**Abstract**

Generally, coconuts are dehusked manually using either a machete or a spike. These methods require skilled labour and are tiring to use. Attempts made so far in the development of dehusking tools have been only partially successful and not effective in replacing manual methods. The reasons quoted for the failure of these tools include unsatisfactory and incomplete dehusking, breakage of the coconut shell while dehusking, spoilage of useful coir, greater effort needed than manual methods, etc.

The present work involved the design, development and testing of a coconut dehusker which overcomes the drawbacks of the previously reported implements. The design and developmental stages called for a closer look at the magnitude and direction of the dehusking forces and their generation mechanisms. Details of a simple, sturdy and efficient hydraulic dehusker unit, financially beneficial to labourers and producers, are given here. Comparative assessment of this unit in relation to those reported in the literature is provided. Test results and assessment of the present unit in both laboratory and field conditions are also reported. Safety aspects are incorporated. The unit can dehusk about 70 coconuts per hour compared with about 40 nuts per hour from a skilled worker using the spike method. It can be operated by unskilled labourers. Cost benefit analysis indicates that it should be commercially viable.

**Chapter 1**

**Introduction**

Coconut, the fruit of the coconut palm tree which has the scientific name as “Cocos nucifera”. India is one of the leading producers of this coconut. It is usually grown in coastal areas. Coconuts are large, dry drupes, ovoid in shape, up to 15" long and 12" wide. The coconut is smooth on the outside, yellowish or greenish in color. Within the outer shell is a fibrous husk one to two inches (2.5 to 5cm) thick. The inner shell is brown and hard, surrounding the white coconut meat. [Coconut](http://www.wisegeek.com/what-is-a-coconut.htm) husks are the rough exterior shells of the coconut. This outer shell or husk has to be removed for the usage of coconut.

**1.1 Present study**

We have many methods to dehusk the coconut. It is by manually, mechanically and also by the use of machines. Manual dehusking with knife is a common practice.

Need for the improvement in present method is the lack of sufficient manpower. This necessitates the use of appropriate machinery to aid in various tasks in coconut plantation. Traditional devices currently in use, such as the blade and spear are dangerous and minimum productive. Based on this realization we are planning to make the device that simplifies an important process as well as increases the productivity of the coconut industry. This new mechanism will indirectly boost any economy that relies on coconut plantations.

**1.2 Machine description**

This coconut dehusking machine peels off the coconut husk from coconut fruit to obtain dehusked coconut fruit via mechanical controlled dehusking devices. The coconut is placed on the holder in vertical position. The holder is moved up by the foot operation mechanism. The top assembly which comprises the gripper pokers held vertically with link mechanism and is pivoted to the coconut body. The top assembly movement effects the pokers to move in the downward slide to poke into the coconut and at certain depth will make the pokers to move apart at 45 degree by the pusher link mechanism to tear apart the husk with force. The foot operated holder can be adjusted to the required height by the height adjuster. The foot lever is operated to continue the pumping till the mechanism is pulled down to its lowest position till the coconut is de-husked from the fruit. The foot operation is returned to the original position and also the top assembly is lifted back to its original position by the release valve operation of the pump and cylinder facilitating the removal of the coconut.

The main parts involved in the project are hydraulic pump, cylinder, coconut holder mechanism, height adjusting knob, and poker arms.

**1.3 Field of use and benefits**

This machine is useful to the coconut estates and co-operatives, coconut growers and coconut processing factory. The machine can provide faster work rate and less human interaction. This machine is expected to increase the coconut production, hence an additional income to coconut growers. It is useful to the coconut growers by many ways. It does not require direct human force as in normal methods because in this hydraulic pump and cylinder is used to enhance the force at the head of the coconut to put pressure on poker assembly. Also the coconut of any size and shape can be dehusked easily. It is easy to operate, does not need skilled labour, rapid, safe operation and simple maintenance. It can be easily assembled and disassembled and it can be carried from one place to another.

The cost of this machine is lesser as compared to the present available machines. Also these available machines require external electrical power supply and the worker should be skilled with the machine. Also these machines are not safe because they work with a very high speed and a large tools and equipments.

**Chapter 2**

**Literature Review**

**2.1 General**

In this chapter we have done a detailed description about the topics given below.

1. Traditional coconut dehusking machine

2. Hydraulic pump

3. Control valves

4. Cylinders

5. Hydraulic fluid or oil

6. Composition

7. Tubes, pipes and hoses

8. [Seals](http://en.wikipedia.org/wiki/Seal_(mechanical)), [fittings](http://en.wikipedia.org/wiki/Compression_fitting) and connections

9. Mild steel

10. Springs

**2.2 Traditional coconut dehusking machines**

Here we studied about the traditional methods of husking machines and their efficiency, durability, ease of operation etc. There are many different methods followed by the farmers of our region. In that some are more effective and some are costlier. Some of those machines are described below.

In the figure 2.2.1 is one of the traditional model of coconut husking machine which consists of a solid vertical shaft and a poker which has two parts one of which is fixed two solid shafts and another one is movable. The movable poker is fitted to the arm which can be lifted to husk the coconut. It is cost effective but it requires large force to operate which makes it not to use in some places.

In the figure 2.2.2 shows one of the traditional methods of coconut husking machine which consists of one vertical sharp column like structure in which poker is fixed at the top. This is worked by using human energy. This is cost effective and efficient also but danger to the worker involved is more because if his hand slips from the coconut the sharper edge will directly move into his hands and it may create injury to the hands. And hands may be pained if the worker is continuously worked for about three to four hours. Now a day the availability of labours is a very big problem, if available daily wages will be very high.

Figure 2.2.1 Traditional tool Figure 2.2.2 Traditional method of dehusking

**2.2.1 Two blade dehusking machine**

In this two-blade model one blade would be inserted inside the husk of the nut and the other blade would help in the process of peeling.

A 1.5hp motor is coupled through a belt to a long, cylindrical metal rod. Two sharp blades were fixed at the tip of the rod. The blades were three quarter of an inch long and placed one inch apart. The rotating motion of the blades would dehusk the coconuts easily. A switch was used to operate the machine. Initially, the switch could be turned only by hand. Figure 2.2.3 shows a two blade dehusking machine.



Figure 2.2.3 Two blade dehusking machine

This coconut-dehusking machine, works on the principle of conversion of electrical energy from electrical motor into mechanical energy in terms of rotation of the centrally mounted iron shaft. The power is being transmitted to the rotating shaft from the electric motor through the belt-drive. This rotation of the machine blades facilitates the dehusking process. A better grip on the coconut is provided by the iron plate, which acts as the stopper that prevents the nut to slip away vertically. But the problem in this machine is that the hands may get damaged because the worker has to hold the coconut in his hand during dehusking.

**2.2.2 Change of attention towards hydraulic systems**

Now a day the hydraulic machines are more efficient and easy to use. And also we can get more force at the output by applying a small amount of force at the input. Hence we studied about the hydraulic system to make a hydraulic machine. Some of the details about the hydraulic systems are discussed here.

In the recent there has been a significant increase in the use of hydraulics in our industries. The use of hydraulic systems as a means of power transmission in modern machines evolved a few decades earlier in the western world. But its application in Indian industries is of comparatively resent choice. Hydraulic systems are now extensively used in machine tools, material handling devices, transport and other mobile equipment, in aviation systems, etc.

There are six basic components required in a hydraulic system,

* 1. A tank is a reservoir to hold the liquid, which is usually hydraulic oil.
  2. A pump to force the liquid through the system.
  3. An electric motor or other power or manual sources to drive the pump.
  4. Valves to control liquid direction pressure and flow rate.
  5. An actuator to convert the energy of the liquid into mechanical force or torque to do useful work.
  6. Piping which carries the liquid from one location to another, in this case the piping is not there, the tank, pump, and actuator are inbuilt.

**2.3 Hydraulic pump**

Basically a hydraulic system consists of a pipe of liquid ending in a piston at each end. One piston is small and the other one is large, effort is applied to the smaller piston pursuing it into the liquid and creating pressure throughout the liquid. The pressure then causes the larger piston to move, thus transmitting the effort. The force produced is equal to the liquid pressure multiplied by the area of the piston, so the large piston produces a greater force than that exerted on the small piston depending upon the difference in their areas. It will also move a shorter distance than the smaller piston. This is as shown in the figure 2.3.1 below.

W

F

OD

D

RAM

Figure 2.3.1 Schematic representation of a hydraulic pump

**F** = force applied on the plunger

**W** = weight lifted by the ram

**D** = diameter of the ram

**OD** = outer diameter of the piston

Hydraulic machinery offers a very large amount of power and force with relatively small components. A typical hydraulic cylinder with a 75mm (3inch) bore, for example, can supply 89000 [N](http://en.wikipedia.org/wiki/Newton).

Hydraulic pump supplies fluid to the components in the system. Pressure in the system develops in reaction to the load. Hence a pump rated for 1000psi is capable of maintaining flow against a load of 1000psi.

Pumps have a power density about ten times greater than an electric motor. They are powered by an electric motor or an engine, connected through gears, belts, or a flexible elastomeric coupling to reduce vibrations [1].

Common types of hydraulic pumps to hydraulic machinery applications are

**2.3.1** [**Gear pump**](http://en.wikipedia.org/wiki/Gear_pump)

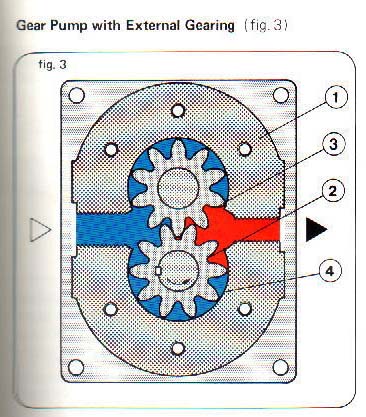


Figure 2.3.1 Gear pump with external gears

This pump is cheap, durable, simple, less efficient, because they are constant displacement, and mainly suitable for pressures below 200 bar (3000 psi). The advantage of this pump includes simple construction, only two moving parts, no reciprocating parts, running at constant speed and experience uniform force. However, they have very low efficiency due to leakage between teeth. The figure 2.3.1 shows gear pump with external gears [1].

**2.3.2** [**Vane pump**](http://en.wikipedia.org/wiki/Rotary_vane_pump)

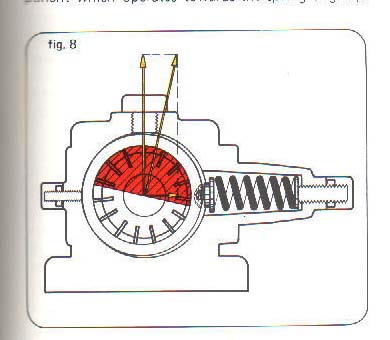


Figure 2.3.2 Vane pump

This is cheap and simple, reliable (especially in gerotor form). Good for higher flow low pressure output. The advantages of the vane pumps are more efficient than the gear pump. They can be operated even with moderate contamination of the fluid. They are suitable for 30 to 130 bar pressure operations. The figure 2.3.2 shows the vane pump [1].

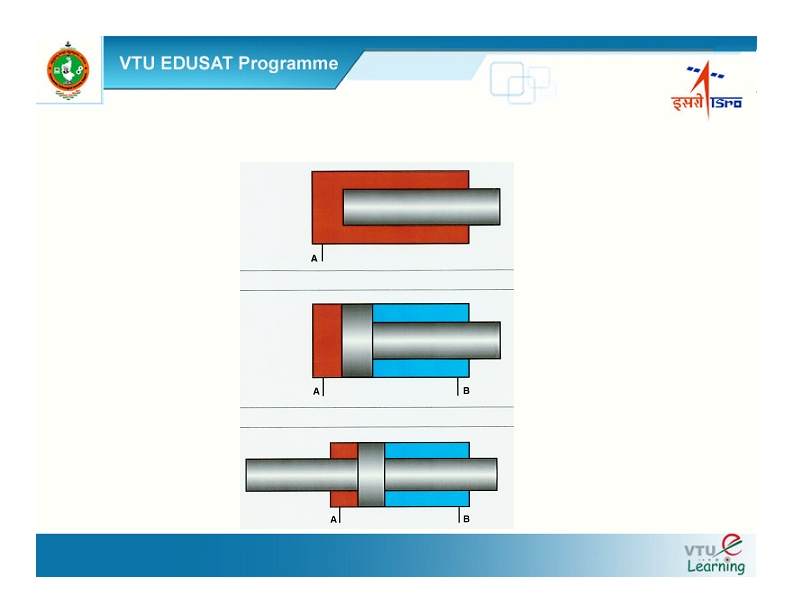
**2.3.3** [**Axial piston pump**](http://en.wikipedia.org/wiki/Axial_piston_pump)

Figure 2.3.3 Axial piston pump

This is designed with a variable displacement mechanism, to vary output flow for automatic control of pressure. There are various axial piston pump designs, including swashplate (sometimes referred to as a valveplate pump) and checkball (sometimes referred to as a wobble plate pump). The most common is the swashplate pump. A variable-angle [swash plate](http://en.wikipedia.org/wiki/Axial_piston_pump) causes the pistons to reciprocate. The figure 2.3.3 shows the axial piston pump where A is input and B is output [1].

**2.3.4** [**Radial piston pump**](http://en.wikipedia.org/w/index.php?title=Radial_piston_pump&action=edit)

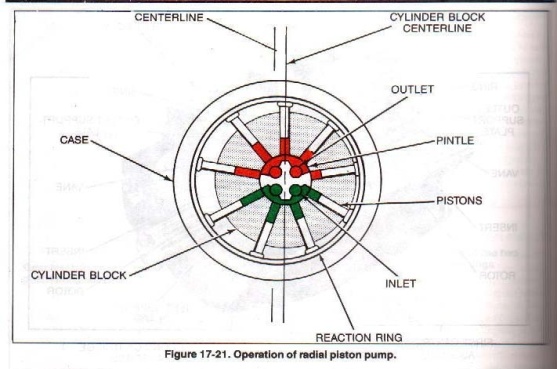


Figure 2.3.4 Radial piston pump

This pump is normally used for very high pressure at small flows. The pistons are parallel to the axis of rotation. The incase radial piston pumps, the pistons are located radially around the pump axis. Hence the name radial piston pumps. The figure 2.3.4 shows the radial piston pump [1]

**2.4 Control valves**

**2.4.1** [**Directional control valves**](http://en.wikipedia.org/w/index.php?title=Directional_control_valve_%28hydraulics%29&action=edit)

These valves route the fluid to the desired actuator. They usually consist of a spool inside a [cast iron](http://en.wikipedia.org/wiki/Iron) or [steel](http://en.wikipedia.org/wiki/Steel) housing. The spool slides to different positions in the housing, intersecting grooves and channels route the fluid based on the spools position.

The spool has a central (neutral) position maintained with springs; in this position the supply fluid is blocked, or returned to tank. Sliding the spool to one side routes the hydraulic fluid to an actuator and provides a return path from the actuator to tank. When the spool is moved to the opposite direction the supply and return paths are switched. When the spool is allowed to return to neutral (center) position the actuator fluid paths are blocked, locking it in position.

Directional control valves are usually designed to be stackable, with one valve for each hydraulic cylinder, and one fluid input supplying all the valves in the stack.

Tolerances are very tight in order to handle the high pressure and avoid leaking, spools typically have a [clearance](http://en.wikipedia.org/wiki/Hydraulic_clearance) with the housing of less than a thousandth of an inch. The valve block will be mounted to the machine’s frame with a three point pattern to avoid distorting the valve block and jamming the valve’s sensitive components.

The spool position may be actuated by mechanical levers, hydraulic pilot pressure, or [solenoids](http://en.wikipedia.org/wiki/Solenoid) which push the spool left or right. A [seal](http://en.wikipedia.org/wiki/O-ring) allows part of the spool to protrude outside the housing, where it is accessible to the actuator.

The main valve block is usually a stack of off the shelf directional control valves chosen by flow capacity and performance. Some valves are designed to be proportional (flow rate proportional to valve position), while others may be simply on-off. The control valve is one of the most expensive and sensitive parts of a hydraulic circuit [1, 2].

**2.4.2** [**Pressure relief valves**](http://en.wikipedia.org/wiki/Pressure_relief_valve)

These are used in several places in hydraulic machinery; on the return circuit to maintain a small amount of pressure for brakes, pilot lines, etc… On hydraulic cylinders, to prevent overloading and hydraulic line/seal rupture. On the hydraulic reservoir, to maintain a small positive pressure this excludes moisture and contamination.

**2.4.3** [**Pressure reducing valves**](http://en.wikipedia.org/w/index.php?title=Pressure_reducing_valve_%28hydraulic%29&action=edit)

They reduce the supply pressure as needed for various circuits.

**2.4.4** [**Sequence valves**](http://en.wikipedia.org/w/index.php?title=Sequence_valve_%28hydraulic%29&action=edit)

The sequence valves control the sequence of hydraulic circuits; to insure that one hydraulic cylinder is fully extended before another starts its stroke.

**2.4.5** [**Shuttle valves**](http://en.wikipedia.org/w/index.php?title=Shuttle_valve_%28hydraulic%29&action=edit)

It provides a logical [or](http://en.wikipedia.org/wiki/Logical_disjunction) functions.

**2.4.6** [**Check valves**](http://en.wikipedia.org/wiki/Check_valve)

These are one way valves, allowing an accumulator to charge and maintain its pressure after the machine is turned off.

**2.4.7** [**Pilot controlled check valves**](http://en.wikipedia.org/w/index.php?title=Pilot_controled_Check_valve&action=edit)

One way valve can be opened (for both directions) by a foreign pressure signal. Often the foreign pressure comes from the other pipe that is connected to the motor or cylinder.

**2.4.8** [**Counterbalance valves**](http://en.wikipedia.org/w/index.php?title=Counterbalance_valve_%28hydraulic%29&action=edit)

A counterbalance valve is in fact a special type of pilot controlled check valve. Whereas the check valve is open or closed, the counterbalance valve acts a bit like a pilot controlled flow control.

**2.4.9** [**Cartridge valves**](http://en.wikipedia.org/w/index.php?title=Cartridge_valve_%28hydraulic%29&action=edit)

It is in fact the inner part of a check valve; they are off the shelf components with a standardized envelope, making them easy to populate a proprietary valve block. They are available in many configurations; on/off, proportional, pressure relief, etc. They generally screw into a valve block and are electrically controlled to provide logic and automated functions.

**2.4.10 Auxiliary valves**

Complex hydraulic systems will usually have auxiliary valve blocks to handle various duties unseen to the operator, such as accumulator charging, cooling fan operation, air conditioning power, etc… They are usually custom valves designed for the particular machine, and may consist of a metal block with ports and channels drilled. Cartridge valves are threaded into the ports and may be electrically controlled by switches or a microprocessor to route fluid power as needed.

**2.4.11 Relief valve**

This is s manual control valve, which is opened by unscrewing the bolt which is in the way of the ball port again pressed to the port by the pressure of the spring. When unscrewed, the spring tension is released on the ball due to which the ball retracts back from the port making the way to the oil to enter the tank chamber [1].

**2.5 Details of non return valve:**

The non return valve is required in this system to with hold the pressure in the suction chamber when ready for the downward stroke of the handle yoke. The construction of this type of valve is a port which is blocked by the ball which is held against the port by the spring pressure. The pressure is such that when suction is carried, the spring tension is less compared to the suction force due to which the oil from the tank enters the suction chamber, when suction is completed, the oil pressure is more which forces the ball to close on the port.

**2.5.1** [**Hydraulic fuses**](http://en.wikipedia.org/wiki/Fuse_(hydraulic))

These are in-line safety devices designed to automatically seal off a hydraulic line if pressure becomes too low, or safely vent fluid if pressure becomes too high [1].

**2.6 Cylinders**

As per their functions, cylinders are classified as

**2.6.1 Single acting cylinders**

In these, the oil pressure is fed only on one side of the cylinder either during extension or retraction. When the oil pressure is cut-off, these cylinders return to the normal position either by a spring or by an external load.

**2.6.2 Double acting cylinders**

These are operated by applying oil pressure to the cylinder in both directions. Due to inherent mechanical problems associated with the spring, single acting cylinders with spring return are not used in applications using larger stroke lengths. They may be either single rod ended or double rod ended type.

**2.6.3 Plunger or ram cylinders**

These are used as a single acting cylinder in a vertical position so that the load on the cylinder can retract when the oil supply is stopped. E.g. Cylinders used as lifts in automobile service stations.

**2.6.4 Telescoping cylinders**

These cylinders provide long working strokes in a short retracted envelope and are used in mobile applications such as tilting of truck dump bodies and fork lift trucks, hydraulic cranes etc.

**2.6.5 Cable cylinders**

These are double acting cylinders that can be powered either pneumatically or hydraulically and find usage in applications requiring relatively long strokes and moderate forces and can be operated in limited spaces.

**2.6.7 Diaphragm cylinders**

These are often used in pneumatic applications and are either of the rolling diaphragm or flat diaphragm type. They have very low break-out friction with absolute zero leak across the piston.

**2.6.8 Bellows cylinders**

These are used for very low force applications in sensitive pneumatic control systems. The pressure and the spring rate of the bellows determine the amount of tension and contraction and may be used for basic servo-control systems since metal bellows have a linear spring rate.

**2.6.9 Tandem cylinders**

These are commonly used in hydraulic and pneumatic systems, two cylinders are mounted in line with the pistons connected to a common piston rod in order to multiply the force in a limited lateral space [1].

**2.7 Hydraulic fluid or oil**

Hydraulic fluids or liquids are the medium by which power is transferred in hydraulic machinery. Common hydraulic fluids are based on mineral oil or water**.** The primary function of a hydraulic fluid is to convey power. In use, however, there are other important functions of hydraulic fluid such as protection of the hydraulic machine components from corrosion, wear and tear etc [5].

**2.7.1 Composition**

**Base stock:** Base stock may be any of: [castor oil](http://en.wikipedia.org/wiki/Castor_oil), [glycol](http://en.wikipedia.org/wiki/Glycol), [esters](http://en.wikipedia.org/wiki/Ester), [ethers](http://en.wikipedia.org/wiki/Ether), [mineral oil](http://en.wikipedia.org/wiki/Mineral_oil), [organophosphate ester](http://en.wikipedia.org/w/index.php?title=Organophosphate_ester&action=edit&redlink=1), [polyalphaolefin](http://en.wikipedia.org/wiki/Polyalphaolefin), [propylene glycol](http://en.wikipedia.org/wiki/Propylene_glycol), or [silicone](http://en.wikipedia.org/wiki/Silicone).

## 2.7.2 Other components

## Hydraulic fluids can contain a wide range of chemical compounds, including: [oils](http://en.wikipedia.org/wiki/Oil), [butanol](http://en.wikipedia.org/wiki/Butanol), esters (e.g. [adipates](http://en.wikipedia.org/wiki/Adipate), like [bis(2-ethylhexyl) adipate](http://en.wikipedia.org/wiki/Bis(2-ethylhexyl)_adipate)), [polyalkylene glycols](http://en.wikipedia.org/w/index.php?title=Polyalkylene_glycol&action=edit&redlink=1) (PAG), [phosphate esters](http://en.wikipedia.org/wiki/Organophosphate) (e.g. [tributylphosphate](http://en.wikipedia.org/wiki/Tributylphosphate)), silicones, alkylated aromatic hydrocarbons, polyalphaolefins (PAO) (e.g. [polyisobutenes](http://en.wikipedia.org/wiki/Polyisobutene)), [corrosion inhibitors](http://en.wikipedia.org/wiki/Corrosion_inhibitor), etc.

## The table below lists the major functions of a hydraulic fluid and the properties of a fluid that affect its ability to perform that function.

|  |  |
| --- | --- |
| **Function** | **Property** |
| Medium for power transfer and control | * Low compressibility (high bulk modulus) * Fast air release |
| Medium for heat transfer | * Good thermal capacity and conductivity |
| Sealing Medium | * Adequate viscosity and viscosity index * Shear stability |
| Lubricant | * Viscosity for film maintenance * Low temperature fluidity |
| Pump efficiency | * Proper viscosity to minimize internal leakage * High viscosity index |

Table 2.7.2 Functions and properties of hydraulic fluid

**2.7.3 Biodegradable hydraulic fluids**

Environmentally sensitive applications (e.g. [farm tractors](http://en.wikipedia.org/wiki/Tractor#power_and_transmission) and marine [dredging](http://en.wikipedia.org/wiki/Dredging)) may benefit from using biodegradable hydraulic fluids based upon [rapeseed](http://en.wikipedia.org/wiki/Rapeseed) ([Canola](http://en.wikipedia.org/wiki/Canola)) [vegetable oil](http://en.wikipedia.org/wiki/Vegetable_oil#industrial_uses) when there is the risk of an [oil spill](http://en.wikipedia.org/wiki/Oil_spill) from a ruptured oil line. Typically these oils are available as [ISO](http://en.wikipedia.org/wiki/International_Organization_for_Standardization) 32, ISO 46, and ISO 68 specification oils. [ASTM](http://en.wikipedia.org/wiki/ASTM) standards ASTM-D-6006, Guide for Assessing Biodegradability of Hydraulic Fluids and ASTM-D-6046, Standard Classification of Hydraulic Fluids for Environmental Impact are relevant [1].

**2.7.4 Brake fluid**

[Brake fluid](http://en.wikipedia.org/wiki/Brake_fluid) is a subtype of hydraulic fluid with high [boiling point](http://en.wikipedia.org/wiki/Boiling_point) and low [freezing point](http://en.wikipedia.org/wiki/Freezing_point). It is intentionally [hygroscopic](http://en.wikipedia.org/wiki/Hygroscopic), so that it will absorb water which could otherwise cause corrosion of brake system components [1].

**2.7.5 Safety**

Because industrial hydraulic systems operate at hundreds to thousands of psi and temperatures reaching hundreds of degrees celsius, severe injuries and death can result from component failures and care must always be taken when performing maintenance on hydraulic systems. Fire resistance is a property available with specialized fluids.

Trade names: Some of the trade names for hydraulic fluids include Durad, Fyrquel, Houghton-Safe, Hydraunycoil, Lubritherm Enviro-Safe, Pydraul, Quintolubric, Reofos, Reolube, and [Skydrol](http://en.wikipedia.org/wiki/Skydrol) [1].

### 2.8 Tubes, pipes and hoses

Hydraulic [tubes](http://en.wikipedia.org/wiki/Tubing_(material)) are seamless steel precision pipes, specially manufactured for hydraulics. The tubes have standard sizes for different pressure ranges, with standard diameters up to 100mm. The tubes are supplied by manufacturers in lengths of 6m, cleaned, oiled and plugged. The tubes are interconnected by different types of flanges (especially for the larger sizes and pressures), welding cones (with o-ring seal), and several types of flare connection and by cut-rings. In larger sizes, hydraulic pipes are used. Direct joining of tubes by welding is not acceptable since the interior cannot be inspected.

Hydraulic [pipe](http://en.wikipedia.org/wiki/Pipe_(material)) is used in case standard hydraulic tubes are not available. Generally these are used for low pressure. They can be connected by threaded connections, but usually by welds. Because of the larger diameters the pipe can usually be inspected internally after welding. [Black pipe](http://en.wikipedia.org/w/index.php?title=Black_pipe&action=edit) is [non-galvanized](http://en.wikipedia.org/wiki/Galvanization) and suitable for [welding](http://en.wikipedia.org/wiki/Welding).

Hydraulic [hose](http://en.wikipedia.org/wiki/Hose_(tubing)) is graded by pressure, temperature, and fluid compatibility. Hoses are used when pipes or tubes cannot be used, usually to provide flexibility for machine operation or maintenance. The hose is built up with rubber and steel layers. A rubber interior is surrounded by multiple layers of woven wire and rubber. The exterior is designed for abrasion resistance. The bend radius of hydraulic hose is carefully designed into the machine, since hose failures can be deadly, and violating the hose’s minimum bend radius will cause failure. Hydraulic hoses generally have steel fittings [swaged](http://en.wikipedia.org/wiki/Swaging) on the ends. The weakest part of the high pressure hose is the connection of the hose to the fitting. Another disadvantage of hoses is the shorter life of rubber which requires periodic replacement, usually at five to seven year intervals.

Tubes and pipes for hydraulic applications are internally oiled before the system is commissioned. Usually steel piping is painted outside. Where flare and other couplings are used, the paint is removed under the nut, and is a location where corrosion can begin. For this reason, in marine applications most piping is stainless steel [2].

# 2.9 [Seals](http://en.wikipedia.org/wiki/Seal_(mechanical)), [fittings](http://en.wikipedia.org/wiki/Compression_fitting) and connections

In general, [valves](http://en.wikipedia.org/wiki/Valve), [cylinders](http://en.wikipedia.org/wiki/Cylinder_(engine)) and [pumps](http://en.wikipedia.org/wiki/Pump) have [female](http://en.wikipedia.org/wiki/Gender_of_connectors_and_fasteners) threaded bosses for the fluid connection, and hoses have female ends with captive nuts. A male-male fitting is chosen to connect the two. Many standardized systems are in use. The seals play an important role in the hydraulic systems, since the hydraulic system does not work if there is any leakage in the joints.

Fittings serve several purposes

1. To bridge different standards; [O-ring boss](http://en.wikipedia.org/wiki/O-ring_boss_seal) , or [pipe threads](http://en.wikipedia.org/wiki/Threaded_pipe) to [face seal](http://en.wikipedia.org/w/index.php?title=Face_seal_%28o-ring%29&action=edit), for example.
2. To allow proper orientation of components, a [90°](http://en.wikipedia.org/wiki/Angle), 45°, straight, or swivel fitting is chosen as needed. They are designed to be positioned in the correct orientation and then tightened.
3. To incorporate bulkhead hardware.
4. A quick disconnect fitting may be added to a machine without modification of hoses or valves

A typical piece of heavy equipment may have thousands of sealed connection points and they are of different types

* [**Pipe fittings**](http://en.wikipedia.org/w/index.php?title=Pipe_threads&action=edit)**,** the fitting is screwed in until tight, difficult to orient an angled fitting correctly without over or under tightening.
* [**O-ring boss**](http://en.wikipedia.org/wiki/O-ring_boss_seal), the fitting is screwed into a boss and orientated as needed, an additional nut tightens the fitting, washer and [o-ring](http://en.wikipedia.org/wiki/O-ring) in place.
* [**Flare seal**](http://en.wikipedia.org/w/index.php?title=Flare_seal&action=edit), a metal to metal compression seal with a cone and flare mating.
* [**Face seal**](http://en.wikipedia.org/w/index.php?title=Face_seal_%28o-ring%29&action=edit)**,** metal flanges with a groove and o-ring are fastened together.
* [**Beam seal**](http://en.wikipedia.org/w/index.php?title=Beam_seal&action=edit), a costly metal to metal seal used primarily in aircraft.
* [**Swaged**](http://en.wikipedia.org/wiki/Swage) **seals,** tubes are connected with fittings that are swaged permanently in place. Primarily used in aircraft.

Elastomeric seals (O-ring boss and face seal) are the most common types of seals in heavy equipment and are capable of reliably sealing 6000+ [psi](http://en.wikipedia.org/wiki/Pound-force_per_square_inch) (41368+ [kPa](http://en.wikipedia.org/wiki/Pascal_(unit)#Definition)) of fluid pressure [2].

**2.10 Mild steel**

Mild steel differs from stainless steel in its [chromium](http://www.buzzle.com/articles/chromiumthe-element.html) content. Stainless steel contains a lot more chromium than ordinary carbon or mild steel. Mild steel is a type of steel alloy that contains a high amount of [carbon](http://www.buzzle.com/articles/carbon-the-element.html) as a major constituent.

**2.10.1 Mild steel properties and uses**

Here is a compilation of mild steel properties and its uses in various fields of technology.

* Let us see, what makes the mild steel composition. Other than maximum limit of 2 % carbon in the manufacture of carbon steel, the proportions of manganese (1.65%), [copper](http://www.buzzle.com/articles/copper/) (0.6%) and silicon (0.6%) are fixed, while the proportions of cobalt, chromium, niobium, molybdenum, titanium, nickel, tungsten, vanadium and zirconium are not.
* A high amount of carbon makes mild steel different from other types of steel. Carbon makes mild steel stronger and stiffer than other type of steel. However, the hardness comes at the price of a decrease in the ductility of this alloy. Carbon atoms get affixed in the interstitial sites of the iron lattice and make it stronger.
* What is called as mildest grade of carbon steel or ‘mild steel’ is typically carbon steel, with a comparatively mild amount of carbon (0.16% to 0.19%). It has ferromagnetic properties, which make it ideal for manufacture of electrical devices and motors.
* The calculated average industry grade mild steel density is 7.85 gm/cm3. Its Young’s modulus, which is a measure of its stiffness, is around 210,000 Mpa.
* Mild steel is the cheapest and most versatile form of steel and serves every application which requires a bulk amount of steel.
* The high amount of carbon also makes mild steel vulnerable to rust. Naturally, people prefer stainless steel over mild steel, when they want a rust free technology. Mild steel is also used in construction as structural steel. It is also widely used in the car manufacturing industry [3].

**2.11 Springs**

A spring is an [elastic](http://en.wikipedia.org/wiki/Elasticity_%28physics%29) object used to store mechanical [energy](http://en.wikipedia.org/wiki/Energy). Springs are usually made out of [hardened steel](http://en.wikipedia.org/wiki/Hardened_steel). Small springs can be wound from pre-hardened stock, while larger ones are made from [annealed](http://en.wikipedia.org/wiki/Annealing_%28metallurgy%29) steel and hardened after fabrication. Some [non-ferrous metals](http://en.wikipedia.org/wiki/Ferrous) are also used including [phosphor bronze](http://en.wikipedia.org/wiki/Phosphor_bronze) and [titanium](http://en.wikipedia.org/wiki/Titanium) for parts requiring corrosion resistance and [beryllium copper](http://en.wikipedia.org/wiki/Beryllium_copper) for springs carrying electrical current (because of its low electrical resistance). A typical type of coil spring is shown in figure 2.11.1 below [6].



Figure 2.11.1 Spring descriptions

**2.11.1 Leaf spring**

America when the move to front wheel drive, and more sophisticated suspension designs saw automobile manufacturers use coil springs instead. Today leaf springs are still used in heavy commercial vehicles such as vans and trucks and railway carriages. For heavy vehicles, they have the advantage of spreading. Leaf springs were very common on automobiles, right up to the 1970s in Europe and Japan and late 70's in the load more widely over the vehicle's chassis, whereas coil springs transfer it to a single point. Unlike coil springs, leaf springs also locate the rear axle, eliminating the need for trailing arms and a panhard rod, thereby saving cost and weight in a simple live axle rear suspension [6].

**2.11.2 Torsion beam suspension spring**

A torsion beam suspension is a vehicle [suspension](http://en.wikipedia.org/wiki/Suspension_%28vehicle%29) similar to a [trailing arm](http://en.wikipedia.org/wiki/Trailing_arm) suspension but where both trailing arms are connected by a beam. In contrast to a [torsion bar suspension](http://en.wikipedia.org/wiki/Torsion_bar_suspension), the main weight bearing springs are usually coil springs, either mounted over the [shock absorbers](http://en.wikipedia.org/wiki/Shock_absorber) or independently from them. Obviating [anti-roll bars](http://en.wikipedia.org/wiki/Anti-roll_bar), the central torsion beam allows for a limited degree of freedom of each wheel when forced [6].

**2.11.3 Coil suspension spring**

A Coil spring, also known as a helical spring, is a mechanical device, which is typically used to store energy and subsequently release it, to absorb shock, or to maintain a force between contacting surfaces. They are made of an elastic material formed into the shape of a helix which returns to its natural length when unloaded. Coil springs are a special type of torsion spring. Metal coil springs are made by winding a wire around a shaped former - a cylinder is used to form cylindrical coil springs [6].

**2.12 Summary**

The main expectations of coconut customers are to have high quality product. That means the farmers should provide more qualitative products. Along with the quality, the farmer also needs high capacity and most efficient equipment for more productivity.

But from the above discussions we came to know that the machines available are not much economical. The hydraulic systems are easily usable, economical and we can get a large force at the output by applying small input force. Hence we conclude some of the design criteria to fabricate an economical and perfect working coconut dehusking machine.

Thus the following design criteria’s have to be fulfilled to reach farmers goal

1. The quality of peeled coconut is the main criteria.
2. The dehusking capacity of machine per hour.
3. Contamination of coconut with lubricating system of the machine.
4. Collection of properly peeled coconut
5. Collection of separated husk.
6. The requirement of manpower.
7. The volume occupied by the machine.
8. The electrical power requirement.
9. Flexibility of machine with respect to handling.

**Chapter 3**

**Part Descriptions**

**3.1 General**

This chapter reviews about the major parts involved in coconut dehusking machine. The uses of those parts in this machine along with the drawings are to be explained in detail. These parts are explained along with the dimensions as required for this machine.

**3.2 Major parts**

To introduce this mechanism to coconut dehusking operation the main components that we have made use are

* Hydraulic pump
* Springs
* Coconut holders
* Ram
* Cylinder or hone tube
* Reservoir tube
* Plunger
* Poker arm

**3.2.1 Hydraulic pump**

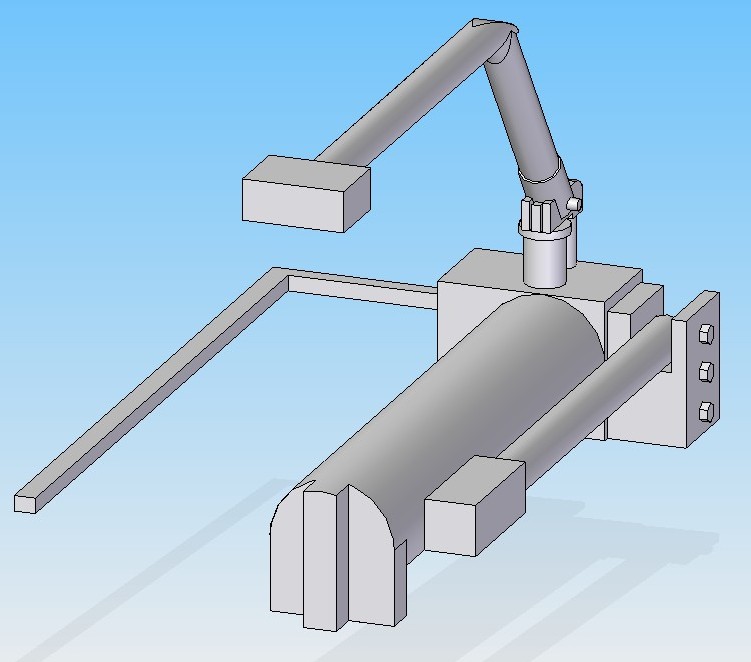
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Figure 3.2.1 Model of a hydraulic pump

Hydraulic pump supplies fluid to the components in the system. Pressure in the system develops in reaction to the load. Hence a pump rated for 1000psi is capable of maintaining flow against a load of 1000psi. This hydraulic pump has a power density about ten times greater than an electric motor. It has a foot operated pedal for pumping of the oil to the cylinder. Also it has a foot operated pressure relief valve. It has two non return valves to control the flow of oil.

**3.2.2 Springs**

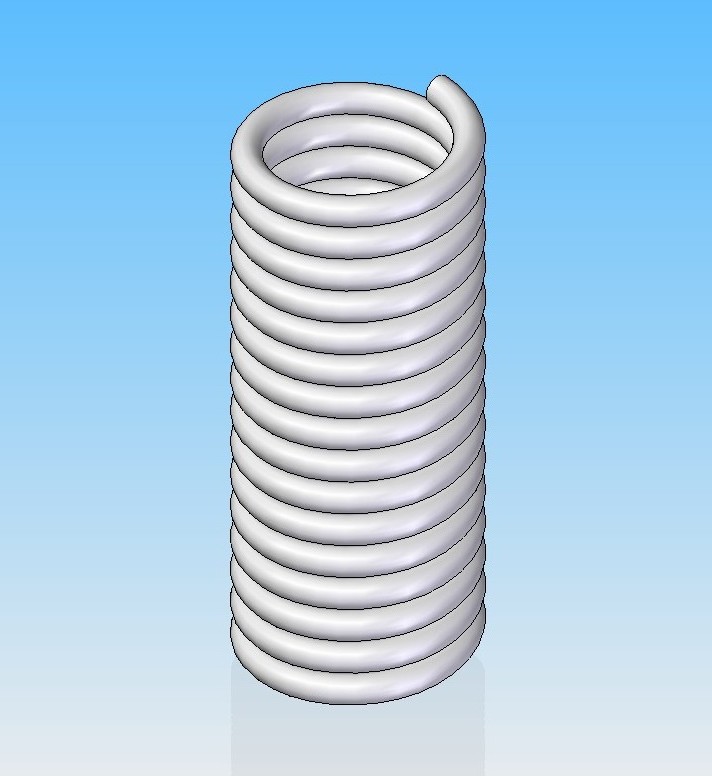
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Figure 3.2.2 Model of a spring

In this project we have used 5 numbers of springs. In that 3 are tensile and remaining 2 are compressive springs. All the 5 springs are made up of spring steel material. The 2 tensile springs used in the front are of same type and same dimensions and 2 compressive springs used at the top are also of equal dimensions.

The dimensions of the springs used are listed below

The dimensions of bottom 2 tensile springs are

Outer diameter of the spring **----->** 39mm

Diameter of the wire **----->** 6mm

Free length of the spring **----->** 280mm

Number of active coils **----->** 40

The dimensions of bottom backside tensile spring is

Outer diameter of the spring **----->** 52mm

Diameter of the wire **----->** 6mm

Free length of the spring **----->** 455mm

Number of active coils **----->** 59

The dimensions of top 2 compressive springs are

Outer diameter of the spring **----->** 47mm

Diameter of the wire **----->** 6mm

Free length of the spring **----->** 220mm

Number of active coils **----->** 17

**3.2.3 Coconut holders**



Figure 3.2.3 Model of a coconut holder

These are used to hold the coconut during dehusking. Three coconut holders are used in setup. These holders are made up of mild steel. The holder end is made circular to hold the coconut tightly and the outer shape is in “Y” shape for external lock. The diameters of these circular holders are 40mm each. These holders are connected directly to the cylinder ram through the links.

**3.2.4 Ram**

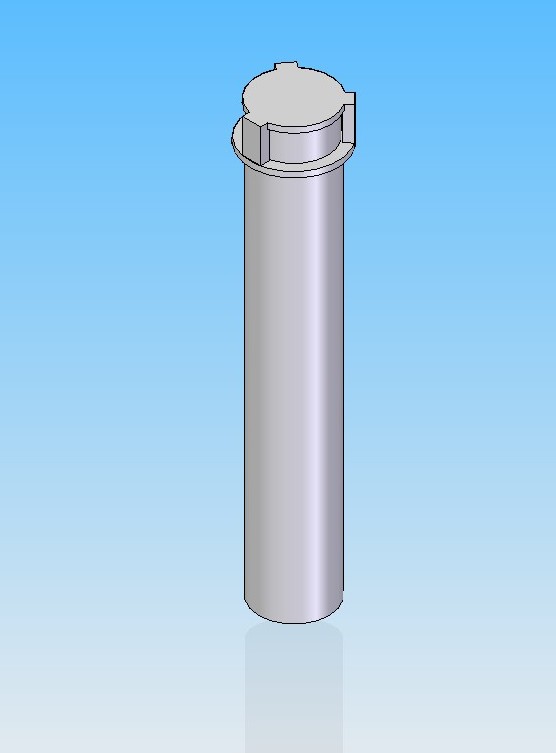


Figure 3.2.4 Model of a ram

Ram comes out of the cylinder and it supplies the power produced from the hydraulic pump to the parts of the machine. During the idle position of the machine ram will be inside the cylinder or hone tube. This is made out of EN8 steel (an unalloyed medium carbon steel with good tensile strength) round bar of diameter 52mm cut for the length of 290mm and being rough turned on lathe machine to maintain the diameter as 50.2mm, 49.5mm, 42mm groove for the width of 12mm, 46.8mm step diameter for the length of 35mm. It is then drilled from one side to tap M12 for the depth of 25mm to lock the bolt with the moving jaw. The undercut is done for the diameter of 49.5mm to be convenient for external grinding. This ram is then loaded for external grinding to make the diameter as 49.95mm collar, 49.00mm, 46.4mm, and 44.00 mm.

**3.2.5 Cylinder or hone tube**

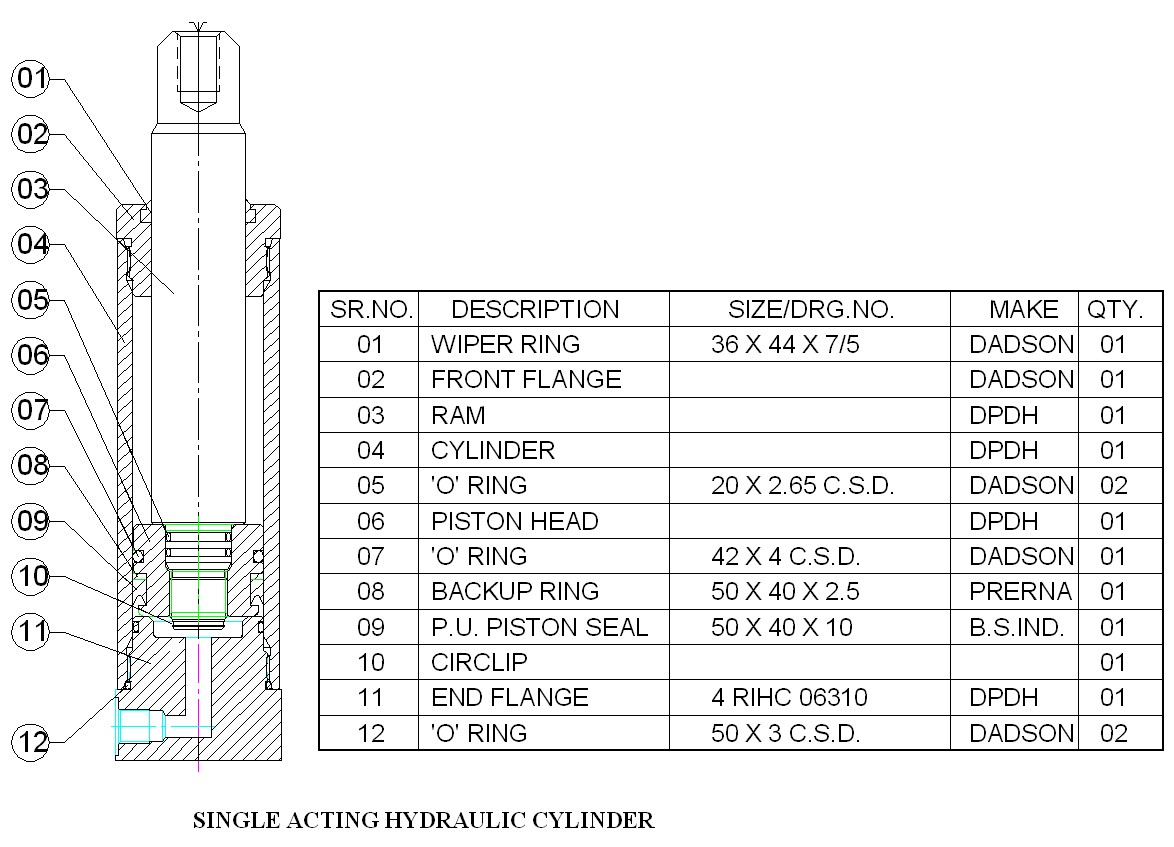


Figure 3.2.5 Part details of a single acting hydraulic cylinder

Hydraulic cylinders are actuation devices that utilize pressurized hydraulic fluid to produce linear motion and force. Important operating specifications for hydraulic cylinders include the cylinder type, stroke, maximum operating pressure, bore diameter, and rod diameter. This is made out of round bar of Mild steel of diameter 65mm cut for the length of 280mm and turned on lathe machine to make the diameter as 60mm for the length of 275mm and internal bore as 50mm for the entire length. End chamfer is done on internal bore for 3mmx30degree at both the ends and from outside at both the ends threading is done of size M60x2mm for the length of 26mm from both the ends. Then internal grinding is done to suit it to the diameter of 50.00mm. It is then honed on honing machine for 50.00mm diameter.

**3.2.6 Reservoir tube**

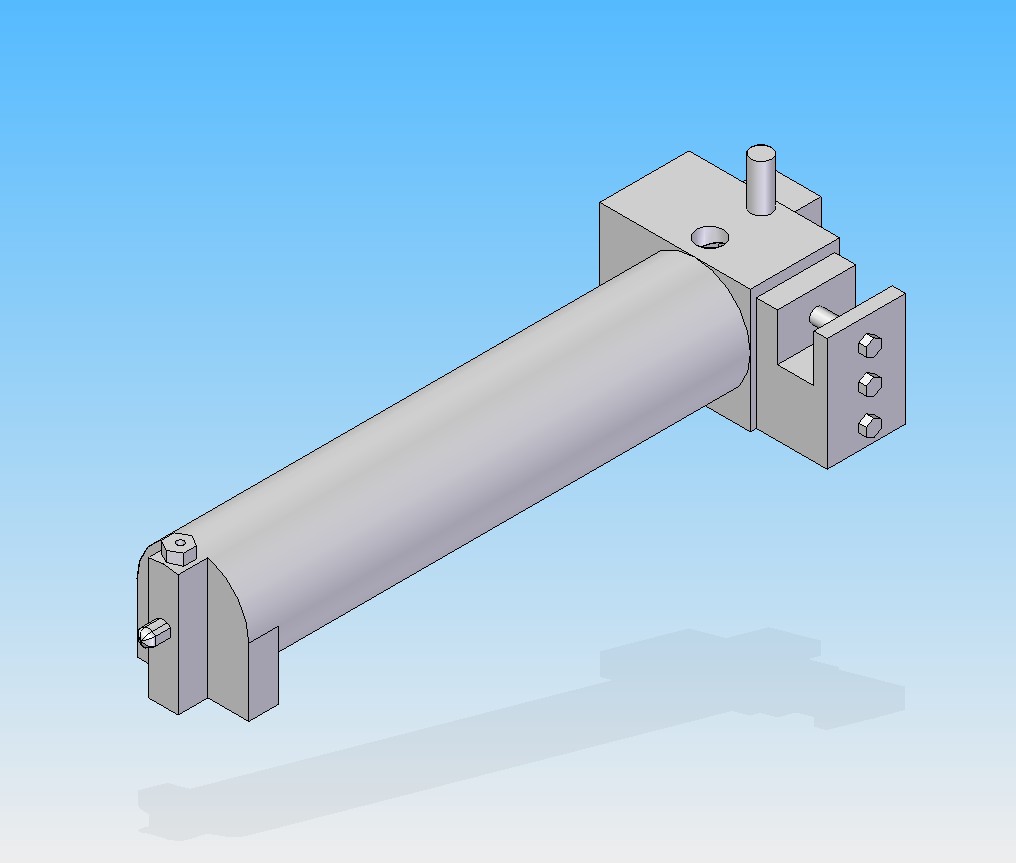


Figure 3.2.6 Model of a reservoir tube

Reservoir tube is used for the storage of the hydraulic oil inside the pump. This is made out of mild steel tube of diameter 76mm with internal diameter of 68mm cut for the length of 110mm and being faced on lathe machine to maintain the length as 150mm and end chamfer is machined for outside diameter as 0.5mmx45degree. It is counter bored for the diameter 70.15mm for the depth of 14mm at both the sides and then counter bored for the size of 3mmx30degree.

**3.2.7 Plunger**

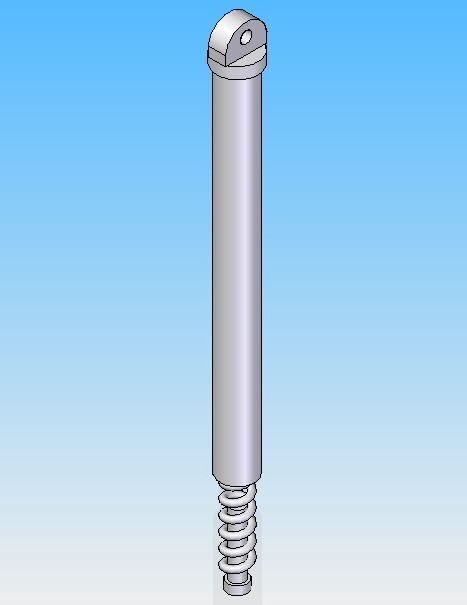
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Figure 3.2.7 Model of a plunger

This is made out of EN8 round bar of diameter 25mm being cut for the length of 100mm and turned on lathe machine to make the diameter as 24.6mm and step diameter of 20.8mm for the length of 60mm and undercut is made of diameter 17mm and the end radius is made with radius 13mm to end at the diameter as 13.5mm at 20.8mm diameter side. This is then ground on cylindrical grinding machine to make the diameter as 20.00mm.

**3.2.8 Poker arm**

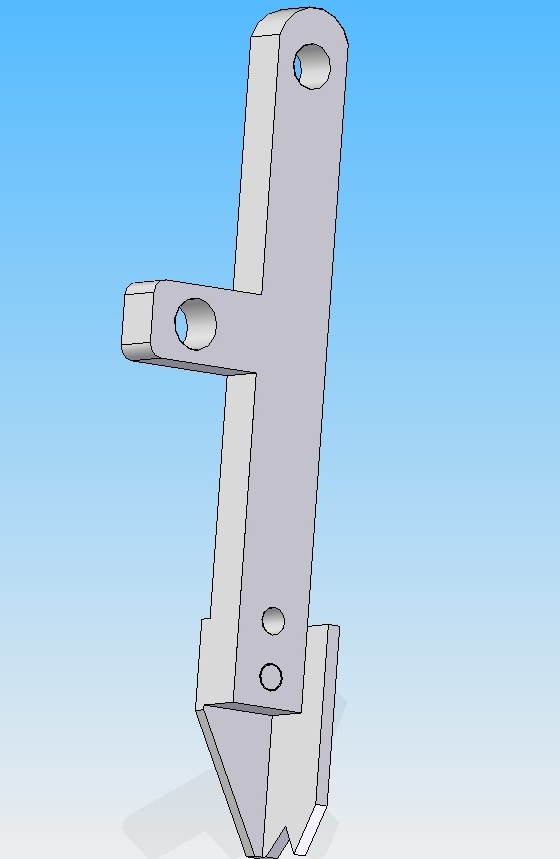
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Figure 3.2.8 Model of a poker arm

The poker is a part used to peel the coconut husk. This is made up of the mild steel material. The tip of the poker is made sharper to pierce into the coconut husk. The other end of the poker is fitted to upper assembly by using bolt and nut, which gives provision for oscillation of the poker. The middle portions of these pokers are connected to the movable ring by the links. There are 6 numbers of pokers which are fitted in a radius of 65mm to upper assembly and the poker is about 200mm long. Another link connects the poker to the holding ring which is of 80mm and it is connected to the poker at a distance of 110mm from the tip of the poker. The thickness of the poker is 10mm. The holes are drilled in the poker to fit to the assembly by using the nuts and bolts.

**3.3 Summary:**

The complete details about major parts used in coconut dehusking machine are mentioned above. The uses of parts with the dimensions are detailed in this chapter. Also it gives idea about the preparation and availability of these parts along with the 3D drawing for each part.

**Chapter 4**

**Design and Calculations**

**4.1 General**

In this chapter the design and calculations of the parts are to be included.

**4.2 Hydraulic pump design**

Maximum working pressure= 600bar.

Diameter of the plunger= 20mm.

Diameter of ram/cylinder at the vice= 50mm.

The pressure put on the piston of the pump is to be calculated considering the pressure arm length and the pressure applied on the arm pedal, say approximately 30kg. Considering the leverage the approximate force on the piston may be 90kg which is to be termed as the pressure on piston. Calculating the area of the piston of the pump with force, we will get the working pressure of the fluid which is to be used for the clamping force resulted at the vice jaws, considering the diameter of the ram as 36mm.

Diameter of the pump piston= 2 cm.

Area of master cylinder= 3.143/4 × (2)2= 3.141cm2

Pressure arm of foot pedal= 30cm.

Force arm of foot pedal = 10cm.

Assuming pressure applied on foot pedal = 30kg.

Pressure arm x pressure= force arm × force.

30 × 30 = 10 × force.

Force = 30×( 30%10) = 90kg.

**Pressure in the pump**

Fluid pressure = force/area = 90/3.141 = 28.65 kg/cm2

Force at the ram coming out of the cylinder = pressure × area of vice ram.

Area of cylinder=10.18 cm2

28.65×10.18=291.65kgf

This is force by the ram in kg when we are applying 30kg load on the foot pedal. If the load put on the foot pedal is more, we will get more pressure.

**4.3 Design of front lower spring**

Deflection of a spring, y= 100mm

Total force on the spring, W= 2855N

Force on the individual spring, W= 1427.5N

We have space limit, Do= 40mm

But D= Do –d

D= 40 – d 4.1[4]

Assuming the material as high carbon steel,

We get ultimate tensile strength= 1380 M N/m2

= 1380 N/mm2

Shear stress, fs =

=690 N/mm2

We have,

W = 4.2[4]

1427.5=

d= 5.66 mm ≈ 6 mm

From equation 4.1

D= –d

D= 34mm

We have,

Modulus of rigidity, G= 0.07845×106 N/mm2

= 78.45× 103 N/mm2

The number of active coils in the spring, i = 4.3[4]

i =

i = 22.65 ≈ 23

For safer design, we have taken i= 40

Spring scale or rate,

4.4[4]

Fo =

Fo = 14.06 N/mm

We have, spring index C=

= 5.66

From Design data hand book [4]

We get,

x = 0.15

Clearance in mm, a= d × x × i

=6 × 0.15 × 40

= 36mm

Free length of the spring, lo= (i+2)d + y + a 4.5[4]

= (40 + 2)6 + 100 + 36

=388mm

**4.4 Design of back side lower spring**

Deflection of a spring, y= 100mm

Total force on the springs, W= 2855N

Force on the individual spring, W= 952N

We have Space limit, Do= 55mm

But D= Do – d

D= 55-d 4.6[4]

Assuming the material as high carbon steel,

We get ultimate tensile strength= 1380 M N/mm2

= 1380 N/mm2

Shear stress, fs =

= 690 N/mm2

We have,

W = 4.7[4]

952 =

d = 5.77mm = 6mm

From equation 4.6

D= Do –d

D= 49mm

We have,

Modulus of rigidity, G= 0.07845×106 N/mm2

= 78.45×106N/mm2

The number of active coils in the spring, i = 4.8[4]

i =

i = 11.34

For safer design, we have taken i = 59

Spring scale or rate,

4.9[4]

Fo = 9.52 N/mm

We have, spring index C=

= 8.16

From Design data hand book [4]

We get,

x= 0.19

Clearance in mm, a= d × x × i

= 6×0.19×59

= 67.26mm

Free length of the spring, lo = (i + 2)d + y + a 4.10[4]

= (40 + 2)6 + 100 + 67.26

= 533.26mm

**4.5 Summary**

The full design and related calculations are detailed with units.

**Chapter 5**

**Working Principle and Methodology**

**5.1 General**

Chapter 5 outlines working principle, method of operation of the coconut dehusking machine. The methodology describes how the different parts discussed in chapter 3 are made.

**5.2 Working**

This coconut dehusking machine peels off the coconut husk from coconut fruit to obtain dehusked coconut fruit via mechanically controlled de-husking devices. It consists of a foot operated hydraulic pump, which pumps the oil to the cylinder for the upward movement of the ram. The ram is connected to the coconut holder directly. The coconut is placed on the holder in vertical position. The three coconut holders made of mild steel material are connected to the ram. The coconut holder is moved up by the foot pedal operating the hydraulic pump by the foot lever. The actual force on the plunger will be around 30kg but we feel only about 5kg of force. This is due to the length of the foot lever provided to operate. But the force produced from the hydraulic cylinder will be around ten times the force we apply to the foot lever i.e. around 300kgf force can be obtained from the cylinder. The upward ram movement will move the coconut holder closer to each other to hold the coconut tightly. At this position the hydraulic force will overcome the force exerted by the two tensile springs provided at the front side.

At the upward movement of the foot lever plunger will suck the oil from the tank into the pump chamber through the non return valve provided, which makes the oil to be sucked into the pump cylinder. At this time the release valve is in closed position. The downward stroke of the foot lever plunger will push the oil out through another non return valve which passes through the metal pipe into the cylinder. These pipes are properly sealed and fitted so that no oil will be leaked through the joints. The oil entering and filling the cylinder chamber makes the ram to move out of the cylinder effecting the upward slide of the ram. Since we have used the hydraulic systems we can get about 292kgf of force at the ram end from the force of 30kg that applied to the foot lever plunger.

The coconut holder connecting links are hinged to the coconut base holder and the ram. This coconut base holder is also hinged to the ram which while moving out or upward will make to close down on the bottom of the coconut. The holder ends are sharp which tends to pierce into the base part of the coconut. The arrangement is such that the coconut will be firmly holded at the base holder. There is one more arrangement for adjusting the initial height difference between poker and the base holder. This can be adjusted only while the base holder starts moving in upward direction. At the end of this piercing, the ram touches the coconut base holder which is connected through the body holders and guided in the pillars and bushes. After the holder firmly connects to the coconut for the further foot pedal operation the base coconut holder will move upwards bringing the coconut closer to the poker that will pierce into top portion of the coconut and will stop at a height that adjusted by the adjusting knob.

Further pedal operation will lift the poker arm holding ring effecting the downward slide of the vertical pokers (since the distance between the top assembly and the base reduces) onto the coconut head. The top end of poker arm is rigidly fixed to the top ‘H’ shaped mild steel holder which is connected to the long shaft coming from the base. The connecting links are provided and are connected at the middle of the poker arm to the ring at the top and this ring is connected to the ram and also this ring mounted to the base long shaft for the guide line for the movement. Due to the upward movement of this ring the connecting links will pull the vertical pokers to the side ways. The top assembly will be stationery effecting the pulling of poker links out at 45 degree removing the husk out of the coconut and leaving only the coconut fruit. Due to the 45 degree movement of the poker arm the coconut fruit will not be harmed.

The release of the pumping is effected by another foot lever which through the cranking lever will push the release pin inside. This makes the non return valve to open to return back the oil into the oil reservoir. The return stroke is effected by the two springs provided at the front face and one at the back side connecting the moving base (base gripper) along with the link holder ring. During releasing the top ring will come downward effecting the poker to move upward and poker will come closer to each other. After the ring comes down and seats at a point the coconut base holder will start moving downwards and the coconut holder will leave the coconut shell and settles at the original position. At this time the full length of the ram will be inside the cylinder and oil will be stored inside the reservoir. The process is repeated for the next coconut which is to be dehusked.

**5.3 Methodology**

Most of the parts in this project are prepared by the lathe operation. Various operations like cutting, sanding, knurling, drilling are done by the use of lathe. The shafts are turned on the lathe to get smooth and good surface finish. The height adjusting knob is also turned to get good surface finish. Along with this drilling, milling and shaping machines are also used for many operations. The coconut base holder assembly is cut and shaped by using milling and shaping machines. Different types of drilling machines are used to drill many holes for the seating of bolts and nuts. The drills are done on the links to connect different links each other. The holes on the height adjuster are made by using drilling machine. Most of the parts are given good and smooth surface finish by using shaping machine and by polishing.

The links and poker arms are made for required shape and length by forging operations. The sharper ends for the poker are cut and fixed to the poker by welding. Casting is done to obtain many parts. The top poker holding ring, coconut base holder, top “H” shaped rigidly fixed poker holder are prepared by casting process.

The main operation done on this machine is the welding. All the parts are joined together by welding process. The welding methods used here are arc welding and gas welding. All the separate parts are assembled together by arc welding process. And some spot welding is also done by spot welding process. The links and some other parts are joined by the bolts and nuts.

**5.4 Summary**

This chapter reviewed the working principle of the coconut dehusking machine. It explains the working principle and method of operating the machine. The methodology is explained to review that process of manufacturing of different parts. It is briefed about the different operations in lathe, milling, shaping, and drilling machines.

**Chapter 6**

**Results, Advantages and Disadvantages**

**6.1 General**

This chapter reviews about the results of coconut dehusking machine. The final assembly, working capacity, time of operation etc are to be discussed in this chapter. Also the advantages and disadvantages of this machine are to be briefed.

**6.2 Results**

The coconut dehusking machine prepared by us is operated by hydraulic pump. This hydraulic pump exerts the force ten times more than the force applied on the foot lever. The machine is of 1 feet breadth, 1 feet width and 4 feet height. The whole weight of the machine is about 70 kg. The materials used in this machine are of good quality and durable. And the parts are painted to prevent from rusting. Most of the parts are made from mild steel material and springs are made of spring steel material.

The machine has the capacity to dehusk the coconut of any shape and size. Also the coconut shell of different thickness and hardness can be easily removed by this with a less force. The manually applied force is very less on the foot pedal and the force produced to peel the coconut husk is very high. For a single operation it is taking nearly 1 minute. The machine can dehusk about 50 to 60 coconuts per hour. But if the stroke length is increased it can dehusk about 120 coconuts per hour.

**6.3 Advantages**

* Does not require the use of direct human force as in the normal. Instead it involves the use of hydraulic mechanism and applying force with leverage.
* Hydraulic pump and cylinder is used to enhance the force at the head of the coconut to put pressure on poker assembly.
* It is user friendly, rapid and can be operated safely.
* Small enough to be either carried by two workers or rolled into place.
* Can be conveniently assembled or disassembled.
* Removes husks of various shapes and sizes.
* The coconut shell of any thickness and hardness can be removed easily.
* Can be operated by anyone regardless of age.
* Simple and easy maintenance.
* Does not require lengthy training for the operation and the machine can be understood easily
* Portable.
* De-husks about 60 to 70 coconuts per hour.

**6.4 Disadvantages**

* Since the stroke length is lesser, more pumping has to be done for the operation. This will give stress to the legs of the operator.
* Cost of the machine is little more so for the common man it is difficult to purchase. But compared to other machines this is cheaper.
* The height has to be adjusted manually for the dehusking of different shapes of coconut. It is difficult to adjust every time in a large scale dehusking.
* The hydraulic pump and cylinder should be taken care, so that oil should not be leaked at the joints.

**6.5 Summary**

The results obtained from coconut dehusking machine are briefed in this chapter. The size of the machine is smaller compared to other machines. Also the advantages and disadvantages of this machine is discussed in this chapter.

**Chapter 7**

**Conclusion and Future Enhancements**

In this modern world the time and cost has more weightage for each and every operation. So to overcome this concept we have designed and fabricated the machine named “Coconut dehusking machine” to reduce the cost and to save human energy. By viewing many types of machines like manual, traditional, electronic and other, so we conclude that hydraulic machines is using less human effort. This machine has many advantages over other machines. The cost is less compared to other types of machines and the human power used is also very less. The time consumed by this machine is little more. If we increase the stroke length by external mechanisms we can dehusk quickly about minimum three to four coconuts per minute. Machine can be operated efficiently unskilled labours. In this project we have used very heavy and strong machine parts so as to eliminate the regular maintenance. We conclude that this machine is more useful to the large scale coconut growers and the coconut industry where the large numbers of coconuts are to be dehusked.

**Future enhancement**

* By inserting a booster to the hydraulic pump the stroke length can be increased. The coconut can be dehusked in a less time and more coconuts can be dehusked with less man power.
* By inserting motors for the pedaling operation, the machine can be automated.

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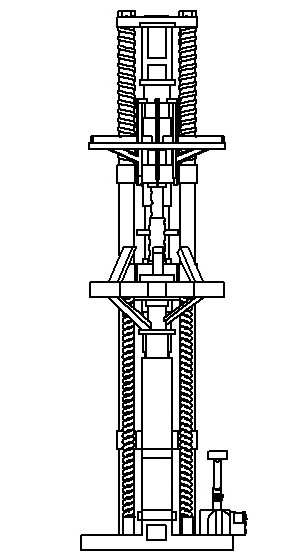
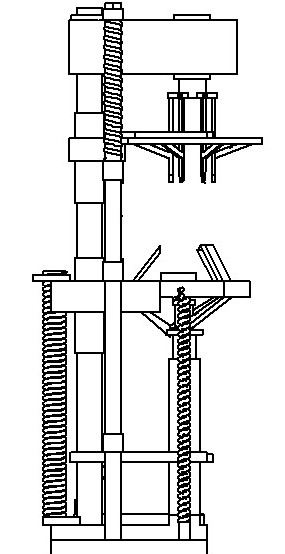
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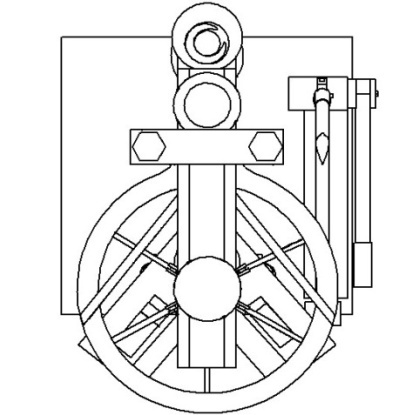
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**Drawings**

** **

Front view Side view

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Top view

Orthographic views of coconut dehusking machine