

Is Human Intelligence the Undoubted Originator of Screw Connections?

by Jozef Dominik

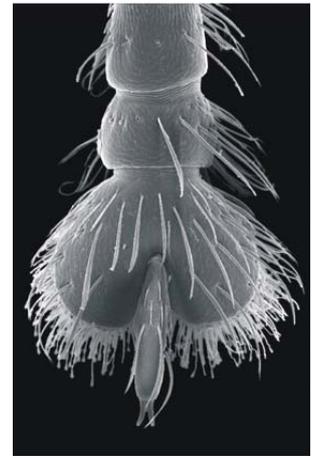


Fig. 1. Biological screw in a beetle's leg; source from Wikipedia

Contrary to historians' opinions, the bolt and nut do not appear to be the product of the human brain. Characteristic detail of the screw – thread – is namely an autochthonous geometric element which has existed in nature since time immemorial. Even according to *New Scientist*, beetles are the creatures with a body mechanism working on the principle of a screw and a nut. This mechanism was first discovered in the beetle *Trigonopterus oblongus* (Fig. 1).

Further evidence for the existence of a spiral without human intervention is the galaxies for example (Fig. 2). And, you could continue with a snail shell, various kinds of climbing plants, etc.

However, human intelligence was applied because it was able to use this geometric element to its advantage. It would be a shame not to take such an opportunity. The result is currently perhaps the most widespread structural element - the screw.

The first originator is generally attributed to Arsytas of Tarentum (about 428 BC), Archimedes (about 287 BC) or Leonardo da Vinci (1452 - 1519). But the greatest development occurred in the 18th century during the technical revolution. Without screws, industrial revolution would not be possible, because all the machines would disintegrate into individual parts of which they were assembled. The screws enabled the rapid development of road (Fig. 5) and rail transport (Fig. 6), too.



Fig. 2. Milky way; source from Wikipedia

Fig. 3. Guttenberg Movable-type Printing



Fig. 4. Ford Car



Fig. 5. Watt Steam Engine

The first industrial screws were made of wood (Fig. 7). At present, it is steel with a strength of 800 - 1400N/mm², stainless steel with high corrosion resistance and at the same time high mechanical properties (martensitic stainless steel), brass, Cu and aluminum. Ti alloys are used for special purposes.

Henry Maudslay (1771 – 1831), Joseph Whitworth (1803 - 1887), William Sellers (1827 – 1905) and many unnamed pioneers have contributed to the fact that screw, based on the spiral is currently one of the most common elements used in construction and machine design to

Fig. 6. Rail Transport



prevent loosening. Despite many attempts, the screw can still not be replaced equally.

An interesting overview of this is provided by the Museum Würth, Schrauben und Gewinde. We will learn from it, for example, about the bold applications of threaded elements in medicine, the armaments industry, architecture, fine mechanics, optics, etc.

However, a screw won't be a screw if there is no other natural property of the material – friction. This also exists without the will of man. We can enlarge or reduce it, but can not cancel it because it is a natural property of the surface. Here, it is necessary to recall the well-known screwdriving paradox, which lies in the opposite meaning of friction during assembly and operation. While minimal friction is required during assembly, the opposite is true in operating conditions. Here, high friction is required to prevent the screw connection from loosening. Although there are many solutions to deal with this paradox (Fig. 8), it cannot be said that everything is in order. Cases of accidents involving machinery, various equipment and means of transport are proofs of this. The nature will no longer help here. Or is it? Fig. 9 is an example where corrosion prevents spontaneous loosening of all wheel nuts.

Of course, such a screw locking system cannot be used in common practice. Only the US Navy has a patented method of artificially corroding some nuts and bolts.

Fig. 7. Screws made of wood



Fig. 8

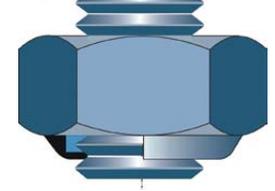


Fig. 9. Wheel nuts



Conclusion:

No matter what their origin is, screw connections are still an irreplaceable component and there is no indication that this should change in the near future.

The way of stressing in operating conditions ranks screws among the most complex cases of strength, thus discouraging many young engineers from demanding study. There is a danger that there will be no one to continue research and development of screw connections. That is why the author tries to popularize this topic by including it on the UNESCO list. The screws deserve it.



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