DEPARTMENT OF MECHANICAL ENGINEERING

F5 Wrench Warmers

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Motivation, Goal, Impact

MOTIVATION

- Traditional fastening is time-consuming and requires the use of two separate tools.
- Fully electric torque tools that allow for precise torque are expensive, bulky, and often unnecessary

GOAL

- Develop a hybrid torque wrench that uses electric assistance for snugging and manual control for final torquing.

Target Audience:

➔ Professional Contractors, Technicians, and Mechanics

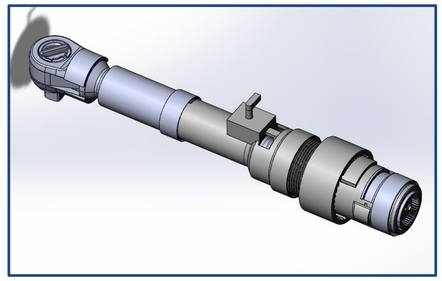
➔ Experienced Retail Consumer

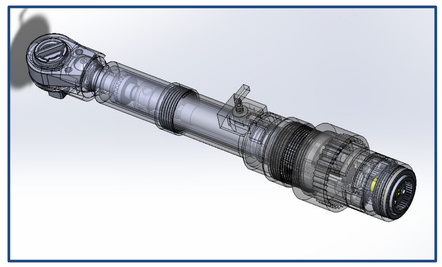
IMPACT

- Improved Efficiency, Ergonomics, and Safety

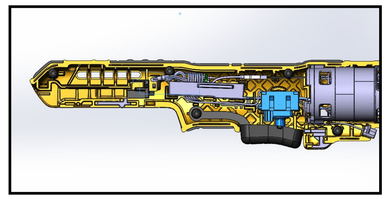
Requirements

- Use electric power for initial tightening
- Use mechanical power from manual work to alert user when fastener is at desired torque
- Must be able to manually tighten fastener with 100 ft-lb torque for a 3/8“ drive or 250 ft-lb for a ½” drive version
- Limit the head size to remain the same as the current open head ratchet design (1.5” diameter and 1.5” of height)
- Length of tool must be comparable to that of a torque wrench for ease on the user. The DeWalt DWMT75462 has a length of 27”. While our prototype is based off a 3/8” drive, we recognize that with both the technology of a torque wrench and a cordless ratchet, it will be more comparable to that of a ½” drive tool.

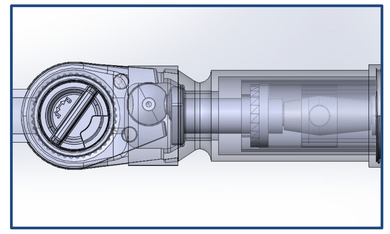




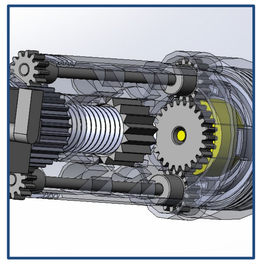
Final Design



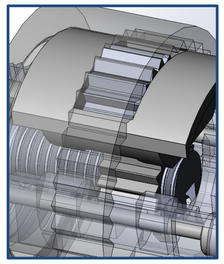
DeWalt DCF513 electric cordless ratchet handle is screwed onto bottom of prototype



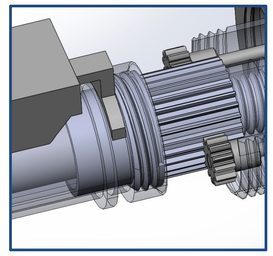
DeWalt DCF513 open head ratchet mechanism is used in prototype



Transmission shafts allow for click mechanism adjustment gap



Adjustment sleeve provides user with same feel as a standard torque wrench



Switch moves outer shaft back and forth, however, it always remains engaged with transmission shafts

Design Calculations & Decisions

DESIGN CALCULATIONS

➔ Spring for manual mode must exceed a k stiffness value of 115.4 lb/in

➔ One revolution of the threaded rod (5 TPI) adds 17.50 ft-lb of torque

➔ Electric torque output is able to achieve a calculated value of 89.7 ft-lbs

DESIGN DECISIONS

➔ Spring can be bought off-the-shelf/easily sourced for manufacturing

➔ 17.50 ft-lb of additional torque per thread is reasonable

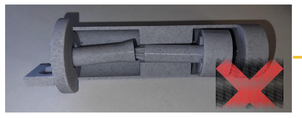
➔ Mechanical-Electrical Switch Mechanism designed to minimize friction on internal rotating components while secure enough to prevent it sliding.

➔ Sleeve bearings are used as opposed to ball bearings to keep a slim profile for the tool

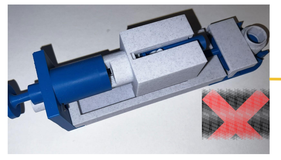
➔ Length of prototype is 2 feet and is comparable to that of DeWalt DWMT75462

Prototype & Test Results

Concept Prototyping Process



Disengaging shaft: Difficult to balance click mechanism with two springs and keep stable while transmitting torque.



Linear click mechanism: difficult to disengage pawls + novel idea would make product development difficult.

Internal mechanism: Utilizes proven concepts which DeWalt is familiar with. High fidelity prototype development integrated DeWalt open-head cordless ratchet parts for the drive of the transmission and torque wrench parts for the internal click mechanism (seen in Final Design).

RPM Testing:

- RPM at planetary gearset - 9217 RPM

- RPM at ball joint of original design - 7834 RPM

- RPM at ball joint with prototyped attachment - 1151 RPM

On our high fidelity prototype we tested the speed output utilizing a stroboscope. We noted the higher speed coming from the planetary gearset attached to the motor pinion compared to the ball joints on the DCF513 and the prototype. We recognize that our tool has a lower speed than the DCF513 due to the gear reduction associated with the transmission shafts as opposed to simply a metal shaft..