

RIVET

FIELD OF THE INVENTION

[0001] The present disclosure relates to a rivet for joining or connecting two miniature parts.

BACKGROUND OF THE INVENTION

[0002] The current trend is to manufacture smaller and slimmer electronic and electrical devices. Designers are thus faced with the challenge of connecting miniature parts without compromising product reliability.

[0003] Some known fasteners for connecting miniature parts include bolts, micro-screws, thread-forming screws, inserts and special non-metallic patches.

[0004] Some of these fasteners have functional limitations. For instance, micro-screws, inserts and thread-forming screws require the parts to have a sufficient height and/or sufficient length of engagement to function properly. For example, thread-forming screws require at least 3 thread engagements. Furthermore, drilling and tapping a 1.0mm blind hole into a material with an allowable 0.5mm engagement requires precision workmanship, which is time consuming and susceptible to inconsistencies. Most importantly, such fasteners are not able to hold miniature parts to a required clamping force because of the limitation to the torque applied.

[0005] Another disadvantage of such fasteners is the high percentage of failures in the production assembly due to thread stripping where a torqueing accuracy of +/- 5% is considered.

[0006] A further disadvantage is that these known fasteners require the use of hard materials. As such, alternative materials such as Aluminum and Magnesium, which are cost effective, light-weight and easily shaped, could not be used.

[0007] Therefore, there exists a need for a fastener that addresses the above problems or at least provides a novel rivet.

SUMMARY OF THE INVENTION

[0008] According to a first aspect of the invention, a rivet for securing a first part to a deformable second part is described, the rivet comprising a head for engaging the first part, and a substantially cylindrical and longitudinal shaft extending axially from the head. The shaft comprises a neck portion adjacent to the head, a tapered portion, the neck portion transitioning into the tapered portion, the tapered portion increasing in diameter as it extends away from the neck portion. The shaft further comprises a stem portion adjacent to the tapered portion, the stem portion having at least two beveled edge portions being connected by a split edge, the at least two edge portions adapted to penetrate the second part and displace a deformed portion of the second part. Wherein the split edge is adapted to flare out when the at least two edge portions have penetrated into the second part, thereby urging the at least two edge portions apart and displacing the deformed portion of the second part towards the tapered portion.

[0009] Preferably, the split edge has a split angle which is obtuse.

[0010] Preferably, the at least two edge portions each comprises a tip portion.

[0011] According to a second aspect of the invention, an assembly is described, the assembly comprising a first part, a deformable second part and a rivet. The rivet comprises a head and a substantially cylindrical and longitudinal shaft extending axially from the head. The shaft comprises a neck portion adjacent to the head, a tapered portion, the neck portion transitioning into the tapered portion, the tapered portion increasing in diameter as it extends away from the neck portion. The shaft further comprises a stem portion adjacent to the tapered portion, the stem portion having at least two beveled edge portions being connected by a split edge, the at least two edge portions adapted to penetrate the second part and displace a deformed portion of the second part. Wherein the head engages with the first part, and wherein the split edge is adapted to flare out when the at least two edge portions have penetrated into the second part, thereby urging the at least two edge portions apart and displacing the deformed portion of the second part towards the tapered portion.

[0012] Preferably, the split edge has a split angle which is obtuse.

[0013] Preferably, the at least two edge portions each comprises a tip portion.

[0014] Preferably, the second part is made up of a magnesium alloy.

[0015] Preferably, the second part comprises a blind hole and is made up of an aluminum alloy.

[0016] According to a third aspect of the invention, a method for securing a first part to a deformable second part with a rivet is described, the rivet comprising a head and a substantially cylindrical and longitudinal shaft extending axially from the head. The shaft comprising a neck portion adjacent to the head, a tapered portion, the neck portion transitioning into the tapered portion, the tapered portion increasing in diameter as it extends away from the neck portion. The shaft further comprises a stem portion adjacent to the tapered portion, the stem portion having at least two beveled edge portions being connected by a split edge, the at least two edge portions adapted to penetrate the second part and displace a deformed portion of the second part. The method comprises the steps of placing the first part onto the second part, positioning the rivet relative to the first part and the second part and applying a force such that the at least two edge portions penetrate into the second part and the split edge flares out, urging the at least two edge portions apart and displacing the deformed portion of the second part towards the tapered portion.

[0017] Preferably, the step of applying a force is done using an assembly gun.

[0018] The invention will now be described in detail with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Embodiments of the disclosure are described hereinafter with reference to the following drawings, in which:

[0020] Figure 1(a) shows a front view of a rivet, in accordance with an embodiment of the disclosure;

[0021] Figure 1(b) shows a side view of the rivet of Figure 1(a), in accordance with an embodiment of the disclosure;

[0022] Figure 1(c) shows a bottom view of the rivet of Figure 1(a), in accordance with an embodiment of the disclosure;

[0023] Figures 2(a), 2(b), 2(c) and 2(d) show a method for using a rivet to secure a first part onto a second part, in accordance with an embodiment of the disclosure;

[0024] Figure 3 depicts how the deformed portion of the second part is displaced towards the tapered portion and above the edge portions;

[0025] Figures 4(a), 4(b), 4(c) and 4(d) show a method for using a rivet to secure a first part onto a second part, in accordance with another embodiment of the disclosure;

[0026] Figure 5(a) shows a front view of a rivet, in accordance with another embodiment of the disclosure;

[0027] Figure 5(b) shows a side view of the rivet of Figure 5(a), in accordance with another embodiment of the disclosure;

[0028] Figure 5(c) shows a bottom view of the rivet of Figure 5(a), in accordance with another embodiment of the disclosure;

DETAILED DESCRIPTION

[0029] Figure 1(a) shows rivet 100 in accordance with a preferred embodiment of the invention. Rivet 100 has head 101 and shaft 102. Rivet 100 is generally made of a metallic material. Head 101 can have a circular shape and can be flat, countersunk or cheese. Shaft 102 is generally cylindrical and longitudinal, and extends axially from head 101.

[0030] Shaft 102 has neck portion 103, tapered portion 104 and stem portion 105. Neck portion 103 is adjacent to head 101. Preferably, neck portion 103 tapers in an arcuate manner with a taper angle. The taper angle can be between 2° to 15°.

[0031] When the diameter starts to increase, neck portion 103 transitions into tapered portion 104. Tapered portion 104 increases in diameter until it reaches a maximum diameter. This maximum diameter can be 1.0mm.

[0032] Stem portion 105 is adjacent to tapered portion 104. Stem portion 105 has at least two beveled edge portions 106. Edge portions 106 can have tip portion 107. Though Figure 1(a) shows two edge portions 106, one skilled in the art will appreciate that more than two edge portions 106 are possible. The angle between adjacent edge portions 106 is the split angle and the edge connecting adjacent edge portions 106 is split edge 108. If there are two edge portions 106, the split angle can be an obtuse angle of between 90° to 120° .

[0033] Referring to Figure 2(a), rivet 100 is used to secure first part 200 onto second part 201. Second part 201 is deformable in that a portion of it can be displaced when shaft 102 of rivet 100 penetrates into second part 201. Preferably, second part 201 can be made up a magnesium alloy or an alloy that has similar physical properties to magnesium. Advantageously, if second part 201 is made up of magnesium alloy or an alloy that has similar physical properties to magnesium; second part 201 does not require a blind hole due to it being softer and of lower density when compared to Aluminum.

[0034] First part 200 is placed onto second part 201 where a connection is desired, as shown in Figure 2(a). Force 202 is then applied on rivet 100 which causes shaft 102 to penetrate into second part 201, as shown in Figure 2(b). Force 202 can be applied using an assembly gun.

[0035] In figure 2(c), the further application of force 202 results in shaft 102 penetrating deeper into second part 201. The penetration of shaft 102 into second part 201 deforms second part 201 such that a portion of it is displaced. Due to the split angle between adjacent edge portions 106 and the further penetration of shaft 102 into second part 201, split edge 108 begins to flare out or split wider, urging adjacent edge portions 106 away from one another. In other words, split edge 108 acts like a fault line in which rivet 100 would distort upon application of force 202 on rivet 100 against second part 201. The urging of adjacent edge portions 106 away from one another displaces the deformed portion of second part 201 above edge portions 106 and towards tapered portion 104 as shown in direction 301 (please see figure 3).

[0036] Continued application of force 202 results in the resting position of rivet 100 where the rivet 100 fastens first part 200 to second part 201, as shown in Figure 2(d). In this resting position, head 101 is engaged with first part 200 and shaft 102 is disposed substantially entirely within second part 201. Also, split edge 108 has flared out or widened to such a degree that the split angle is almost flat.

[0037] As the deformed portion of second part 201 is sandwiched between head 101 and edge portions 106, a "clinching effect" is therefore obtained. This is advantageous as it results in a stronger connection between rivet 100, first part 200 and second part 201. Further still, rivet 100 is not limited by any number of thread engagements as it does not need thread engagements to work.

[0038] Referring to Figure 4, rivet 100 is used to secure first part 400 onto second part 401. Second part 401 is deformable in that a portion of it can be displaced when shaft 102 penetrates into second part 401. In this alternate embodiment of the disclosure, second part 401 can have a preformed blind hole 402. Preferably, second part 401 can be made up an Aluminum alloy or an alloy that has similar physical properties to Aluminum.

[0039] First part 400 is placed onto second part 401 where a connection is desired, as shown in Figure 4(a). Rivet 100 is then placed within blind hole 402. Force 202 is then applied on rivet 100 which causes shaft 102 to penetrate into second part 401, as shown in Figure 4(b). Force 202 can be applied using an assembly gun.

[0040] In figure 4(c), the further application of force 202 results in shaft 102 penetrating deeper into second part 401. The penetration of shaft 102 into second part 401 deforms second part 401 such that a portion of it is displaced. Due to the split angle between adjacent edge portions 106 and the further penetration of shaft 102 into second part 401, split edge 108 begins to flare out or split wider, urging adjacent edge portions 106 away from one another. In other words, split edge 108 acts like a fault line in which rivet 100 would distort upon application of force 202 on rivet 100 against second part 401. The urging of adjacent edge portions 106 away from one another displaces the deformed portion of second part 401 above edge portions 106 and towards tapered portion 104 as shown in direction 301 (please see figure 3).

[0041] Continued application of force 202 results in the resting position of rivet 100 where the rivet 100 fastens first part 400 to second part 401, as shown in Figure 4(d). In this resting

position, head 101 is engaged with first part 400 and shaft 102 is disposed substantially entirely within second part 401. Also, the split edge 108 has split or widen to such a degree that the split angle is almost flat.

[0042] As the deformed portion of second part 401 is sandwiched between head 101 and edge portions 106, a "clinching effect" is therefore obtained. This is advantageous as it results in a stronger connection between rivet 100, first part 400 and second part 401. Further still, rivet 100 is not limited by any number of thread engagements as it does not need thread engagements to work.

[0043] In accordance with another embodiment of the disclosure, rivet 500 is shown in Figure 5(a), Figure 5(b) and Figure 5(c). Similar to rivet 100 described above, rivet 500 has head 501 and shaft 502. Rivet 500 is generally made of a metallic material. Head 501 can have a circular shape and can be flat, countersunk or cheese. Shaft 502 is generally cylindrical and longitudinal, and extends axially from head 501.

[0044] Shaft 502 has neck portion 503, tapered portion 504 and stem portion 505. Neck portion 503 is adjacent to head 501. Preferably, neck portion 503 tapers in an arcuate manner with a taper angle. The taper angle can be 2° to 15° .

[0045] When the diameter starts to increase, neck portion 503 transitions into tapered portion 504. Tapered portion 504 increases in diameter until it reaches a maximum diameter. This maximum diameter can be 1.0mm.

[0046] Stem portion 505 is adjacent to tapered portion 504. Figures 5(a) and 5 (b) shows that stem portion 505 has three edge portions 506. Edge portion 506 can have pointed tip portion 507. The angle between adjacent edge portions 506 is the split angle and the edges connecting adjacent edge portions 506 are split edges 508. The split angle can be between 30° to 90° .

[0047] In the application, unless specified otherwise, the terms "comprising", "comprise", and grammatical variants thereof, intended to represent "open" or "inclusive" language such that they include recited elements but also permit inclusion of additional, non-explicitly recited elements.

[0048] It will be apparent that various other modifications and adaptations of the application will be apparent to the person skilled in the art after reading the foregoing disclosure without departing from the spirit and scope of the application and it is intended that all such modifications and adaptations come within the scope of the appended claims.

CLAIMS

1. A rivet for securing a first part to a deformable second part, the rivet comprising:
 - a head for engaging the first part; and
 - a substantially cylindrical and longitudinal shaft extending axially from the head, the shaft comprising:
 - a neck portion adjacent to the head;
 - a tapered portion, the neck portion transitioning into the tapered portion, the tapered portion increasing in diameter as it extends away from the neck portion; and
 - a stem portion adjacent to the tapered portion; the stem portion having at least two beveled edge portions being connected by a split edge; the at least two edge portions adapted to penetrate the second part and displace a deformed portion of the second part; wherein the split edge is adapted to flare out when the at least two edge portions have penetrated into the second part, thereby urging the at least two edge portions apart and displacing the deformed portion of the second part towards the tapered portion.
2. The rivet according to claim 1, wherein the split edge has a split angle which is obtuse.
3. The rivet according to claim 1 or claim 2, wherein the at least two edge portions each comprises a tip portion.
4. An assembly comprising :
 - a first part;
 - a deformable second part; and
 - a rivet; the rivet comprising:
 - a head and a substantially cylindrical and longitudinal shaft extending axially from the head, the shaft comprising:
 - a neck portion adjacent to the head;
 - a tapered portion, the neck portion transitioning into the tapered portion, the tapered portion increasing in diameter as it extends away from the neck portion; and
 - a stem portion adjacent to the tapered portion; the stem portion having at least two beveled edge portions being connected by a split edge; the at least two

edge portions adapted to penetrate the second part and displace a deformed portion of the second part;

wherein the head engages with the first part, and wherein the split edge is adapted to flare out when the at least two edge portions have penetrated into the second part, thereby urging the at least two edge portions apart and displacing the deformed portion of the second part towards the tapered portion.

5. The assembly according to claim 4, wherein the split edge has a split angle which is obtuse.
6. The assembly according to claim 4 or claim 5 wherein the at least two edge portions each comprises a tip portion.
7. The assembly according to any one of claims 4 to 6, wherein the second part is made up of a magnesium alloy.
8. The assembly according to any one of claims 4 to 6, wherein the second part comprises a blind hole and is made up of an aluminum alloy.
9. A method for securing a first part to a deformable second part with a rivet, the rivet comprising a head and a substantially cylindrical and longitudinal shaft extending axially from the head, the shaft comprising:
 - a neck portion adjacent to the head;
 - a tapered portion, the neck portion transitioning into the tapered portion, the tapered portion increasing in diameter as it extends away from the neck portion; and
 - a stem portion adjacent to the tapered portion; the stem portion having at least two beveled edge portions being connected by a split edge; the at least two edge portions adapted to penetrate the second part and displace a deformed portion of the second part;the method comprising the steps of:
 - placing the first part onto the second part;
 - positioning the rivet relative to the first part and the second part; and
 - applying a force such that the at least two edge portions penetrate into the second part and the split edge flares out, urging the at least two edge portions apart and displacing the deformed portion of the second part towards the tapered portion.

10. The method according to claim 9, wherein the step of applying a force is done using an assembly gun.