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Enhancing Operator Safety in Manufacturing: A Cost-Efficient Two-Hand Safety Device for Press Machines

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***Abstract*— Every operator's safety is a top priority in a manufacturing workplace, which is a crucial component of the sector. Industries that use high-power press machines frequently need training on how to operate equipment safely and perform correct press machine maintenance. Lack of safety precautions when using mechanical power presses is responsible for a significant portion of workplace amputations. This paper describes a press machine two-hand safety device that is cost-efficient, easy to implement with the usage of industry grade material and components.**

***Index Terms*— Hand Safety, Mechanical Power Press, Hand Injuries, Finger Amputation, Safety Measures**

I. INTRODUCTION

Safety is critical in any work setting, especially when dealing with potentially hazardous machinery such as power press machines [1]. A strong commitment to safety not only protects workers' health but also adds to overall operational efficiency and productivity [1]. Employers build a culture of trust and well-being among their workers by following to stringent safety measures, resulting in increased job satisfaction and morale. Prioritizing safety also minimizes the likelihood of accidents, injuries, and potential legal obligations, resulting in cheaper insurance costs and a healthier bottom line [2]. Finally, a safe workplace encourages an environment in which employees can focus on their responsibilities without constantly worrying about their safety, resulting in improved concentration, greater job performance, and a more harmonious and successful working environment [2].

Fig. 1: Finger Injuries due to press accidents

From 2007 to 2015, OSHA received 204 reports of incidents with mechanical power presses (mentioned in the table below), an average of roughly 23 per year. These incidences resulted in 388 injuries (an average of 43 per year), with finger amputations being the most common injury, accounting for 39% of all injuries during that time period [3]. Many workers or operators lose their fingers or hands as a result of such incidents and become disabled

Table.1: Mechanical Power Press Incidents and Injuries, 2007-2015 [3]

	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
Crush	17	5	6	14	12	10	6	9	6	85
Finger Amputation	29	10	16	19	26	24	9	10	10	153
Fingertip amputation	18	6	8	11	1	6	7	8	1	66
Fracture	3	3	8	0	1	2	5	3	1	26
Laceration	10	6	7	0	6	2	4	3	4	42
Other/ Unspecified	4	0	2	1	2	2	3	0	2	16
Total Injuries	81	30	47	45	48	46	34	33	24	388
Total Incidents	37	15	20	27	24	24	20	21	14	204

II. METHODOLOGY

1. Design and Proposed Solution

The proposed double hand safety device presents an innovative and effective solution to address the pressing concern of crush injuries and fractures that often occur during the operation of mechanical power presses or similar equipment. By integrating key components such as a microcontroller, a 24V/5A switch-mode power supply (SMPS), two no-contact push buttons, an LED indicator, and a buzzer, this safety device ensures a comprehensive and foolproof mechanism for safeguarding operators.

At the core of this ingenious concept lies a simple yet highly efficient principle: simultaneous and deliberate engagement of both hands by the operator is required within

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a 300ms time frame to initiate the operation of the press machine [4]. This critical time window is carefully chosen to maintain a balance between safety and operational efficiency. When the operator's hands press the two push buttons concurrently within this time limit, the microcontroller processes the input and triggers the press machine to operate. This design ensures that accidental or unintended button presses do not activate the machine, thereby minimizing the potential for mishaps.

Crucially, the double hand safety device operates with a fail-safe mechanism. As soon as the operator releases either of the push buttons, the press machine immediately halts its operation. This instantaneous response to hand removal is pivotal in preventing any delay in stopping the machine, further enhancing the safety of the operator. The incorporation of visual and auditory feedback through the LED indicator and buzzer ensures that operators are aware of the device's status, facilitating seamless and confident operation.

By mandating the engagement of both hands, the safety device effectively immobilizes the operator's hands away from the hazardous area, significantly reducing the risk of crush injuries and fractures to the fingers, hands, and arms. This design not only complies with the crucial safety standards of the manufacturing industry but also promotes a culture of responsible and secure equipment operation. The device's utilization of readily available industry-grade materials and components adds to its practicality and cost-effectiveness, making it a viable and accessible solution for a wide range of manufacturing settings.

2. Circuit Diagram

The below circuit diagram shows the power flow and working of the device. The S1 and S2 are GSMS 2 Push Buttons Green with 2 NO 2NC Three Phase. The R5F10268ASP#V0 microcontroller is used in this safety device, and it is programmed so that an operator must use both hands within 300ms to start the press machine. K1 is 24V DC DPDT Glass 8 Pin Relay. R1 and R2 are the resistors of 4.7KOhm.

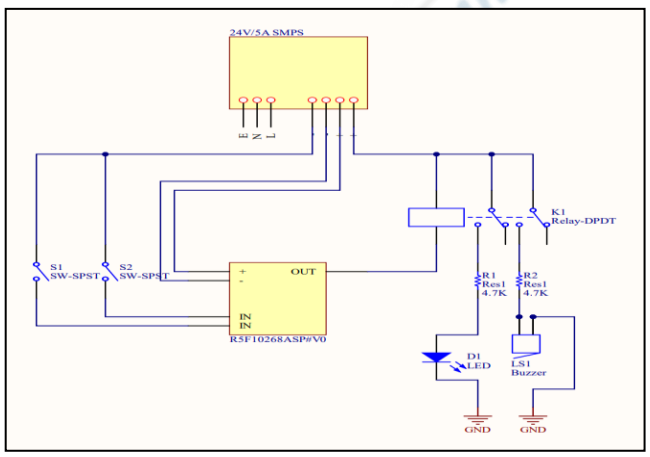

Fig. 2: Circuit Diagram

3. Hardware Design and Components

This safety device's electronics and hardware components are all of the highest quality. Yet, it is a cost-effective device because the overall cost of the entire device is around $50, which is low when compared to other products on the market. Below is the table which contains the electronic components along with its specifications.

Table.2: Electronics components and its specifications

Sr. No.	Electronic Components	Specification
1.	Microcontroller - R5F10268ASP#V0	Number of I/Os: 18 I/O Data RAM Size: 768 B Supply Voltage - Min: 1.8 V Supply Voltage - Max: 5.5 V
2.	GSMS 2 Push Green Buttons	2 NO 2NC Three Phase
3.	SMPS	24V/5A
4.	24V DC DPDT Relay 8 Pin	220 / 250V AC 5A GLASS RELAY
5.	MB27A - 24V Piezo Buzzer	-
6.	10mm LED (Green, Red) with metal holder	-
7.	Resistor (4.7k), diode (1N4007 - 1A General Purpose rectifier Diode)	R = 4.7K Ohm
8.	HDPE (High Density Polyethylene) Plastic Sheet	Green Color
9.	Plastic Enclosure box	

4. Working demo of the Device

a) When AC Power is ON and Push buttons are not pressed:

The power press machine will not work in this case as operator is not pressing the push buttons.

b) When AC Power is ON and Push buttons are pressed simultaneously:

The press machine will start working as both hands of operator are engaged for pressing the buttons. Green LED indication means press machine is working.

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c) When AC Power is ON and either of two button is pressed:

If operator presses either of the buttons then press will not start. If he or she presses one button first then the second one still it will not work. Operator must press the buttons simultaneously to start the press machine.

III. CONCLUSION

In conclusion, the proposed double hand safety device represents a substantial leap forward in preventing crush injuries and fractures during the operation of mechanical power presses. Its incorporation of advanced technology, intuitive design, fail-safe mechanisms, and real-time feedback ensures both the safety and operational efficiency of manufacturing workplaces. By compelling operators to engage both hands before initiating machine operation, this device exemplifies a forward-thinking approach to enhancing workplace safety and underscores the indispensable role of innovation in addressing critical industrial challenges.

REFERENCES

[1]. Rajesh Power Press India. (2023, January 13). What is a power press machine: Its uses, benefits & safety. https://rajeshpowerpressindia.com/what-is-power-press-machine-it-uses-benefits-safety/

[2]. Delgado, E. (2023, May 23). Mechanical power press accidents: Does control help? LinkedIn. https://www.linkedin.com/pulse/mechanical-power-press-accidents-does-control-help-elena-delgado/

[3]. Federal Register. (2021, July 28). Mechanical power presses update. https://www.federalregister.gov/documents/2021/07/28/2021-15995/mechanical-power-presses-update

[4]. International Social Security Association (ISSA). (2014, February). Two-hand control device. https://ww1.issa.int/sites/default/files/documents/prevention/Two_Hand_Control_Device_2014-36085.pdf

[5]. Gupta, A. K. (n.d.). Accidents with Power Press. www.linkedin.com. https://www.linkedin.com/pulse/accidents-power-press-arun-kumar-gupta/

[6]. Corporation, N. (2006). Pressing responsibilities: How to operate power presses safely. Reliable Plant. https://www.reliableplant.com/Read/807/pressing-power-presses-safely

[7]. Safety Measures For Power Press. (n.d.). https://www.slideshare.net/FarhanaFarahHanna/safety-measures-for-power-press