

Design Development and Manufacturing of Table Saw for Human Safety

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Abstract—This project proposes strategies for safe working of table saw. The table saw is used extensively in wood working. The worker working on this machine is unskilled or semi-skilled worker, hence the machine has to be made incorporating the safety features so that it is to operate. The existing table saw is used and is associated with more injuries than any other type of woodworking tool, but there are no published national epidemiologic studies of table saw related injuries. The proposed design also avoids the costly disc brake attachment used in existing advance saws which are to be replaced very frequently.

The project aims at to give safety during working on table saw machine and cost effective solution in industry.

Keywords—component; formatting; style; styling; insert (key words)

I. INTRODUCTION

The table saw is one of the most important and versatile power tools for anyone who working with wood. The table saw is the basic saw for straight-cut operations. Many furniture makers and cabin makers use only a well-tuned table saw for all their precision cuts. Table saw differ in size depth in horsepower, in Table makes saw factors. other in weight some and cut of and the process of wood cutting faster & easier.

A table saw is a working tool consisting of a circular saw blade, mounted on an arbor that is driven by an electric motor.

In a new table saw varied is cut the and up blade the by moving down. The blade higher protrudes above table, deeper cut that is made in the material.

Problem:

- There are many types of industry where the chances of accidents are more or less. But Wood working is one of the industry which is known for a high accidents ratio in compare to other industry only because of the safety precaution are less applied to this particular industry.
- The existing wood cutting machine in use is associated with more injuries than any other type of wood working tool, but there are no published national epidemiologic studies of table saw-related injuries.

- working wood the in working machine saw table the condition normal In industry without any precaution to be taken for the possibility of the injury.
- Due to this in normal working condition the worker it has to take care about the injury which likely to be happens.
- So any lag of concentration happens on the shop floor while working the injury will bound to be occurring.
- As to create a fear free environment for the workers of the wood cutting industries the action should be taken for it.
- Due to this there should be prevention available for this possibility of the injury.

II. METHODOLOGY AND MODEL PREPARATION

Proximity Sensors:

A Proximity sensor can detect objects without physical contact. A proximity sensor often emits an electromagnetic field or beam and look for changes in the field. The object being sensed is often referred to as the proximity sensor's target.



There are two basic ways to detect object presence contact and proximity. Contact implies that there is mechanical contact and a resulting force between the sensor and the object. Proximity indicates that the object is near, but contact is not required. A proximity sensor disposed on the saw blade and motor assembly for detecting the presence of objects within a zone of detection associated with the table, and electrical circuitry connected to the proximity sensor configured to generate an electrical detect ion signal in response to the proximity sensor detecting the presence of an

object.

Types of Proximity Sensor: -

Inductive Proximity Sensors: -

Inductive proximity sensors detect the presence of metallic objects. Their operating principle is based on a coil and high frequency oscillator that creates a field in the close surroundings of the sensing surface. The presence of metal in the operating area causes a change in the oscillation threshold circuit amplitude. This change is identified by the IC, which changes the output of sensor. The operating distance of the sensor depends on the coil's size as well as the target's shape and size.

Capacitive Proximity Sensors: -

Capacitive sensors are used for non-contact detection of metallic objects & nonmetallic objects. Capacitive proximity sensors use the variation of capacitance between the sensor and the object being detected. When the object is at a preset distance from the sensitive side of the sensor, the inside circuit electronic begins sensor to oscillate. The rise or fall of such oscillation is identified by a threshold circuit that drives an amplifier for the operation of an external load. A screw placed on the backside of the sensor allows regulation of the operating distance. This sensitivity regulation is useful in applications, such as detection of full containers and non-detection of empty containers.

Capacitive proximity sensors are designed to operate by generating an electrostatic field and detecting changes in this field caused when a target approaches the sensing face. The sensor's internal workings consist of a capacitive probe, an oscillator, a signal rectifier, a filter circuit and output circuit.

Applications of Proximity Sensors: -

- Ground proximity warning system for aviation safety
- Vibration measurements of rotating shafts in machinery
- Top dead center sensor in reciprocating engines.
- Sheets break sensing in paper machine.
- Anti-aircraft warfare
- Mobile phones
- Roller Coasters
- Conveyor systems
- Touch screens on mobile devices that come in close proximity with the face.

Pneumatic cylinder:

Pneumatic cylinders (cylinders air are) mechanical devices which utilize the power of compressed gas to produce a force in a reciprocating linear motion.

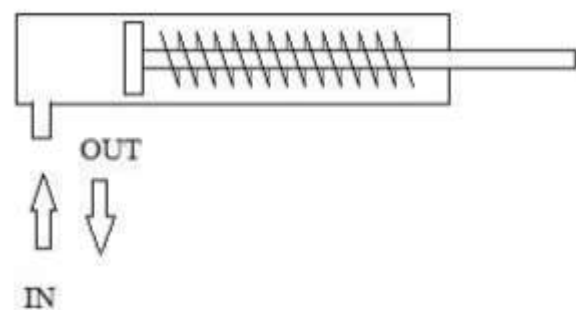


Pneumatic cylinders use the stored potential energy of a fluid, in this case compressed air, and convert it into kinetic energy as the air expands in an attempt to reach atmospheric pressure. This air expansion forces a piston to move in the desired direction. The piston is a disc or cylinder.

Types of Pneumatic Cylinder: -

Single acting cylinder: -

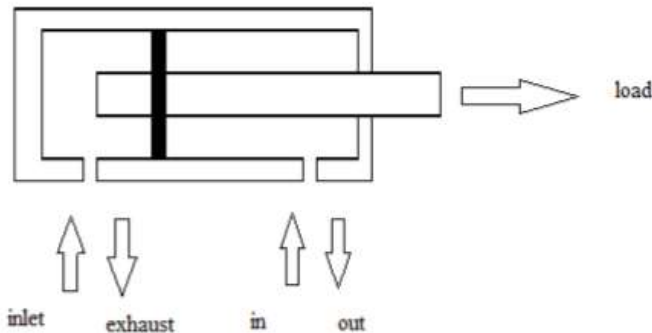
A single acting cylinder controlled by 2, two port valves. There is a cylinder with piston; piston rod is connected to the load. The forward stroke is provided by the compressed air. For the return stroke the piston is spring loaded. This system required 2 two port valve. In one case the valve connects the incoming compressed air line to the left hand side of the actuator cylinder. The pressure air of piston force. It piston product the on operating the in results of area and overcomes the spring forces and moves the piston towards the right resulting in the positive stroke and forward motion of the load.



Double acting cylinder:

To control double acting cylinder 4 two port valves are required. In double acting cylinder the spring is removed. Forward and return stroke of the piston are control by pneumatic pressure force acting on the piston. For this purpose there are 2 two port valves on the left hand end of the exhaust. Similar arrangement is on cylinder, one for inlet right hand end of the for and one cylinder. At the first inlet

valve on the left hand side is open, exhaust valve is closed. The high pressure air enters the cylinder. Exerts pressure force on the piston towards right.



At this time on right hand end the inlet valve is closed and outlet valve is open. On the left hand side the piston movement absorbs additional air. On the right hand side volume is decreasing. The extra air is diverted to exhaust.

For returns stroke inlet valve on the right hand side is opened. Exhaust valve is closed. It accepts pressurized air pushes the piston towards left. The volume on left hand side is decreasing. To divert the air from the left hand side the exhaust valve on the left hand side is kept open and inlet valve on the left hand side is closed. This sequence is continued to impart reciprocating motion to the piston and the load.

When the stroke is over the inlet valve is closed. Now exhaust valve is open. The spring exerts force on the piston towards the left. The piston starts negative stroke forcing the air through exhaust port by operating the other valve. The load moves in other direction.

Benefits of Pneumatic cylinder:

- Low & medium forces and pressure
- Excellent energy storage characteristics
- Fast control and operating speed

An compressor air and is a device that converts power into kinetic energy by compressing press numerous are There bursts. quick in be surizing air, which, on command, can released methods of air compression, divided into either po sitive - displacement or negative displacement types.

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Positive displacement air compressors work by forcing air into a chamber whose volume is reduced to effect the

compression. Piston - type air compressors use this principle by pumping air into an air chamber through the use of the constant motion of pistons. They use unidirectional valves to guide air into a chamber, where the air is compressed. Rotary screw compressors also use positive - displacement compression by matching two helical screws that, when turned, guide air into a chamber, the volume of which is reduced as the screws turn.

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Application of air compressor: -

- To supply high - pressure clean air to fill s gas cylinder
- To supply moderate - pressure clean air to a submerged surface supplied dive r
- To supply moderate - pressure clean air for driving some office and school building pneumatic m HVAC control system valves
- To supply a large amount of moderate - pressure air to power s pneumatic tool for filling tire.
- To produce large volumes of moderate -pressure air for macroscopic industrial processes.

Other Components of Table Saw:

Motor:

Table saws are considered as powerful tools employed to work in producing finer cuts through the thicker wood pieces mainly in the industry. The table saw motor is the main part of the tool that facilitates faster work, accurate work and fewer mistakes.

Most 1/2 1, a either have saws Cabinet motor. Horse power the on saws, other hand, generally have between 3 and 5 horsepower motors in them. For most applications, the 1, 1/2 horsepower motor on the contractor saw is powerful enough. A typical motor is running at 4000r.p.m.



Saw Blades:

An accurate cut starts with blade installation make sure the arbour, nut, washer and flange are free of burrs or residual build - up. Next, make sure you have the right blade for each task, blades with many teeth cut cleaner, while blades with fewer teeth cut faster.

Most table saws have a 10 - inch blade, but some of the most expensive cabinet saws have a 12 inch blade. Either works just fine on most tasks. More important than the blade size is the quality and finish of the blade itself. You can get blades designed for ripping, crosscutting, both ripping and crosscutting and blades specifically made for wood, plastic laminates, and other man made materials.

RIP SAW BLADES:

The rip saw blade is designed for greatest efficiency when sawing a board lengthwise in the direction of the grain. When a given job consists entirely of rip - sawing, use of the rip saw blade will save time.



PULLY:

A pulley is a wheel on an axle that is designed to support movement of a cable or belt along its circumference pulleys are used in a variety of ways to lift loads, apply forces, and to transmit power is also called pulley sheave or drum a may and have groove two between flange around its circumference . The drive element of a pulley system can be a rope , belt , chain that runs over the pulley inside the groove.



BELT:

A belt is a loop of flexible material used to link two or more rotating shafts mechanically. Belts may be used as a source of motion, to power efficiently, or to track relative movement. Belts are looped over pulleys. In a two pulley system, the belt can either drive the pulleys in the same direction, or the belt may be crossed, so that the direction of the shafts is opposite.



Power was distributed from the shaft to the machinery by a system of belts and pulley .

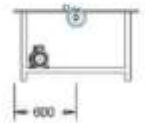
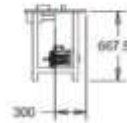


Relay:

Relay are used to repeating the signal coming from one circuit and re - transmitting to another.



DIMENSIONS:



Solenoid Valve:

This is the 4V series 3 - way solenoid coil valve 208 - 10. There is one inlet to the valve from compressor.



There are two outlets from valve to cylinder, one outlet the air is coming out to hold the piston and when circuits get complete the air comes out from the second outlet.

Solenoid valve is used in pneumatic system to control the system.

Bearing and Bearing House:

The internal diameter of the bearing is 1".

The bearing provided with bearing house.



TABLE:

- Table saws are often used to rip long boards or sheets or plywood or other sheet materials.
- The use of an out feed table makes this process safer and easier. Many of these are sop built, while others are commercially available.

MOTOR:

The motor is 3 phase , 1440 rpm, 0.5 HP and 37 watts.

PROXIMITY SENSOR:

- The diameter of sensor is M40.ie 40 mm.
- The range of the sensor is 22 mm .
- The supply to the sensor is 230 V AC .

PNEUMATIC CYLINDER:

- The size of the pneumatic cylinder is 50 X 50 mm.
- The bore diameter is of 50 mm . The stroke length is 50 mm .
- The maximum pressure that the cylinder can sustain is 1.

CUTTER:

- Rip saw blade is used in table saw.
- The outer diameter of blade is inch 8 .
- The inner diameter is 25 m m .
- Material of blade is carbide.

PULLEY:

The pulley is made up CAST IRON.

- There are two pulleys one is attached to the motor and other is attached to the pedestal.

BEARING:

- The internal diameter of the bearing is 1"
- The bearing provided with bearing house.

RELAY:

- Relay are used to repeating the signal coming from one circuit and re-transmitting to another.

SOLENOID VALVE:

- This is the 4V series 3 way solenoid coil valve 208 - 10.
- There is one inlet to the valve from compressor.
- There are two outlets from valve to cylinder, one outlet the air is coming out to hold the piston and when circuits get complete the air comes out from the second outlet.
- Solenoid valve is used in pneumatic system to control the system.

SHAFT:

The shaft is solid and made of steel.

- The diameter of shaft is 25 mm.
- The points to be taken care of selecting the shaft are. Bending, Torsion, Rigidity, Friction, Hardness.

III. EXPERIMENTAL SETUP

Mechanical Experiment Setup:

- There is a table. The motor is fixed to the table below it. The pulley is attached to the motor shaft.
- There are two pedestals with bearings at the below surface of the table. The shaft is put on the bearings.
- Plate welded with the shaft. There blade of an assembly. There is a pedestal and shaft on pedestal.
- The plate is having the pedestal for the blade. The blade is attached on the pedestal shaft. The blade is properly fixed to the pedestal shaft with the help of small circular plate.
- The blade comes out of the table up to some height only. The shaft of pedestal is threaded so that the blade is properly tightened.
- So there is as less as possible vibrations.
- If the blade is not properly tightened the blade might get out of the assembly.
- The plate assembly is lock with small lock system so that plate does not fall down and it can hold blade above the table surface to perform operation properly.
- The blade in the setup is run by the motor. There is a pulley on the shaft of the pedestal. The pulley on the pedestal shaft is attached to the pulley on the motor by the belt. There is tension in the blade.
- The belt should be properly fixed in the pulleys so

that the transmission of the motion is proper. There should be no slip on the belt.

- The sizes of both the pulley are different. The pulley on the motor is big and pulleys on the pedestal shaft are small. The motor is given 3-phase supply. The motor transmits 34W Power.



Electrical Experiment Setup:

- There is a proximity sensor is attached to the relay.
- The proximity sensor and relay is supplied with 230V AC supply.
- The proximity sensor is set on the blade. The sensor sends signal to the relay.
- The relay and sensor is provided with three wires. All the neutral wires are joined to the 3-phase supply. As soon as the signal sends to the relay, the circuit is actuated.
- The output from the sensor is joined to the input of relay.
- There are two rows of screws. One is NO and another is NC.



Combined Setup:

- The relay and solenoid valve are joined together.
- Now the worker's hand is provided with the metal cover on the finger.
- When the worker's hand is just some distance away from the blade, the sensor detects the metal cover on the worker's hand it sends the signal to the relay.
- This will actuate solenoid pneumatic the actuate turn in valve
- The pressurized air is supplied to the cylinder. As pressurized air passed to the cylinder, it will push the lock on which the plate with blade on the pedestal is attached. This will make the plate to fall down.
- This in turn brings the portion of the blade above the table below the table. This will save the workers finger from being cut by the leaving only with a small cut on finger. Now the set up can fit easily. The pressurized air in the pneumatic cylinder is released.
- The plate can be locked again.



The proposed design of the Table saw machine is consist of the proximity sensor and the pneumatic cylinder arrangement, by the combination of this the machine sensor will detect any finger or part of the human body came across in the prohibited region that means came near to the circulating saw and will stop the saw circulating automatically.

- The design also avoids costly disc brake attachment used in exiting in design proposed wood cutting industry.
- This machine is run with the help of the universal motor which is connected to it for the rotor to be operated in the rotating motion.
- So when the cutting rotor is running, any portion of finger or the part of the human body will came in the sensing region at in the fraction of the time the cutting rotor will stops and of there will be no possibility arises the injuries for workers whomever working at this particular machine.
- piston the of end one tube the into enters air compressed actuated, Once at and, hence, imparts force on the piston. Consequently, the piston becomes displaced (moved) by the compressed air expanding in an att empt reach atmospheric pressure .
- This expanded piston forces blade to move downwards hence, this will prevent accidents occurred by physical contact with moving blade.
- Blade will drop down to the Shock absorber at the angle of 45 degree.

IV. COMPARISON BETWEEN EXISTING AND INNOVATION SYSTEM

Comparison between the components:

There are different types of components involved in the current system and the proposed system.

The existing Setup has components like Straight shaft, Shaft support, Linear & oil free bushing, Heat resistant, Dust prevention, Ball screw nut brackets, Slide plate, Guides, Motor, Pulley, Belt, Gears, Sprocket, Locating pins, Shock absorbers, Table metal plate, Straighter plate, Adjustable lever, Hydraulic and Pneumatic components, Other miscellaneous items like screws, nuts, bolts, lubricating oil,

etc.

The innovative setup Shaft components has table, Slide like support, shaft, Straight Motor, Pulley, Belt, Shock absorber, Solenoid coil valve, Electrical relay, Hose pipes, Compressor, Proximity sensor, Pneumatic components, Other miscellaneous items like screws, nuts, bolts, lubricating oil, etc.

The costs involved in both the setups are also different. The functionality of the parts is also different.

With the safety, economical is also the thing which should be kept in mind.

The existing setup is quite heavy so it cannot be move here or there, while the innovative setup is light weight. We can move it anywhere.

There is use of heavy cylinder in the innovative setup to run the pneumatic cylinder, which is not there in existing setup.

V. SAFETY

Causes of Table Saw injuries include:

1. Failure to read warning labels and the owner's manual before use.
2. When the saw is not in use, leaving the blade projecting above the table.
3. power when performing maintenance and changing blades in table Not disconnecting saw.
4. using push stick or other Not when device safety such otherwise that cuts making requires fingers to be close to the blade.
5. Using the saw in a way that fingers advance into the path of the blade.
6. Failing to be alert and pay consistent attention. This piece of equipments causes more serious injuries than anything else in the shop. Many woodworkers know someone who has lost a finger.
7. Not wearing Eye protection. The rotational mass of spinning saw blade combined with a large electric motor can contribute to the violent and unexpected ejection of material.
8. Wearing unsuitable safety glasses that don't fully encompass the eye area, including the front and sides of the eye, can also results in injuries. Good safety glasses are comfortable so they are always worn when needed.
9. Lack of ear protection. Extremely loud noises as well as prolonged fairly loud noises can contribute hearing loss as well as tinnitus.
10. Wearing clothing that's excessively loose fitting, and failing to tie back long hair. These are dangerous if they come in contact with blade be . Cuffs should also buttoned if wearing a long - sleeves shirt.

11. Not pushing the material past the saw when finishing a cut. These pieces can get caught and violently drawn into the blade, resulting in kickback.

Failing to operate defensively. The nature of wood includes variation in structures and internal forces, and it's not uncommon for natural stresses in a piece of wood to cause the blade to be pinched and thrown violently. So cautious working is important.

VI. FUTURE SCOPE

The proposed system is mainly encompassing the pneumatic cylinder and proximity sensors for prevention of hazardous accidents in wood cutting industries. As the sensors sense the presents of body parts and governs the pneumatic cylinder to break down the work.

As in factory there are still many machines which need persons to be operated them. The sensors and the cylinder that is used in this machine can be implemented in other machine which senses the presents of body parts and immediately suspend work of danger part like cut ter in cutting machine or reciprocating carriage of lathe machine.

VII. CONCLUSION

Most saw table - the with contact from result injuries related saw blade. Passive injury prevention strategies focusing on preventing finger/thumb/hand contact with the blade need to be implemented. The conclusion from this experimental set up or project is that the cost of machine is much more less than the cost of the worker's finger. By this experiment the safe ty of the worker is assured to a large extent (90%) though not 100%. A less skilled person can also work on the table saw. This is a sturdy, reliable table saw that runs smoothly and cuts just as smoothly with very has many fine, well It little vibration. designed features including pneumatic cylinder and proximity sensor. It is an excellent table saw that may become Powermatic's primary saw in the future.

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