2023-2024 Reverse Engineering Challenge:
DIGITAL QUARTZ INFRARED HEATER

Student: Odin P.
Team 603B - I Don't Know
Belmont, New Hampshire

Model No.
CZ2011O – Oak Finish
CZ2011C – Cherry Finish
CZ2011W – Walnut Finish
CZ2011B – Black Finish

COMFORT ZONE®

DIGITAL QUARTZ INFRARED HEATER

OWNER'S MANUAL

TABLE OF CONTENTS

INTRODUCTION

I chose the Quartz Infrared Heater for a few reasons. I wanted to see what the quartz looked like in the heater if there was any. It's an old heater and doesn't work right anymore. I wanted to see if anything was broken inside. Plus, I've always been curious how a tip-over mechanism works. It's heavy, so I think I will find a lot of motors or heating coils when I open it.

DISASSEMBLY

Here is the step-by-step deconstruction of the heater and what we found:

STEP 1: Remove the screws from the back panel (8 screws total).

STEP 2: Remove the screws from the front plate (4 screws total).

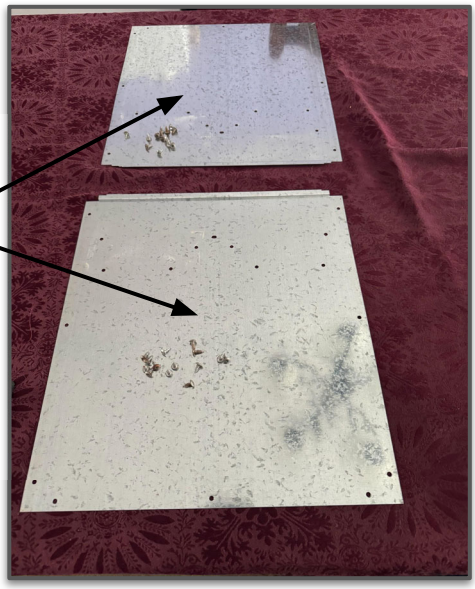
STEP 3: Pull the heating unit out of the wooden frame.

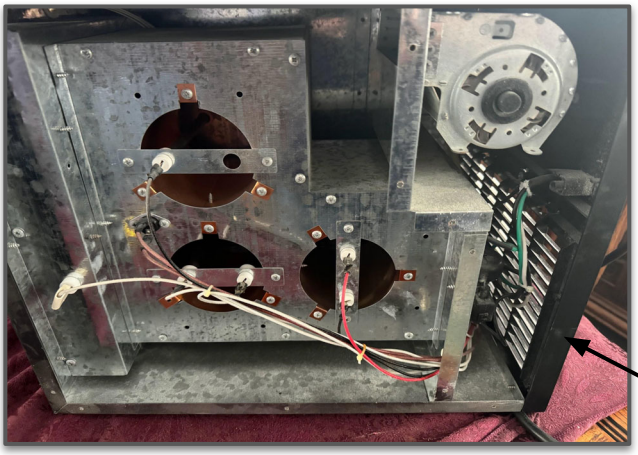
DISASSEMBLY

DISASSEMBLY

STEP 4: Remove the vent cover and filter.

STEP 5: Take off all screws from around the left and right side panels, then remove the panels (28 screws total).

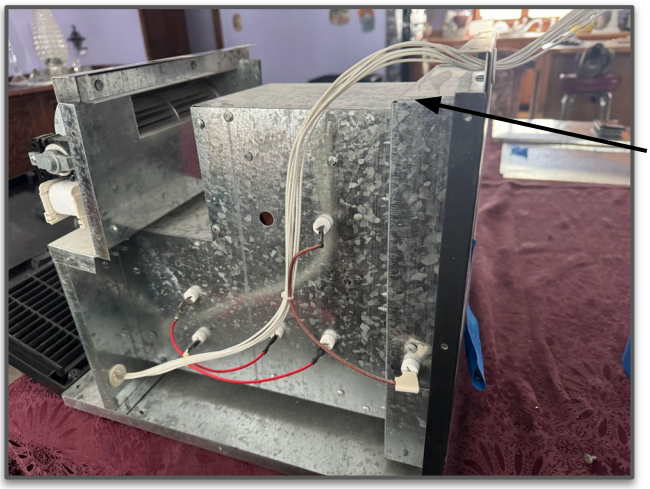




STEP 6: Unscrew front and back panels (12 screws on front, 6 screws on back). The front panel is attached to the bottom panel.

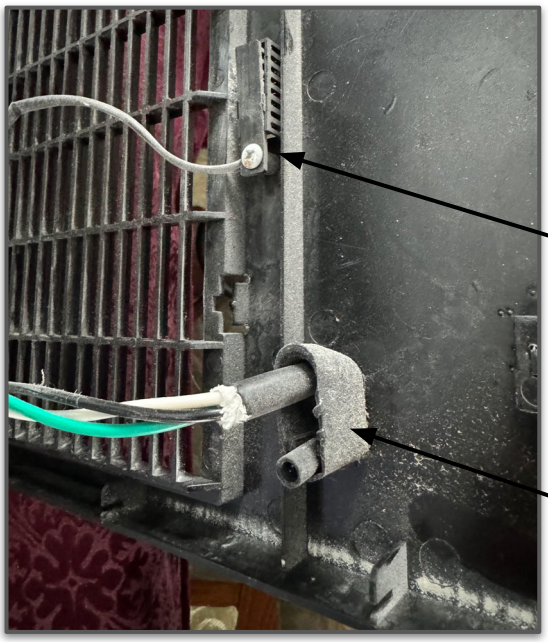
Back panel

DISASSEMBLY



STEP 7: Unscrew top panel (6 screws total) and remove.

STEP 8: Detach front display board from front control wire.

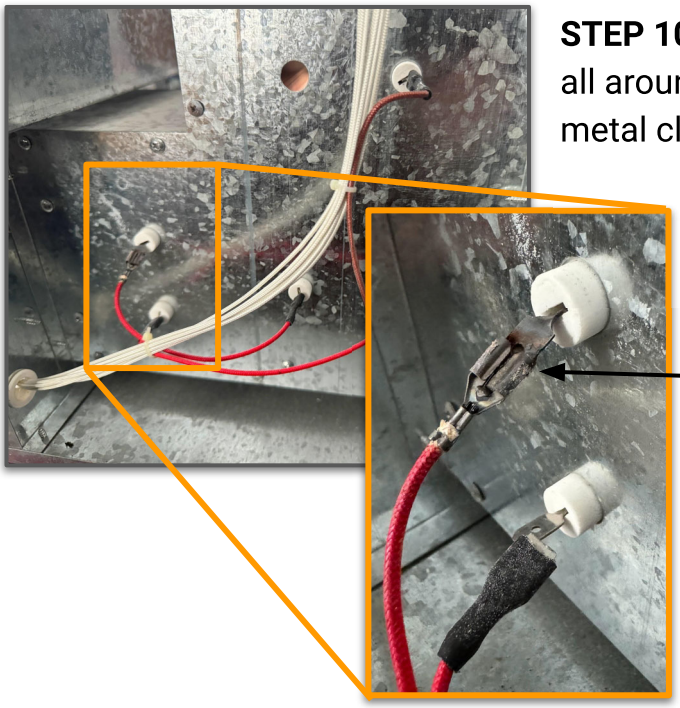


STEP 9: Unscrew ground from the back panel.

Power cord

DISASSEMBLY

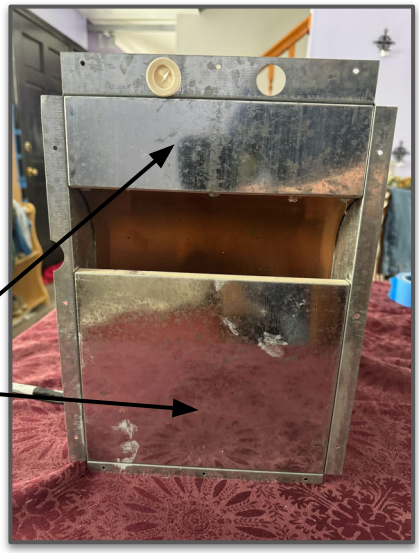
DISASSEMBLY



STEP 10: Remove wires from all around the panels. The metal clips will slide off.

Note: one of the connectors looks burned through with no plastic cap on it. It was easier to remove the panels first, then deconstruct the wiring.

STEP 11: Unscrew the bottom panel (which is part of the front panel). Note: the backside of the front panel was a lot darker than the other side. It almost looks burned.



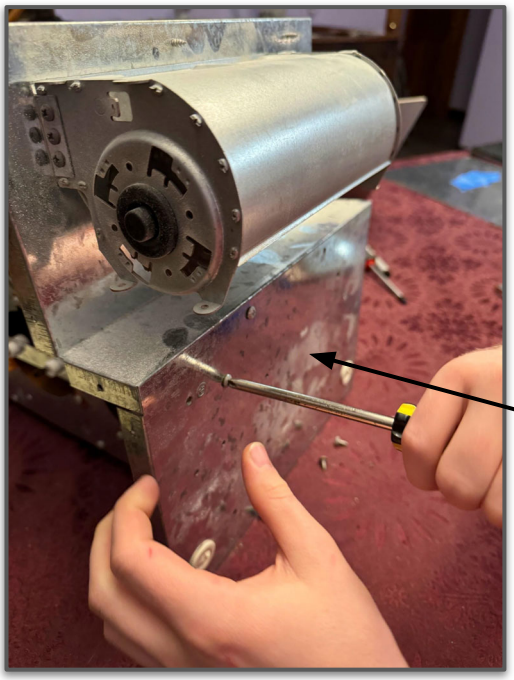
STEP 12: Unscrew both of the small front panels (20 screws total).

DISASSEMBLY

DISASSEMBLY

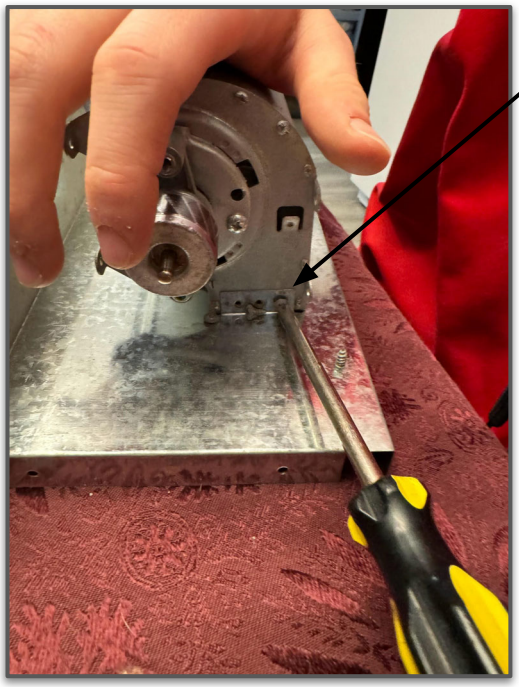
STEP 13: Remove the copper curved panel from the front (2 screws total).

STEP 14: Unscrew and remove the inner side panels (10 screws total). This exposes three cylindrical spaces.



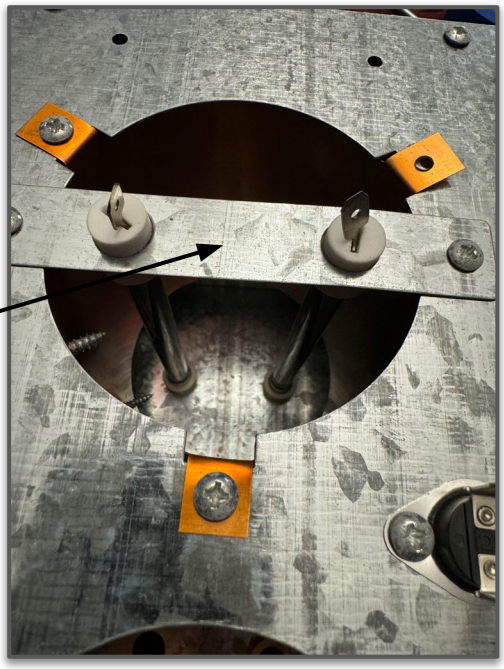
STEP 15: Unscrew the back fan panel and remove it from the rest of the heater.

DISASSEMBLY

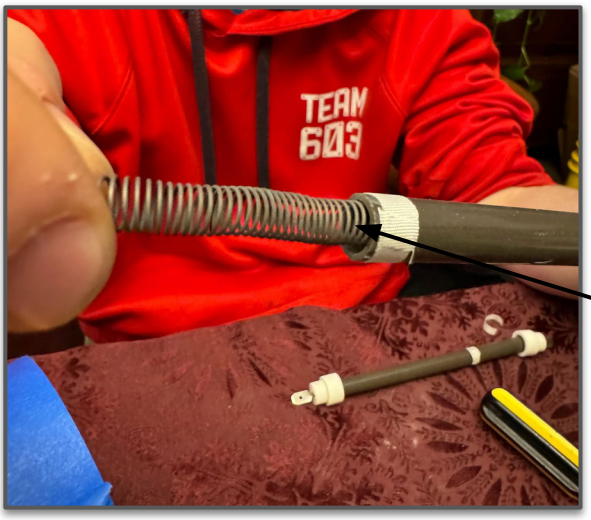


STEP 16: Remove fan motor from the inner back panel (6 screws total).

I tried to take apart the fan motor, but I could not pull apart the drive shaft or take it apart. So I set it aside.

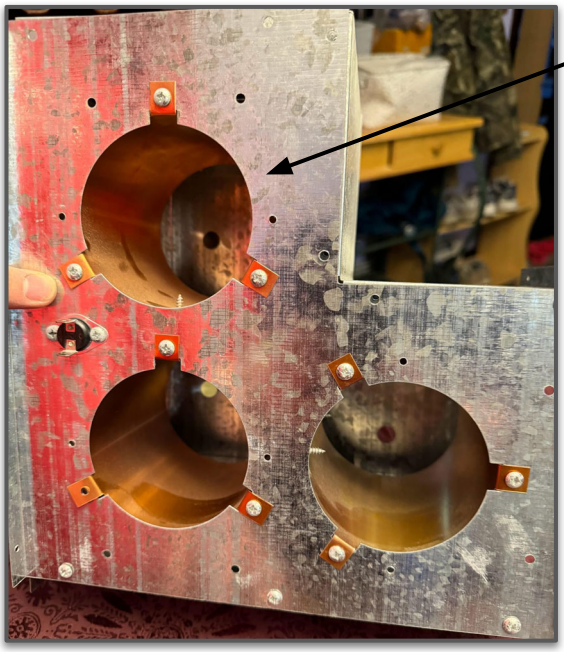


STEP 17: Remove the three quartz rod support plates from the inner left side panel.

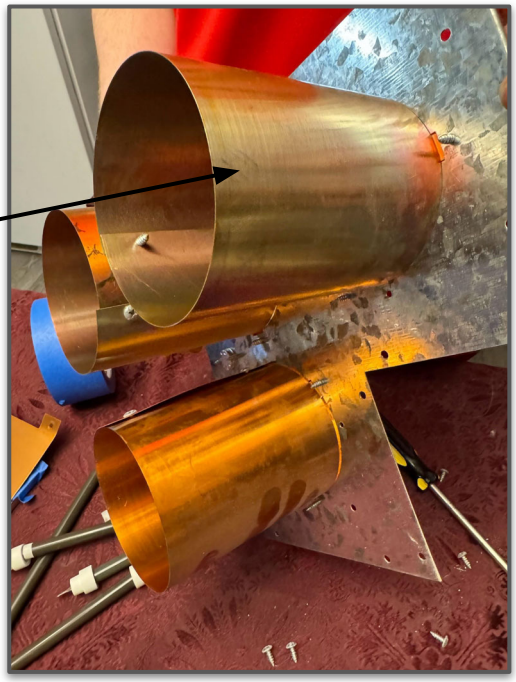


The rods have springs inside of them. They sound a little bit like jingle bells.

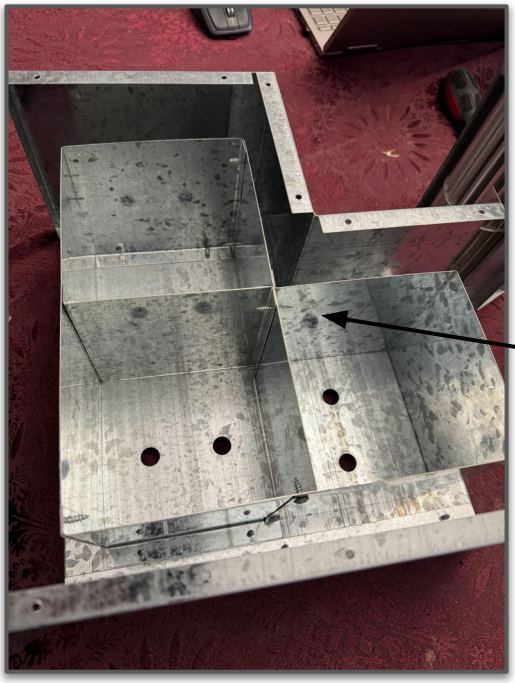
DISASSEMBLY



STEP 18: Remove the inner left side panel (9 screws total). There are three cylinders that are attached to the left side panel.



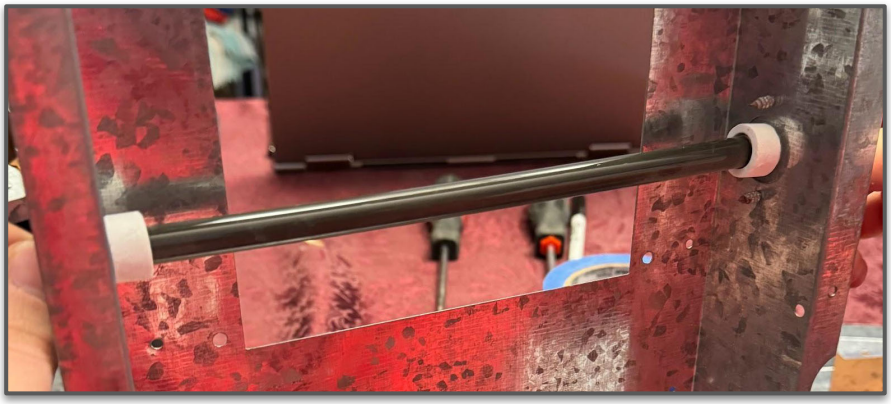
Two of the cylinder areas look like copper; the other one is lighter and looks like brass but it is actually copper. It especially is noticeable from the sides of the cylinders.



After the side panel with the cylinders was removed, it was just a metal frame with three squares in it. I did not take apart since there were no electronic components.

PARTS LIST

Quartz Heating Elements: These are the glass-looking tubes with the spring coil inside them. They are used to heat the metal inside. When electricity passes through the quartz material, it heats up and begins to emit infrared radiation.



Digital Control Panel: The heater has a digital control panel and interface with settings for temperature, timer functions, and fan speed. We do not have a remote control for it.

Thermostat: The thermostat monitors the temperature and adjusts the heating elements accordingly to reach the desired setting.

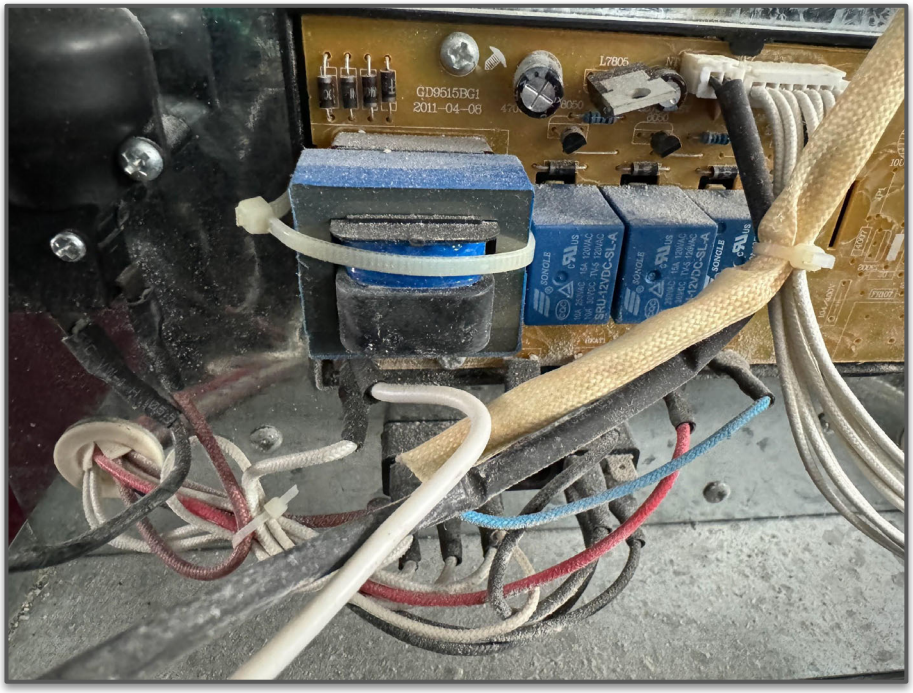
Safety Features: There is a mechanism to turn the heater off if it falls down. This will help prevent fires and accidents.

Fan: There is a fan assembly made of a combination of plastic and metal.

PARTS LIST

Housing and Design: The exterior housing is a wooden structure. The interior housing is made of several layers of sheet metal to allow for air flow and heating.

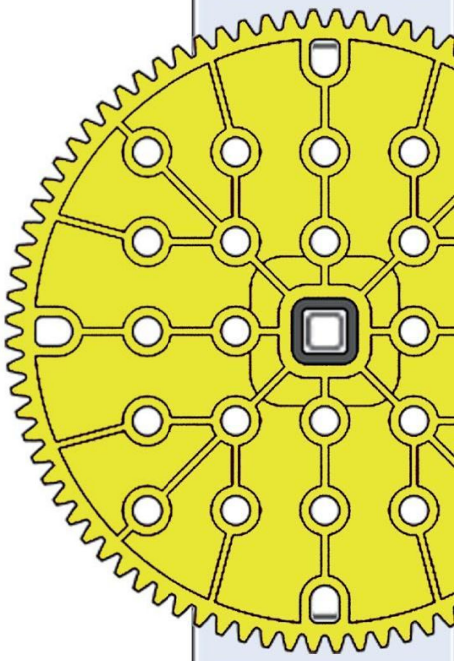
Power Supply and Wiring: There is a standard power cable and plug with a lot of wires inside to run the heater.



ANALYSIS

How is this heater and our robot the same?

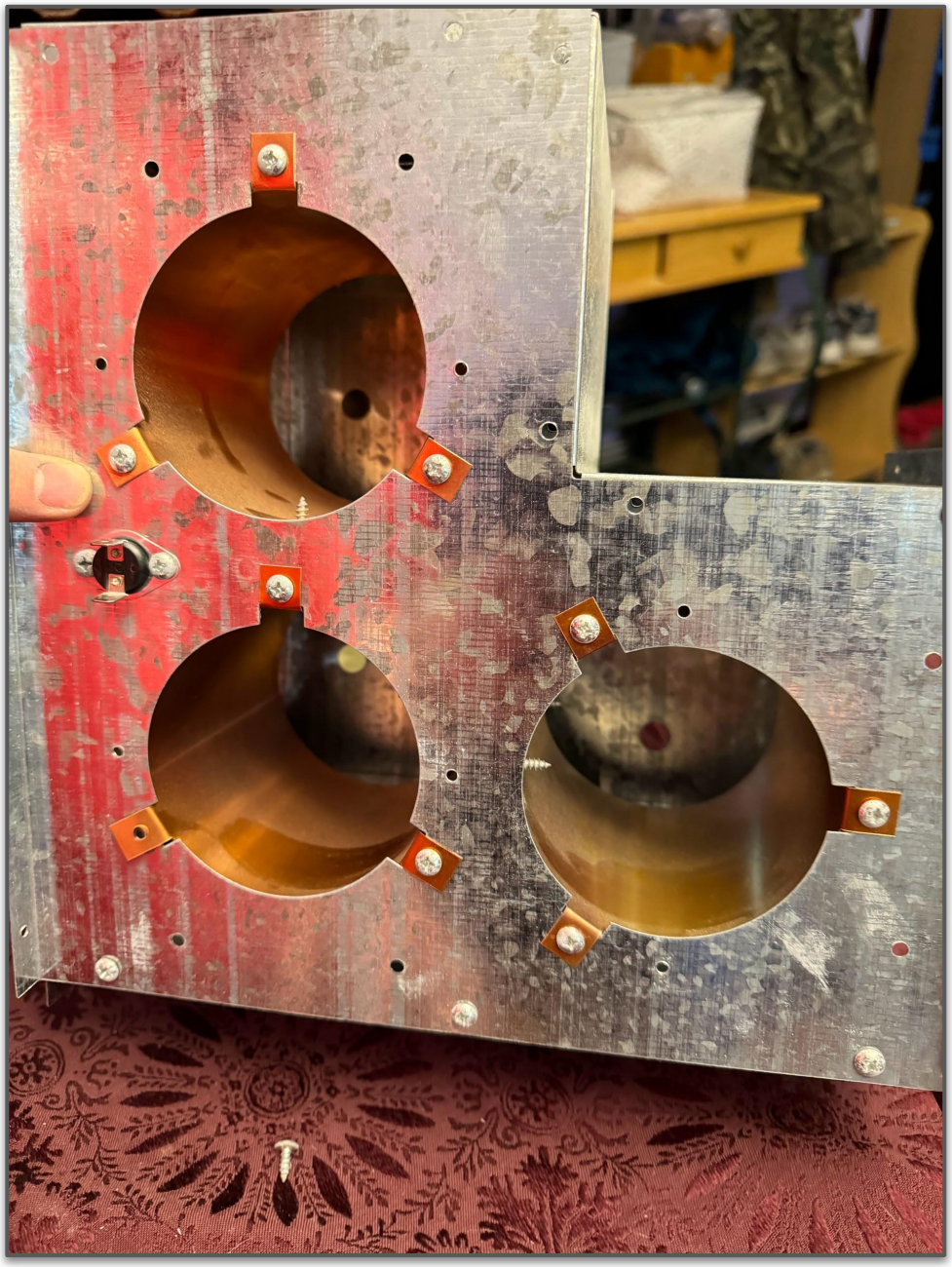
- Both require parts to assemble and hold the mechanisms together.
- Both use sensors to achieve certain tasks. There is a safety feature that uses a limit switch to shut off the heater.
- Both need to be wired to work and require power.



CONCLUSION

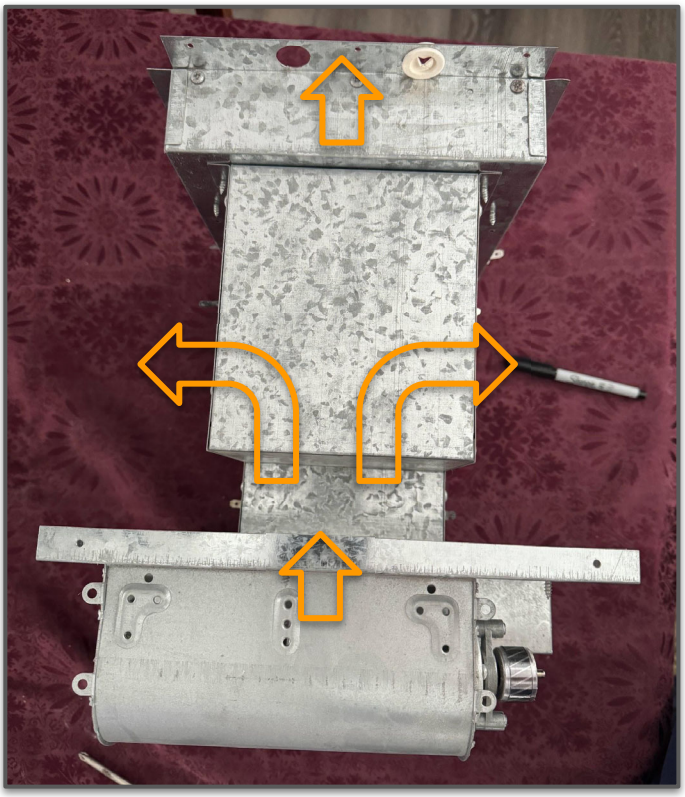
I learned several things from taking apart the heater.

First, I did not realize there was so much air space on the inside. I thought there would be more motors or coils because of how heavy the heater is. But it turns out the wooden frame is heavier than everything inside.

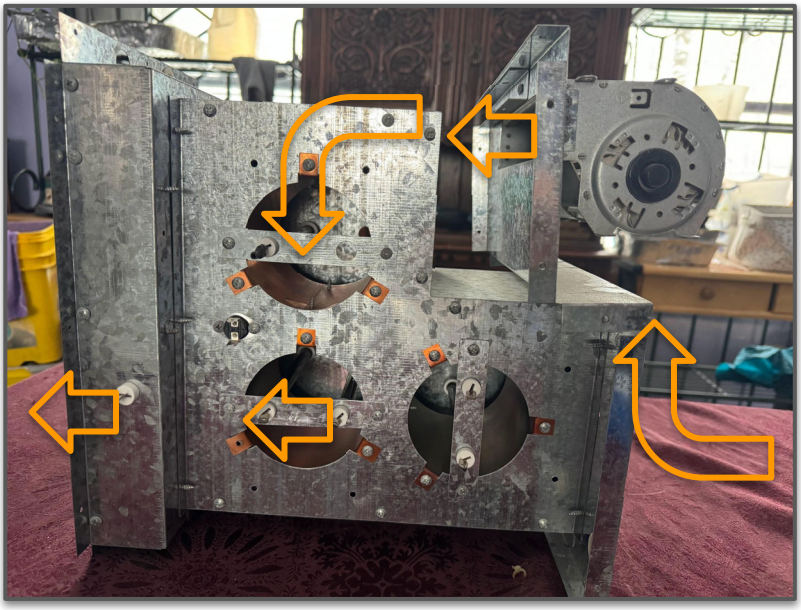


CONCLUSION

Second, the fan in the back of the heater sucks in the air and it goes through all the open areas as it is heated up with the quartz cylinders and spring coil inside.

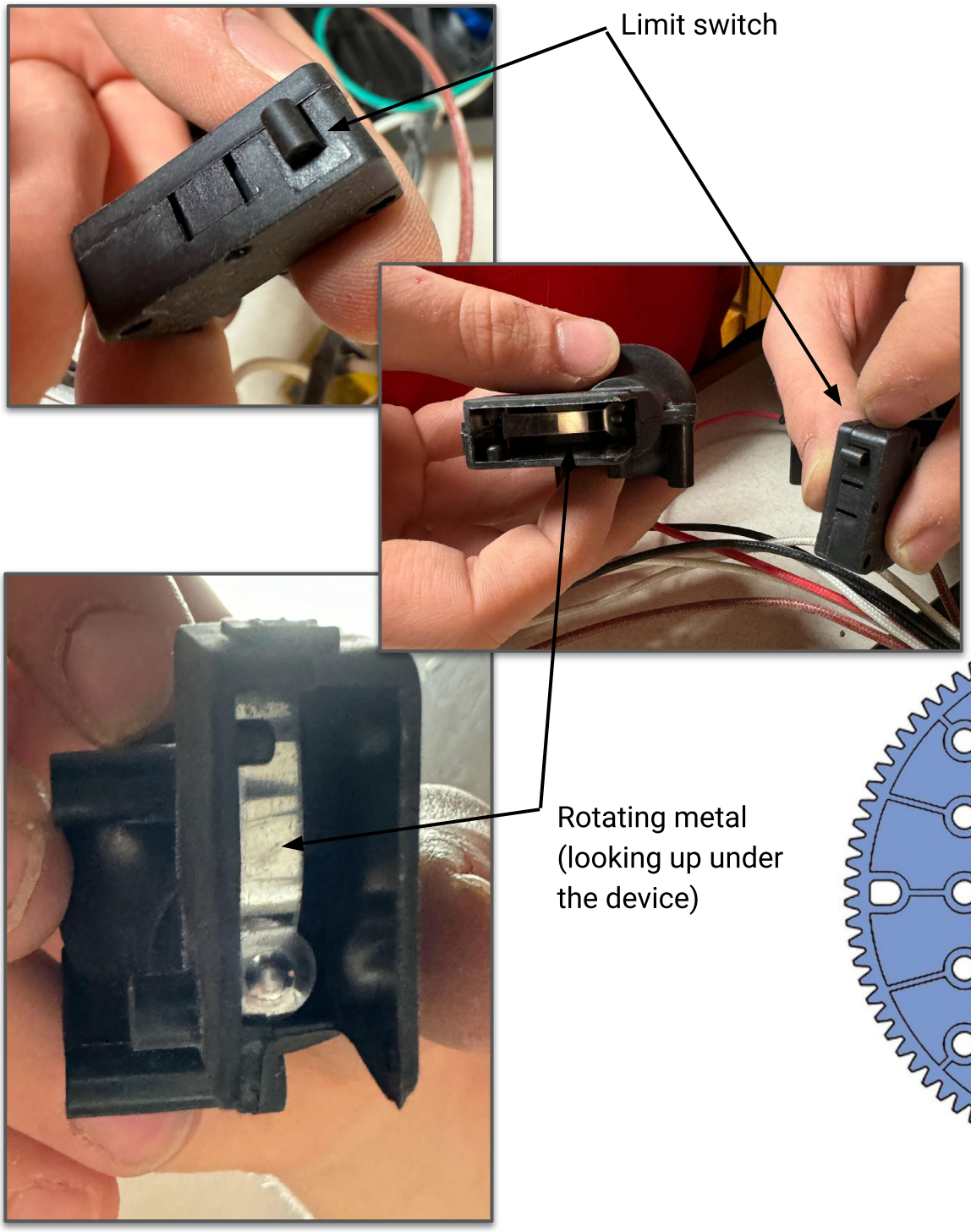


Arrows show air flow on top view (top image) and left side view (bottom image).



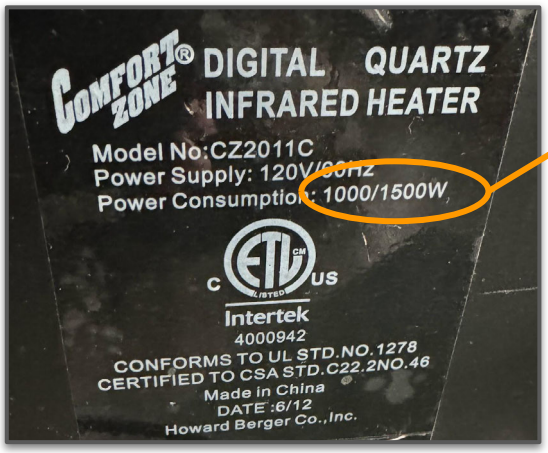
CONCLUSION

Third, I learned how the safety feature works. When the heater tips over, the free-rotating metal piece hits a limit switch. This limit switch turns the heater off so nothing catches on fire.



CONCLUSION

Finally, I learned how to calculate how much electricity the heater would use over time. My mom showed me how to read the electric bill and explained how kilowatt-hours and usage are calculated.



How much electricity used per hour

If the heater was used for 8 hours during the night, then:

1500W * 8 hours = 12,000 Wh = 12 kWh

Eversource (our electric company for the house) charges this much each month:

Rate R, Residential Standard Service
Available to customers living in individual residences and apartments.

• Customer Charge (per month):	$13.81
• Distribution Charge (per kWh):	5.357 ¢
• Regulatory Reconciliation Adjustment (per kWh):	0.047 ¢
• Pole Plant Adjustment Mechanism (per kWh):	0.270 ¢
• Transmission Charge (per kWh):	2.965 ¢
• Stranded Cost Recovery Charge (per kWh):	0.694 ¢
• System Benefits Charge (per kWh):	0.905 ¢
• Energy Charge (per kWh):	12.582 ¢

CONCLUSION

Using the total rate from Eversource, the total charged per kWh =
$0.2282

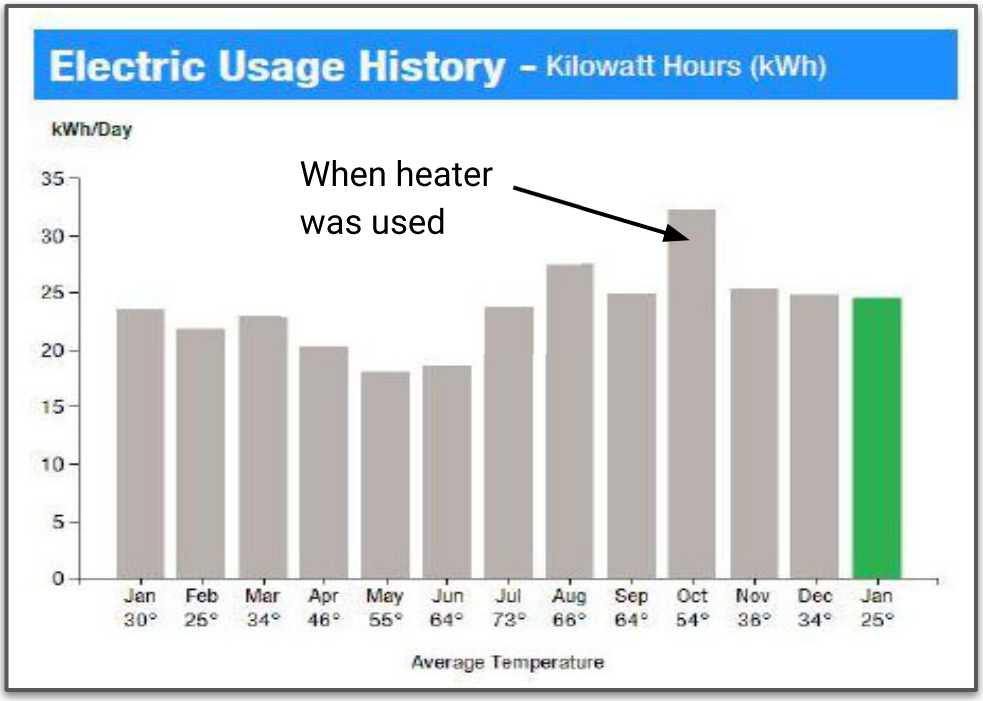
The total cost of running this heater for 8 hours a night each night =
$0.2282 * 12 kWh = $2.7384 per day

For the total month:
$2.7384 per day * 30 days = $82.15 each month to use this heater

or

$2.7384 per day *365 days/year = $999.52 per year

Because it uses so much electricity, we only used the heater in October when we did not want to use the boiler to heat the house.



I did not put the heater back together to use it again. The burned areas, corrosion, and melted plastic were a safety risk and my parents did not trust using the heater again. I'm still glad I took it apart because I learned quite a bit on how they work.

WORKS CITED

1. For current supply rate, delivery rate, and residential usage information: www.eversource.com

2. To calculate electric usage and cost per month: https://energyusecalculator.com/electricity_spaceheater.htm

3. Product information: https://www.heaterstoreonline.com/product/cz2011-comfort-zone-deluxe-infrared-quartz-heater/

4. Information on quartz heating and how it works: https://www.tansun.com/gb_en/technical/how-quartz-heating-works.html

WORKS CITED