Walnut Huller Wire Cutting & Bending Machine

Sponsor: *Wizard Manufacturing Inc.*

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Advisor: Professor Matt Simkins

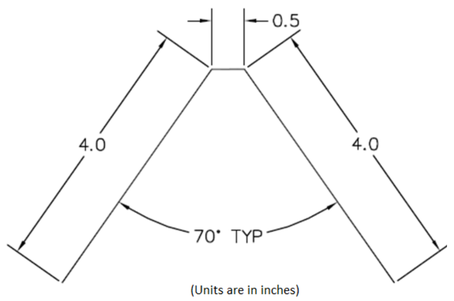
Background and Overview

INTRODUCTION:
Often times walnuts are harvested when they are not fully ripe. In such cases, the hull of the walnut does not easily fall off and must be forcefully removed. This is the job of a Walnut Huller, which consists of a large rotating drum with steel brushes fastened to it. The steel brushes wear out over time and the bristles must be replaced. The production of these wire bristles is the job of a machine appropriately called The Wire Machine.

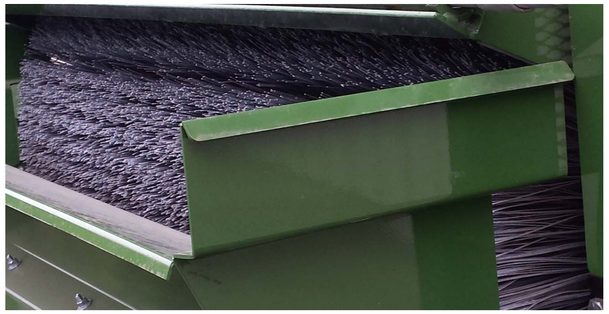
PROBLEM:
The previous Wire Machine was built over sixty years ago and most parts require special machining when failure occurs. There is also significant waste caused by machine error along with not being able to keep up with product demand.

GOAL:
To redesign the Wire Machine for increased production rate, reduced waste, and “off the shelf” replaceable parts.

Standard Wire Dimensions



REQUIREMENTS:
- Produce 40 lbs/hr of wire bristles
- Cut and bend wire to standard size (see above)
- Safe and simple to operate for someone in high school
- Requires no programming
- <10% of operating time is dedicated to maintenance
- Overhead lighting
- Ability to bypass safety measures to troubleshoot

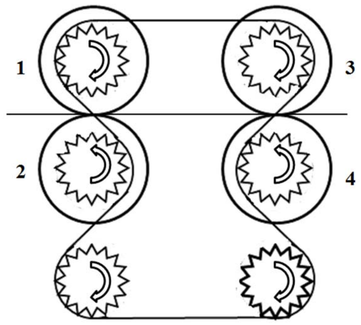


How It Works

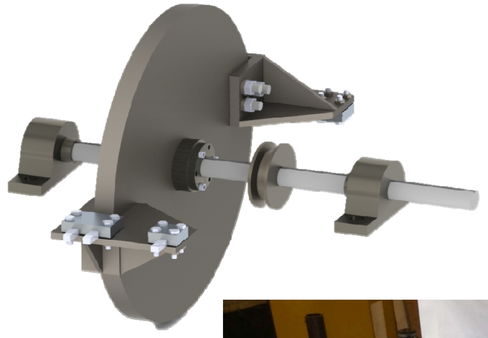
OPERATION:
The machine operates by controlling a single 3-phase AC motor with a VFD and having all other moving components mechanically coupled for sequential timing. Using a belt and pulleys, the flywheel is driven. The flywheel shaft is coupled to a 90° bevel gear box with a 1:1.8 gear ratio. The output shaft of the bevel gear box is coupled with the driving shaft of the wire puller. The wire puller draws wire from a large spool and feeds it into the flywheel where the wire is cut and bent using tool steel dyes . The wire is cut in direct shear and bent by passing two dyes over a stationary dye.

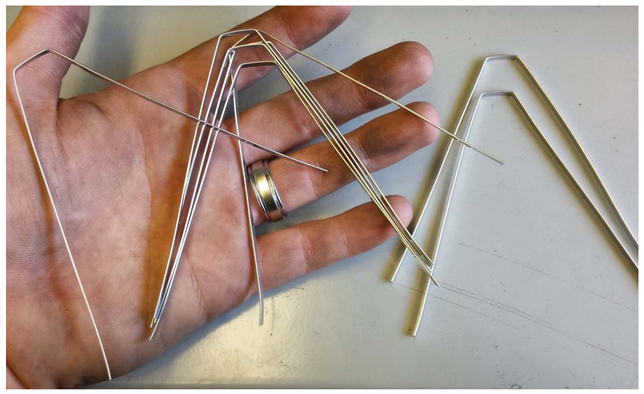
Wire Puller

The wire puller draws wire off of the spool and feeds it into the flywheel cutting and bending dyes. It utilizes two pair of wheel which are mechanically couple with a chain and sprocket serpentine system. This ensures all puller wheels are operating at the same speed for a consistent wire feed rate. The puller wheels are made out of oil quench hardened 4140 steel to increase their surface hardness and reduce surface fatigue from the constant point contact with the wire.



Flywheel





Design Parameters

- Flywheel must have a large mass moment inertia to reduce change in speed during cutting and bending, but small enough to reduce motor size
- Repeated impact results in large machine vibrations so a flexible shaft coupler and belt/pulley drive were used to reduce backlash
- Wire must not jam so a tubular wire guide system was implemented
- Cutting and bending dyes must be “off the shelf”

Future Recommendations

- Constrain wire bristles after it is cut and bent
- Implement a collection system to orient the wire bristles for packaging
- Further analysis on the process of cutting and bending using slow motion equipment