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Reverse Engineering Challenge

Ryobi Air Compressor

Figure 1: Pumpithy, 6627A's Ryobi Air Compressor

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INTRODUCTION

In 2021, VEX Robotics lifted the ruling that only 6 motors can be used (compared to normal limit of 8) if the robot uses VEX pneumatic components, allowing teams to build complex mechanisms using pneumatic pistons without sacrificing crucial motors.

With pneumatics now available, many teams sought for an efficient way to pressurize air tanks and the majority, including ourselves, used an air compressor.

For our Reverse Engineering Challenge, we disassembled a **Ryobi Air Compressor** so we could learn more about a machine we use daily.

We deconstructed our faithful Pumpithy (Figure 1). We will not forget his service and how he diligently filled our reservoirs during his long life.

Figure 2: Pumpithy, in the last moments of his life

DISASSEMBLY PROCESS

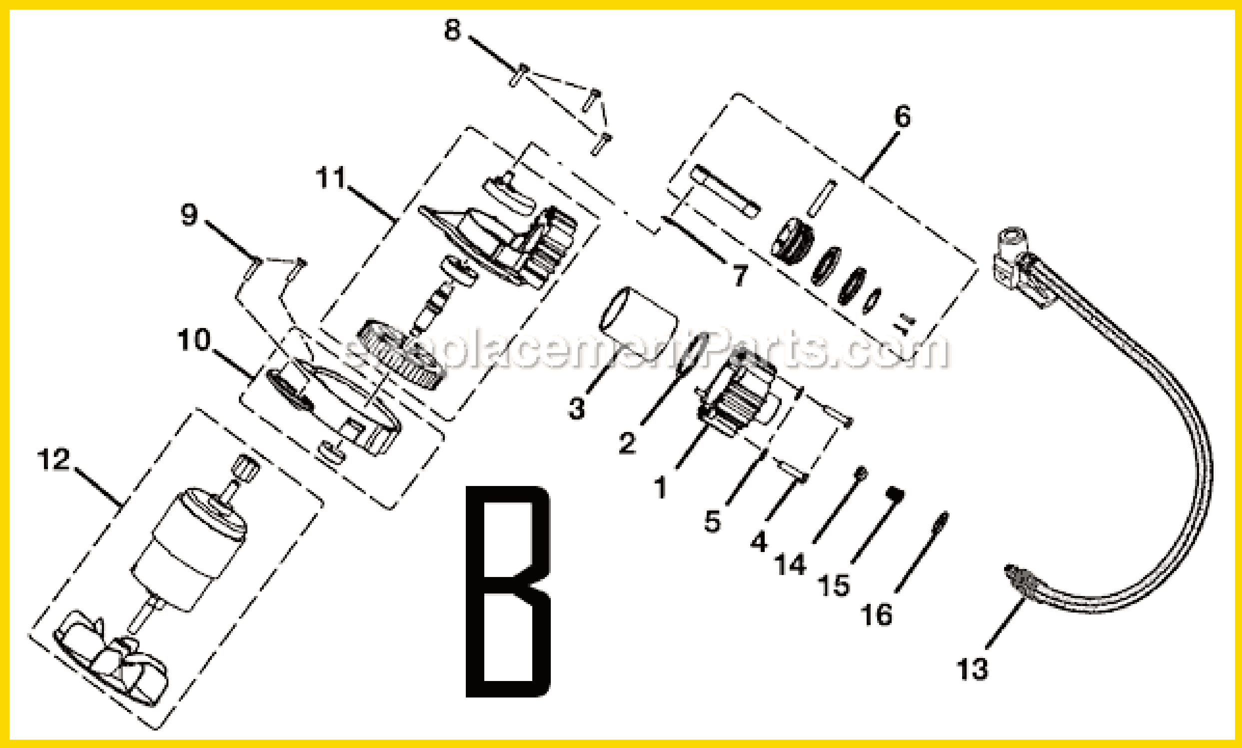


Figure 3: Ryobi Air Pump Compressor Parts Diagram

Tools Used:

- Pliers
- Phillips screwdriver
- Eye protection
- Brute strength

Figure 4: Fully assembled air compressor

Figure 5: Outer shell removed

Figure 6: Internal components removed from outer shell

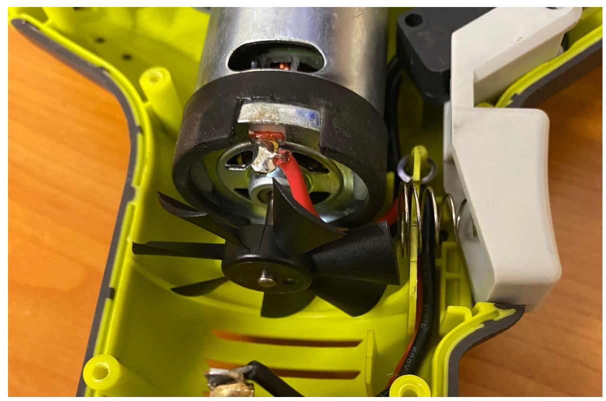
Disassembly Steps

1. Removed the outer shell.
2. Removed internal components from the outer shell, still connected.
3. Internal components separately analyzed.

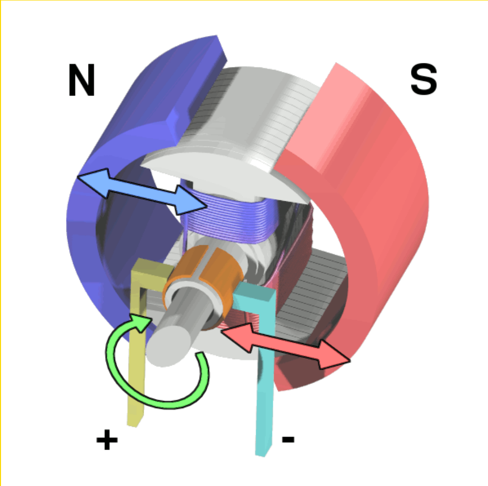
PARTS LIST

1. Battery connector
2. Trigger/switch
3. Motor + fan
4. Gear train (torque ratio)
5. Piston powered by gear train
6. Valve inside the piston, controls airflow
7. Tube that connects pump to tank
8. Display/circuit board

DC Motor



From top left, clockwise:
Figure 7: DC motor and fan, inside shell
Figure 8: DC motor and fan, outside shell
Figure 9: DC motor model number close-up



Electricity flows from the **switch** to the **motor**, powering the **motor** and spins the gear connected to the **air compression system**. Simultaneously, the **motor** spins a **fan** pointed towards the **motor**, which cools the system.

Figure 10: DC motor internal diagram

Air Compression System

Figure 12: Larger gear

Figure 13: Smaller gear

Figure 11: Complete air compression system

When the **motor** spins, the smaller gear connected to the **motor** spins the bigger gear. Since the smaller gear is powered in this gear train, more torque is exerted.

Figure 14: Gear attached to piston

Figure 15: Piston, disconnected

To push air into the tube, a **piston** mounted to the gear is used by converting rotational force (gear) to linear force through an engineering concept called a **slider crank linkage**.

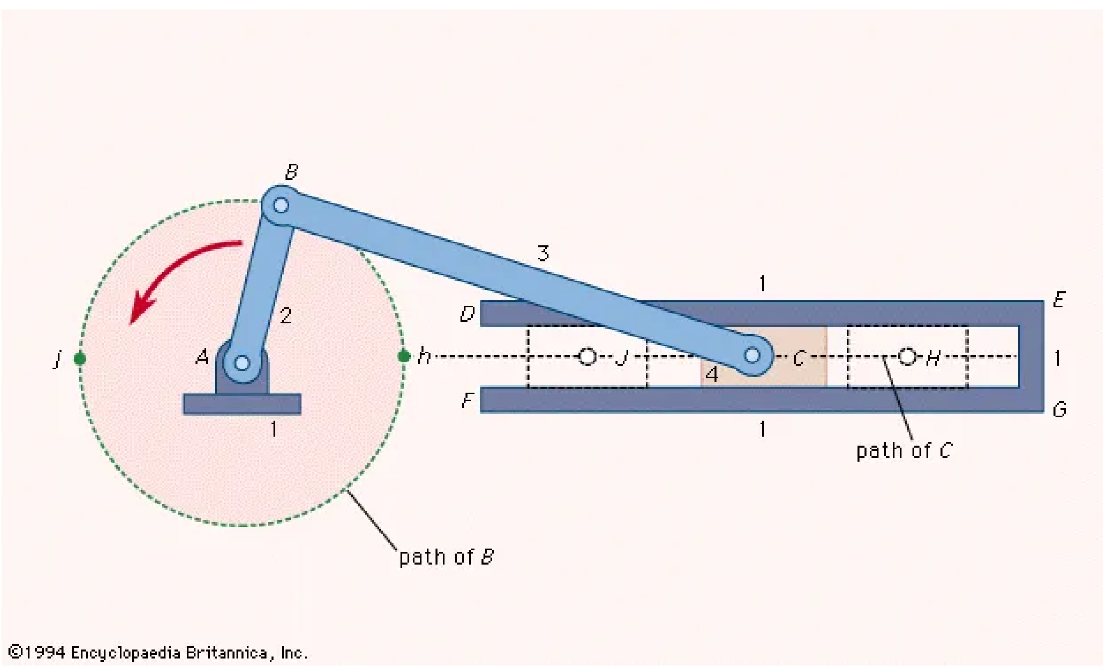


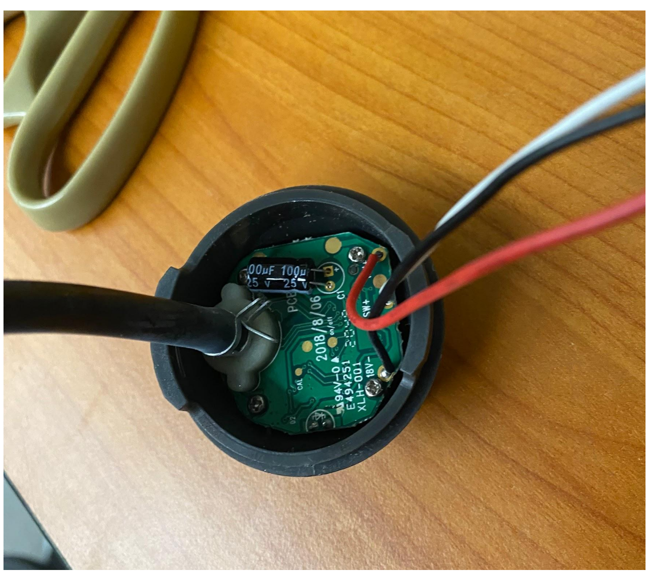
Figure 16: Slider crank linkage diagram

Figure 16: Chamber, top-down view

Figure 17: Chamber, isometric view

When the **piston** retracts, the **valve** closes, filling the **chamber** with air. When the **piston** extends, the **valve** opens, forcing air down the tube. This process is repeated while the **pump** is running.

Circuit Board



The **circuit board** in this display is connected to a tube connected to the **chamber** to measure the pressure per square inch (PSI) of the tank. The **circuit board** reads and displays this value to the user.

Figure 18: Circuit board, top-down view

Miscellaneous

Battery clip takes battery power and sends the current to the **limit switch**.

Figure 19: Battery clip

Limit switch, connected to the **battery clip**, controls flow of electricity. The **switch** completes the circuit and sends power when the **trigger** is pressed.

Figure 20: Limit Switch

Trigger connected to the **limit switch**. When the **trigger** is pressed, the **limit switch** is activated.

Figure 21: Trigger

CONCLUSION

Findings

- The fan provides insufficient cooling, with the motor heating up faster than the fan can cool it.
    - Possible improvements if given resources could be *replacing* the fan with a better cooling system.
- We found real-world applications of engineering principles like the slider crank linkage that pumps air.

Summary

Working on this project allowed us to understand that engineering is not just about creating. Engineering is also analyzing mechanisms for new ways of innovation. By breaking down a system, we learned exactly how the air compressor worked and could brainstorm methods of improvement.

WORKS CITED

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3. Figure 14: https://www.britannica.com/technology/slider-crank-mechanism