Market

Number of fire stations in U.S
- 50,000

Estimated cost of traditional battering ram
- $300

Total market
- $15 million

U.S. Fire Administration
Video: Problem
Benchmarking

Halligan Bar

Hydra-Ram

Traditional Battering Ram
## Benchmarking Results

<table>
<thead>
<tr>
<th></th>
<th>Fatal Funnel</th>
<th>Time</th>
<th>Size</th>
<th>Ease of Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional</td>
<td>Red</td>
<td>Green</td>
<td>Red</td>
<td>Red</td>
</tr>
<tr>
<td>Hydra-Ram</td>
<td>Red</td>
<td>Green</td>
<td>Green</td>
<td>Green</td>
</tr>
<tr>
<td>Halligan Bar</td>
<td>Red</td>
<td>Red</td>
<td>Green</td>
<td>Red</td>
</tr>
</tbody>
</table>

Key problems to address:
- Fatal Funneling
- Time/Efficiency
Automatic Battering Ram

Solves all 4 issues effectively
- Fast and Efficient
- Small and Light
- Avoids Fatal Funneling
- Easy to use

Demonstration
Sketch Model Takeaways

- Double-sided blades
- Strong blades to support large moment arm
  - Resist 15N-m bending moment
- Blades tapered for easy insert
- Strong recoil just from a spring
Pressure to Breach a Door

Assuming a 3in² piston cross-sectional area

Breaching Pressure (PSI)

<table>
<thead>
<tr>
<th>Material</th>
<th>Breaching Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood</td>
<td>300</td>
</tr>
<tr>
<td>Metal</td>
<td>600</td>
</tr>
<tr>
<td>Reinforced</td>
<td>900</td>
</tr>
</tbody>
</table>

Target

U.S. Patent 6877988
Calculated Feasible Methods

Hydraulic
  – Pump and accumulator

Pneumatic
  – Hand pump, valve, piston/cylinder
  – Directly from a cartridge

Spring-Actuated
  – High pressure air to highly compressed spring