

Fastener

FIELD OF INVENTION

This invention relates to the field of driving heads of fasteners, for example screws, and a driver for these fasteners (for example a screwdriver):

The invention relates more particularly to miniature screws (hereinafter referred to as fasteners) that are small and have thin heads.

BACKGROUND OF INVENTION

Recently, electric appliances and intelligence apparatus such as computers, mobile phones and PDAs (Personal Digital Assistants) have been improved in performance and their sizes are starting to get comparatively smaller. Given the modern society that we live in today, many of us are always on the move. Thus, it is convenient to have such electric appliances and intelligence apparatus that are smaller in size so that it is less of a hassle to carry them around. Thin, resultantly light-weight, electronic apparatus such as electronic pocketbooks, notebook-sized personal computers, and handy mobile phones have been rapidly widespread because of their portability. These apparatus must be as light in weight as possible and be thin to ensure their portability. As a natural result, with consumer products getting dimensionally thinner and smaller, there is a need for smaller fasteners that are relevant to the assembly of these products. This need is imperative especially for those devices that are applied and assembled in an automated operation.

Fasteners, such as bolts or screws, have a variety of uses. Typically, a fastener will have a threaded shank portion and a driving head. Torque is applied to the driving head to drive the threaded shank into threaded engagement with a nut or another threaded surface.

To drive the fastener, the driving head may have recessed slots or grooves, such as a Phillips type, so that a tool may be inserted into the recess to apply torque to the

fastener. Or, the head may have a polygonal-shaped recess on the driving head to apply torque to the fastener.

For thinner and small appliances and apparatus, fasteners have to have a thinner driving head to accommodate the assembly of the product. Miniature fasteners or screws whose major diameters of external threads are 2 mm or less have been used to assemble such products. In the case of an assembly line where the product is being assembled, the assembly speed becomes crucial in determining the productivity in the manufacture of the products. In which case, the thin head fasteners have to be able to absorb and withstand the high transient torque resulting from the rotational speed of the driver. For a fully automated unmanned assembly line, any stoppage in the assembly line triggered by any circumstances would require the whole line to be reset. The reset would require all fasteners which were previously held by the suction driver to be fully disposed into a bin and to pick up fresh fasteners. This reset would require all moving mechanisms in the assembly line including the torque driver to be positioned to the start point. The start position is whereby the driver torque bit has no screws on it. It is important that there is no screw attached to the torque bit at the start position otherwise accident would occur during the fresh screw pick up.

Ideally, the fastening system will allow for quick insertion to minimize the time required for the procedure and will have sufficient engagement with the insertion device to prevent positional divergence such as slippage of the driver from the fastener which could cause the fastener to be improperly positioned and/or cause additional damage to the product, among other problems. The need to have the fasteners engaged properly on the driver bit in a shortest time is also a prime concern in gaining a competitive edge. Moreover the miniature fasteners used today to secure component onto high speed motor thus the maximum torque is desirable to achieve optimal fastening strength.

Previous attempts for manufacturing miniature fasteners that are able to withstand a high torque strength have not been effective. What usually happens is that the recess of the screw with a thin head is not able to withstand a high torque strength, having difficulty in bit insertion and, as a result, is not effective in an automated manufacturing environment. There are miniature fasteners where the internal recess on the driving head is a slot that helps to drive the fasteners. An example is the cross recess which has 4 slots

in the cross configuration or the struck slot recess which have a slot to enable the fastener to be driven. However, the slot-type recesses are not effective on a thin head fastener due to the lack of material between the screw head and shank and too little recess depth which are important for effective engagement with the driver bit.

It has been observed that increasing the number of slots in a recess on a driving head would provide a better engagement of the fastener to the driver bit. However, for a miniature fastener with a thin driving head, the increased number of slots in the recess would result in a weak driving head structure because of lesser material remaining at the neck area of the screw.

Therefore, there is a need to have an improved miniature fastener that have thinner driving heads and, at the same time, be able to withstand the torque applied to it by a driver bit to meet the stringent standard required today.

SUMMARY OF THE INVENTION

According to the present invention, there is provided a fastener comprising a driving head and a shank, wherein the driving head includes a recess having a top and bottom portion for receiving a bit of a driver, said recess further comprising an abutment extending from the bottom portion of the recess and said abutment runs along the periphery of the recess. Thus, relative to conventional fastener/driver systems, the fastener can be inserted and removed by the driver more quickly and with a reduced possibility of slippage, stripping, or other hazardous, undesired positional divergence of the driver from the fastener.

Preferably, the abutment runs only along a part of the periphery of the recess

Preferably, the abutment does not extend beyond the top portion of the recess.

Preferably, the recess is angular.

Preferably, the recess is generally triangular in configuration and the abutment is at each corner of the triangular recess.

Preferably, the recess tapers into the shank of the fastener.

Preferably, the shank is threaded.

The configuration of the recess is effective in automated assembly process. It allows the thin head fastener to transmit higher torque to allow better clamping force in a miniature assembly. There is also ease of engagement and disengagement between the driver bit and the screw recess.

In another aspect of the invention, a driver is provided for use with a fastener having a bit of complementary shape to the recess of the fastener.

The configuration of the recess allows ease of fabrication of the driver bit. The profile enable either forming or machining to be carry out.

In yet another aspect of the invention, a forming tool is provided for forming a fastener having a punch of complementary shape to the desired recess of the fastener.

The configuration of the recess allows ease of fabrication of the forming tool. The profile enable either forming or machining to be carry out.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 is a cross section view of the fastener at line X-X of Figure 2.

Figure 2 is a top view of the fastener showing the recess on the driving head surface.

Figure 3 is a perspective view of the driver for use with the fastener as shown in Figure 1.

Figures 3a – 3c show the locating sequences of the bit to the screw.

Figures 3d – 3f show the schematic pictures of the suction process for screw pick up and drop off.

Figures 4a – 4c show the forming tool for forming the fastener as shown in Figure 1.

DESCRIPTION OF PREFERRED EMBODIMENT

Reference will now be made in detail to the preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. The preferred embodiments of the invention are not intended to limit the invention in its broadest aspect to these embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims. Furthermore, in the following detailed description of the embodiments, numerous specific details are set forth in order to provide an understanding of the present embodiments.

Figure 1 shows a cross section (at line X-X of Figure 2) of an embodiment of a fastener of the present invention, as viewed from the top, having a recess in the driving screw head 40. The recess profile (as seen at the side in the cross section) has top 11 and bottom 12 portions for receiving a bit of a driver. An abutment in the form of a step 10 extends from the bottom portion 12 of the recess. In this embodiment, the abutment step 10 exists at each corner of the generally triangular recess. The figure shows the thin head thickness 30, with the required screw threads 50 and the drive recess with its abutments forming steps 10 with the inner surface 20 as a seating surface for the driver bit. In the embodiment, an abutment step 10 exists at each corner of the triangle recess while the recess portion 25 facing the abutment step 20 tapers down towards the shank. The shank is threaded and shown at 50 and the screw thin head thickness at 30.

Figure 2 shows the fastener of Figure 1 as viewed from the top. The recess portion is generally triangular in configuration. While the recess portion is generally triangular in configuration, the recess portion may be of any shape or combination of shapes.

The abutment step 10 enhances the torque capability and the corners of the triangle do not extend to the edge of the driving head 40. The corners of the triangle are rounded to prevent stick fit of the fastener to the driver, a feature that is undesirable for automation.

By "torque capability", we mean better engagement of driver bit into the recess portion of the fastener, which in turn, allows better grip for driving the fastener into a threaded hole component. The unique configuration of the recess portion allows for better engagement because of the deep engagement depth and high surface area contact / broadest contact surface between a driver bit and the recess portion. This high contact surface maximises depth of engagement between driver and fastener and spreads driving forces over the surface area, extending tool life and maximising torque transfer. This is difficult to achieve for miniature screws because there is not much material left on the screw head surface if there are too many slots or grooves in the recess portion of such screws. In the present invention, enhanced torque capability is achieved while leaving as much material of the screw head and threaded shank portion. This also results in a stronger screw, which in turn reduces tool slippage as well as costly and unsightly damage to the fastener and surrounding area.

At Figure 3b, the driver bit would have made contact with the screw recess at the inner surface of the recess portion.

The driver bit or screwdriver is required to drive the threaded shank component of the screw 50 into the threaded hole component, for example, in a nut until it reaches its required torque.

The fabrication of the driver bit is quite standard. It is the recess tip configuration 75 that requires attention. For such a small screw, the tolerances and clearances between the screw and the driver bit are critical to prevent any failure such as recess stripping or slipping during the driving process. The configuration of the driver bit is such that the tip must match the recess of the screw to avoid bit slipping during screw tightening. This invention allows better fit between bits and screws without the full stick-fit effect. The driver tip configuration 75 enables the screw to sit squarely with sufficient area of contact onto the bit. This would enhance the alignment of the screw to the assembly product during automation processes. This would also enable tightening to a higher degree of precision especially required during unmanned automation assembly processes.

Figures 3d-f show the schematic pictures of the suction process for picking up and dropping off the screws in an automation process. A driver bit 85 (shown in dotted lines)

resides in a sleeve 80. When a screw approaches the driver bit 85, air is being sucked into the sleeve 80 at the gaps 90, occurring between the sleeve 80 and the driver bit 85. Once the screw has been tightened and the required torque is reached, the suction will be turned off. Because of its no stick fit effect, the screw is able to be rejected into the reject bin whenever necessary by just turning off the suction feature. The advantage of this is that the whole process is automatic and does not require the screw to be manually removed from the driver bit 85.

Figure 4a shows the forming tool for forming the fastener. This is a standard punch used on the process known as cold heading, which is commonly used in producing screw recess. The punch head out the shape on the part known as a screw blank, which is a threadless screw. The punch 65 has a punch tip 70, which is complementary in shape to the desired recess that will eventually be punched into the screw blank 55. The punch tip 70 can either be manufactured by either machining or cold forming (hobbing). In the cold forming process, the reciprocating punch 65 will approach the screw blank 55, being held by the heading die 60, and punch the desired recess into the screw blank 55.

CLAIMS

1. A fastener comprising a driving head and a shank, wherein the driving head includes a recess having a top and bottom portion for receiving a bit of a driver, said recess further comprising an abutment extending from the bottom portion of the recess and said abutment runs along the periphery of the recess.
2. A fastener according to claim 1, wherein the abutment runs along part of the periphery of the recess.
3. A fastener according to claim 1 or 2, wherein the abutment does not extend beyond the top portion of the recess.
4. A fastener according to any one of the preceding claims, wherein the recess is angular.
5. A fastener according to any one of the preceding claims, wherein the recess is generally triangular in configuration.
6. A fastener according to claim 5, wherein the abutment is at at least one corner of the generally triangular recess.
7. A fastener according to claim 5, wherein the abutment is at each corner of the generally triangular recess.
8. A fastener according to any one of the preceding claims, wherein the recess tapers into the shank.
9. A fastener according to any one of the preceding claims, wherein the shank is threaded.
10. A fastener according to any one of the preceding claims, wherein the driving head has a chamfered edge.

11. A driver for use with a fastener as described in any of the preceding claims having a bit of complementary shape to the recess of the fastener.
12. A forming tool for forming a fastener as claimed in any of claims 1-10 having a punch of complementary shape to the desired recess of the fastener.