Design and Development of an End-of-Arm Tooling: The Design

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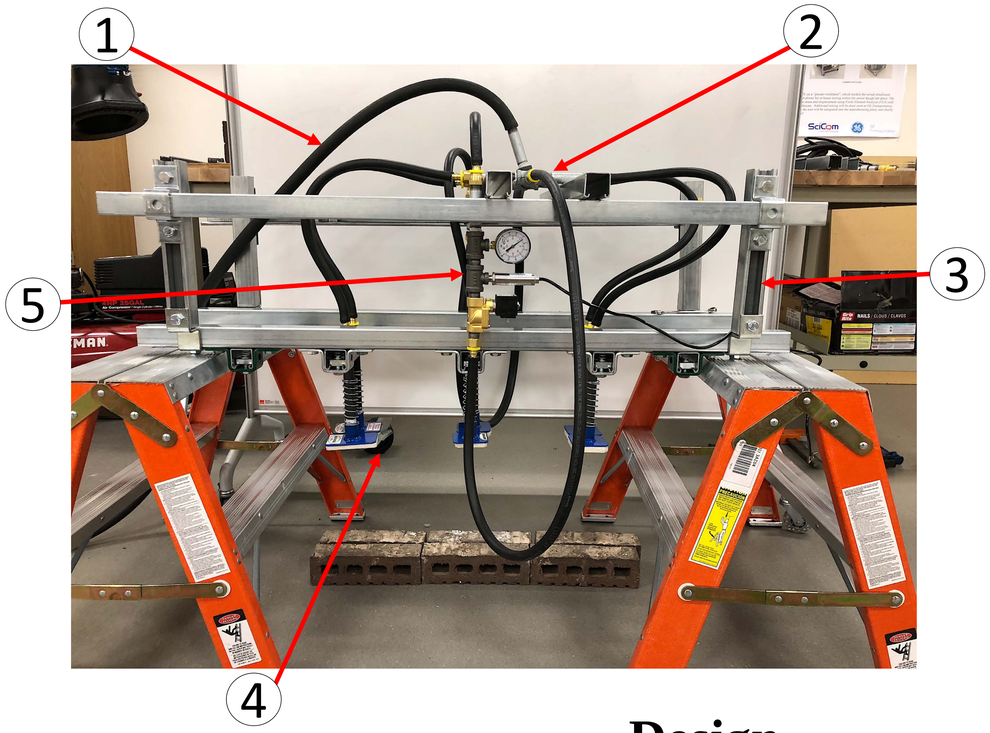
Abstract

The purpose of this project is to design an end of arm attachment in order to automate the removal of bricks from the kiln cars. This project is being made for ACME brick company. It is intended to serve as a replacement to manual labor they are currently using. There are a few challenges we have designed for when building the system. The bricks can become displaced once fired and occasionally one will be missing. Our design is utilizing vacuum technology connected to multiple foam heads that will interface with the bricks. Springs are attached above the heads in order to account for variability. Each foam head is equipped with a sensor to recognize if a brick is missing so it can close off to maintain pressure.

Background

ACME brick has been involved in the brick manufacturing business for over 100 years. They make almost every type of brick and have had a hand in building almost all of Fort Worth, including TCU's campus. They have almost 20 manufacturing plants across America, and sales offices in 10 different states. The main problem they have and need our help with is removing bricks from a big stack, called a kiln hack, after they have been fired and cooled. They use countless workers that are going non-stop to unload these bricks for the next step, the inspection phase. For years, they have looked into different solutions for unloading bricks including vacuum pumps, assisted grippers, and other types of automated systems. They needed a new idea, or system, that could help solve their de-hacking problem.



Legend

1.Hose to Vacuum
2.Centralized point for hose
3.Metal Structure
4.Foam Heads
5.PLC valves

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The goal of this project is to design and prototype a system that picks up, moves, and releases bricks. This is accomplished through a metal structure supporting foam heads acting as an interface between the bricks. These foam heads are connected to a vacuum system to provide suction in order to successfully pick up the bricks safely.

Engineering

Design

The Pave Mor Design® consists of 6 individual heads attached to a metal structure that are designed to pick up 6 bricks at once. Each head is made up of 2"x 3" of aluminum with a female hole drilled in the middle and a ½" thick rectangular of foam placed on the bottom. This foam has a cut out in the middle of the head where the female hole is drilled through the aluminum in order for the foam to create a seal on top of the brick. Each head is placed according to a 9x3 kiln hack where there is the highest chance of hitting the brick and creating a clean seal. Each head is attached to a metal pipe that has a spring above it which allows the head to move freely up and down. This is done to allow for different heights in the bricks on the hack. From the metal pipe, there is a hose that attaches to the structure. All 6 heads are then attached to a centralized pipe system where a single hose is attached to the vacuum. On 2 of heads, there is a solenoid valve and gages. The gages and valves talk to the plc to let the system know if there is a brick missing. This allows the solenoid valve to close and allow the rest of the system to pick up the bricks.

Design and Development of an End-of-Arm Tooling: Automation of Brick De-Hacking

By: TCU Engineering Senior Design 2018 – ACME Brick
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Background

The objective of this project is to design and prototype an automated end-of-arm tool for the de-hacking of bricks. The reasoning behind this is to improve workplace conditions by reducing worker turnover rate and injuries. As a part of the scope of this work, the control of the tool will be an automated process.

Abstract

The programmable logic controller (PLC) is used to control the automated process of the project. Through its own logic program, the code enables the PLC user to turn on and off the vacuum supply though a connected monitor display. The PLC then collects data from vacuum transmitters, which is filtered through a control loop, and can stop the flow of air to individual heads or the entire system if the measurements are below a designated threshold. The display monitor allows the user to readily access the values received by the PLC. As a precautionary protocol, there is an embedded system override that shuts down power to the vacuum.

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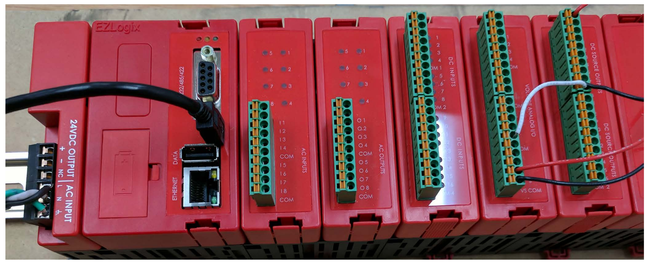
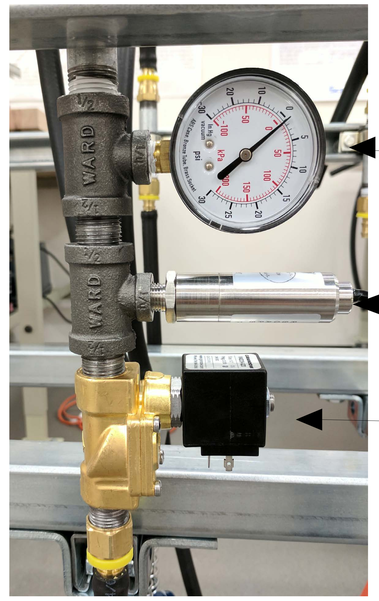
The goal of this project is to design and prototype an automated system that picks up, moves, and releases bricks. The automation is accomplished through the use of a programmable logic controller that interfaces with electronic vacuum gauges, valves, and a display. The gauge signals tell the controller to turn on or off valves based on the programed logic. The display allows the user to monitor the measurements.

Engineering



PLC

Monitor Display

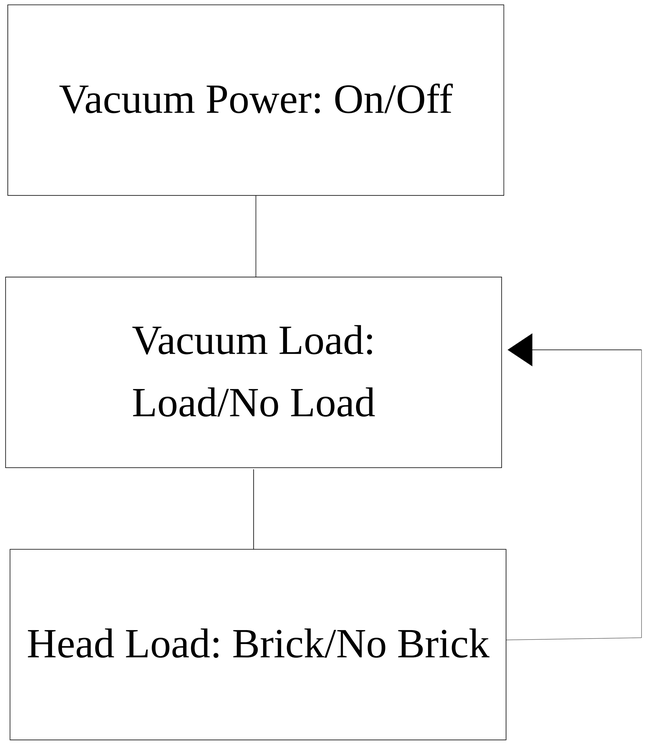


Vacuum Gauge

Vacuum Transmitter

Solenoid Valve

Head Setup



Process Steps

The user will turn the vacuum on or off using the monitor.

The signals from all transmitters determine whether to continue loading the vacuum.

A vacuum transmitter detects for the presence of a brick at each head and sends a signal to the PLC.