Design, Build, and Testing of Resonant Air Compressor

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Mechanical resonance of a system is achieved when the oscillation amplitude of a system is maximized and the resultant velocity and input force are in phase. In theory, a vacuum pump running at resonance should be more efficient when compared to an off-the-shelf air compressor. The focus of this project was to build a resonant compressor, obtain efficiency values from that compressor, and compare those values to that of an off-the-shelf compressor. An off-the-shelf air compressor was tested by pulling a vacuum of a bell jar while collecting data for every 100 mmHg of vacuum that was pulled to the vacuum pressure of 400 mmHg. The values collected were the current, voltage, power, and time it took to reach each vacuum value. In building the resonant air compressor various pieces were printed using 3D printing technology, machining various parts out of steel, and purchasing steel springs. In the design of the new compressor, the piston and valving from the off-the-shelf compressor were used. A copper wire was coiled around a 3D printed bobbin and the compressor was assembled. Alternating current was sent through the copper wire and the current, voltage, and power values were all collected during the same vacuum test as previously defined. These values were then compared to the values collected from the off-the-shelf air compressor.