepared and taught by “advertising”. The case of the shower⁶ is exemplary – it took almost a century until its benefits were understood, and even more until it was massively used by the public.

Surprisingly, the life of the great inventor we here present has been satisfactorily documented by the Romania media after 1995, yet his name is missing from the above cited lists of Romanian inventors (List of Romanian inventors and discoverers, Wikipedia [3]). This may seem even more surprising, taking into account that, probably, the vast majority of people use almost daily his inventions. Yet, it is true that the everyday use of many objects obscures the brilliance, even technical virtuosity of their concept, as well as their source, including inventors and entrepreneurs who originally brought to the public that

³ English version List of Romanian inventors and discoverers, https://en.wikipedia.org/wiki/List_of_Romanian_inventors_and_discoverers; Romanian version <https://www.libertatea.ro/lifestyle/inventatori-romani-celebri-2799246>. Accessed August 15, 2021.

⁴ Listă de inventatori și descoperitori români. https://ro.wikipedia.org/wiki/List%C4%83_de_inventatori_%C8%99i_descoperitori_rom%C3%A2ni. Accessed August 15, 2021.

⁵ <https://www.britannica.com/place/Romania/Cultural-institutions>. Accessed August 11, 2021.

⁶ Inventor: William Feetham, 1767, England.

type of item. It is the case of the electric toothbrush⁷ (Tomlinson Moseley, 1937, US [4]), of the PET bottle⁸ (Nathaniel C. Wyeth, 1973 [5]), and of several other objects in our houses, including the unassuming plastic bags that have a means of hermetically closing them.

Steven Ausnit is the main inventor of the 'Ziploc'^{®9} plastic bags and of their various forms, of the plastic bags that have a simple and effective way of closing, which people have in the kitchen or they bring home when they buy any of the myriad of items that are packed in such bags. Steven Ausnit was born in Romania, in the city of Galați (in the southern part of the Moldova region of Romania), in 1924, March 21¹⁰. He moved to UK in 1939, where he continued studies in high school, and then to US in 1941¹¹. There, Steven Ausnit became a naturalized citizen at the age of 20, on October 27, 1944 [6]. He graduated in 1945 from Harvard and he remained deeply connected with this university, where he frequently participated in festivities.

This great contriver, who had almost 200 inventions patented in US and in many other countries, has spent his childhood initially in Galați¹², then mostly in Reșița¹³, where his father, Max Ausnit, had industrial interests. Steven Ausnit's work has got notoriety when the best-seller author Henry Petroski dedicated a large section of Chapter 4 of his book, entitled "Invention by Design: How Engineers Get from Thought to Thing", to the inventions of Ausnit, [7] and when his profile appeared in New York Times [8].

While his contributions to improve life of people in Lugoj and in the region and his affectionate attachment¹⁴ to the country where he was born and grown until 1938¹⁵ were well documented by the press, TV outlets, and on

⁷ Inventor Tomlinson I Moseley, Assignee MOTODENT Inc., Worldwide applications 1937-12-13 US, Application US179427A events, Application filed by MOTODENT Inc., Application granted 1940-04-09, Publication of US2196667A.

⁸ Nathaniel C. Wyeth (1988) Inventing the PET Bottle, Research-Technology Management, 31:4, 53-55, DOI: 10.1080/08956308.1988.11670536.

⁹ There are various spellings in the literature, such as ZipLoc and ZipLock. The correct spelling is Ziploc®. The name "Ziploc" is a registered trademark of S.C. Johnson & Son. (Note based on information from Mrs. C. Ausnit-Hood).

¹⁰ <https://www.toli.us/toli-news/in-memory-of-steve-ausnit-toli-board-member/>.

¹¹ Unsure year; might have been 1940.

¹² According to <https://www.toli.us/toli-news/in-memory-of-steve-ausnit-toli-board-member/>. Accessed Aug 14, 2021.

¹³ Based on information from Mrs. C. Ausnit-Hood.

¹⁴ "Steven Ausnit is very much attached to România (Steven Ausnit este foarte atașat de România)". See https://adevarul.ro/locale/timisoara/despagubiri-37-miloane-dolari-urmasii-magnatului-interbelic-max-ausnit-transa-fost-platita-avocatii-iau-jumatate-suma-1_53d166750d133766a8b6559c/index.html. Accessed Aug 17, 2021.

¹⁵ "I am American, but the Romanian blood can be seen" (Eu sunt american, dar se simte sângele de roman)" /adevarul.ro/news/societate/o-noua-investitie-marca-auschnitt-romania-galerie-foto-_50ae33ac7c42d5a6639aa333/index.html. Accessed Aug 17, 2021.

YouTube¹⁶, only few of these reports mentioned his inventive activity¹⁷. His name is not included in the Romanian literature in the field of technology and science history. Therefore, this note tries to correct this situation.



Fig. 1. Steven Ausnit. Credit and © Ausnit family and Steven Ausnit Memorial Fund. Reproduced with permission

3. THE GENIUS OF MAKING THINGS USABLE

This section is a preliminary analysis of Steven Ausnit's inventions; as such, it may be found more arid.

Many if not most patented inventions are never mass manufactured, because technologically they have one or several faults – either the required materials to make them are not available, or they have operational or usability deficiencies that became obvious only after they are used for a long enough time under diverse

¹⁶ <https://www.youtube.com/watch?v=5HJ9f8PwCQM>. Accessed Aug 17, 2021.

¹⁷ An exception is the article at <https://www.paulaherlo.ro/romanul-care-a-facut-avere-din-inventia-unui-japonez-si-din-aroganta-lui-gigi-becali-cea-mai-usoara-afacere-din-viata-mea/>. Accessed Aug 17, 2021.

circumstances. Correcting the deficiencies often necessitates additional, sometimes numerous extra inventions that, combined together, constitute the basis of a manufacturable and effectively usable item that people agree to pay for. The history of technology developments includes innumerable examples of this type of slow development.

Steven Ausnit's contributions to technology fall into four directions: inventions for making the Ziploc[®] practical; inventions for improving the functionality and operation of Ziploc[®], inventions for extending the applicability of Ziploc[®] bags; patents related to the Ziploc[®] but with different applications, such as toys.

Although his inventive activity¹⁸ may be characterized by two words, "plastic fasteners", the questions he addressed are numerous: what type of fasteners would work, being easy to fasten, de-fasten, and re-fasten numerous times repeatedly with good reliability; how to industrially produce bags with such fasteners; how to produce machinery that are more efficient to manufacturing bags with fasteners; how to use plastic fasteners in other objects, *e.g.*, toys; how to make heavy-duty plastic fasteners, able to withstand large forces (weights in the bags); how to improve usability of the bags with fasteners.

His interest in innovating may seem to have constantly changed but, at a closer look, he remarkably and systematically followed the same self-disciplined pattern: firstly, devising fasteners that better suit a certain group of applications, thus extending the market, then finding improved, cheaper, and faster ways of manufacturing bags, and then inventing items – mainly bags – with the respective fasteners. In all these stages, innovating the fasteners that fit a new class of applications, then imagining the machines that improve their production, the management genius of Steven Ausnit, his material research prowess, and his dexterity and proficiency as a mechanical engineer designing new tools and manufacturing equipment are all remarkable and reveal how much a methodical inventor and meticulous engineer he was.

The inventions of the initial phase of Steven Ausnit's activity are extremely diverse, as they regard not only the bag with Ziploc[®], but also materials for plastic bags, methods for manufacturing, devices for manufacturing plastic bags and fasteners for such bags, and devices for automatic filling and packaging of bags.

¹⁸ According to Espacenet, "Approximately 475 results found in the Worldwide database for Steven Ausnit as the inventor". https://worldwide.espacenet.com/searchResults?submitted=true&locale=en_EP&DB=EPODOC&ST=advanced&TI=&AB=&PN=&AP=&PR=&PD=&PA=&IN=steven+ausnit&CPC=&IC=&Submit=Search. Accessed Aug 18, 2021. These results represent distinct patents, but include also patents in various countries, some of them for the same invention. So, while the total number of patents Steven Ausnit had is about 475, the number of inventions is almost 200.

4. A BUSINESS MODEL

The Ausnit family (Steven, the leading spirit of the business, his father Max, and his uncle Edgar) started an affair having to bear several severe disadvantages. First, probably Steven had some inventive ideas, but the initial technical innovation was patented by someone else, and the patent was already licensed to a large company in UK; so, they needed to buy an exclusive license for US, which they succeeded. Secondly, for applying that patent in a meaningful way that could bring profit, they needed an efficient manufacturing technology for plastic foils. Then, again that initial technology was not invented by the Ausnit family, but by a Japanese inventor who assigned the patent to a Japanese firm. Therefore, the Ausnit family had to buy an exclusive license for using that technology in US. These disadvantages were so big that one may wonder how they had the courage to start the business.

Steven Ausnit originated a business model involving the development of three components: innovative products continuously improved, machinery for their manufacturing, and inventing new applications. Together, the three Ausnits had a good understanding of business and technology. They were aware that new inventions will surely be produced both for fasteners for plastics and for technologies for processing plastics, as plastics were at that time in their beginning days. Steven Ausnit should have concluded that their business is not viable without a continuous protection of their main assets – the two licenses and the involved technologies. That protection meant, on one side, that new innovations were required and, on the other, pursuing their legal protection. Steven Ausnit decided to dedicate himself, as an engineer, to continuously re-inventing both the fasteners and their manufacturing technology.

He was certainly aware that his strategy meant an uphill battle, because he was forced to produce incremental inventions facing the opposition of a large number of patents already extant in the field of fasteners, and also the opposition of large firms relentlessly inventing new technologies for processing plastics. Such a decision meant a lot of fortitude that the youngster Ausnit – he was less than 30 when they started – proved to have. For the next 60 years, he kept patenting improvements of fasteners, machinery for manufacturing them, and new applications.

There is one distinct feature of his business strategy: not assigning the patents (or most of them) to the firm (Flexigrip, then Minigrip), but to himself or to other firms. This is unusual. There is no documented explanation for this business behavior of his. One may guess that he wished to better maintain control of the firm by keeping in his personal property most of the inventions. He may also have done so to keep the firm more independent from his person and to establish a business relationship with his own firm. He may have thought that, if he institutes other companies, it would be easier to license himself to them all the same patent.

Another reason may be that, sometimes, the shareholders of private companies are not seeing the commercial advantage of some inventions and therefore are not willing to financially support the patent application. He may have also thought that, if the company fails, remaining the owner of the patents would allow starting of another business. Whatever his reasons were, this is an interesting feature of the business model he established.

Also, a distinct feature of his business strategy was to assign some of his patents on machinery for plastic bag manufacturing to a firm specialized in producing such machines, Illinois Tool Works Inc. (ITW)¹⁹, which is now “an American Fortune 200 company that produces engineered fasteners and components, equipment and consumable systems, and specialty products”²⁰. While undocumented, one can derive that Steven Ausnit had a very personal relationship with this company (in fact, it is a conglomerate of business actions, which produces today the “ZipPak™” brand of plastic bags²¹ by a former competitor of Minigrip, currently a part of ITW²², and the MaxiGrip Industrial Zippers & Plastic Closures²³; MaxiGrip is now “A division of Illinois Tool Works, ITW MaxiGrip”²⁴ as is MiniGrip²⁵).

5. LEGAL BATTLES

Many inventors have to fight legal battles to protect their rights based on patents, or to defend them. Steven Ausnit and MaxiGrip Inc. had several such legal fights. Some of them are well documented in the law literature. When a foreign firm introduced on the US market bags with plastic fasteners legally covered by Steven Ausnit’s patents, the inventor asked the Department of Commerce to intervene and finally succeeded to oust the infringing firm from the US market. S. Ausnit vividly defended his patents and won over several suitors, for example:

¹⁹ ITW business model is discussed in Pangarkar, N. Illinois Tool Works: Making a big impact with small-wins strategy. GBOE. 2019; 38: 18–25. <https://doi.org/10.1002/joe.21919>.

²⁰ https://en.wikipedia.org/wiki/Illinois_Tool_Works. Accessed Aug. 24, 2021. According to <http://minigrip.com/oldabout.html>, “ITW is comprised of over 850 decentralized business units, of which numerous are dedicated to providing innovative solutions within the packaging industry.” The same webpage provides the address of Minigrip as 3060 Kimball Bridge Road, Alpharetta, GA 30022. Accessed Aug. 24, 2021.

²¹ <https://www.itw.com/about-itw/business-segments/specialty-products/>. Accessed Aug. 24, 2021.

²² <http://products.minigrip.com/category/medical-specimen-transport-bags>. Accessed Aug. 22, 2021.

²³ http://www.itwmaxigrip.com/commercial_waterproof_horizontal%20plastic_zipper.html#. Accessed Aug. 24, 2021.

²⁴ http://www.itwmaxigrip.com/leading_plastic_zipper_manufacturer.html/. Accessed Aug. 24, 2021.

²⁵ It is unclear to the author if MaxiGrip and MiniGrip are not two branches founded by S. Ausnit or if any of them are still manufacturing products based on S. Ausnit’s patents. We have not find any source to clarify that.

“Judgment in Interference No. 103,640 is entered against the senior party, Hiromichi Inagaki, on the ground of unpatentability. Hiromichi Inagaki is not entitled to a patent containing claims 11–26, which claims correspond to the count in interference. Judgment is entered in favor of Steven Ausnit, the junior party. Steven Ausnit is entitled to his patent containing claims 1–19, which claims correspond to the count in interference.” Patent Trial and Appeal Board May 30, 200007166024 (P.T.A.B. May. 30, 2000.)²⁶

Because the US law literature (including the articles on Steven Ausnit’s cases) is freely available, this topic is not further detailed here.

6. PATENT ANALYSIS

As describing all of Steven Ausnit’s almost 200 inventions would require a book, only a few examples are provided of his orderly and logical innovative activity cycles.

Method notice. The remaining part of this article is based on a comprehensive search of the sources on Steven Ausnit and his activity. The bibliographic search used includes: full search in the US Patent Office (USPTO) database with the name as inventor; full search of the European ESPACENET Worldwide Database (database of all patents in the World that have at least a national recording on the Internet); detailed search with Google of the media (worldwide) for the name Steven Ausnit (about 200 items); search with Google Scholar for the name (5 items found). For patents issued in US before 1976, there is no abstract or other description at USPTO; however, for some of these patents I was able to find some more information at the French, Belgian, UK, and German patent offices, *via* ESPACENET. All searches were made in 2021.

6.1. PATENTS ON FASTENERS: CONTEXT AND BUSINESS MODEL ADAPTATION

To understand the innovative activity of Steven Ausnit one has to see it from the perspective of the development of plastic materials. At that time, in the 1950s and 1960s, plastic materials were new. It is in the early 1950s that polyethylene started to be used for bags (“1950s – the polyethylene bag makes its first appearance”²⁷), with the production of good quality (*i.e.*, high density) polyethylene (PE) in major countries, like UK, starting only after 1955 (“1955 – First production of high density polyethylene in UK”²⁸). On the other hand, Nylon is older, as it was commercially produced since October 1938 in US, by DuPont. Polyethylene was produced industrially in US by Du Pont starting in 1944, but commercial success came after

²⁶ https://casetext.com/admin-law/ausnit-v-inagaki?__cf_chl_jschl_tk__=pmd_n7FC3BvZ54ZfiVRlhE_Tuq7XtKonmkz1IRI_6UanVit4-1629362056-0-gqNtZGzNAiWjcnBszQd9

²⁷ https://www.bpf.co.uk/plastipedia/plastics_history/Default.aspx.

²⁸ https://www.bpf.co.uk/plastipedia/plastics_history/Default.aspx

1951 and 1953, when two improvements were achieved in the quality of industrial polyethylene. High flexibilities of the polyethylene foils were obtained only in the 1970s.

Developments in polyethylene materials and technology continued until the 1980s, when an improved version of polyethylene, better suitable for bags – low density polyethylene (LDPE) with improved properties – was introduced²⁹. For better clarifying the context, understanding of the properties of the materials for bags and of their availability is needed. PE is not a single material, but a class of materials with very different properties that depend on the length of the polymeric molecules, on their arrangement in the physical structure, on the degree of crystallization, and on the various inclusions. These constitutive (morphological) material properties determine the physical and chemical properties on which the uses of PE depend (see Ch. 4, Andrew Peacock (Ed.), *Handbook of Polyethylene: Structures: Properties, and Applications*. CRC Press, Jan 20, 2000); namely, the later properties are transparency (high density PE, HDPE, is less transparent), temperature range of usability – with LDPE having a narrower range, strength, resistance to other compounds (to acids and bases), with LDPE more resistant³⁰, easiness of to process and mold.

Two breakthroughs Steven Ausnit produced regarded the choice of the material and the selection of a cheap method of production. According to Henry Petroski (1996), vinyl was used in the early days of plastic industry, but vinyl is a material unusable for foils, somewhat brittle at lower temperatures and having other disadvantages. Steven Ausnit chose the recently developed plastic, polyethylene, which is a perfect material for foils and thus bags; he avoided nylon, another early alternative choice with good properties for building fasteners, because it is difficult to attach to polyethylene foils. Secondly, S. Ausnit chose extrusion as a cheap method to fabricate the fasteners, as it allows its production at large dimensions, easy attaching them to foils, and their cutting to the desired dimensions in an easy way; choosing this method allowed him to mass produce at low price.

The early difficulties of producing a flexible fastener are made clear in a patent by Borge³¹ Madsen³² (US2558367³³):

²⁹ “1980 – First production of linear low density polyethylene” https://www.bpf.co.uk/plastipedia/plastics_history/Default.aspx.

³⁰ see LDPE vs HDPE_ Properties, Production and Applications – Matmatch, <https://matmatch.com/learn/material/ldpe-vs-hdpe>.

³¹ There is a typo in Petroski’s book: Madsen’s forename was Borge, not Borgia, as it appears in the book.

³² Wikipedia (<https://en.wikipedia.org/wiki/Ziploc>. Accessed Aug. 21, 2021) mentions that “This zipper was based on a set of patents, which were purchased from their inventor, Borge Madsen”, but that is not so. Madsen had only one patent that FlexiGrip acquired; the other patents Madsen produced were assigned to FlexiGrip when they have been applied for. There are several other issues with that article at the accessing date.

³³ US2558367, Inventor Madsen Borge, Current Assignee Flexico (USA) S A. Priority to DK2558367X: 1948-12-23; Application filed by Flexico USA on 1949-12-14, Application granted on 1951-06-26.

“All attempts to make a reliable and efficient fastener of this kind have so far failed owing to the fact that the two parts have a tendency to become disengaged when subjected to a pull tending to separate the two parts of the garment to which the fastener is attached.”

Another difficulty well described in the same patent by Madsen is maintaining the flexibility of the fastener, while preserving the attaching power:

“It is another object of the present invention to increase the flexibility of the two strips constituting the fastener, so as to permit bending of the fastener in a lengthwise direction without risking disengagement of the two components.”

Steven Ausnit had to continuously reinvent by modifying the configurations and dimensions of the fasteners, by making use of new materials with changed properties and by a better use of the newly created PE materials, matching fastener configurations with the changed properties of the plastics. All his designs of fasteners prove that he had excellent knowledge on the materials, especially of plastics, although he was not a material scientist. By using polyethylene early in the 1960, Steven Ausnit was a farsighted engineer. The change in the shape and dimensions of the fasteners in his inventions are obviously directed by the improvements of the properties of the materials he used for bags and fasteners, especially strength, rigidity (which are low for polyethylene) and ductility (which is very high).

His business and technology models were based on a continuous innovation process that responded fast, possibly anticipating the progresses in material technology, namely in the chemistry of plastics. He kept innovating at a vigorous pace for more than 50 years. Without that continuous stream of inventions, a business based on his early concepts would have become obsolete in less than a decade. His creativity kept his company competitive.

6.2. PATENTS ON FASTENERS: STATE OF THE ART IN 1949 AND EARLY INVENTIONS

The three Ausnit, brothers Edgar and Max, and Steven, the son of Max, started from Borge Madsen's Danish patent, which they acquired. Their firm also employed Madsen. However, Madsen's was not the first patent on flexible fasteners made of soft materials. There have been several attempts to produce similar fasteners before Madsen invention³⁴ – in fact, Madsen built his invention (Fig. 2) on a set of previous ones, including one that his patent cites, namely US1887741A 1932-11-15, “Fastening device”, by Arthur H Trotter. That patent had been assigned to Hookless Fastener Co; it was applied for on 1927-11-22 (filed by Hookless Fastener Co) and had priority 1927-11-22; that patent was granted on 1932-11-15.

³⁴ Several errors in Petroski book: Madsen Borge, not Borga –probably a typo.

Notice the hook in the section of the protrusions in Figure 2; these hooks have an angle of less than 90 degrees and a means to engage each other to prevent the release (opening) of the strips. However, when engaged, they may fracture if the material is not extremely elastic, which is a disadvantage. One difficult choice was how to (geometrically) place the lock with respect to the two sheets to be connected, so that a good locking is obtained, yet flexibility is preserved and manufacturability is not compromised. An early Steven Ausnit's patent is US Patent 3,054,434, issued Sept. 18, 1962; Figure 3(a) shows how he initially conceived the plastic bag as a two mating grooves lock.

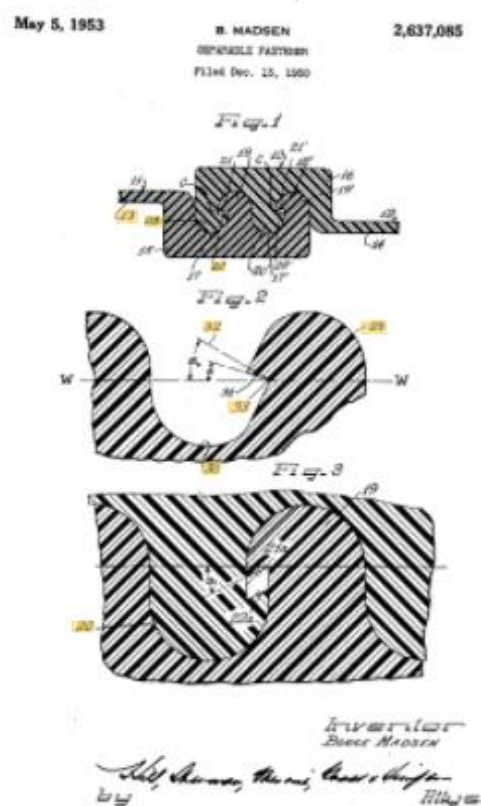


Fig. 2. Madsen's patent. US2637085A Patented May 5, 1953 SEPARABLE FASTENER. Inventor Madsen Borge Current Assignee Flexigrip Inc. 1949-12-14 Priority to DK2637085X, 1950-12-13 Application filed by Flexigrip Inc, 1953-05-05 Application granted, 1953-05-05 Publication of US2637085A. Credit: USPTO

Visibly, that lock was difficult to unlock, a disadvantage that he eliminated in a patent issued in 1965 (US Patent 3,173,184, March 16, 1965), where two ears

(extensions of the plastic foil) were added, allowing easy unlocking – Figure 3(b)³⁵. The same patent also changes the placement of the lock with respect to the two foils. Notice that in US Patent 3,173,184 the connection of the fastener to the right-hand foil is more reliable than in US Patent 3,054,434.

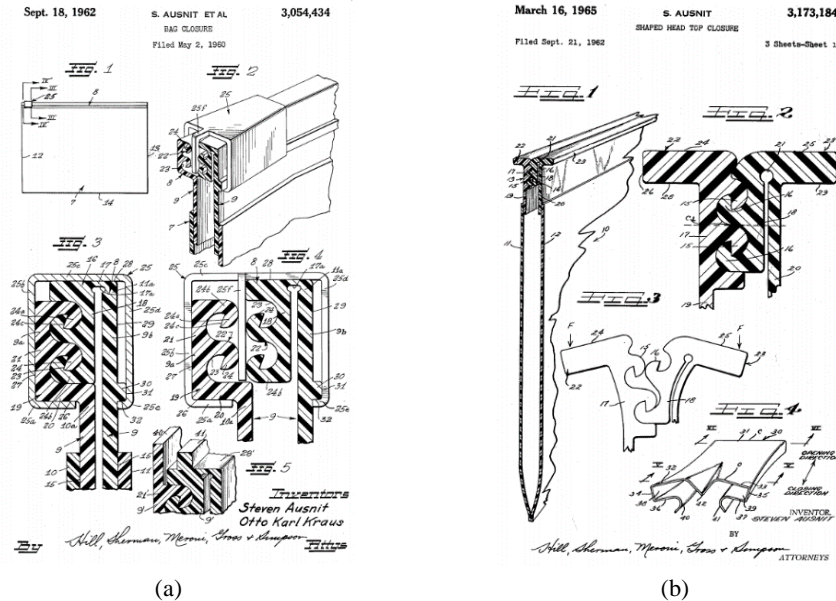


Fig. 3. (a) Sketch from US Patent 3,054,434; (b) drawing from US Patent 3,173,184 showing the “ears” (opening flanges) allowing easy de-fastening. Notice the difference in the hooks.
Credit: USPTO

Recognizing that there is a danger of accidental unlocking of the zip, Steven Ausnit introduced a third, independent safety lock in the US Patent 3,220,076 issued November 30, 1965 (Fig. 4 (a)), and then a more intricate lock in US Patent 3,049,779, August 21, 1962 (Fig. 4 (b)). Later on, he also conceived a protection to the plastic lock for preventing inadvertent opening, in US Patent 3,430,329, March 4, 1969 (Fig. 4 (c)). More than 10 years later, he further pursued these inventions in his US Patent 4,447,935 (May 15, 1984) with improvements for a heavy-duty lock provided with a releasable jaw extension structure. The description in the patent reads “... a pair of complementary extruded plastic members provided with resiliently separable interlocking fastener profiles, and at least one, and generally both, of the fastener members having releasable jaw extension structure...”. Notice that the hooks in US Patent 3,054,434 are similar to the ones in Madsen’s patent;

³⁵ Fig. 2(b) also appears in Petroski, 1996, but at a lower resolution and apparently with dimensions not at scale.

that was changed in US Patent 3,173,184, where the hooks are normal to their support, and in US Patent 4,447,935 (Fig. 5).

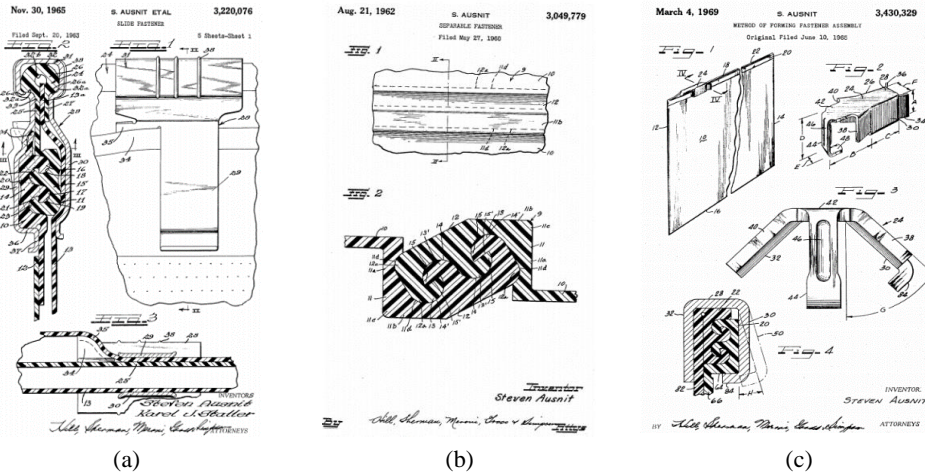


Fig. 4. (a) Drawing from US Patent 3,220,076 Issue Date: November 30, 1965; (b) Drawing from US Patent 3,049,779 Issue Date: August 21, 1962; (c) US Patent 3,430,329 Issue Date: March 4, 1969. Credit: USPTO

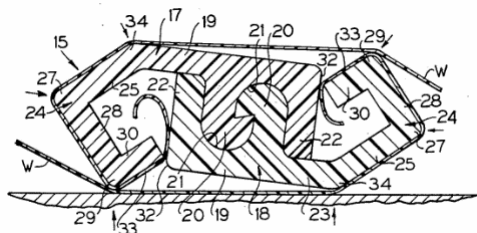


Fig. 5. Drawing from US Patent 4,447,935, May 15, 1984. The inner surface of the hooks is not normal to their support, but there is no space between these surfaces, as in Madsen's patent. Credit: USPTO

He also experimented with variants of the fastener, for example using different materials for the groove and the rib, as in US Patent 3371696, 1968, titled "Reclosable bags with rib and groove elements formed of different materials"³⁶, for which he applied as a private person.

³⁶ US Patent 3371696 (A) — 1968-03-05, titled "Reclosable bags with rib and groove elements formed of different materials". Inventor(s): Steven Ausnit; Applicant: Steven Ausnit. Application number US19650500652 19651022. Priority number(s) US19650500652 19651022.

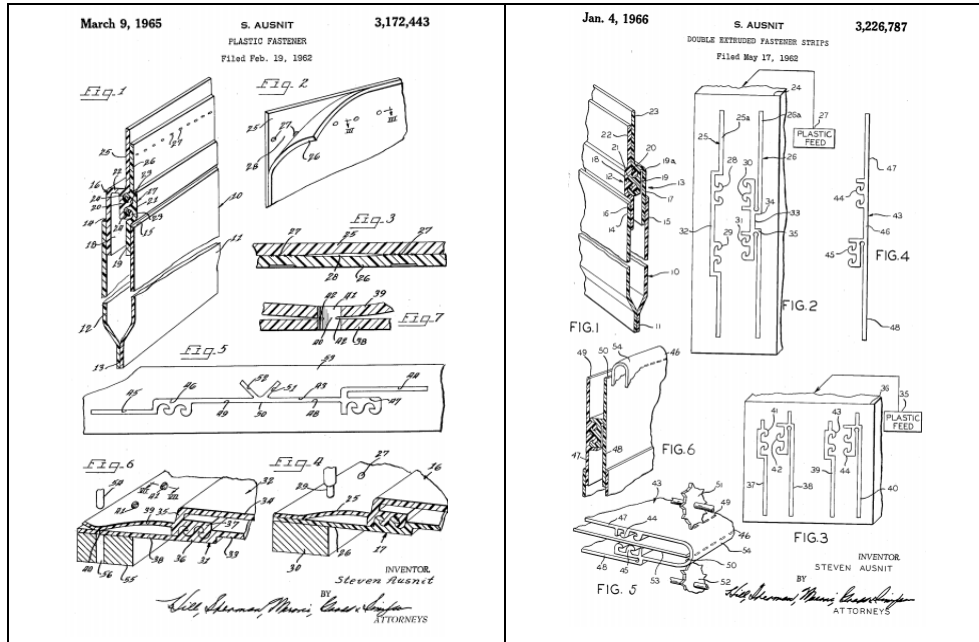


Fig. 6. Left: US Patent 3,172,443, Issue Date: March 9, 1965. Credit: USPTO. Right: US Patent 3,226,787, Issue Date: January 4, 1966. Credit: USPTO

The attention to minute details is apparent when comparing US Patent 3,991,801 (S. Ausnit November 16, 1976; “Plastic fasteners with connecting web”) with US Patent 3,226,787 issued one year later. The small differences reside in the geometry of the fasteners, as seen in Figure 6.

We will sketchily compare three patents from the perspective of their first claims, to understand the evolution of Ausnit’s ideas and working method, by underlying significant elements in Table 1. For all these patents, all applied early in the 1960s, he applied himself for the patents – no firm is involved and no attorney seems to have helped him, which demonstrates that he was skilled in the legal issues related to patenting. Notice that the advances and variations from one patent to another are incremental and frequently at the level of the details (see our underlying of text), indicating that numerous experiments were needed for finding the improvements.

His uncle Edgar has also been involved in patenting. He authored one of the patents of the company Flexigrip, US3122807, issued on 1964-03-03 (this is his only patent found on Google Patents³⁷). His patent also refers to a fastener with a

³⁷ US3122807A Inventor Edgar M Ausnit, 1960-07-22 Application filed by Edgar M Ausnit; 1960-07-22 Priority to US44668A; 1961-06-23 Priority claimed from BE605326A, 1961-06-26 Priority claimed from GB2306261A; 1964-03-03 Application granted; 1964-03-03 Publication of US3122807A

slider that is easy to manufacture, able to open and close the strips of the fastener just by its movement along the strips. The patent impresses by the minimalism and elegance of the slider and its configuration idea. This invention was then patented in Belgium (BE605326A) and in GB (GB2306261A), as well.

Table 1

Claims of Three us Patents Applied in the Early 1960s by S. Ausnit

<p>US3173184A Inventor Ausnit Steven Worldwide applications 1962 US 1963 GB Application US225267A events 1962-09-21. Application filed by Ausnit Steven. Granted 1965-03-16</p>	<p>US3226787A Inventor Ausnit Steven 1962-05-17 Application filed by Ausnit Steven Worldwide applications 1962 US 1963 GB 1964 OA Application US195444A</p>	<p>US3371696A Inventor Ausnit Steven Worldwide applications 1965 US Application filed by Ausnit Steven 1965-10-22 Application granted 1968-03-05</p>
<p>1. A flexible closure assembly comprising opposed flexible fastener strips each having a marginal portion and attached web portions for attaching to a wall extending downwardly below the marginal portions, said web portions extending parallel and in the same direction and with one of said <i>web portions attached hingedly to its marginal portion</i> at the upper part thereof, said marginal portions extending parallel to each other and having facing coacting releasable pressure interlocking continuous <i>rib and groove</i> elements parallel to the strips on their lateral inner sides, continuous separating lugs coextensive with the marginal portions and projecting laterally from the lateral outer sides at the upper outer edges of the marginal portions so that bending forces can be applied in a direction toward the lower edges of the marginal portions to help pry them apart to separate the interlocking elements, and a strip separating</p>	<p>1. A flexible closure structure comprising a flexible plastic closure strip having side edges, <i>a male fastener element integral with said strip</i> extending parallel to a first edge spaced inwardly therefrom, <i>a female fastener</i> element integral with said strip parallel to the male element and spaced inwardly from the other edge of the sheet and being shaped to coactingly releasibly pressure interlock with the male' element, said elements being spaced with a planar sheet portion therebetween, said closure strip having marginal bag attaching edge planar areas outside of said fastener elements at each side edge of the strip for attaching to the mouth of a bag, said elements being positioned on' the same surface of the sheet so that the sheet may be doubled and said planar sheet' portion form a doubled flange</p>	<p>1. A sheet with a flexible closure comprising a web portion and a marginal portion, said web portion being formed of a first thermoplastic substance having a given set of physical characteristics, said marginal portions having interlocking <i>rib and groove</i> elements extending longitudinally thereon for providing a lock therebetween, <i>said interlocking rib and groove elements being formed entirely of a separate second thermoplastic substance having a different set of physical characteristics from that of said first thermoplastic substance.</i> 2. A sheet with a flexible closure comprising: a pair of flexible closure strips each having a web portion and a marginal portion, said web portion being formed of a <i>first thermoplastic substance having a given set of physical characteristics,</i></p>

<p align="center">US3173184A Inventor Ausnit Steven Worldwide applications 1962 US 1963 GB Application US225267A events 1962-09-21. Application filed by Ausnit Steven. Granted 1965-03-16</p>	<p align="center">US3226787A Inventor Ausnit Steven 1962-05-17 Application filed by Ausnit Steven Worldwide applications 1962 US 1963 GB 1964 OA Application US195444A</p>	<p align="center">US3371696A Inventor Ausnit Steven Worldwide applications 1965 US Application filed by Ausnit Steven 1965-10-22 Application granted 1968-03-05</p>
<p>slider mounted on the strips and movable therealong in an opening direction for applying a force to said separating lugs to pry apart the interlocking elements.</p> <p>2. A flexible closure assembly comprising, opposed flexible fastener strips each having a marginal portion and attached web portions for attaching to a wall extending downwardly below the marginal portions, said marginal portions extending parallel to each other and having facing coating releasable pressure interlocking elements on their lateral inner sides, <i>continuous separating lugs coextensive with the marginal portions and projecting laterally from the lateral outer sides at the upper outer edges of the marginal portions so that bending forces can be applied in a direction toward the lower edges of the marginal portions to pry them apart</i> to help separate the interlocking elements, and a strip separating slider having a closing end and an opening end and mounted on the strips and movable there along in an opening direction for separating the strips and in a closing direction for joining the strips, said slider having a central V-shaped separating element with upwardly outwardly extending</p>	<p>bridging said elements and closing they bag and having a severable portion for severance to grant access to the bag.</p> <p>2. A flexible closure structure in accordance with claim 1 wherein said male and female fastener elements each include a pair of ribs and grooves <i>with the ribs having enlarged heads to seat in the base of the grooves</i> and be lockingly retained thereby.</p> <p>3. A flexible closure structure comprising a flexible plastic closure strip having side edges, a male fastener element integral with said strip extending parallel to a first edge spaced inwardly therefrom. a female fastener element integral with said strip parallel to the male element and spaced inwardly from the other edge of the sheet and being shaped to coactingly releasibly pressure interlock with the male element, said elements being spaced with a planar sheet portion therebetween, <i>said closure strip having marginal bag attaching edge planar areas outside of said fastener elements at each side edge of the strip</i> for attaching to the mouth of a bag,</p>	<p>said marginal portions having interlocking rib and groove elements extending longitudinally thereon for providing a lock therebetween,</p> <p><i>said marginal portions extending above said rib and groove elements for providing a grip flange therewith,</i> <i>said grip flange having an inner face and an outer face,</i> <i>a first of said grip flanges having a spacer ridge formed integrally at the inner face thereof and being disposed longitudinally thereon,</i> <i>said spacer ridge being formed entirely of a separate second thermoplastic substance having a different set of physical characteristics</i> from that of said first thermoplastic substance, ...</p> <p>3. A container having a flexible closure including interlocking rib and groove elements comprising: a pouch having front and back walls and a pouch opening at the upper edge thereof, said interlocking elements disposed at the inner surface of said front and back walls for closing said pouch opening, said walls of said pouch being <i>formed of a first thermoplastic substance</i> having a given set of physical characteristics, said interlocking rib and groove elements being formed entirely of a</p>

<p>US3173184A Inventor Ausnit Steven Worldwide applications 1962 US 1963 GB Application US225267A events 1962-09-21. Application filed by Ausnit Steven. Granted 1965-03-16</p>	<p>US3226787A Inventor Ausnit Steven 1962-05-17 Application filed by Ausnit Steven Worldwide applications 1962 US 1963 GB 1964 OA Application US195444A</p>	<p>US3371696A Inventor Ausnit Steven Worldwide applications 1965 US Application filed by Ausnit Steven 1965-10-22 Application granted 1968-03-05</p>
<p>separating surfaces at the opening end engaging the inner surfaces of the marginal portions and tapering apart toward the opening end ...</p>	<p>said elements being positioned on the same surface of the sheet so that <i>the sheet may be doubled and said planar sheet portion form a doubled flange bridging said elements</i> and closing the bag and having a severable portion for severance to grant access to the bag, ...</p>	<p><i>separate second thermoplastic substance</i> having a different set of physical characteristics from that of said first thermoplastic substance.</p>

6.3. MACHINERY PATENTS

Being a graduate in Mechanics, Steven Ausnit had all competences needed for designing production machinery. He used these skills in designing equipments that would lower the manufacturing cost and, at the same time, increase productivity for the fasteners he invented. The US Patent 3,948,705 (Ausnit; Steven single inventor), April 6, 1976, has the title “Method for making multiple plastic bags with reclosable fasteners thereon” and refers to “A mechanism and method for making material for multiple plastic bags with reclosable fasteners”. To appreciate its complexity, we reproduce two figures from that patent (Fig. 7).

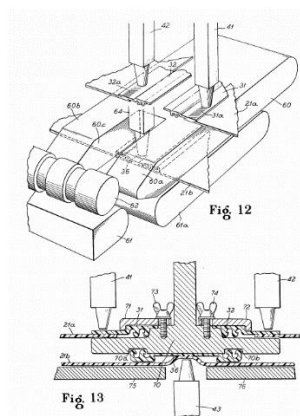


Fig. 7. Example of machines invented by S. Ausnit for efficiently manufacturing bags with fasteners. Patent #: US003948705. Credit: USPTO

6.4. EXTENDING APPLICATIONS: TOYS, CHEESE PACKAGING, COMPUTER PAPER ...

A constant S. Ausnit's concern was to apply the invented fasteners and bags to new applications. His US Patent 3,987,580 (1976), titled "Separably connective flexible toy", is aimed at building Lego-type toys using his fastening method:

"A separably connective flexible toy comprising a plurality of generally flat geometric flexible toy members each of which has a plurality of edges, each of the edges having resiliently flexible interhooking rib and groove separable fastener means therealong..."

Similarly, US Patent 4,107,870 (1978), titled "Separable connective flexible toy assembly", deals with an application to toys. The description also features elements of the toy that can be assembled together:

"A separably connective flexible toy assembly comprises a plurality of generally flat elongated geometric flexible toy members each of which has at its opposite ends complementary fastener means, at least one of the members having a slit intermediate its length through which another of the members may project whereby to provide a multi-arm configuration, each of the arms being bendable and twistable along its length such that the fastener ribs and grooves of the arm ends are interlockable with fastener ribs and grooves of another arm end..."

Another patent, US Patent 4,589,145, having several inventors (Van Erden, Donald L., Steven Ausnit, 1986) and titled "Packaging material and package", describes a method for packaging cheese:

"A method of and apparatus for packaging a blocky product such as cheese, into a wrapped envelope package, with material especially adapted for said packaging ..."

This patent was assigned to another company, Signode Corporation (Glenview, IL). It is unclear if this invention resulted from a demand from Signode Co., or if S. Ausnit came with the whole commercial idea. Finally, another patent co-authored by S. Ausnit, US Patent 4,859,083 (applied for in 1987), relates to computers and is titled "Bag chain attached to computer paper"; this patent was assigned to Minigrip, Inc. (Orangeburg, NY).

6.5. CARE FOR THE USERS

What is remarkable is that Steven Ausnit's inventive work was either aimed at customer satisfaction, or business-driven. Many patents have the purpose to help the users of Ziploc®; others aim to create new products (markets), or to lesser the

production price. An example of invention aimed at extending the market is US Patent Application 20120297736 (2011), named “In-Line Production of a Cardboard Container”. The aim of this patent is double: on one side, it proposes “Cartons with semi-rigid or rigid box-like container sections, along with attached plastic or polymeric reclosable flexible material structures”, on the other it addresses machinery to produce such boxes: “Furthermore, methods and apparatus for the manufacture of these cartons are disclosed.” This patent was applied for by Illinois Tool Works Inc. In the same vein is the US Patent Application (2010; assigned to Illinois Tool Works Inc.) titled “Carton with Plastic Reclosable Header”, which has as object “a method and apparatus for manufacturing a package with a rigid or semi-rigid container and a polymeric or plastic header with a reclosure, such as a zipper”.

A good example of patent aiming at responding to users’ needs by signaling that fastening is correct is the Patent Application 20130207311, (2012), titled “Audible Zipper with Laterally Crushed Elements and Methods of Manufacture Thereof” (again, assigned to Illinois Tool Works Inc.). The invented fastener “generates tactile and audible feedback when the zippers are opened or closed by the user”. To improve fastening, Steven Ausnit also introduced a “Magnetic plastic fastener and method of making same“, US Patent Application 3326399, 1967.

7. BEYOND THE INVENTOR

7.1. CREATING COMPANIES AND MANAGERIAL ACTIVITIES

Steven Ausnit contributed to establishing several companies and also produced inventions for other firms. The main firms to which he assigned his patents are Flexigrip³⁸ Inc and Illinois Tool Works Inc.³⁹. The searching USPTO database with the term “Flexigrip” finds 7 patents after 1970, but actually only two are assigned to Flexigrip, one in 1968 and one in 1969. Steven Ausnit has extensively collaborated with Illinois Tool Works Inc. Several patents he authored have been applied for by this firm.

7.2. CONSEQUENTIAL INFLUENCES

In the US Patent Collection database, 1961 patents are citing Ausnit’s patents; many of the citations are before 1976, meaning that his patents already got

³⁸ The Ausnit family confirmed that the original company was Flexigrip. Minigrip was founded in 1961 when the Seisan Nippon Sha license was acquired. Steven Ausnit decided to merge the companies into Minigrip at the end of the 1960s or early 70s as the future appeared much stronger for the reclosable plastic bag business. (Note due to Mrs. C. Ausnit-Hood).

³⁹ <https://www.itw.com/>

attention during the first decades, before the Ziploc® became well-known in the US market. Interestingly, many patents citing Ausnit's ones were issued in Germany and France.

7.3. CONTRIBUTIONS TO EDUCATION

While he was not a professor, Steven Ausnit had a strong belief in education as the way to improve people's life and people mutual understanding and tolerance. He supported numerous students at Harvard University, paying for them grants covering their tuition. After 1990, he established a foundation in Romania and refurbished an old large building in Lugoj, establishing a high school:

“... established in 2001 with a mission to stimulate positive self-esteem and the emotional, physical, spiritual and intellectual development of its students. Operating first out of a church basement in Lugoj, Liceul Teoretic Harul began with just 20 students in its preschool and kindergarten programs. Today, Grace High School's staff of almost 100 provides superior class instruction to more than underprivileged 500 students.” Steven Ausnit Memorial Fund pages, <https://stevenausnitmemorialfund.com/>.

After his death, a legacy he established helped create a school in Romania; the school bears his name⁴⁰. He also received recognition from the Memorial Library in New York for his work⁴¹.

7.4. THE PRIVATE PERSON

Steven Ausnit was a very unassuming person, with deep love for making good and fulfilling others' dreams. Extremely shy, he used to minimize his huge contribution to everyone's life, saying publicly in an interview “I'm sort of a side issue', Ausnit says.” (Kruger, Reunion Class Gathers Writings. The Harvard Crimson, June 5, 1995 [9]). The interviewer notices:

“It [the contribution of Steven Ausnit] includes the patent for a plastic reclosable container--better known as the Ziploc® bag--contributed by Steven Ausnit '45, the 30-year chair of Minigrip, the company that produced the bag. Though Ausnit submitted the patent himself, he says he doesn't consider his patent to be on the same level as his literary classmates.”⁴²

⁴⁰ O școală din Lugoj va purta numele marelui industriaș interbelic Max Ausnit. Opinia Timișoarei, 23 iulie, 2015. Also video.:www.opiniatimisoarei.ro/o-scoala-din-lugoj-va-purta-numele-marelui-industrias-interbelic-max-ausnit-video/23/07/2015.

⁴¹ <https://corinthian.online/mr-steve-ausnit-cobham-42/>. Accessed Feb. 15, 2023.

⁴² Kruger, Reunion Class Gathers Writings. The Harvard Crimson, June 5, 1995. Notice the error: S. Ausnit had numerous patents for reclosable containers, not just one.



Fig. 8. Steven Ausnit and his wife Anne. Courtesy of Steven Ausnit Memorial Found. ©Steven Ausnit family and Ausnit Memorial Found. Reproduced with permission

He loved Romania very much; he spent several weeks every year in Romania since 1990s, during summers, where he devoted his time and part of his fortune to help school students and organize sport activities. His last visit to Romania was in August 2019, when he celebrated his 95-year anniversary. He passed away in November 2019. Steven Ausnit was one of those few, selected people enjoying doing good deeds. Steven Ausnit is described by his acquaintances as a marvelous personality, and a lovely person in every sense.

He was a complex personality who knew to fight, loved inventing, understood very well business, was dedicated to his family, enjoyed helping “with all his heart” people, had a profound respect for the education process, and liked making others feel well.



Fig. 9. Steven Ausnit in one of Harvard's yards, 2018. © The author

Acknowledgments. I thank Prof. Bogdan Simionescu, fellow of the Romanian Academy, for encouragements and a few corrections to the original form of the manuscript. I due thanks to Mrs. Cristina Irimia, Secretary of the Editorial Board, for help with English correction. I thank the reviewers for very helpful remarks. I am grateful to Mrs. Suzanne Ausnit for providing pictures and to Mrs. Christine Ausnit-Hood for corrections, support, and permission for reproducing family pictures.

Credits

USPTO uspto.gov and ESPACENET are the source of all the patents (co)authored by Steven Ausnit as cited in this article and for all drawings from those patents. Pictures 1 and 8 are courtesy of Ausnit family and/or Steven Ausnit Foundation. All pictures are copyrighted and should not be copied without permission.

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