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Assembly Notebooks P19046

Catch Device Notebook

Document Intent:

This document will keep track of all and any observations made during the assembly and machining process of the Catching Device for the Overcomer.

Machining:

- While we originally planned to have the rings cut on a CNC machine, this was changed to the waterjet machine on recommendation from the shop staff. Some minor CAD and drawing changes had to be made to make our design compatible on that machine.
- We found it extremely difficult to get even a rough estimate from the shop staff on when the waterjet process would be completed, which led to some scheduling frustrations on our end. This was partially alleviated by continuously applying pressure to the shop staff and pestering them until they finished the work.
- The waterjet left some small tabs on each piece that needed to be filed off manually.
- They accidentally cut radially through the large ring, but we were able to epoxy it back together and keep the ring sturdy enough to use.
- Some additional holes had to be drilled into the large and small rings in order to attach directly to the support arms.

Assembly:

Netting frame and rings assembly:

- After some initial prototyping by the team, we found that using steel tubing for the net ring supports, with a friction fit into the holes on the rings, provided enough stability for our design. This prompted us to change the ring supports design, as this is a much simpler, more adjustable, and more elegant solution than our previous design.
- We were able to find a local supplier of the necessary sized steel tubing, which allowed us to just pick up the material ourselves and not have to wait on shipping times. This allowed us to stay on schedule even as we changed the design.
- We initially cut the tubing with a lot of extra length after the small ring to allow for adjustability when assembling the full design, and then cut it down when we finalized everything.
- Because of the positioning of the throwing device and the limitations of our frame, we weren't able to position the netting completely in front of our user. This isn't ideal, but we did position it in order to mostly protect the user.
- During our initial testing, we determined that the small ring flap isn't necessary to guide the ball to the throwing device, which simplifies the final design and BOM.
- While we originally planned to mount the catch device to the frame using the small and large rings, we found during the initially assembly that mounting it using the small and

medium rings would require much less support material and still be sturdy enough to withstand the forces of a ball being thrown at it.

Net assembly: First step was detaching the red and white plastic portions of the netting, to do this cut the top of the opening and cut the threading at the end to rip off.

- Once the plastic parts of the net are cut off, begin the assembly.
- Start with the top and largest hoop and work your way down.
- Once the top hoop is all set, add 2 zip ties to each support bar before adding more on the bars.
- Add zip ties to the middle hoop before moving to the next section, ensuring the top portion of the net is taught.
- Zip tie the bottom portion support bars, placing 2 on each bar before adding more.
- Trim overlapping net and have the end of the net connect to a support bar and make sure there are no holes in the netting.
- Trim net as you go down.
- Place zip ties on bottom hoop, trimming as you go along and make sure there is no net bunching in the middle.
- Finish off by placing any necessary zip ties on portions of the net to make sure the design is taught.

Modifications:

- Netting: Make sure the zip ties are facing inwards.
- Make sure there are no sharp ends by sanding down zip ties.
- Used steel tubing as opposed to beams for the net framing.
- Attached net frame to chair frame using middle ring instead of large ring.
- Removed flap and door hinge from final assembly.
- Machined rings on waterjet instead of CNC.
- Drilled additional holes into catch rings for potential support connections.

Launch Device Notebook

Document Intent:

This document will keep track of all and any observations made during the assembly and machining process of the Launching Device for the Overcomer. Notes highlighted in yellow indicate the most recent entries.

Machining:

Given the long wait time for the Garrolite material to be machined into the two Cover Plates of the device, a plastic sheet from the shop's stock material was used to make the Cover Plates. The plastic sheet was a ½" thick white material of at least 1' x 2'. Since this material is thicker than what the device was designed for, counterbores were drilled on the plates. This actually allowed the bolt heads, nuts, and e-rings to be hidden within the Cover Plates, which was a rather positive result.

The coupler that was originally machined to attach the cam's drive shaft to the motor shaft was not thick enough. It was about ¾" OD with 1/2 " ID on one side and 7/16" on the other. The holes were drilled near half-way through the coupler's length but did not meet. The holes created for the shafts left a wall thickness on coupler of about ¼". This was too thin to engage the threads of the set screw that was being used (about 3 threads). A new coupler was machined with the same length and holes diameter but with an OD of 1½", which allowed for a much better thread engagement and removed the backlash of the set screw on the flat surface of the shafts. A jigsaw was used to clean the sliding slot of the old cover plates. This was a much better method to manually create the arch geometry rather than using a mill press. CNCing the parts is most likely the best way to perform that cut if one knows how to operate it. To allow the user to crank the device with a wrench, a bolt spun in the lathe to remove the threads and achieve the appropriate ID of the coupler. Longer bolts for the clamps were found that could be used as extenders to move the device a few inches away from the wheelchair. Although, the bolts were not fully threated so they were brought to the shop to have the threads extended. The bolt material was unknown but it's likely to have been stainless steel. The task to thread this bolts was very labor intensive and unproductive as it took about 15-20min to nearly 2-3 threads, which by then it was decided that it would be better to just purchase the right size bolts.

Drilling the holes on the garolite material for the switch was easy, but the machine shop did not have taps for the small screw size for the switch. The threads in the holes were formed by manually screwing the screws using a screwdriver. The holes' diameter was at least the same as the root diameter of the screw, but it was still very challenging to manually perform this task.

Assembly:

The Drive Shaft was press-fitted into the Cam which makes it hard for small adjustments but is necessary to keep the cam aligned with the ball bearing.

For the moment being, a paracord rope has been used as the mechanism connecting the spring to the launch arm. A simple knot was done at both ends and the spring was slightly pre-tensioned to keep the rope tightened.

Disregarding the lead time to have the garolite CNCed (about a month and a half), it has shown to have been a great option due to the high precision and snug fit in between components. The assembly and disassembly process has become considerably easier and faster due to the new cover plates.

Modifications:

To allow the motor shaft to move the Drive Shaft part, a coupler piece was machined and inserted in between the two parts. The coupler is a ½" diameter shaft that is about 2.5" long. Each end has a 1" deep hole that matches the diameter of each shaft, and perpendicular to the holes a threaded hole was drilled to allow for a set screw.

The Drive Shaft part was cut to shorten its length. This was done to compensate for the motors shaft and the coupler in order to keep the drive shaft from sticking out of the cover plates.

Due to the uneven spacing of the curved slot of the Cover Plates, washers were used on both sides to allow for a better grip of the upper clamp when tightening it to the plate.

Two holes were drilled near the back of both cover plates to allow screws to hold a switch in place. This switch will be the one that will stop the motor when the arm reaches the "loaded" position.