PRECAUTION OF MIXING MILL SHAFT BROKEN AND ENHANCEMENT OF EMPLOYEE SAFETY

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Abstract: This abstract describes a control system for a 3 horsepower (3hp) alternating current (AC) motor that operates in both forward and reverse directions with a delay of 2 seconds using two limit switches. The system is designed to ensure the safety of the motor and surrounding equipment by introducing a delay before the motor changes direction, and by using two limit switches to control the direction of the motor. When the motor runs in the forward direction and the first limit switch is triggered, the motor is stopped for a period of 2 seconds before it changes direction to reverse. When the motor runs in the reverse direction and the second limit switch is triggered, the motor is stopped for a period of 2 seconds before it changes direction to forward. The control system uses a motor controller to regulate the motor's speed and direction, and two limit switches to control the motor's direction and ensure its safe operation. This system is suitable for use in industry. When the motor runs in the forward direction and the limit switch is triggered, the motor is stopped for a period of 5 seconds before it changes direction to reverse. The control system uses a motor controller to regulate the motor's speed and direction, and a limit switch to trigger the reversal of the motor. The system is designed to ensure the safety of the motor and surrounding equipment by stopping the motor before reversing its direction, and by introducing a delay to allow the motor to come to a complete stop.

Key words: Control System, Horse Power, Alternating Current(AC), motor and delay.

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Introduction:

The rubber and rubber commodities manufacturing sector is extensive and diverse. It can be broadly categorized into two main divisions: one focuses on tires, and the other on non-tire products. The tire division is responsible for producing a variety of automotive and non-automotive tires. On the other hand, the non-tire division specializes in manufacturing high-tech and sophisticated items such as conveyor belts and rubber seals. The range of rubber commodities produced by this industry is vast, including heavy-duty earth-moving tires, automotive tires, tubes, vehicle parts, footwear, and beltings, among others.

Rubber, a polymer, exists in two primary forms: natural rubber and synthetic rubber. Natural rubber consists solely of isoprene monomers and is derived from the coagulated latex of specific tropical trees. On the other hand, synthetic rubber incorporates various types of monomers, typically obtained from petroleum by-products like butadiene and styrene. Approximately 70% of rubber production falls under the category of synthetic rubbers. Manufacturers of synthetic rubber can adjust chemical formulations to meet specific requirements of diverse industries.

To produce useful products such as rubber mats and automobile tires, rubber undergoes processing involving various chemicals. The rubber additives market is expanding for several reasons, including the growth of the automotive, footwear, and consumer goods industries. The automotive sector, in particular, is experiencing significant growth due to increased demand for two- and four-wheeler vehicles, driven by a growing population. This surge in demand is a key factor in the expansion of the rubber additive industry, as automobiles heavily rely on rubber for tire manufacturing.

Rubber finds diverse applications, from shoe soles to industrial tape, acting as a thermal insulation material. The processing of rubber involves methods like astication and various operations such as amalgamation, calendaring, and extrusion. Each process is crucial in transforming crude rubber into a suitable state for shaping the final products.

Rubber plays a pivotal role in various industries, existing in both natural and synthetic forms. Natural rubber, sourced from specific tropical trees, consists solely of isoprene monomers. In contrast, synthetic rubber, comprising diverse monomers like butadiene and styrene, accounts for a significant portion of the rubber market, allowing manufacturers to tailor chemical formulations to meet specific industry needs.

The demand for rubber additives is on the rise, driven by factors such as the growing automotive, footwear, and consumer goods industries. The automotive sector, in particular, is experiencing remarkable growth due to increased demand for both two- and four-wheeler vehicles. This surge in demand serves as a key catalyst for the expansion of the rubber additive industry, as rubber is a crucial component in tire manufacturing.

MOTOR (3HP) INDUCTION MOTOR:

- Power output: 3 horsepower (2.2 kW)

- Voltage: 208-230 volts or 460 volts

- Frequency: 60 Hz

- Current: varies depending on the voltage and load

- Phase: 3 phase

- Speed: 1750 RPM (rotations per minute) or 3450 RPM

- Frame size: 56 or 143T

- Enclosure: ODP (Open Drip Proof) or TEFC (Totally Enclosed Fan Cooled)

- Insulation class: F or higher

- Efficiency: typically 85% or higher

(120HP) SQUIRREL CAGE INDUCTION MOTOR:

- Power output: 120 horsepower (89.5 kW)

- Voltage: 230/460 volts or 575 volts

- Frequency: 50 Hz

- Current: varies depending on the voltage and load

- Phase: 3 phase

- Speed: 1780 RPM or 3560 RPM

- Frame size: 444/5T or 5009T

- Enclosure: TEFC (Totally Enclosed Fan Cooled)

- Insulation class: F or higher

- Efficiency: typically 95% or higher

GEAR RATIO (3HP) INDUCTION:

Motor: If a 3 horsepower (3hp) induction motor has a gear ratio of 1:30, it means that the output shaft of the gearbox rotates one time for every 30 rotations of the motor's input shaft. This gear reduction ratio allows the motor to deliver lower torque and higher speed to the load, which can be useful in applications that require higher speed but lower torque. The actual speed and torque output of the gearbox (120HP)

SQUIRREL CAGE INDUCTION MOTOR: A gear ratio of 1:2.5 means that for every one revolution of the motor shaft, the output shaft (which is connected to the load) will rotate 2.5 times. This can be used to increase the torque output of the motor at the expense of speed. For example, if the motor is rated for 120 horsepower at 1800 RPM, the output shaft would rotate at a speed of 360 RPM (1800 RPM / 2.5), but with a torque output that is 2.5 times higher than if the motor were not geared down.

Gear Ratio Calculation:

This can be calculated using the following formula:

Output speed = Input speed / Gear ratio

where the output speed is 360 RPM, and the input speed is 900 RPM.

Rearranging the formula to solve for the gear ratio gives:

Gear ratio = Input speed / Output speed Gear ratio = 900 RPM / 360 RPM Gear ratio = 2.5:1 (approx.)

Necessity of our Proposal:

Preventing mixing mill shafts from breaking and improving worker safety are important goals for any industrial process. Mixing mill shafts can break due to a variety of reasons, including material fatigue, improper maintenance, or operator error. When a shaft breaks, it can cause significant damage to the equipment and pose a serious safety hazard to workers in the area. Therefore, taking steps to prevent shaft breakage is essential for maintaining a safe and efficient workplace.

Improving worker safety is also a critical concern for any industrial operation. Injuries and accidents can lead to lost productivity, increased costs, and, most importantly, harm to workers. Implementing safety measures such as guards, warning signs, and training programs can help reduce the risk of accidents and injuries, and promote a culture of safety in the workplace.
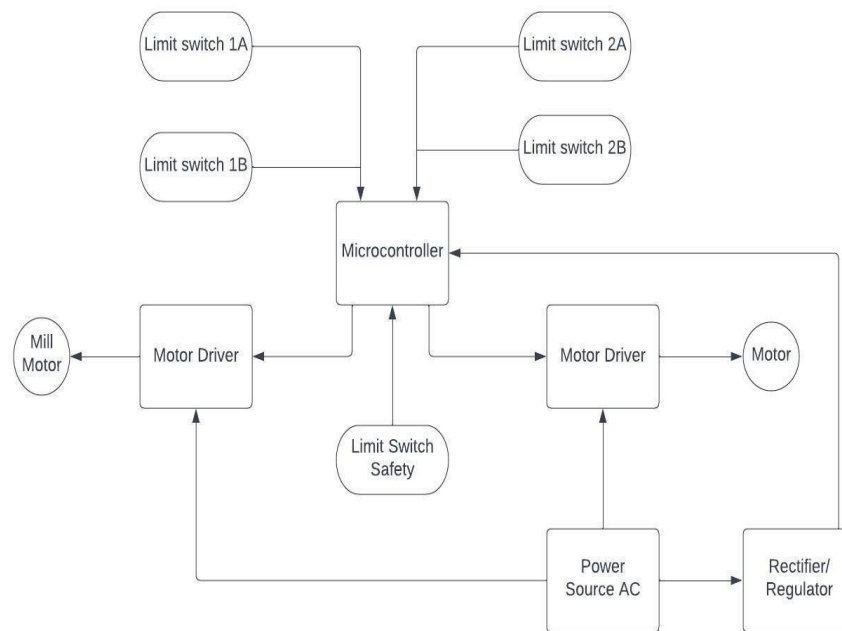
Fig.1. Block Diagram of Control System:

Importance of Work:

- Safety: When a mixing mill shaft breaks, it can cause serious injuries to workers in the vicinity. This could lead to lost productivity, increased medical costs, and harm to the reputation of the company.

- Therefore, ensuring worker safety is essential for maintaining a healthy and productive workplace.

- Equipment Damage: If a mixing mill shaft breaks, it can also cause significant damage to the equipment. The cost of repairs or replacement can be high, and downtime can affect productivity and output.

- Product Quality: When equipment malfunctions or breaks, it can affect the quality of the final product. This could lead to customer dissatisfaction, lost sales, and harm to the company's reputation.

- Cost Savings: Preventing mixing mill shaft breakage and improving worker safety can result in cost savings in the long run. By reducing equipment downtime, preventing injuries, and avoiding damage to the equipment, a company can improve its bottom line and increase profitability.

Proposed Control System:

In this diagram, the 3hp AC induction motor is connected to a power source through two power lines L1 and L2. The power is controlled by two relays T1 and T2. The forward and reverse limit switches T3 and T4 are connected in series with the control circuit of the relays.

When the forward limit switch T3 is activated, the control circuit of T1 is energized and it closes the contacts, allowing power to flow to the motor in the forward direction. Similarly, when the reverse limit switch T4 is activated, the control circuit of T2 is energized and it closes the contacts, allowing power to flow to the motor in the reverse direction.

The limit switches are used to ensure that the motor does not continue to run in the same direction once it has reached the end of its travel. When the limit switch is activated, it interrupts the control circuit of the corresponding relay and de-energizes it, stopping the motor.

- Regular Maintenance: A regular maintenance schedule should be established to inspect the mixing mill and identify any potential issues that could lead to shaft breakage. This includes checking for wear and tear on the shaft, bearings, and other components, as well as lubricating the equipment as needed.

- Use of High-Quality Materials: The mixing mill should be constructed using high-quality materials that can withstand the stresses and strains of the milling process. This includes using high-strength shafts, bearings, and other components that are designed for heavy-duty applications.

- Installation of Safety Guards: Safety guards should be installed on the mixing mill to protect workers from moving parts and potential hazards. Guards can be designed to cover the shaft and other components, while still allowing workers to access the equipment for maintenance and operation.

- Implementation of Training Programs: Workers should be trained on the safe operation of the mixing mill and the importance of following safety protocols. This includes identifying potential hazards, wearing appropriate personal protective equipment (PPE), and using proper equipment handling techniques.

- Use of Limit Switches: Limit switches can be installed to prevent the mixing mill from overloading or over- traveling, which can lead to shaft breakage. The limit switches can be designed to shut down the equipment if it exceeds certain limits or if it encounters an obstruction.

- Implementation of Safety Protocols: A set of safety protocols should be established for the operation and maintenance of the mixing mill. This includes lockout/tagout procedures, hazard identification and reporting, and emergency response procedures.

Conclusion & Future Scope:

Reduce mechanical damage on the screw shaft and improve the product quality.Then in this method less maintenance occurs on the screw shaft by changing motor direction,And ensure the workers safety by operating near the mixing mill. The development of more advanced monitoring systems, Even the machine running time and off time or ideal time. All data will be stored on the computer, even if we check weekly or monthly and take graph output for machine running time.

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