MECHANICAL LOCK (M-LOCK)

FIELD OF INVENTION

The present invention relates to mechanical lock (M-lock), and more specifically to a plastic injection molded with a three (3)-dimensional isosceles trapezium type of structure.

BACKGROUND OF THE INVENTION

A hook and loop type fastener mainly consists of a hook strap and a loop strap. Existing invention consists of a loop and a strap and both are usually in fabric-like substrates. When the two (2) substrates are pressed together, the hooks on one substrate catches or engages the loops on the other substrate, thus providing a fastening effect. The fastening effect can also be easily disengaged with a particular force so that the two different substrates can be easily ripped off.

Mushroom type hook structure can be injection-molded, and such mushroom type hook structures can have different shapes and forms. In the prior art US 5,845,375 & US 6,096,667, one of the very earliest shapes is the circular-headed mushroom type hook that can be injection molded. The injection molded mushroom type hook structure as seen in the prior art has a hook stem that is substantially cylindrical in nature as well as a head portion that can be substantially circular at the top end of the cylindrical stem. For this prior art, such circular-headed mushroom type hooks have a lower percentage of effective engagement with the fabric loops on the loops strap. The reason for the lower percentage of effective engagement is due to the relatively smooth surface area of the circular hook head and there are also no protruding portions that can engage with the fabric loops. Thus, this has a drawback of being unable to provide sufficient fastening strength. Moreover, such circular-headed hooks can only provide effective fastening engagement only when the head of the hooks are fully inserted into

the fabric loops, forming a lockup type of engagement. Although this lockup type of engagement can be pretty firm, the fabric loops will usually be destroyed by the hooks during the detaching operation involving the hook strap with the loop strap. Assuming that this detaching operation is repeated several times, the fastening capability will wear off or degrade sharply and become loosened. The reason is because as frequency or the number of times the engaging / detaching operation increases, the percentage of loops being destroyed increases as well. When this happens, the effective lifetime or shelf-life of the circular-headed mushroom type hooks will be relatively cut short.

Besides the circular-headed mushroom hook, another common mushroom shape hook that can be injection molded is having an octagonal head hook at the top with a substantially tetragonal stem which is found in Taiwan Patent No. 1371247 as a form of prior art. This octagonal head is an improved version from the cylindrical head since it has a number of protrusions that make it easier to engage with the fabric loops to provide effective engagements or fastening. However, it does have its shortcomings such as the hook-to-loop engagement / fastening rate is different for longitudinal and transverse direction. Moreover, due to the engagement between the head portion of the hook and the loops are provided by the protrusions of the head portion, there are instances where there may be insufficient engagement strength between the hooks and the loops which may occur at times.

In addition to the two (2) mushroom shapes mentioned, another prior art that is injection molded can be found in US 20190231034A1. According to this prior art US 20190231034A1, the mushroom type hook structure comprised a stem portion and a substantially planar head portion formed at the top end of the stem portion. The head portion found in US 20190231034A1 comprised of two protrusions each protruding

outwardly from a respective one of two opposite sides of the head portion in a first direction along a portion of the length of the side, and another two extended portions each extending outwardly from a side of the head portion in a second direction that is perpendicular to the first direction. These two extended portions each has a free end that curves downwards slightly as a hook. The design found in the prior art US 20190231034A1 aims to solve the issues encountered in previous designs such that it has better hook-to-loop engagement rate in multiple directions. Also, the free end curving downwards design served to provide more firm and effective engagement with the loops as well as to have a higher hook-to-loop engagement / peeling off strength.

However, do note that due to the unique and special design specified in prior art US 20190231034A1, it can be quite hard to peel off or disengaged the hook from the loop. It may be good for certain fastening applications that require the kind of performance specified in the US 20190231034A1 prior art. Hence there exists a need to have an injection molded mechanical lock (M-lock) with a three (3)-dimensional isosceles trapezium type of structure that is novel. Such design allows ease of adhering between two (2) plastic molded surfaces with similar three (3)-dimensional isosceles trapezium type of structure being applied by a force to ensure each 3-dimensional isosceles trapezium structure is secured by the opposite side of the same. This design enables it to have many potential adhering applications such as in medical, consumer, footwear, recreation applications or even for automotive etc.

The present invention disclosed a plastic injection molded mechanical lock (M-lock) with a three (3)-dimensional isosceles trapezium type of structure, with one surface side that has the following:

(a) a stem portion that is cylindrical-like in nature and starts with extending from the base of the substrate via a radius feature;

(b) a head portion that has a three (3)-dimensional isosceles trapezium type of structure at the top end of the cylindrical-like stem portion, with the top portion of the head being flat and has a cylindrical hollow well in the centre portion, with the cylindrical hollow well extending somewhat to the mid portion of the head;

and wherein

(c) both the stem portion and the head portion are integrally formed as a single entity via injection molding; and wherein

(d) The other surface side have the same exact shape and configuration which is a three (3)-dimensional isosceles trapezium type of structure, is injection molded and is able to have effective engagement / disengagement.

In addition, the present invention can have a different iteration of the same concept. The difference is that the other iteration has a head portion that features the same three (3) dimensional isosceles trapezium at the top end of the cylindrical-like stem portion with the top portion of the head being flat and has no cylindrical hollow well portion (unlike what was described in the prior paragraphs).

The two (2) proposed designs and its iteration mentioned above are for different and various engineering functional applications, thus enabling the present invention to cater to a wider application usage with different forces of engagement.

In addition, the head portion of the three (3)-dimensional isosceles trapezium type of structure is able to flex easily during engagement / disengagement. The cylindrical hollow well portion also aids in the flexing. Being able to flex easily enables the mechanical lock with the three (3)-dimensional isosceles trapezium type of structure to accommodate each other easily when pressed against each other during engagement. Conversely during disengagement, the mechanical lock on the

substrates can also be easily removed due to the ease of flexing based on a certain force. The distance between each injection molded mechanical lock with the three (3)-dimensional isosceles trapezium type of structure is optimized such that each of these structures are evenly spaced out from one another at equal pre-defined distances in order to facilitate the ease of engagement / disengagement. In addition, the design of the head with the three (3)-dimensional isosceles trapezium type of structure as described in the prior paragraph has been chosen and tested for its gripping (or engagement) efficiency as well as displaying good injection molding feasibility.

The polymeric material used for the injection molded mechanical lock with the three (3)-dimensional isosceles trapezium type of structure is thermoplastic elastomer (TPE) or any equivalent soft polymer which can be injection molded that exhibits high tear resistance as well as good flexibility. Depending on the chosen engineering application, the two (2) materials that are to be injection molded can either be of different hardness index, i.e., one that is rigid and the other is softer material, or of the same hardness index. In doing so, it can facilitate ease of engagement and disengagement of the mechanical lock for multiple usages without any fear of having the material deteriorate over time unlike the prior art. If one application needs a soft and hard material molded out for efficient grip, the combination will enhance the engagement (or gripping) efficiency of the mechanical lock. Moreover, having a polymeric material with good flexibility also enables the proposed design in the present invention to be able to flex easily, thus making it easier to engage / disengage the mechanical lock. Thus, using polymeric material such as TPE or equivalent material that is able to withstand multiple times of engagement and disengagement for the mechanical lock is a better choice than fabric.

Hence to summarise, the two (2) different designs and its' iterations that the present invention disclosed are able to offer the following **advantages** for the three (3)-dimensional isosceles trapezium type of structure type structure:

1. Ease of applying the present invention for different and various engineering mechanical lock functional applications.
2. Ease of injection molding using TPE (thermoplastic elastomer) or equivalent material.
3. In addition, the proposed design in the present invention allows the flexibility of using polymeric materials of different shore hardness for different engineering mechanical lock functions.
4. Due to the design and choice of the polymeric material, it can withstand multiple times of engagement and disengagement without less wear and tear as compared to fabric over prolonged usage. This means that the shelf-life of the three (3)-dimensional isosceles trapezium type of structure is longer and is suitable for applications that demand high usage frequency.
5. Conventional methods utilise a hook and a loop substrate but in this present invention, one only needs the same injection molded polymer / elastomer three (3)-dimensional isosceles trapezium type of structure head that interacts with each other on different and opposite plastic surfaces in order to have effective engagement / disengagement. Hence one does not need to mold two (2) different plastic parts but instead can mold the same plastic part with the two (2) different surfaces interacting and fulfilling the function.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings attached here are to aid comprehension of the description of the invention here. The drawings are not to scale and they are to be used for merely illustrating the principles and concepts of the invention only.

To aid in comprehension of the invention, the drawings are separated into the various Figures as described below:

Figure 1A and **Figure 1B** illustrates an overall perspective view of the two (2) different designs for the embodiment of the present invention.

Figure 2A and **Figure 2B** illustrates a perspective view of the two (2) different mechanical lock design for the embodiment of the present invention.

Figure 3A and **Figure 3B** illustrates a side view of the two (2) different mechanical lock designs for the embodiment of the present invention.

Figure 4A and **Figure 4B** illustrates another side view of the two (2) different mechanical lock designs for the embodiment of the present invention.

Reference numbers

1	Mechanical lock polymer surface area
2	Mechanical lock with three (3)-dimensional isosceles trapezium type of structure (with cylindrical hollow well)
3	Substrate backing
4	Head portion of the Mechanical lock with three (3)-dimensional isosceles trapezium type of structure (with cylindrical hollow well)
5	Stem
6	Radius-portion of the stem (for mechanical lock with cylindrical hollow well)
7	Hollow portion
8	Radius-portion
9	Mechanical lock with three (3)-dimensional isosceles trapezium type of structure (without cylindrical hollow well)
10	Substrate backing
11	Head portion of the Mechanical lock with three (3)-dimensional isosceles trapezium type of structure (without cylindrical hollow well)
12	Stem
13	Radius-portion of the stem (for mechanical lock without cylindrical hollow well)
14	Radius-portion
15	Mechanical lock with three (3)-dimensional isosceles trapezium type of structure (with cylindrical hollow well) interacting with each other
16	Mechanical lock with three (3)-dimensional isosceles trapezium type of structure (without cylindrical hollow well) interacting with each other

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT OF THE PRESENT INVENTION

In the following description, details and drawings are provided to describe the embodiment of the application.

The present invention is applicable for an injection molded mechanical lock (M-lock), and more specifically to a plastic injection molded with a three (3)-dimensional isosceles trapezium type of structure. The present invention disclosed has two (2) different designs for different and various engineering functional applications. The material used for the injection molded mechanical lock (M-lock) is thermoplastic elastomer (TPE) or equivalent material with different shore hardness for different engineering applications.

Figure 1A and **Figure 1B** illustrates an overall perspective view of the two (2) different designs for the embodiment of the present invention. **Figure 1A** illustrates the overall perspective view of the first design that has a mechanical lock **1** that includes a plurality of injection molded mechanical lock with three (3)-dimensional isosceles trapezium type of structure (with cylindrical hollow well) denoted as **2** that is integrally formed on the surface of the substrate backing denoted as **3**. The mechanical lock structure **2** has a cylindrical hollow well portion as illustrated in **Figure 1A**. According to the present invention, the mechanical lock with three (3)-dimensional isosceles trapezium type of structure denoted as **2** which is part of the overall mechanical lock **1** design, are all manufactured by means of plastic injection molding using thermoplastic elastomer (TPE) or equivalent material. Similarly, **Figure 1B** illustrates the overall perspective view of the second design that has a mechanical lock **1** that includes a plurality of injection molded mechanical lock with three (3)-dimensional isosceles trapezium type of structure (without cylindrical hollow well) denoted as **9**, and that is

integrally formed on the surface of the substrate backing denoted as **10**. The mechanical lock structure **9** has no cylindrical hollow well portion as illustrated in **Figure 1B**.

Figure 2A and **Figure 2B** illustrates a perspective view of the two (2) different mechanical lock design for the embodiment of the present invention. For **Figure 2A**, the mechanical lock structure **2** has a cylindrical hollow portion denoted as **7** at the top portion of the head portion of the mechanical lock with three (3)-dimensional isosceles trapezium type of structure (with cylindrical hollow well) denoted as **4.** As illustrated in **Figure 2A**, the mechanical lock structure **2** consists of the following:

(a) a stem portion denoted as **5** that is cylindrical-like in nature and starts with extending from the base of the substrate **3** (as per **Figure 1A**) via radius portion denoted as **6**;

(b) a head portion **4** that has a three (3)-dimensional isosceles trapezium type of structure at the top end of the cylindrical-like stem portion **5**, with the top portion of the head **4** being flat and has a cylindrical hollow well **7** in the centre portion, with the cylindrical hollow well **7** extending somewhat to the mid portion of the head **4**.

For **Figure 2B**, the mechanical lock structure **9** has no cylindrical hollow well portion at the top portion of the mechanical lock head **11.** Similarly, as illustrated in **Figure 2B**, the mechanical lock structure **9** consists of the following:

(a) a stem portion denoted as **12** that is cylindrical-like in nature and starts with extending from the base of the substrate **10** (as per **Figure 1B**) via radius portion denoted as **13**;

(b) a head portion **11** that has a three (3)-dimensional isosceles trapezium type of structure at the top end of the cylindrical-like stem portion **12**, with the top

portion of the head **11** being flat and has no cylindrical hollow well in the centre portion of the head **11**.

Figure 3A and **Figure 3B** illustrates a side view of the two (2) different mechanical lock designs for the present invention. **Figure 3A** shows the side view of the mechanical lock design **2** with three (3)-dimensional isosceles trapezium type of structure (with cylindrical hollow well **7**) as illustrated. **Figure 3B** illustrated the mechanical design **9** has no hollow portion on it. As mentioned in earlier descriptions, the two (2) different designs with different iterations cater for different engineering functional applications. The rest of the design features as illustrated in **Figure 3A** and **Figure 3B** are exactly similar. Such key design features include having the three (3)-dimensional isosceles trapezium type of structure for the head portion (denoted as **4** & **11** in **Figure 3A** and **3B** respectively), with the same radius feature (denoted as **6** and **13**) for the stem **5** and **12** in **Figure 3A** and **3B** respectively. It also includes the same radius portion **8** and **14** as illustrated in **Figure 3A** and **3B** respectively.

Figure 4A and **Figure 4B** illustrates another side view of the two (2) different mechanical lock designs for the present invention. Both **Figures 4A** and **4B** illustrate same injection molded polymer / elastomer three (3)-dimensional isosceles trapezium type of structure head (denoted as **4** and **11** in **Figure 4A** and **4B** respectively) that interacts with each other on different and opposite plastic surfaces in order to have effective engagement / disengagement.

Figure 4A shows the side view of the mechanical lock design (denoted as **15)** with each head of the three (3)-dimensional isosceles trapezium type of structure (with cylindrical hollow well **7**) interacting with each other. As shown in **Figure 4A**, the cylindrical hollow well **7** aids in flexing of the different heads **4**, hence facilitate the engagement / disengagement when forces are applied. **Figure 4B** illustrated the mechanical design (denoted as **15)** with each head of the three (3)-dimensional

isosceles trapezium type of structure (without cylindrical hollow well **7**) interacting with each other. As mentioned in earlier descriptions, the two (2) different designs with different iterations cater for different engineering functional applications.

While what has been described hereinabove is the preferred embodiment of the invention, those skilled in the art will understand that numerous modifications may be made without departing from the spirit and scope of the invention. The embodiments described herein are meant to be illustrative only and should not be taken as limiting the invention, which can be expressly set forth in the following claims.

CLAIMS

What is claimed is:

1. An injection molded mechanical lock, with one surface side comprising of:
   (a) a stem portion that is cylindrical-like in nature and starts with extending from the base of the substrate via radius feature;
   (b) a head portion that has a three (3)-dimensional isosceles trapezium type of structure at the top end of the cylindrical-like stem portion, with the top portion of the head being flat and has a cylindrical hollow well in the centre portion, with the cylindrical hollow well extending somewhat to the mid portion of the head; and wherein
   (c) The other surface side have the same exact shape and configuration which is a three (3)-dimensional isosceles trapezium type of structure, is injection molded and is able to have effective engagement / disengagement when forces are applied.

2. An injection molded mechanical lock structure of **claim 1** comprising of:
   (a) both the stem portion and the head portion are integrally formed as a single entity via injection molding.

3. An injection molded mechanical lock, with one surface side comprising of:
   (a) a stem portion that is cylindrical-like in nature and starts with extending from the base of the substrate via radius feature;
   (b) a head portion that has a three (3)-dimensional isosceles trapezium type of structure at the top end of the cylindrical-like stem portion, with the top portion of the head being flat and has no cylindrical hollow well in the centre portion; and wherein
   (c) The other surface side have the same exact shape and configuration which

is a three (3)-dimensional isosceles trapezium type of structure, is injection molded and is able to have effective engagement / disengagement when forces are applied.

4. An injection molded mechanical lock structure of **claim 3** comprising of:
   (a) both the stem portion and the head portion are integrally formed as a single entity via injection molding.