SAE++: TIG Automatic Feed Pen

Objective

General Need:
TIG Welding is a very precise and detailed process that requires a lot of finesse. Feeding the filler material by hand can be cumbersome and sacrifices quality, our product makes welding a much simpler task.

Market:
The primary market consists of over 450,000 professional welders, while the secondary market consists of amateur welders of an unknown quantity.

Design Constraints:
• Comfortable to hold for extended periods of time
• Heat resistant to +500°F
• Shock resistant
• Drop resistant from 6 feet onto concrete

Tradeoffs:
• Motor and gear reduction selection
• Welding rod tensioning mechanism

Operation of Product:
• Motor activated with the push of a button
• Guide wheel feeds the welding rod at the rate set by the trim potentiometer

Key Functionality:
• Allows user to control the amount of rod used to obtain high quality weld beads

Customer Requirements:
• Durability
• Variable Feed Rates
• Accepts Standard Rod Sizes
• Ease of Use
• Electric Feeder
• Comfortable to Hold
• Safe
• Stays Cool in Hand
• Portable

Engineering Requirements:
• Weight
• Time to Reload Filler Rod
• Torque Requirement for Feeding
• Max Feed Rate
• Tool Circumference
• Accuracy of Feed Rate

Table 1 Decision Characteristics and Relative Weights

<table>
<thead>
<tr>
<th>Decision Characteristic</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Durability</td>
<td>0.409</td>
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<tr>
<td>Ease of Use</td>
<td>0.236</td>
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<tr>
<td>Ease of Repair</td>
<td>0.086</td>
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<tr>
<td>Ease of Manufacture</td>
<td>0.078</td>
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<tr>
<td>Variable Feed Rates</td>
<td>0.191</td>
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<tr>
<td>Total</td>
<td>1.0</td>
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</tbody>
</table>

Tradeoffs

Concept Generation

Key Similar Products:

Concepts:

Figure 3 Scroll Wheel Style (Final Concept)

Strengths:
• Adjustable for different sizes
• Adjustable feed rate

Weaknesses:
• Feed rate depends on how fast the user spins the wheel
• Hard to disassemble

Figure 4 Click Style

Strengths:
• Adjustable for different sizes
• Can control the amount of filler rod with clicks

Weaknesses:
• One feed rate
• Small parts make disassembly complicated

Figure 5 Gun Style

Strengths:
• Adjustable for different sizes
• Adjustable feed rate
• Easy to reverse feed direction

Weaknesses:
• Electronics may be affected by connecting with weld torch electrode
• Hard to use with glove

Prototype Description:

Figure 7 Prototype (Side View)

Prototype and Testing

Figure 8 Drop Test Von Mises Stress Distribution

Testing: Performed Using Solidworks
• 6 foot drop test simulation of the simplified Computer Aided Design (CAD) model
• Thermal Analysis – determine if prototype can withstand welding temperatures
• Finite Element Analysis (FEA) showed that the plastic motor casing was the weakest part of the assembly

Test Results and Future Work

Summary of Design Process:
• Incorporated the best aspects from each product and patent to create a product that would be appealing to both amateur and professional welders
• Determined major components, materials, and sizing/modeling of parts through Design for Manufacturing and Assembly Processes
• Created drawings and models with given monetary, manufacturing and assembly constraints

Recommendations for Future Design:
• The main housing would be pressure die cast instead of machined
• Metallic Parts will be anodized
• The motor housing will be injection molded instead of rapid prototyped

Process Reflections:
• Analyzing the market provided information which allowed the design to combine the strengths of existing products and patents while eliminating any known weaknesses

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