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Dual Knife Rotary Sheeter Redesign

Overview:

MAXSON AUTOMATIC MACHINERY COMPANY is a Westerly RI based capital equipment manufacturer that designs, machines, assembles and services rotary cutters and sheet handling systems (known as sheeters) for the Paper, Converting and Printing Industries.

MAXSON would like to work with a team of URI engineering students to develop an alternative, lower cost sheeter that can deliver higher speeds while maintaining sheet length accuracy. The core of a sheeter is the cutter section, which is comprised of a draw drum section that pulls the web from roll stand and a dual knife rotary cutter that cuts the web to a preset length.

The electrical design of a dual knife rotary cutter requires a sophisticated drive program. To insure a clean, dust free cut the peripheral speed of the cross cutting knives needs to match the speed of the web at time of the cut. To accomplish the demand of speed match during the time of cut, the rotational speed of the cylinders 'cycle' during each revolution.

A motor is coupled to one of the knife revolvers. The motor (and thus the drive) need to be sized to control the inertia of the mechanical cutter assembly following the line speed of the draw drive and matching the rotational speed requirements to insure a clean, accurate cut.

The present cutter design package includes a draw motor and drive, a knife motor and drive, power supply, firmware, cabling and other components. The package cost \$36,400, which includes a \$17,500 knife motor.

Mechanically the cutting section's inertia determines the size of the knife motor and drive. A review of how to reduce the knife inertia without impacting performance needs to be undertaken. One method of reducing inertia would be to introduce a reduction between the cutter and a motor. This alternative would require a redesign of the cutter drive train and could result in lower horsepower requirements.

Electrically, a new cutter drive would require component selection and programming to insure that appropriate motion control is maintained for maximum line speed and length accuracy. Other sheeter drives would have to be integrated into the plan as well as a logic control design and a Human Machine Interface (HMI). The recommendation of a vendor platform, the drive, logic control and HMI programming and the testing of the design is within the scope of the project.

Videos of the current cutting system can be found here:

<https://www.dropbox.com/sh/16dxblr5e877xt4/AABdp0j2cz3cZJZai41aP46ua?dl=0>

Team Description:

One Electrical Engineer, One Computer Engineer, Three mechanical engineers provided by ME dept.

Members of the team must have the ability to work as a team, take initiative, accurately calculate engineering application problems, solicit timely information and pricing from vendors, program systems as required and develop documentation packages to include detail drawings, assembly drawings, program and electrical logic schematics and bills of material.

The Mechanical Engineers will require machine design and strength of material experience and use AutoCAD software to create a documentation package. The Electrical Engineer will need to have knowledge of AC drives and motors as it relates to motion control of rotating components and ability to program logic control of a high speed cutter and sheet handling system. In addition to working with a vendor's programming software, the Electrical Engineer will provide schematics in AutoCAD format. The Computer Engineer will use C, C++, JAVA programming to create a Human Machine Interface (HMI) that (s)he will be responsible for selecting and that is compatible with the drive and logic controller selected by the Electrical Engineer. The Computer Engineer will document designs in AutoCAD format.

Deliverables:

- Detailed mechanical calculations, part drawings, assembly drawings and bill of materials for dual knife rotary cutter design (under the guidance of MAXSON Engineering)
- Specification and selection of drives, motors, logic controller and HMI based on performance, price and after sales service capability
- Programming of drives, motors, logic controllers and HMI including schematics and bill of materials.
- Test results of recommendations on a dual knife rotary cutter

Division of Labor:Mechanical Engineering Team (Redesign of Knife Revolver and Mechanical Reduction)

A team of three URI Mechanical Engineering students will be provided from the ME department in order to modify the current system to accommodate the new components.

Electrical Engineer 1 (Drive Application and Logic Control)

This Engineer's primary responsibilities are to develop a cost effective drive package that will address the cutter's draw and knife drives, as well as other peripheral drives (slitter, high speed tape, slow speed tape, automatic off loading shuttle) based on the specifications supplied by the Mechanical Engineer and a controller package that will reflect a master logic control for a sheeter operation. The logic control programming will be based on a comprehensive list of basic and optional components that can be incorporated into the sheeter design as identified by MAXSON' Sales Department. For Customer Service purposes, the drive and logic control will possess the capability to be monitored and programmed from a remote location. Working with electrical drive and logic control suppliers, the Electrical Engineer will recommend a vendor, develop a bill of materials and program the drives and logic control to be tested on a cutter platform.

Computer Engineer (Logic Control and HMI Programming)

This Engineer's primary responsibilities are to work with the Electrical Engineer to assist in the programming of the master logic control layout, select and program a Human Machine Interface (HMI) that will govern the drives and logic control of the sheeter. The HMI program will require an intuitive graphic display of sheeter operations, inputs and fault annunciations. Further the HMI program will need to be Windows based, allow the Customer to monitor and down load production and quality metrics and permit the capability of monitoring and programming form a remote location.

Any questions regarding the project can be sent to:

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