Stage 2 Research Project B
Assessment Type 2: Research Outcome

How could the armed forces use compressed air systems to launch supplies?

Introduction

For my research project I have built a compressed air device, for the purpose of launching supplies over a distance. This was to test my idea of building a much larger compressed-air cannon that could be used to launch supplies to soldiers in the front line. The idea behind this concept is to eliminate the need for helicopters to fly overhead and drop the supplies. When a helicopter drops vital supplies it must fly at a low altitude, slow down, descend and drop the supplies. By doing this the helicopter puts itself at great risk of being targeted by a range of anti-air weaponry. These attacks often result in multiple casualties and the loss of multimillion dollar vehicles. Therefore I designed a system that will be used to launch supplies from a safe distance to soldiers on the front line, without the use of a helicopter or expensive equipment. This should reduce the risk of life and injuries from the pilots and crew of the helicopters. I have designed my, down sized, prototype to be cheap, safe, effective and easy to use.

Design

The initial design of the supply launcher came from a Nazi scientist in WWII, Faulker Feurstrum was a major influence with his unique concept of a wind cannon. I set about the task of specifying the best design for the tasks it would face. A family member, who had served in Afghanistan, told me how important the conservation of space was. This is because most military equipment has to be transported to various places, and the smaller the equipment, the easier this task is. After the consideration of size, I decided that one air tank would provide enough power and the shortening the hose would also reduce size. I added a curve from the air tank to the barrel, this allows for the barrel to be positioned over the barrel, reducing the length.

Selecting material

Selecting the right material was a key component of the product. I started with an inspiration of my previously designed PVC air cannons. This required the use of a bike pump to charge the PVC chamber. I intend for my final product to be used by the armed forces, and from witnessing the current terrain faced by the armed forces on ABC’s Hungry Beast I knew it would have to be durable. With the desert and sub zero terrains that the armed forces faced, I knew PVC would stress and fracture in these conditions.

This picture shows the type of environment in which the supply launching system would most likely face if introduced to the armed forces in coming years.


For this reason I decided that I needed to use steel as it is strong and durable and would easily cope with the stresses of these environments, as well as being easily modified.

1. http://discaircraft.greyfalcon.us/FAULKER%20FEURSTURM.htm
2. Discussion with family member
Sourcing and selection of materials

The next key step was to choose the valve that would release the air from the charging tank into the barrel. This needed to be able to hold back a lot of air pressure while being able to release it quickly. The faster the valve is released the more pressure is forced against the supplies in the barrel. This puts the supplies under more force while in the barrel and results in a larger launch velocity. After my informal discussion with the weapons expert, he suggested I use solenoid valve [Figure 2]. I went to various plumbing shops and made inquiries however the valves were far too weak to hold the pressure I was using, from what the shop assistants were telling me. For this reason I chose the much stronger, manually operated, quarter turn valve [Figure 3].

I needed a barrel that was strong, as well as light weight for transporting, from information provided to me by a family member who served in the military. I decided on using PVC pipe, as I have used it on other similar projects and I know that it is reliable and fits the requirements needed for the armed forces. This material can be heated and clamped to the valve to allow for a strong and air tight connection. It is also a cheap material and easily adaptable, two more key reasons that made it the material of choice for the barrel. [Figure 4]

1. Discussion with weapons expert
2. Inquiry with shop assistants
3. Discussion with family member

Synthesis 2
Although the key finding about the solenoid valve is substantiated by a weapons expert and shop assistant this could be confirmed or cross referenced with other sources to ensure validity and thoroughness.
Finally I had to choose the best hose for connecting the high pressure SCUBA tank to my custom reserve tank. Because the SCUBA tank holds high pressure air and the custom reserve tank can only hold low pressure air, it meant that the air had to pass through a regulator to make it safe. However, the weapons expert warned me that I would struggle to find a company that would clamp a hose that would attach my tanks. They were correct, as I tried over 5 companies.

The shop owner also supplied me with the correct fitting to attach the hose. I now had all the components needed to build the supply launching system.

Building

Assembling the components for the supply launching system was fairly straightforward. I started by cutting a 100 by 100 mm wide section of hollow steel square section, 560mm long. [Figure 5]

This is the steel, square hollow section selected for the custom tank.

[Figure 5]

The length was vital; as if it was too small the volume would be reduced, thus reducing the range, as explained to me by the weapons expert. If it was too large then the tank would take too long to charge to an effective pressure. I showed the cut piece to the weapons expert and he agreed that it was around the right length and volume. I then cut the end pieces to cap the ends of the square hollow section in my home work station [Figure 6].

Using an angle grinder to cut the pieces of the custom reserve tank.

[Figure 6]

When the end pieces were cut roughly with the angle grinder, I remeasured and finally cut the end pieces on the cold cut saw at school technology lab on the 8th of April. One of the end pieces was then drilled and a female hose attachment was bolted through the hole [Figure 7,8,9,10].

1. Discussion with shop assistant
2. Discussion with SCUBA shop manager
3. Discussion with weapons expert
Now that the end plate had the female attachment fitted, it was ready to be welded on to the square hollow section. A technology teacher insisted that he use the school MiG welder to weld these pieces, as he had the ability to create a strong air tight weld. I then used an Arc welder to add extra strength at home [Figure 10] as recommended by the weapons expert.

Next I had to drill another hole into the top of the square hollow section. This hole was drilled as large as possible and a simple steel link was welded around the hole. This was a tricky circular weld and the teacher again recommended he did the initial air tight weld. I then strengthened it with the arc welder. [Figure 12]

1. Discussion with the weapons expert
Adding the final, strengthening welds to the steel link, connecting the barrel to the tank. [Figure 12]

Then I simply screwed a 90 degree turn into the steel link, the quarter turn valve then screwed into that and then I clamped on the PVC pipe, completing the supply launch system [Figure 13]

![The final product] [Figure 13]

Safety

From previous buildings of similar systems, and from the knowledge gained in tech³ subjects at school, I knew that safety was the first priority in both construction and use of the compressed air system. During construction I wore the correct personal protection equipment. Such as, safety glasses and ear defenders when angle grinding. A welding mask, gloves and overcoat were worn when welding the custom tank. During the firing of the supply launch system, I wore ear defenders to protect from the loud sound of firing and eye protection to prevent dust going in my eyes after discharge.

Skills

Skills were needed in construction of the supply launching system to produce a quality system that would be safe for the user. The safety and basic operational skills used in construction were gained from technology studies I have taken at school. I also have taken civil construction course that taught me the more advance techniques of welding and cutting metal.

Results

I have put the launching system through a series of tests so far, I have been using fruit as supplies and testing the velocity of short distances. The results have been very promising. The fruit is staying intact during the flight and travels well over 200 meters currently. This is possibly only a fraction of the power that is achievable by the supply launching system. However I have only been limited by having a large enough space to test fire, without losing the projectile. I hope to be able to travel to a remote field where I can test the full potential of the launching system.

1. Lessons with technology teachers at schools, teaching standard safety procedures
Bibliography

Primary research

4. 3rd of April, 2013, SCUBA shop owner, pers. Comm.
5. 8th of April, school technology teacher, pers. Comm.
6. Various dates, shop assistants on varied, plumbing and compression specialist shops.

Secondary research

2. Unknown author, "images of Middle Eastern landscape", bing images, unknown date http://www.bing.com/images/search?q=Iraq+Landscape&FORM=RESTAB

Additional Comments
The Research Outcome is a B grade.
<table>
<thead>
<tr>
<th>Planning</th>
<th>Development</th>
<th>Synthesis</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td><strong>P1</strong> Thorough consideration and refinement of a research question.</td>
<td>D1 Thorough and highly resourceful development of the research.</td>
<td>S1 Insightful synthesis of knowledge, skills, and ideas to produce a resolution to the research question.</td>
</tr>
<tr>
<td></td>
<td><strong>P2</strong> Thorough planning of research processes that are highly appropriate to the research question.</td>
<td>D2 In-depth analysis of information and exploration of ideas to develop the research.</td>
<td>S2 Insightful and thorough substantiation of key findings relevant to the research outcome.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D3 Highly effective development of knowledge and skills specific to the research question.</td>
<td>S3 Clear and coherent expression of ideas.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D4 Thorough and informed understanding and development of one or more capabilities.</td>
<td></td>
</tr>
<tr>
<td><strong>B</strong></td>
<td><strong>P1</strong> Consideration and some refinement of a research question.</td>
<td>D1 Considered and mostly resourceful development of the research.</td>
<td>S1 Considered synthesis of knowledge, skills, and ideas to produce a resolution to the research question.</td>
</tr>
<tr>
<td></td>
<td><strong>P2</strong> Considered planning of research processes that are appropriate to the research question.</td>
<td>D2 Some complexity in analysis of information and exploration of ideas to develop the research.</td>
<td>S2 Substantiation of most key findings relevant to the research outcome.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D3 Effective development of knowledge and skills specific to the research question.</td>
<td>S3 Mostly clear and coherent expression of ideas.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D4 Informed understanding and development of one or more capabilities.</td>
<td></td>
</tr>
<tr>
<td><strong>C</strong></td>
<td><strong>P1</strong> Some consideration of a research question, but little evidence of refinement.</td>
<td>D1 Satisfactory development of the research.</td>
<td>S1 Satisfactory synthesis of knowledge, skills, and ideas to produce a resolution to the research question.</td>
</tr>
<tr>
<td></td>
<td><strong>P2</strong> Satisfactory planning of research processes that are appropriate to the research question.</td>
<td>D2 Satisfactory analysis of information and exploration of ideas to develop the research.</td>
<td>S2 Substantiation of some key findings relevant to the research outcome.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D3 Satisfactory development of knowledge and skills specific to the research question.</td>
<td>S3 Generally clear expression of ideas.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D4 Satisfactory understanding and development of one or more capabilities.</td>
<td></td>
</tr>
<tr>
<td><strong>D</strong></td>
<td><strong>P1</strong> Basic consideration and identification of a broad research question.</td>
<td>D1 Development of some aspects of the research.</td>
<td>S1 Basic use of information and ideas to produce a resolution to the research question.</td>
</tr>
<tr>
<td></td>
<td><strong>P2</strong> Partial planning of research processes that may be appropriate to the research question.</td>
<td>D2 Collection rather than analysis of information, with some superficial description of an idea to develop the research.</td>
<td>S2 Basic explanation of ideas related to the research outcome.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D3 Superficial development of some knowledge and skills specific to the research question.</td>
<td>S3 Basic expression of ideas.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D4 Basic understanding and development of one or more capabilities.</td>
<td></td>
</tr>
<tr>
<td><strong>E</strong></td>
<td><strong>P1</strong> Attempted consideration and identification of an area for research.</td>
<td>D1 Attempted development of an aspect of the research.</td>
<td>S1 Attempted use of an idea to produce a resolution to the research question.</td>
</tr>
<tr>
<td></td>
<td><strong>P2</strong> Attempted planning of an aspect of the research process.</td>
<td>D2 Attempted collection of basic information, with some partial description of an idea.</td>
<td>S2 Limited explanation of an idea or an aspect of the research outcome.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D3 Attempted development of one or more skills that may be related to the research question.</td>
<td>S3 Attempted expression of ideas.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D4 Attempted understanding and development of one or more capabilities.</td>
<td></td>
</tr>
</tbody>
</table>