Cordless Ratchet Sub-Assembly Automation

Snap-On

PROBLEM STATEMENT

Snap-on assemblers manually insert and press a Zerk grease fitting into a ratchet selector knob. The selector knob and the grease fitting are received as loose parts. This process is time consuming and has the potential for misalignment of the two parts. By automating the assembly process, operators become free to focus on other areas of importance. The project's main goal is to decrease operator needs and increase production of these sub-assemblies.

REQUIREMENTS

Req #	Requirement Description	Motivation	User/Customer
1	Automation following electrical and mechanical guidelines	Eliminate the use of skilled laborer performing an essentially unskilled task	Snap-On
2	Output rate should exceed 400 pcs. per shift (50 pcs. per hour).	Reflect the product output present to ensure Snap-On does not lose revenue	Snap-On
3	Incorporate pre-existing hardware/software utilized by Snap-On	Ease the new assembly process on employees that were efficient in the old practice	Snap-On
4	Size must comply with already existing space allocated to workcell	Eliminate the utilization of space that are already allocated to other workcells	Snap-On
5	Pressing mechanism must press grease fitting flush with the selector knob	Ensuring product quality	Snap-On

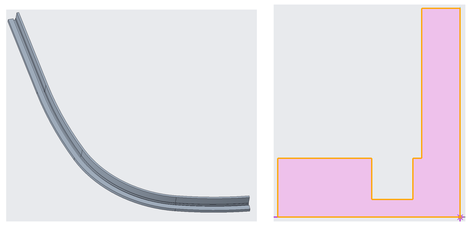
CONCEPTS

The team has decided early on that the selector knobs will be fed with the use of a vibratory feeder bowl. On the other hand, the zerk fittings, with their significantly small size, poses a challenge on how to feed and orient them properly. Early solutions include the utilization of a venturi feeder, and a rotating drum that only lets through properly oriented components.

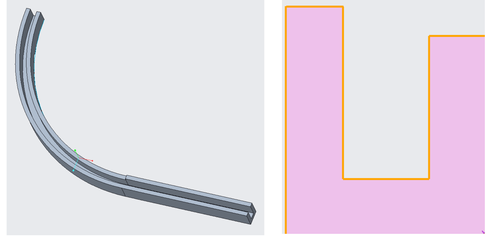
Ultimately, the team discovered during their first site visit that Snap-On has decommissioned feeder bowls that the team can use for the project. After testing to see if it could be a viable solution, the team decided on modifying the two feeder bowls to be utilized on the final design.

FINAL DESIGN, APPROACH, PLAN

- The final design is separated into three parts, the zerk fitting and selector knob vibratory bowls, and the pressing mechanism.
- Both bowls were designed for a different component. The team decided to retrofit both bowls with custom rails that will feed the components into the pressing mechanism.
- A step driver controlling a Nema –17 stepper motor
- Two sets of photoelectric sensors that enable the assembly process if both parts are detected.
- A UIF-5K LED Display with five push buttons to control the production process.

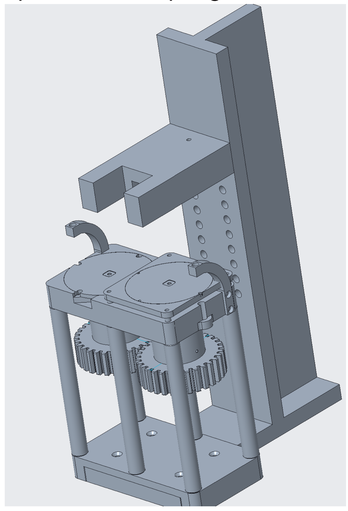


CAD model of the custom zerk feeder bowl rail (left); Cross-section of the zerk feeder bowl rail (right).



CAD model of the custom selector knob bowl rail (left); Cross-section of the selector knob feeder bowl rail (right).

- The pressing mechanism is mounted into a mounting equipment acquired from Snap-On, which is then fitted with several custom designed components.
- Said mechanism utilizes two rotating disks than rotate at the same rate, which then a pneumatic press presses down when the two components line up together.



CAD model of the pressing mechanism

RESULTS

- Both selector knob and zerk fitting feeder bowl custom rails successfully machined and welded to their respective feeder bowls.
- Both feeder bowls yielded favorable results, feeding parts at a consistent rate, but needs further refinement to further eliminate parts being fed in an incorrect orientation.
- Pressing mechanism was manufactured with a mix of 3D printed PLA and machined metal parts, which caused some fit and alignment issues.

An overhead view of the team's deliverable, with the selector knob feeder bowl on the left, and the zerk fitting feeder bowl on the right, converging towards the pressing mechanism at the center.

SUMMARY AND CONCLUSIONS

Each of the three subsystems were tested individually, in which these conclusions were observed:

- A fair amount of selector knobs move throughout the feeder bowl, but some weld material slightly interferes with the movement of the selector knobs in the rail.
- A small percentage of zerk fittings end up in the rails, which might cause production pauses.
- Vertical alignment issues were present at the spot where the rails on both sides meet the pressing mechanism, which causes feeding issues.

Overall, the final design is still a valid one. All of the issues that the team has observed can be solved through further refinement of the bowls, and slight dimensional adjustments.

FUTURE WORK

- The team plans to perform a test with all three subsystems integrated with each other to further determine the viability of the final design.
- Perform minute adjustments to prevent feeding issues from the feeder bowls.
- Further refine feeder bowl capabilities through modifications.

TEAM & ACKNOWLEDGEMENTS

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