DESIGN AND FABRICATION OF PNEUMATIC SUGARCANE 
BUD CUTTING MACHINE

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Abstract: Sugarcane is the main source of sugar in Asia and Europe. Sugarcane is the raw material for the production of white sugar, jaggery (gur) and khandsari. It is also used for chewing and extraction of juice for beverage purpose. The sugarcane cultivation and sugar industry in India plays a vital role towards socio-economic development in the rural areas by mobilizing rural resources and generating higher income and employment opportunities. About 7.5 percent of the rural population, covering about 45 million sugarcane farmers, their dependents and a large number of agricultural labors are involved in sugar cane cultivation, harvesting and ancillary activities. There are several methods for sugarcane bud chipping. It is by manually, and also by the use of machines. Manual bud chip cutting with hand knife is a common practice. These traditional tools used for bud chipping of sugar cane are unsafe, messy, minimum productive and need skill and training. The risk of injury is also too high. This necessitates the development of an automated sugarcane bud chipping machine.

Keywords: pneumatics, compressor, solenoid valve and electric circuit.

1.0 INTRODUCTION: The main objective of our project is to perform job holding and cutting operations effectively with less human effort by incorporating a machine with the pneumatic power. This also takes less time due to its quick action. This pneumatic sugarcane bud cutting machine aims to provide a better and faster bud cutting operations with less human effort thereby promoting agricultural activities of sugarcane cultivation. Nowadays almost all the manufacturing process is being atomized in order to deliver the products at a faster rate. To achieve mass production, the automation of the predefined tasks is necessary and is made mandatory in the current operating conditions of the industries.

1.1 DRAWBACKS OF CONVENTIONAL CULTIVATION METHOD: Conventional method of planting sugarcane causes to chip the complete sugarcane into several fragments with buds present at its nodes. This damages the sugarcane completely and leads to causing loss in the farmer’s hands since they are unable to sell their cultivated sugarcanes to the industries such as sugar factories and other industries that use sugarcane as their source of raw material. Tonnes of sugarcanes are chipped into fragments to utilise the necessary cane buds and the chipped ones rather than used for planting are then sold to the markets at very cheaper rates.

2.0 INTRODUCTION OF BUD CHIPS FOR PLANTING: One alternative to reduce the mass and improve the quality of seed cane would be to plant excised axillary buds of cane stalk, popularly known as bud chips. These bud chips are less bulky, easily transportable and more economical seed material. The bud chip technology holds great promise in rapid multiplication of new cane varieties. The sowing of buds of grown sugarcane ensures the growth of new sugarcane thereby increasing the production rate and decreasing the damaging rate of the sugarcanes. The left-over cane can be well utilized for preparing juice or sugar or jaggery.
2.1 ADVANTAGES OF BUDCHIPS: Bud chip technology could be one of the most viable and economical alternatives in reducing the cost of sugarcane production, provided necessary precautions are taken in handling and storage of bud chip seed material and their subsequent multiplication in the field. Plant mortality rate could be reduced using bud chip raised settlings. Cane yield could be enhanced using bud chip raised settlings. Use of bud chips of sugarcanes for further cultivation purposes reduced the unwanted damage and disposal of sugarcanes by useless chipping methods.

2.2 METHOD OF SUGARCANE BUD CUTTING: One of the most common practice of sugarcane bud cutting is the use of cutting machine operated manually with hand. It requires man power for the cutting operations and is takes much longer time to chip several pieces of sugarcane buds. Hence this method is unsuitable for large scale production of chipped sugarcane buds for the need of agriculture. Few other sugarcane bud cutting machines are made using motor power. But it requires more components for its working and both the initial and operating cost remains high when compared to the conventional hand operated cutting method.
3.0 **PNEUMATIC POWER**: Pneumatic systems use pressurized gases to transmit and control power. Pneumatic systems typically use air as the fluid medium because air is safe, low cost and readily available. Pneumatic systems operate on a supply of compressed air, which must be made available in sufficient quantity and at a pressure level to suit the capacity of the system. When pneumatic system is being adopted for the first time, however it will indeed the necessary to deal with the question of compressed air supply since air is the source of pneumatic operations.

A compressor is a machine that takes in air, gas at a certain pressure and deliver the air at a high pressure. Compressor capacity is the actual quantity of air compressed and delivered and the volume expressed is that of the air at intake conditions namely at atmosphere pressure and normal ambient temperature.

Clean condition of the suction air is one of the factors, which decides the life of a compressor. Warm and moist suction air will result increased precipitation of condense from the compressed air.

3.1 **ADVANTAGES**:

- Air used in pneumatic systems can be directly exhausted back into the surrounding environment and hence the need of special reservoirs and no-leak system designs are eliminated.
- Pneumatic systems are simple and economical.
- Control of pneumatic systems is easier.
- Pneumatic systems are highly reliable since generally they have long operating lives and require little maintenance. Because gas is compressible, equipment is less subject to shock damage.
- There is a very low chance of fire compared to hydraulic oil.

3.2 **DIADVANTAGES**:

- Pneumatic systems exhibit spongy characteristics due to compressibility of air.
- Pneumatic pressures are quite low due to compressor design limitations (less than 250 psi).

3.3 **PNEUMATIC CYLINDER**: All the strange names and terms around pneumatics have evolved through about 100 years of their use in manufacturing. Double acting, four way, quick connect are all terms that were invented to describe the difference between the parts. Don't let the names discourage you. They're just names.

There are only two main kinds of air cylinders.

They are Double acting and Single acting cylinders. They come in all variations, shapes and sizes. Both kinds are useful for haunt work. Double acting cylinders are useful when you need to push in both directions, and single acting cylinders are useful when only a push in one direction is needed. And sometimes 'in a pinch', you can adapt a double to act as a single, and a single to act as a double.

Air cylinders are measured by three main values: "pressure rating", the "bore", and "stroke".
There are lots of calculations to accurately figure the power of a cylinder, but most haunt pop-up applications can be handled by air cylinders in the range of 3/4” to 1-1/2” bore, and 3” to 8” stroke.

Power measurements primarily take into account the air pressure (the higher the pressure, the more power); and the bore (the larger the bore - the more power). The power ratings are usually only quoted at maximum pressure. So if a cylinder produces 180 pounds of ‘push’, it will only deliver that at the maximum pressure (usually 250 psi for commercial cylinders).

Haunters should work their props to work and much, much lower pressures. A good goal is not to exceed 60-70psi for working props. Going much higher causes more stress on the prop and all parts in the air system, and make your compressor run more often. Even at lower pressures, air cylinders can still move very fast and deliver quite a lot push, so always be very careful around pneumatics!

3.4 DOUBLE ACTING CYLINDER : Double Acting means the air cylinder rod is ‘pushed out’ during extension stroke and ‘pushed in’ during retraction stroke.

Every double acting air cylinder has these basic parts. A cylinder to hold everything together, a ‘plunger’ that the air pushes against, two connections to get the air in and out, and a rod that goes in and out.

As air is sent into the left connection, it pushes against the plunger and the rod goes out. At the same time, air is released out of the right connection. To reverse the motion, air is sent into the right connection, pushing against the plunger on the other side and the rod is forced back in.

The trick to the double acting cylinder is that you have to let air OUT of the other side! This is an important feature of the double acting cylinder, and an advantage that gives you great control over the motion of the rod.

A double-acting cylinder is used where an external force is not available to retract the piston or where high force is required in both directions of travel. They are mostly employed at places where it is needed to produce forces in both directions.

3.5 FLOW CONTROL VALVE : In any fluid power circuit, flow control valve is used to control the speed of actuator. The flow control can be achieved by varying the area of flow through which the air in passing. When area is increased, more quantity of air will be sent to actuator as a result its speed will increase. If the quantity of air entering into the actuator is reduced, the speed of the actuator is reduced.
3.6 SOLENOID VALVE: A solenoid valve is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid. Solenoid valves are the most frequently used control elements in fluidics. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design. The directional valve is one of the important parts of a pneumatic system. Commonly known as DCV; this valve is used to control the direction of air flow in the pneumatic system. The directional valve does this by changing the position of its internal movable parts.

This valve was selected for speed operation and to reduce the manual effort and also for the modification of the machine into automatic machine by means of using a solenoid valve. A solenoid is an electrical device that converts electrical energy into straight line motion and force. These are also used to operate a mechanical operation which in turn operates the valve mechanism. Solenoid is one is which the plunger is pulled when the solenoid is energized. The name of the parts of the solenoid should be learned so that they can be recognized when called upon to make repairs, to do service work or to install them.

![5/2 Solenoid Valve](image)

**Figure 3.2 5/2 Solenoid valve**

3.7 CUTTING MACHINE: The pneumatic cutting machine consists of pair of cutters. The cutters are made out of mild steel. One of the cutter is fixed, while other cutter is movable.

The work piece is placed in between the cutters. The moving cutter is moved with the help of pneumatic power, to cut the work piece firmly against the fixed cutter.

**Hoses**: Hoses used in this pneumatic system are made up of polyurethane. These hose can with stand at a maximum pressure level of $10 \times 10^7$ N/m².

**Connectors**: In our system, there are two type of connectors used. One is the Hose connector and the other is the reducer. Hose connectors normally comprise an adopt hose nipple and cap nut. These types of connectors are made up of brass (or) aluminium (or) hardened pneumatic steel.

3.8 CONTROL UNIT: In pneumatic cutting machine is an air-operated device used for many small operations. It is a portable one. Compressed air is the source of energy for this device. The compressed air is allowed through the nozzle in such a way to rotate the fan, the rotation is utilized for machining.

The nozzle is welded and the fan can be rotated in either directions by operating by one-way works. The rpm and torque of the shaft depends upon the pressure of the air admitted, so by varying the pressure, the RPM and torque can be varied. Thick tubes interconnect the parts. The clamps are used at the connecting parts to prevent leakage. In thread parts seals are used to prevent leakage.
Here the compressed air from the compressor firstly enters the Control unit. In the control unit the pressure of the air is controlled and sent to the barrel to rotate the fan in any one direction. The gate valve controls the pressure volume of air.

Then the pressure is read by a pressure gauge. Then the air is admitted to the barrel, a shaft is placed and if carries the fan. The shaft is supported in either and by bearing. The bearings are placed in the Couplings, which covers the end of barrel.

3.9 AIR COMPRESSOR

Compressor is the air producing machine. They collect the air from the atmosphere. Air compressors are used to raise the pressure of the air by reducing its volume. Air compressors are available in many configurations and will operate over a very wide range of flow rates and pressures. Compressed air was expelled by primitive man to give glowing embers sufficient oxygen to allow them to flare up into a fire.

During the compression process, the temperature increases as the pressure increases. This is known as polytypic compression. The amount of compression power also increases as the temperature increases. Compressors are staged thereby reducing the temperature rise and improving the compression efficiency. The temperature of the air leaving each stage is cooled prior to entering the next stage. This cooling process is called intercooling. Volumetric efficiency also increases with multi-stage compression since the pressure ratio over the first stage will be decreased.

Selection of the air compressor is only the first step in designing an efficient and reliable compressed air system. The air exiting the compressor is saturated with moisture and will have compressor lubricants (lubricated compressors only). Other chemicals that may have been drawn into the compressor intake may also be present.

This contamination is harmful to many processes, pneumatic tools, instruments and equipment. Air purification equipment, filters, air dryers, breathing air purifiers, monitoring equipment, used alone or in combination will remove these contaminants. Selection and purchase of the compressor and necessary purification equipment can be easily done based on the parameters. It works in the process of rotating the fan and the piston movement with the help of current supply.
4.0 DESIGN OF EQUIPMENT AND ITS WORKING: The pneumatic sugarcane bud cutting machine consists of the following components to fulfill the requirements of complete operation of the machine.

1. Double acting pneumatic cylinder
2. Solenoid valve
3. Flow control valve
4. Control unit

![Block diagram](image_url)

**Figure 4.1 Block diagram**
4.1 Working principle: The compressed air from the compressor is used as the force medium for this operation. The machine uses a pneumatic double acting cylinder, solenoid valves, flow control valve and the timer unit. The arm from the compressor enters to the flow control valve. The controlled air from the flow control valve enters to the solenoid valve. The function of solenoid valves controls the extension and retraction of air from cylinder at correct time interval. The 5/2 solenoid valve is used. In one position air enters to the cylinder and pushes the piston so that the cutting stroke is obtained. The next position air enters to the other side of cylinder and pushes the piston return back, so that the releasing stroke is obtained. The speed of the cutting and releasing stroke is varied by the timer control unit circuit.

5.0 CONCLUSION: The project carried out by us made an impressing task in the field of small scale industries related to agricultural activities and automobile maintenance shops. It is very useful for the workers work in the lathe and small scale industries. This project will reduce the cost involved in the concern. The speed of the cutting and releasing stroke is varied by the timer control unit circuit. Project has been designed to perform the entire requirement task at the shortest time available.

Figure 4.2 Design of Pneumatic sugarcane bud cutting machine
6.0 REFERENCES


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