

# Engr 482: Senior Design Clinic

## Team Members:

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## Project Advisor:

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## Project Sponsors: Graco

Mark King



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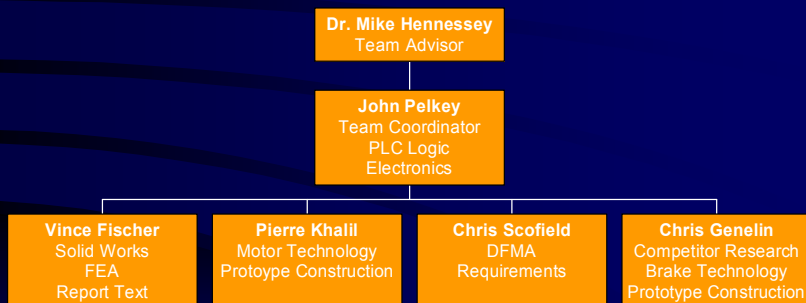
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## Problem Statement

- “Develop a new product to manage dispense hose for automotive service.”  
- Graco
- Graco produces state of the art fluid-handling equipment



## Team Member Assignments



## Hose Reel Design Requirements

- Unique/Marketable Design
- New Technology/State of the Art
- Accommodate up to two service bays
- 3-5 hoses per bank
- Dispense a variety of fluids
- Withstand internal fluid pressures of 250-8000 psi
- Accommodate various hose diameters and lengths
- Use standard male pipe threads
- Easily operated
- Safe

## Main Problems With Existing Reel Designs



- **Ratcheting device**
- **Force required for hose pull-out/retraction (45lbs)**
- **Number of parts & fasteners (88)**
- **Competitive Cost** (Leading competitor model \$13 cheaper)

## Concept Selection

- Automate reel using hose mounted RF controls
- Maintain current foot print
- Integrate Motor
  1. Electromagnets
  2. Outer Turning Motor
  3. DC Motor

## Concept Selection

- These concepts address the existing reel's 2 main problems = Spring force and Ratchet
- Make overall use of the reel quicker
- Focuses on our main customer = the bank of reels used quickly and repeatedly (ex. Lube shops)



## Prototype I: Electromagnetic Reel



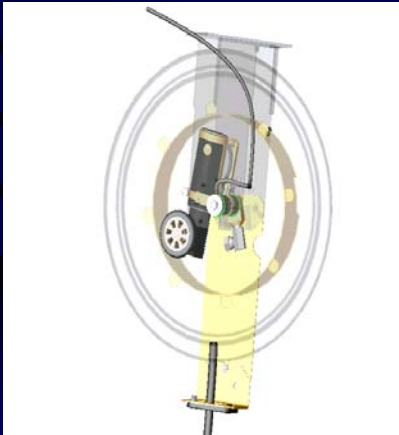
- Outside of the reel is lined with alternating pole magnets
- Two powerful electromagnets ratchet the reel in either direction
- Never been done (patent)
- Negatives :
  1. High cost
  2. Magnets pulling power is a very limited space
  3. Will not work during power outages

## Prototype II: Outer-Turning Motor



- Integrate an outer-turning motor into the reel
- Significantly reduce parts and assembly time
- We used a ceiling fan motor for our prototype
- Single-phase A/C permanent magnet motor
- Dynamic braking
- No torque
- Motor to meet specifications too expensive

## Prototype III: DC Permanent Magnet Motor



- Mount a high torque electric motor inside the reel itself
- DC permanent magnet gives full starting torque and relative small sizes
- Gearbox used to obtain the desired speed, torque, and drag requirements
- RF Controlled
- Dynamic braking

## Electric Motor Prototype

### Benefits

- Less pull out force (Spring)
- Instantaneous brake (Ratchet)
- Base platform unchanged
- Unique configuration

### Drawbacks

- Cost
- Possible maintenance
- Will not rewind during power failures

## Calculated Motor Specifications

- DC Permanent Magnet Motor
- Full Startup Torque
- Dynamic Braking
- Readily Available
- Small Size
- Constant Speed
- Calculations
  - .1817 HP
  - 3600 oz inch Torque
  - 50.9 RPM
  - 20 % Duty Cycle
  - 10" x 4" Dimension

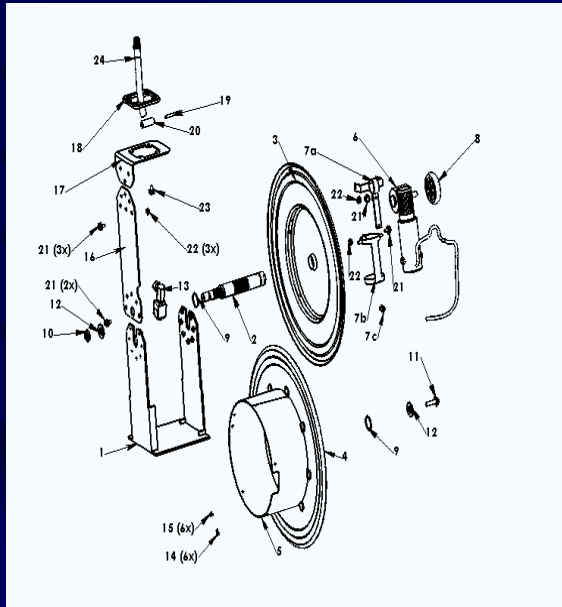
## Actual Motor Specifications



- 746 Right-Angle DC Permanent Magnet Brush
- Bison Gear
- 1/15 Hp
- .77 Amps
- 10:1 Gearbox (Worm Gear Driven)
- 90V = 180 RPM, 15 in-lbs torque
- 15 in-lbs Drag Force

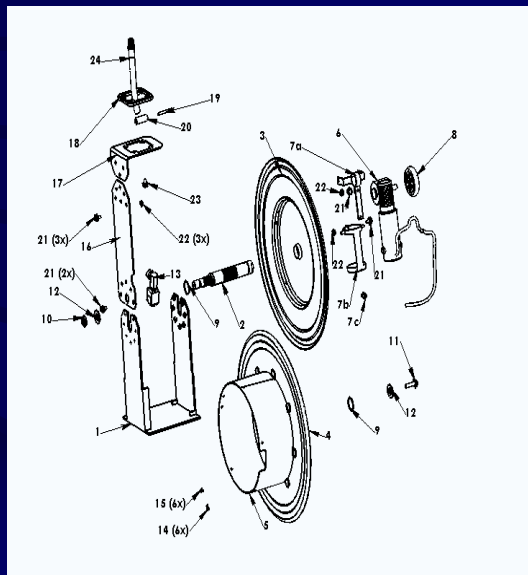
## DFA Sub Assembly

- Arm
  - 107.7 sec
  - 21 Parts
- Motor Mount
  - 45.65 sec
  - 7 Parts
- Axle
  - 142.55 sec
  - 19 Parts
- Base Mount
  - 71.9 sec
  - 8 Parts



## DFA Conclusions

- 55 Parts (88 Original)
- 15 Additional parts potentially eliminated
  - Hose roller assembly
  - Arm Assembly
- Assembly Time = 6 min. and 7 sec.





## Demonstration and Performance

- Problems
  - Drum out of round
  - Drum 2 pieces
- Drag Force
- Wind Force



## Design Conclusions

- Smaller, less expensive motor possible
- Different power drive
  - Chain and Sprocket
  - Internal and Spur Gear
  - Belt and Pulley
- Develop single controller to control one bank of reels

## Course Conclusions

- Order parts early (estimate if necessary)
- Clearly define what you are attempting to solve
- Clearly define how you are going to solve it (so the entire team is on the same page)
- Define roles and a leader early in the process

## Acknowledgements

- We would like to thank the following, for their guidance, assistance, or other input:
  - Mark King, Ken Krieter, Dave Lorden, Steve Knop, Lamonte Auch and the rest of the Graco team
  - Mike Hennessey, Jeff Jalkio, Chris Greene, Dick Welch from University of St Thomas
  - Nick Curtis from Great Fan in Eagan

# Questions