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Design, Prototyping and Evaluation of an Elastically-Based Mechanical Starter for Automotive Engines

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Research Objective: Provide proof of concept and determine feasibility of a spring-powered engine starter.

Design and Prototyping
- Concept was interpreted into commonly available items
- Key components acquired first
- 3-D modeled in Autodesk Inventor around key components for sizing
- Remaining components purchased and assembled

Experimentation
- Video camera and strobe light used to collect data
- Data points fit to curve and differentiated both numerically and theoretically

Evaluation
- Energy and power determined
- Calculated mass of spring capable of providing torque to start engine
- Various steels explored

<table>
<thead>
<tr>
<th>Material</th>
<th>Tensile Strength MPa (ksi)</th>
<th>Mass of Spring kg (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard Drawn</td>
<td>1309 (190)</td>
<td>16.0 (35.2)</td>
</tr>
<tr>
<td>Oil Tempered</td>
<td>1344 (195)</td>
<td>15.2 (33.4)</td>
</tr>
<tr>
<td>Alloy Steel</td>
<td>1516 (220)</td>
<td>11.9 (26.2)</td>
</tr>
<tr>
<td>Music Wire</td>
<td>1654 (240)</td>
<td>10.0 (22.0)</td>
</tr>
</tbody>
</table>

Conclusions
- Spring starter with equal or less weight than conventional electric starter found to be feasible
- Environmental risk decrease realized with reduction in size of battery

Recommendations
- Continue development of this concept
- Next step: incorporate spring starter on real engine