Team Bolt Neuters: Bolt Nut Assistance Device

Objective

Concept Generation

Decision Characteristics

- Range of nut/bolt sizes
- Weight of product
- Maximum Dimensions (Product Envelope)
- Time to Attach (Setup Time)
- Cost
- Attachment complexity (of process)
- Operational complexity (Method of use, not mechanism of use)
- Dependence on excess bolt (can it accept longer bolts than required for joint)
- Dependence on setting (Does the device require environmental aspects)

Concepts

- AHP was used to choose the best concept. This consisted of a Pugh Chart, Pair-wise Rating Matrix, and a Comparison Matrix
- In the end, the reaction force method (top left) was determined most effective and implemented as the final concept, but with a few altered details.

Solution

A tool that allows the removal of a nut and bolt from just the nut end.

Problems

When assembling or disassembling a nut and bolt system, situations arise where the two ends are not located in a convenient manner for the user, causing the task to be impossible or simply take longer than needed.

Market Size

Our target market of general construction & automotive consist of 2,002,560 people. 60% total market would purchase the product (about 1,200,000 units).

House of Quality

Shows the customer requirements of our device, the engineering characteristics created for them, and how important each one is.

Decision Making

Average Time required to remove the nut from bolt (sec)

<table>
<thead>
<tr>
<th>Test Type</th>
<th>1/4 in.</th>
<th>3/8 in.</th>
<th>1/2 in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 wrenches 2 hands Slide Wrench</td>
<td>103.6</td>
<td>31.6</td>
<td>30.8</td>
</tr>
<tr>
<td>2 wrenches 2 hands</td>
<td>1.2</td>
<td>2.2</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Average ease of use rating (1-5, 5 being most comfortable)

<table>
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<tr>
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<th>3/8 in.</th>
<th>1/2 in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 wrenches 2 hands Slide Wrench</td>
<td>5.0</td>
<td>3.8</td>
<td>3.0</td>
</tr>
<tr>
<td>2 wrenches 2 hands</td>
<td>5.0</td>
<td>4.5</td>
<td>4.0</td>
</tr>
</tbody>
</table>

Test Results

- Using this tool, the time required to remove the nut from bolt was the least while also most efficient in terms of ease of use.
- The data of using two hands can be argued as comparable to our tool, however since a large portion of our market will be designated to outdoor situations where oxidation occurs and rust present, using hands would be ill advised.
- The significance of these results show that the Slide Wrench tool is effective in removing the nut from bolt with access to only one side while also protecting the user.

Future Work

- We plan to refine the shaft assembly by minimizing the tolerance between the shaft and its housing.
- Design a more viable method of attaching the rubber to shaft in order to fully remove the nut.
- Implement a locking mechanism using a small steel ball to secure the socket on the drive.

Product Operator

- The device works as a ratchet.
- The standard sockets are fixed during the operation by a lock ball.
- The shaft drive creates the reaction force on the bolt end surface to keep it stationary.

Key Features

- Loosening or tightening bolt nut assembly on one side.
- The reaction force is applied by a Drive Shaft to create the friction on the end surface of the bolt.

Design Requirements

- Performs well in all conditions and positions.
- The device is compatible to the standard sockets.

Training

- Training is not necessary for users.

Basic Functions

- Spring clamp with rubber grips bolt threads.
- Clamp held stationary. Force required to turn bolt despite the grip resistance was measured.

Prototype

- End of bolt loaded axially.
- Force required to turn bolt despite the friction on the end was measured.

Full Prototype Testing

- Prototype was benchmarked against the two wrench method and loosening by hand with no tools.
- Measured time and ease of use ratings for all three situations.
- Tested on 1/4 and 3/8 inch diameter bolt.