
CONCEPTUAL DESIGN

Deliverable D

Client – Canadian Nuclear Laboratories

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GNG1103-F

Dante Casetta – 300408540

Fahad Nadeem – 300429569

Aymeric Sin-Yan-Too – 300383632

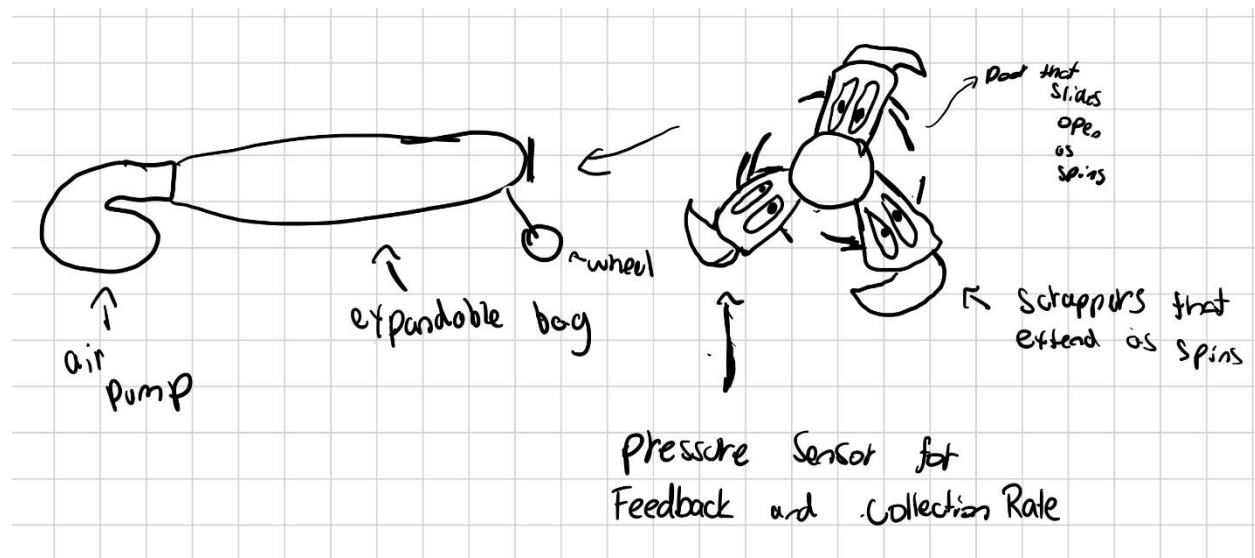
Connor Kiraly - 300410877

Introduction:

This report will discuss the third state of the design process, Ideate. The solution has been split into three different subsections; movement, scrapping and feedback control. Each team member was tasked with coming up with a solution for each subsection, to present to the group. The solutions were analyzed and discussed to be combined into three final designs to be presented to the client. The report follows the design of each team member as well as an explanation of the benefits and downsides, and ends with the three final designs and an explanation of each.

Design Suggestions:

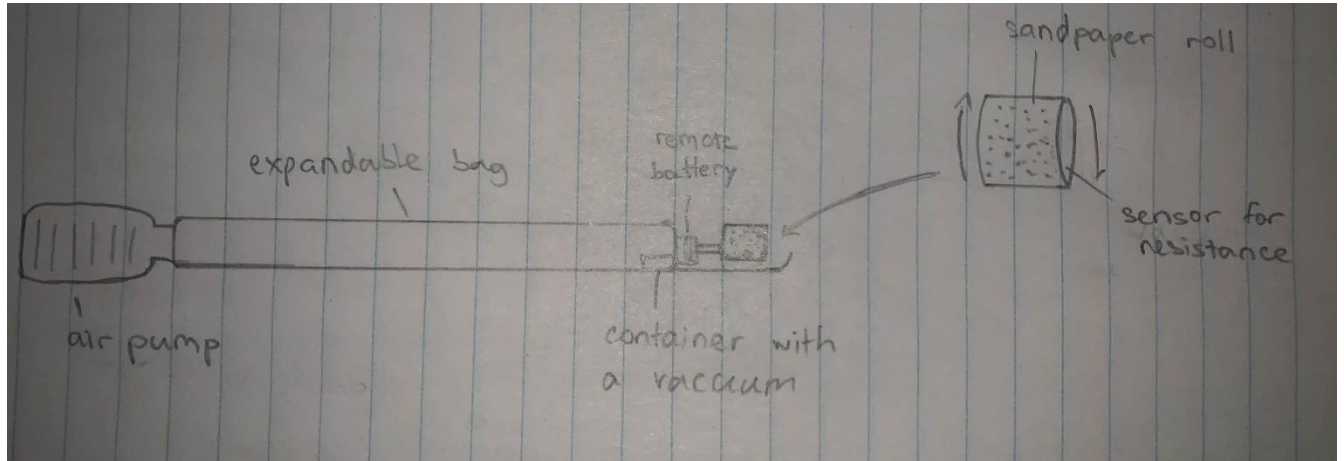
Dante's Design:



This design utilizes pneumatic movement by pushing the scrapping mechanism utilizing an inflatable tube/bag attached to an air pump. This design is beneficial the tube can be deflated making it very compact, the inflatable tube is also very light, drastically increasing the portability of the device. The scrapping mechanism relies on a motor that spins three blades that, utilizing centrifugal force will push out the blades until it hits the side of the pipe. the spinning of the motor will also be used to open compartments on the scrapper that allow for the dust scrapped to fall into. These compartments would auto lock once the scrapper stops spinning. This mechanism plays along with the idea of the device fitting more pipes than just the four inch diameter ones, as it is expandable. For a feedback mechanism this machine would use a pressure sense in one of the scrapper arms instead

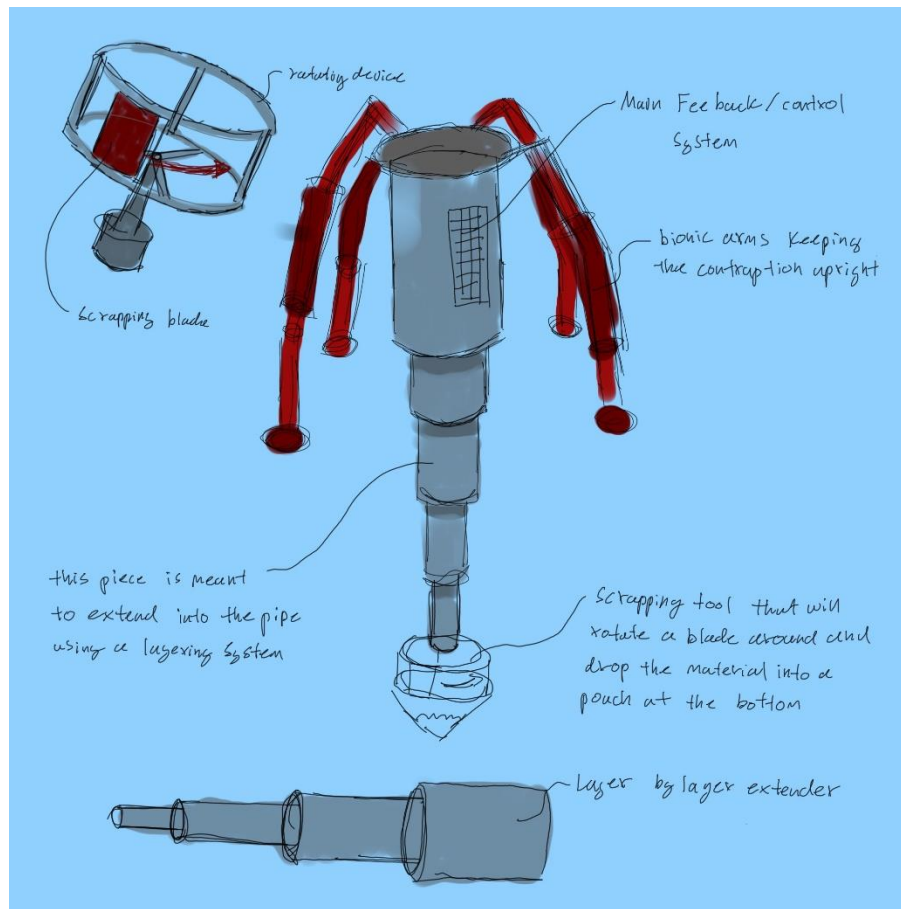
of a scrapper, that would report once the machine has encountered resistance, and that force measured would also be used to calculate how much has been scrapped.

Aymeric's Design:



This design uses the pneumatic movement concept to reach the desired distance in the tube. The remote battery is connected to the rotor and the vacuum inside of the container. The rotor rotates the sandpaper roll to scrape the top of the tube which falls on the platform below which is then vacuumed inside of the container.

Fahad's Design:



This design consists of 4 main components which are the main control center. The bionic arms, the scrapper tool, and the layering device that extends into the pipe of the tube.

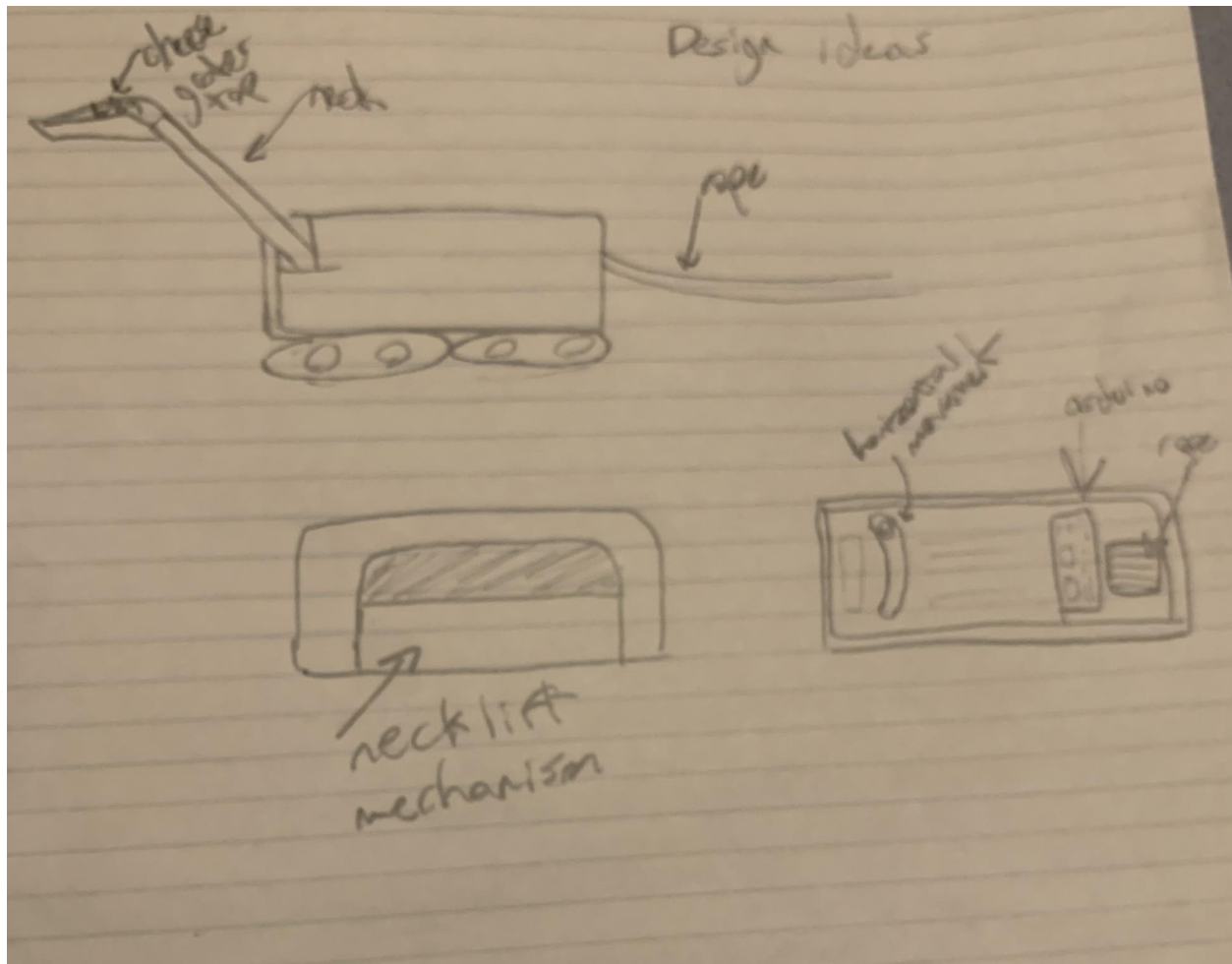
The control center functions as a feedback device that will allow users to determine how far the contraption has made it down the pipe and how much sample has been retrieved. It follows a cylindrical shape with an LCD screen.

The bionic arms are a very simple components as its job is to hold up the entire contraption and keep it stable while it retrieves the sample. There are some hydraulics on the arms that can help with adjustment to the contraptions position.

The scrapper tool is a cylindrical frame that consists of a blade that revolves around the cylinder and scrapes the material of the inside of the pipe.

Finally, the layering device is a component that extends down into the tube layer by layer until it reaches the required distance.

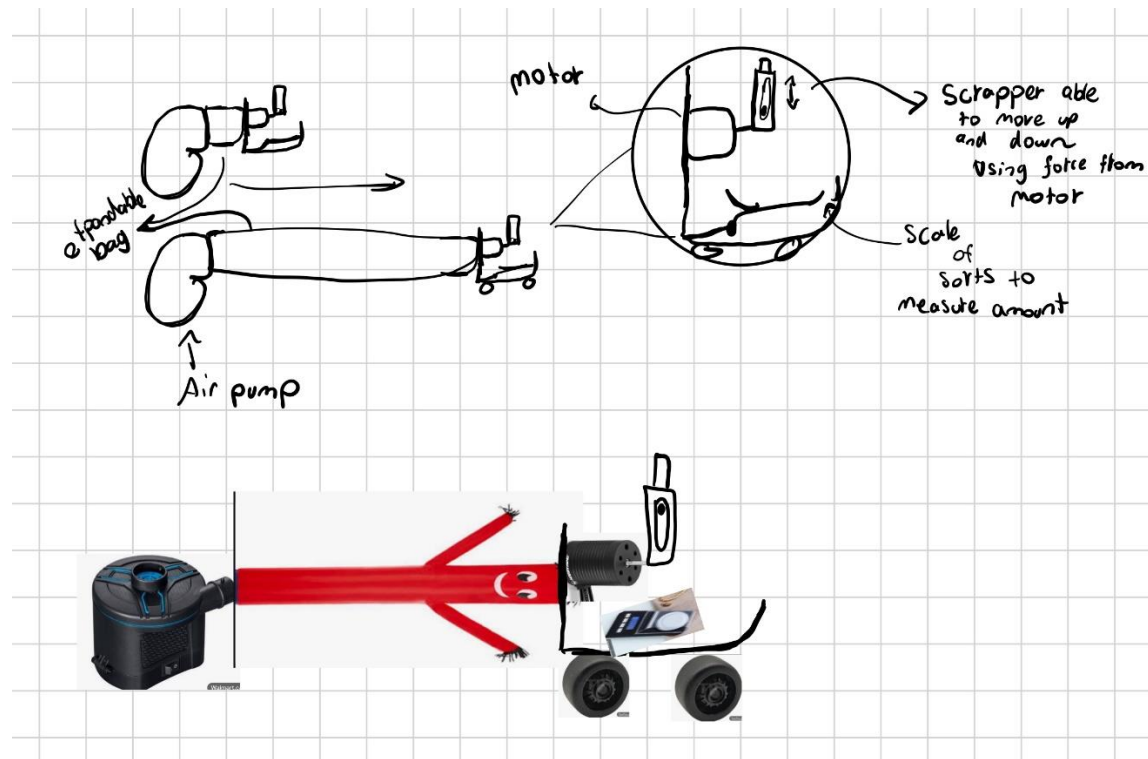
Connor's Design:



This design is a robot like, crawler design. The neck uses a mechanical movement horizontally and implements a hydraulic press/car jack like movement vertically. The machine uses tank tracks to move rather than wheels in a more traditional carlike design. To retrieve the substance, a cheese grater like head is used to grind up a sample to be collected by the pelican mouth bottom below. On the inside, a remote-control car system will be in place electronically and it will take advantage of an Arduino board. In case of failure inside the tube, there will be a string which comes out the back of the machine. This can be used as a failsafe throughout the retrieval process.

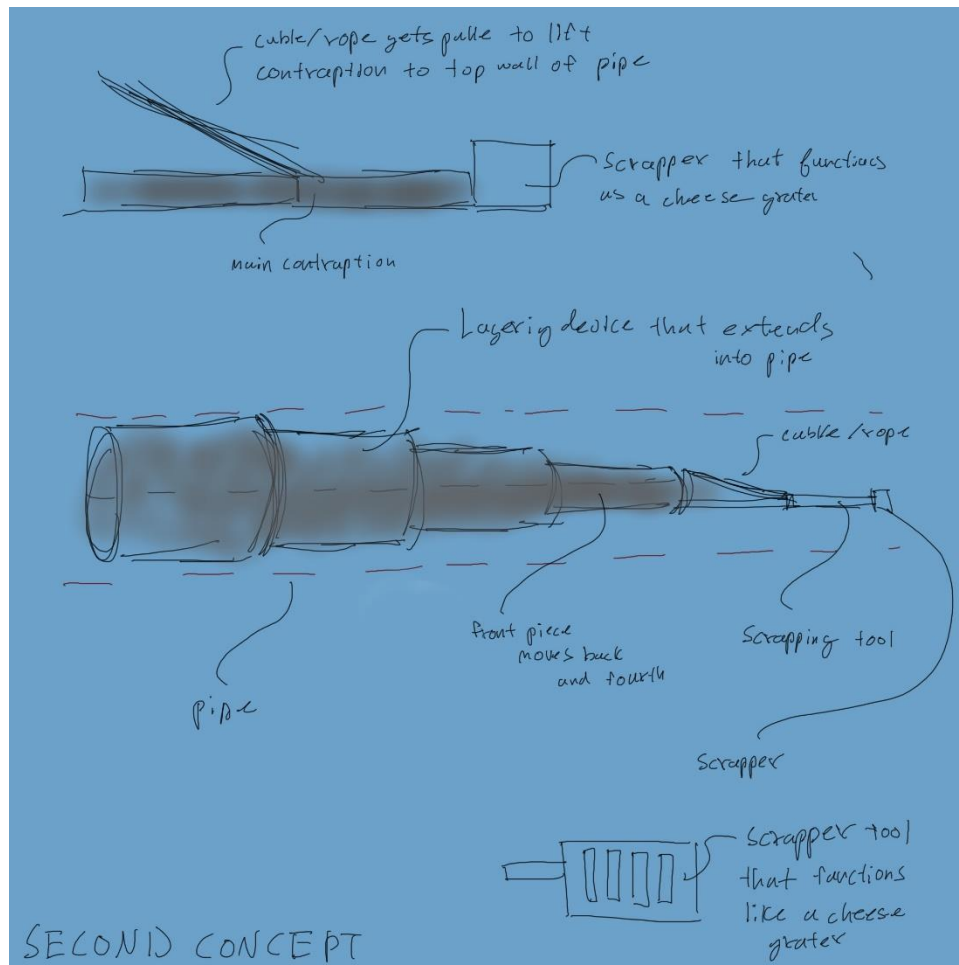
Final Design Concepts:

Design 1:



This design utilizes the pneumatic movement concept, paired up with an edited version of the centrifugal force scrapper. The difference in this design is that the scrapper has been switched to only one blade and moved up from the center of the bag, as to only scrape the top of the pipe. By doing this it allows the dust scrapper's to fall down into a scale which will be used as the feedback system, to know when operations should be stopped. This design is good as it is very compact when retracted, lightweight, and versatile by fitting into a wide range of pipes.

Design 2:

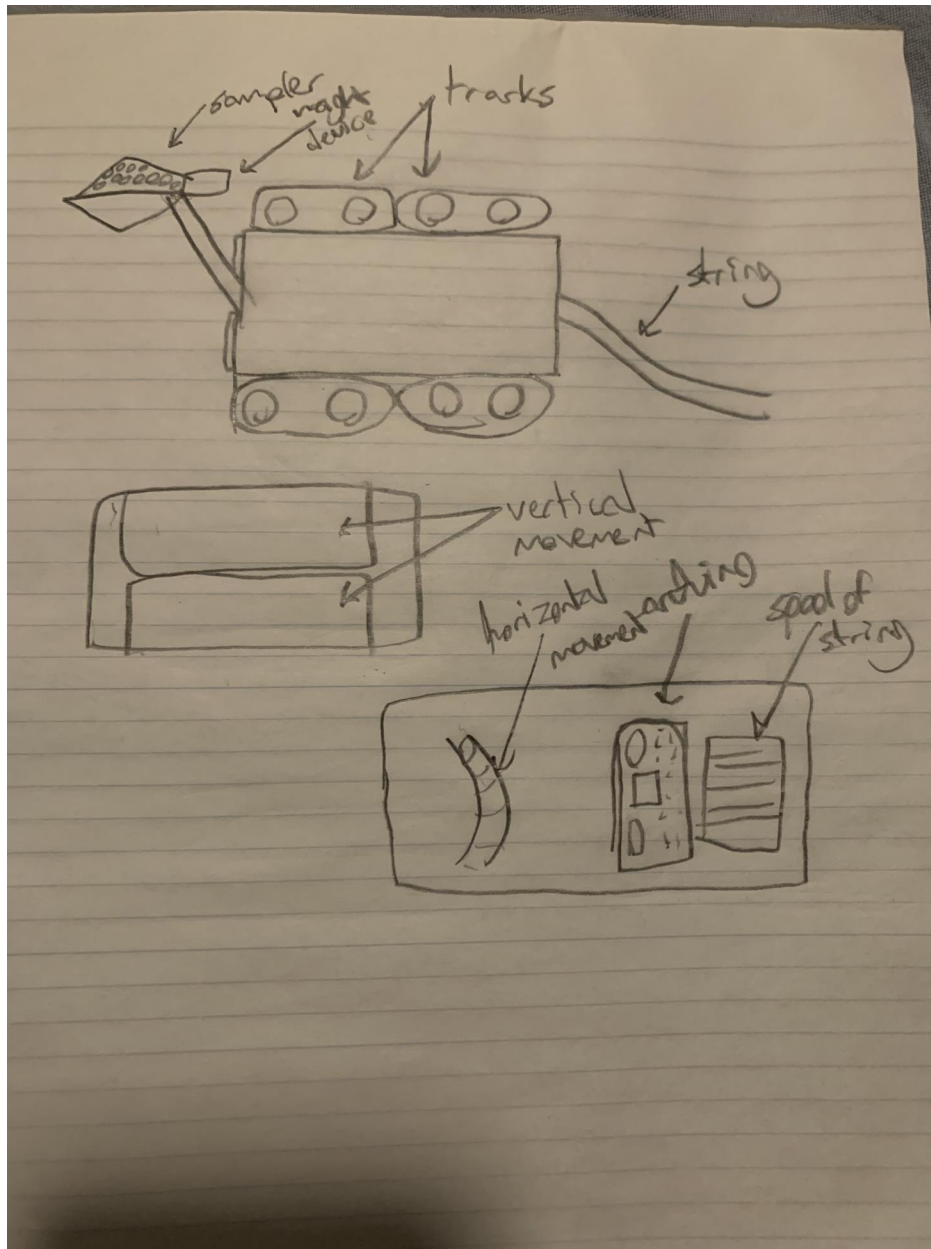


This design consists of two main components which are the scrapping contraption, and the layering device.

Firstly, the layering device is a tool that can extend into the pipe layer by layer allowing the scrapping tool to reach the required distance. The extension of each layer will be calculated to ensure that the device can reach the required distance, and the entire contraption is not very large. The final layer of the device will act with the scrapper as it will move back and forth so the scrapper can collect material efficiently.

Finally, the scrapping tool is attached to a cable that is pulled allowing the scrapper to reach the top of the pipe where the final part of the layering device will move back and forth to collect the material. In terms of the actual scrapping tool, it will be like a cheese grater that can collect bigger chunks of material rather than dust.

Design 3:



This design is a robotic crawler design. The first main component of this design is the sample collection device. It uses a cheese grater style head, and this is fed into a collection pouch which in turn is connected to a scale device, this ensures we can effectively and efficiently collect and weigh the proper amount of material needed for our task. The movement of the device itself into the tube is made possible by tank tracks all the way around the hull for both vertical and horizontal tubes. This is also helped by the double vertical neck movement pieces that have been implemented. The horizontal movement of the neck is the same system as that of Connor's design which is just a simple locking

mechanism. Electronics within the machine will be run by Arduino and the failsafe in case of the machine getting stuck in the tube is a spool of rope that is placed at the rear of the machine.