Automated Regulator Conveyor System
Team Air Liquide
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Project Scope
This project will automate the feed for the flow setting process. Automating the feed will free up the operator for a significant period of time resulting in higher yield and an increase in plant productivity. An automated feed will be ready for installation upon project completion.

Current Layout
- Regulator Assembly
- Flow Rate is Set
- Regulator Tested

- 3 operators
- 5 steps
- 4-12 sec per step
- Complete Assembly in 48 seconds

Project Goal: Eliminate Flow Setting Operator by Automating Feed of Flow Setting Machine

Constraints
- Safety – System must safe for all operators, including emergency stops
- Ability to be incorporated in future designs
- Manufacturability- all parts must either be off the shelf or easily made in a machine shop

Concept Selection

Wants
- Automated Feed
- Easily Repairable
- Speed
- Compatibility

Metrics
- Level of Human Involvement
- Accessibility
- Cycle Time
- Adaptability

Concepts
- Drop in/out
- Rotary Feed
- Linear Feed

Final Concept
- Linear Feed

Detailed Design

Linear Feed
- 2 parallel chains, to resist twisting
- Gear motor to drive chains- 1/8 hp, 14 rpm
- Light Sensors indicate when regulator is in setting position or about to fall of table
- PLC programmed to communicate with sensors, and stop/start motor as needed

Regulator Holder
Bracket- 1021 Aluminum, ¼” thick cut to shape on CNC mill
Holder- High density 1.625” PVC tubing, cut to shape with lathe and drilled out

Flow Setting Machine and Production Issues
- Operator watches each regulator being set, wasting 40 to 50 seconds per regulator.
- Regulators are made in batches of 5 to 100, which leads to unnecessary rework as errors are detected after entire batch has finished the flow setting process.

Flow Setter
- Operator watches each regulator being set, wasting 40 to 50 seconds per regulator.

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Design Prototype

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Proof of Concept

Von Mises Stress
Max stress 4.23 x 10^7 N/m²

Motor Life:
Motor rated to last 10,000 hours
In production motor will run approx 1 hours/day
Motor will last over 30 years with the plant operating 8 hours a day, 5 days a week

Validation

<table>
<thead>
<tr>
<th>Test</th>
<th>Process</th>
<th>Goal</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety</td>
<td>With motor running, recorded</td>
<td>1 sec</td>
<td>&lt;1 sec</td>
</tr>
<tr>
<td></td>
<td>time for system to stop after</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Opening safety door -</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Pressing emergency stop</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>Run system and record the</td>
<td>95%</td>
<td>96.7%</td>
</tr>
<tr>
<td></td>
<td>regulator position while being set</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human Involvement</td>
<td>Record time to load and</td>
<td>4 sec</td>
<td>2.8 sec</td>
</tr>
<tr>
<td></td>
<td>unload regulators</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Implementation
- Make needed alterations to the flow setting machine
- Code flow setting machine’s PLC to communicate with conveyor system PLC
- Install conveyor system in plant
- Train operators to use new machines