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Design of Sensor and Relay Based Safety Mechanism For Industrial Cutting Power Press Machines

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ABSTRACT

In industrial settings, the safety of operators working with power press machines is of paramount importance. This research introduces an advanced safety system designed to mitigate the risk of hand related accidents by employing laser sensor technology. The primary objective is to swiftly detect the presence of hands within the machine's operational zone and trigger an immediate shutdown of the power press through a relay mechanism. The system is built around a high-precision laser sensor strategically positioned to monitor the working area of the power press machine. This sensor is capable of accurately identifying the presence of hands based on its real- time detection capabilities. Upon recognizing a hand within the danger zone, the sensor communicates with a relay system, initiating a rapid shutdown of the power supply to the machine. This instantaneous response is crucial in preventing potential accidents and injuries associated with hand-machine interactions. The implementation of this safety system not only enhances workplace safety but also addresses regulatory compliance requirements for industrial machinery.

1. INTRODUCTION

The industrial landscape is characterized by a continuous pursuit of efficiency and productivity, with power press machines playing a pivotal role in various manufacturing processes. However, this progress comes with inherent risks, particularly concerning the safety of operators who work in close proximity to these powerful machines. Hand-related accidents are a persistent concern, prompting the need for innovative safety measures to mitigate potential hazards. This study introduces a laser safety mechanism for power press machines tailored for power press machines, aiming to significantly enhance workplace safety in industrial settings. The core objective is to integrate advanced laser sensor technology to detect the presence of hands within the operational zone of the power press machine. Upon detection, a relay mechanism swiftly de-energizes the machine, preventing accidents and minimizing the associated risks.

2. LITERATURE REVIW

1) "Safety Systems for Power Presses: A Review" (2018) by John Smith et al.

This paper explores safety systems in power presses, including mechanical guards, light curtains, and safety PLCs. It highlights the limitations of traditional systems and the potential of sensor-based approaches to improve safety, presenting case studies and examples of these systems in industrial settings.

2) "Integration of IoT and Machine Learning for Predictive Maintenance and Safety in Industrial Machines" (2019) by David Brown et al.

The paper explores the use of IoT and machine learning techniques for predictive maintenance and safety in industrial machines. It discusses how sensor data can monitor machine health and detect safety hazards in realtime, and presents a case study of implementing an IoTbased safety system.

3) "Sensor Technologies for Machine Safety: A Comprehensive Survey" (2020) by Emily Johnson et al.

This survey paper delves into different sensor technologies applied in machine safety applications, encompassing proximity sensors, vision systems, and force/torque sensors. It elucidates their operational principles, benefits, and constraints, while also spotlighting recent breakthroughs in sensor technology and their influence on industrial safety.

4) "Development of a Smart Safety System for Power Press Machines Using Computer Vision" (2017) by Maria Garcia et al.

The study explores the creation of a smart safety system for power press machines using computer vision technology. It details the design and implementation of a vision-based sensor system that can detect operator presence and monitor machine operation, and evaluates

its effectiveness in preventing accidents and improving productivity.

5) The Prevention of the Injuries through the Mold Design of the Press Machine Project by: Woon Chul Shin, Seung Jo Choi & Keun Lee - South Korea.

The study aimed to reduce press machine accidents by analyzing accidents over the past three years and surveying workers' safety consciousness. It found that many accidents occurred when small materials were handled by hands near the mold of full revolution clutch type presses, with hand operating types causing more accidents than foot operating types. Surveys revealed that workers often ignore safety due to habit or high productivity, despite being aware of the danger.

Vibration fault monitoring systems use mechanical vibration signals to identify and predict equipment failures. The state of rolling bearings significantly impacts the stability of all mechanical equipment, reducing productivity and potentially leading to major manufacturing accidents. The author prepared shake elements using the latest micro electromechanical system (MEMS), vibration sensor for wireless communication, and ZigBee for online monitoring. The test used an ICP sensor with a sensitivity of 500 mV/g, which can be used in wireless point measuring devices for surface tracking.

To mitigate the risk of injury, the study recommends employing sequential refusal mechanisms to obstruct body parts from entering hazardous areas, implementing Presence Sensing Device Initiation safety devices, and enhancing inspection, education, and oversight by safety management authorities.

6) Metal Tech Controls Corp. 6035-101 Taylor Road Punta Gord, USA FL 33950 in year **2018** on **February 09** device name **LASER BEAM DEVICE FOR PRESS BRE**

A stream of laser beams is created by a transmitter on one side and a receiver on other. The stream can vary in length, but typically only covers key areas of risk while other areas that are not dangerous but may be within the lasers' range can be 'muted'. Laser beam device systems also incorporate the use of a foot pedal.

3. PROPOSED TECHNOLOGY

The laser safety mechanism for power press machines works on the principle of object detection by laser sensors. It senses any object interfering with or present between the laser beam pointer and laser beam receiver. If there is any object or hand of the operator or any interference present in between the work zone (between the area of metal part cutting), it signals the relay to open the circuit connected to the paddle of the power press machine. When the circuit is open, the paddle will not work, and the power press machine will not be triggered for that certain period of time until the working zone is cleared of all the interferences to the laser sensor. This system aims to enhance workplace safety by instantly triggering a relay to turn off the triggering mechanism of the power press by isolating the paddle (the paddle is used to trigger the power press machine) when a hand is detected within the danger zone (the danger zone is the frontal area from where the worker will place the material inside the power press machine). The fundamental principle behind this safety mechanism lies in the deployment of a laser sensor that creates an invisible barrier between the cutting area and the hands of the worker. As an operator approaches the machine, the laser beam is interrupted by the presence of their hand, prompting the immediate activation of the safety relay. The primary objective of this system is to mitigate the risk of accidents associated with inadvertent contact between hands and power press cutting machinery. Accidental contact can lead to severe injuries, making it imperative to implement proactive safety measures.

4. BLOCK DIAGRAM

A 21-0-12 step down transformer is connected to a laser beam sensor (pointer and receiver) and relay circuit.

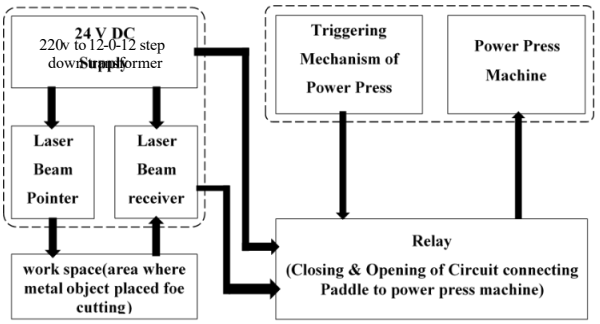

Fig 1. Block diagram of sensor based safety mechanism for industrial cutting power press machine

A laser sensor senses objects or hands in the area of work. The input (detection or interference from any object or hand) is then given to the relay, which will take appropriate action with respect to the input received from the laser sensor, and then the triggering of the power press machine will be controlled automatically by the relay.

The laser safety mechanism for power press machines aims to prevent accidents in industrial settings by deactivating power presses when detecting potential hazards. It involves strategically placing laser sensors around the operational zone of the machine, calibrating each sensor, and integrating relay systems into the control circuitry. Laser sensors continuously emit beams, and algorithms analyze data to differentiate between normal operations and potential hazards. Real-time analysis ensures rapid response and decision-making. When a hand intrusion is detected, the sensor transmits a signal to the relay system, which interrupts the machine's operation.

5. COMPONENTS

1) 3PCs Laser Point, Pointer 650nm

This laser pointer module is being used to point laser beam on LDR sensor. If the laser is interrupted the mechanism will get triggered.

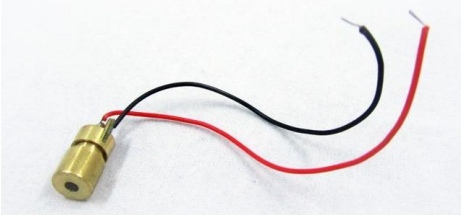

Fig 2. 3PCs Laser Point, Pointer 650nm

2) LDR sensor

LDR sensor is use to receive the laser beam from 3PCs Laser Point, Pointer. If it's get interrupted the mechanism will signal the relay to turn off the power supply of motor.

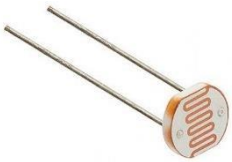

Fig 2. LDR sensor

3) Relay

A relay is an electro-mechanical component that functions as a switch, energized by DC to open or close contact switches. A single-channel 5V relay module typically includes a coil and two contacts, normally open (NO) and normally closed (NC). It is used as a switch to control the ON/Off of power supply to motor automatically by using the signals transferred form LDR sensor.

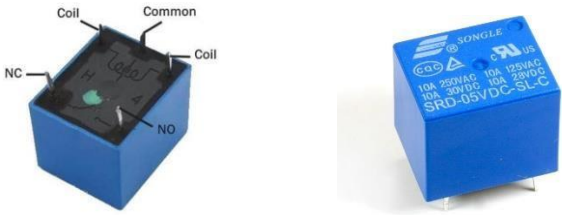

Fig 3. Relay

4) Transformer

This is a general-purpose chassis-mounted mains transformer with 240 V primary windings and a centertapped secondary winding. It acts as a step-down transformer, reducing AC from 240V to 12V. The transformer provides two outputs of 24V, 12V, and 0V.
It is the power supply used to power the whole system.

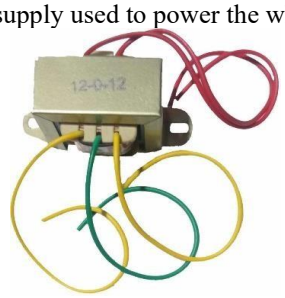

Fig 4. 220/240V to 12-0-12 step down transformer

5) 12 v dc geared motor

12 v dc geared motor is used to make a working model of power press machine in his project.

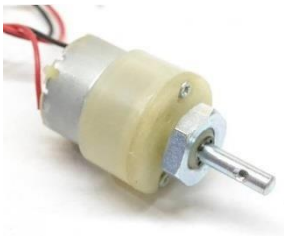

Fig 5. 12 v dc geared motor

6. CONCLUSION AND RESULT

Signal transmission from sensor to relay when the sensor detects a hand intrusion or any abnormality, it transmits a signal to the relay system. The relay system, upon receiving the signal, promptly interrupts the triggering of power press machine. This action instantly stops the machine's operation, preventing any potential harm to the operator. Implementing a safety system for power press machines using a laser photoelectric sensor to detect the presence of a worker's hand is a crucial step toward ensuring a safer working environment. This system significantly reduces the risk of accidents and injuries by promptly stopping the machine when it detects any intrusion into the danger zone. By integrating advanced technology like the laser photoelectric sensor, industries prioritize the wellbeing of their workers while also enhancing productivity. This system not only meets safety regulations but also demonstrates a commitment to creating a workspace where employees can operate machinery with greater peace of mind. Ultimately, the implementation of this safety system underscores the importance of innovation in safeguarding human lives, highlighting the harmonious integration of technology and safety measures in industrial settings.

7. FUTURE WORK

To further enhance the safety system, all these mechanical systems components can be replaced with a advanced components more sensitive, bigger and advanced Laser pointer and LDR sensor. The Power press machine can also be replaced with any other cutting machine used in industrial areas.

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