CHAPTER 10
SAN DIEGO STATE UNIVERSITY

Department of Mechanical Engineering
San Diego State University
5500 Campanile Drive
San Diego, CA 92182-1323

Principal Investigators:

Michael A. Lambert, Ph.D., Asst. Prof.

Karen May-Newman, Ph.D., Assoc. Prof. and Chair

CENTER PEDESTAL GRINDER WITH PIVOTING BASE FOR RACING SAILBOAT

Designers: Guillermo Navarro, Israel Valero and Miguel Santoyo
Supervisors: Peter C. Newman, and Dr. Karen May-Newman
Department of Mechanical Engineering and Rehabilitation Technology Program
San Diego State University
San Diego, CA 92182-1323

INTRODUCTION

Winches are used on sailboats for hauling in and tensioning a variety of sail handling and control lines. Traditional winches have a crank handle mounted directly to the vertical axis of the drum. This configuration requires substantial trunk and lower body strength to power the lateral motions required of the handle. This motion can pose ergonomic challenges for able-bodied sailors and can be impossible for individuals with physical disabilities or limitations in lower body strength.

An improved device provides a pair of cranks rotating about a horizontal axis, using an opposing motion characteristic of bicycle pedaling. This configuration, referred to as a pedestal or "coffee grinder," is commonly found on larger sailboats. Larger sails lead to higher control line tensions, and larger crews allow some crew members to be dedicated primarily to winch grinding. Gearboxes mounted under the deck provide multiple speeds, and allow the power to be directed to different winch drums.

The goal of this project was to design a mechanical interface with a commercially available pedestal winch that could be rotated for use by a crew member sitting on either the port or starboard side of the cockpit of a 40' racing boat. The pedestal mates with a commercially available gearbox and drive shaft components mounted below the deck.

SUMMARY OF IMPACT

The center pedestal grinder provides a method for crew members with limited lower or upper body strength and mobility to raise and adjust the sails of a boat. The center pedestal allows crew members seated in specially designed seats on the track and trolley system (designed by a different student team) to work a variety of winches from a single position.

TECHNICAL DESCRIPTION

The center pedestal winch grinder employs the coffee grinding mechanism, which is mounted in the center of the boat's cockpit and connected to winches on either side of the boat. The pedestal grinder is a common device in larger racing sailboats, and is typically operated with both hands while the user is in a standing or crouching position. The new design enables crew members in a seated position to effectively grind with a powerful, bicycle-like hand motion at chest level (see Figure 10.1).

Several design alternatives were considered before the team decided to adapt an existing commercial pedestal system. A belt drive pedestal from Harken served as the starting point, with the company's representatives providing much help in securing the proper drive elements. Stock parts were chosen for the upper portion of the pedestal, including the hand crank assembly, bearings, pulleys, and toothed drive belt.

A pivoting base assembly was designed to support the modified pedestal at the desired position and interface with the standard below-deck drive components. This assembly transfers the drive power from the pivot to the output shaft. This base includes a quick-release position lock accessible to the user, and also holds a flange to mount the device to the deck. Prototype assembly as well as patent disclosure filings are currently in progress.

The total cost was $3500, including $2844 for the pedestal winch and $656 for materials and supplies.

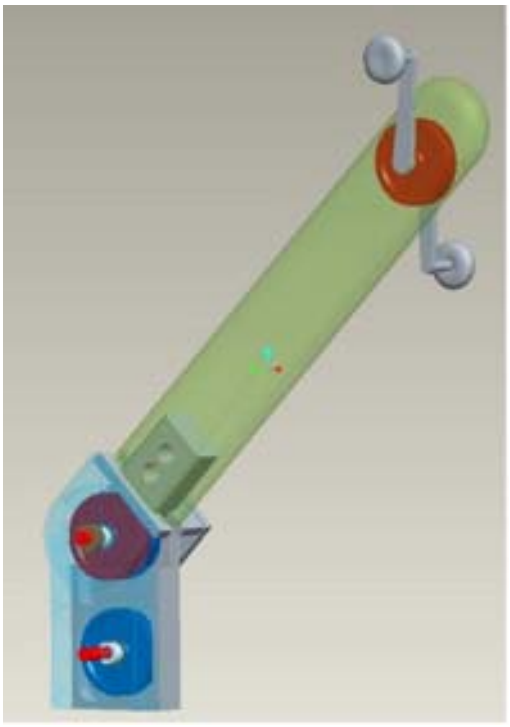

Figure 10.1. Diagram of Center Pedestal Grinder with Pivoting Base

TRACK AND TROLLEY FOR RACING SAILBOAT COCKPIT CREW SEATS

Designers: Michael Romano, Fervin Callo, Philip Yoakem, Chris Aramburo, and Jonny Lam
Supervisors: Peter C. Newman and Dr. Karen May-Newman
Department of Mechanical Engineering
San Diego State University
San Diego, CA 92182-1323

INTRODUCTION

A system was designed to shuttle racing team crew members with quadriplegia or paraplegia around a circuit to each watch station in the cockpit. The stations include the port and starboard jib sheeting winches, the port and starboard mainsheet trimmers, the navigator station, and the helm position. The existing will be mounted onto rolling trolleys seats (see Figure 10.2 A and B). A full-scale mock-up of the cockpit and aft decking has been constructed to test, evaluate, and modify the device before installation on the racing boat. The mock-up is capable of being tilted to simulate maximum expected "heel," or roll angle, while sailing "close hauled" (as far into the wind as possible). The goal of the new design was to reduce the weight, profile, and obstruction of the track and trolley system developed last year.

SUMMARY OF IMPACT

The design will improve the safety and mobility of crew members with limited leg and lower trunk strength. The complete track and trolley system will allow individuals who have paraplegia and quadriplegia to move from one watch station to another without leaving their seats. This innovation will increase safety and comfort for the crew.

During rough weather, there is the possibility that a crewman will be injured or even hurled overboard while changing positions. The new system will reduce this possibility. The only time a crew member will be out of his or her seat will be when he or she is moving from the cabin to the companionway and into a seat immediately adjacent to the companionway, or returning to the cabin.

TECHNICAL DESCRIPTION

The new design represents a different approach from last year's design. The team combined commercially-available components from Bishop Wisecarver (Aurora, CA) with parts the team designed to create a single-track, dual-trolley system. The track is made from stainless steel with hardened edges that fit to v-groove wheels on the trolley. The track is capable of making a 90-degree turn with a radius of curvature of 9 inches, which is sufficient to provide clearance from the hardware on the boat. The single rail system provides less interference and the low profile reduces the risk of a tripping hazard, enabling an ambulatory crew member to sit on the adjacent deck. The aluminum trolley has four independent v-groove wheels that roll smoothly on the track, handle substantial vertical and horizontal loads, and can turn corners easily without the use of bogeys. The trolley profile is more than one cm lower than the previous design. Torques about the guide are supported by wheels mounted to the seat base plate.

The seat plates are attached to the trolley with a carriage plate and a 5/16" hex bolt with an aluminum spacer to create clearance between the carriages. Two spherical bearings are used to distribute the coupling loads on the carriage and are housed by retainers that attach under the bottom seat plate. The seat plates can rotate about the vertical axis on a pivot and have support wheels in front and back. Three new seats were made following a previous design that incorporated a backpack-style frame with padded waist and shoulder belts and a sling-bottom seat positioned over the seat plates and attached with stainless fasteners. The entire assembly rolls smoothly over the deck surface and will allow a crew member to sit comfortably for several hours.

The new design for the track and trolley system is a single-track, dual-trolley system that is light and has a low profile allowing both ambulatory and non-ambulatory crew members to work side-by-side on the boat deck. Total cost was $6280.

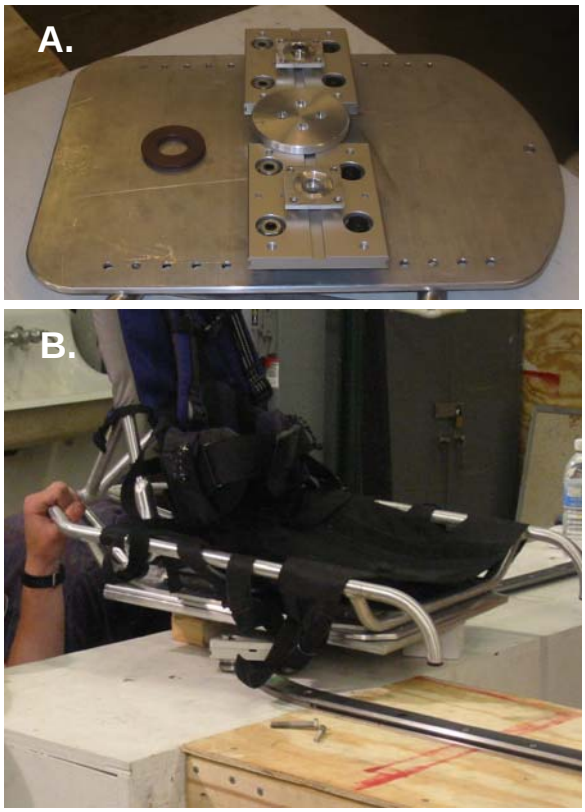

Figure 10.2. A. Seat Plate and Trolley Sliding along Curved Track Section. B. Seat Assembled to Trolley.