



**NATIONAL OPEN UNIVERSITY OF NIGERIA**

**FACULTY OF AGRICULTURAL SCIENCES**

**DEPARTMENT  
OF  
Crop and Soil Sciences**

**FPY/SIWES PRACTICAL GUIDE**

**AGM401**  
FARM MECHANIZATION

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## **INTRODUCTION**

The development of the machines used in modern agriculture has brought new demands on farmers, ranchers and other agricultural workers. They must be familiar with energy and mechanical forces and have mechanical skills. It is important that they be able to select machines for specific jobs and know how to safely operate, maintain and repair them. This practical guide will help assist towards achieving this goal. It is a practical guide meant for students in a university setting who are in 300 level and are taking the course “Introduction to Agricultural Mechanization” this course introduces students to the importance use and care of machines in agriculture.

The practical in this booklet are necessary to familiarize students with the working principles of the machines used in agriculture

## **BASIC MACHINES AND THEIR APPLICATIONS IN AGRICULTURAL MECHANIZATION**

Agricultural mechanization is a dynamic trade that involve the use of force to accomplish work. To make agricultural work easier, the use of machines become very important. To start with, let us look at the types of simple machines that are often applicable to most agricultural mechanization works .science has developed these machines to simplify the various work use in agricultural mechanization .There are:

1. The wheel and axle
2. The lever
3. The inclined plane
4. The pulley
5. The screw and
6. The wedge

To accomplished work, force must move certain distance force acting on an object in the direction of motion. This a machine makes work easier to perform by accomplishing are or more of the following functions.

- a. Transferring a force from one place to another
- b. Changing the direction of a force
- c. Increasing the magnitude of a force
- d. Increasing the distance or speed of a force

Simple machines are devices with no, or very few moving parts that make work easier. These machines may look simple, but they provide us with the means to do many things that we could never do without them.

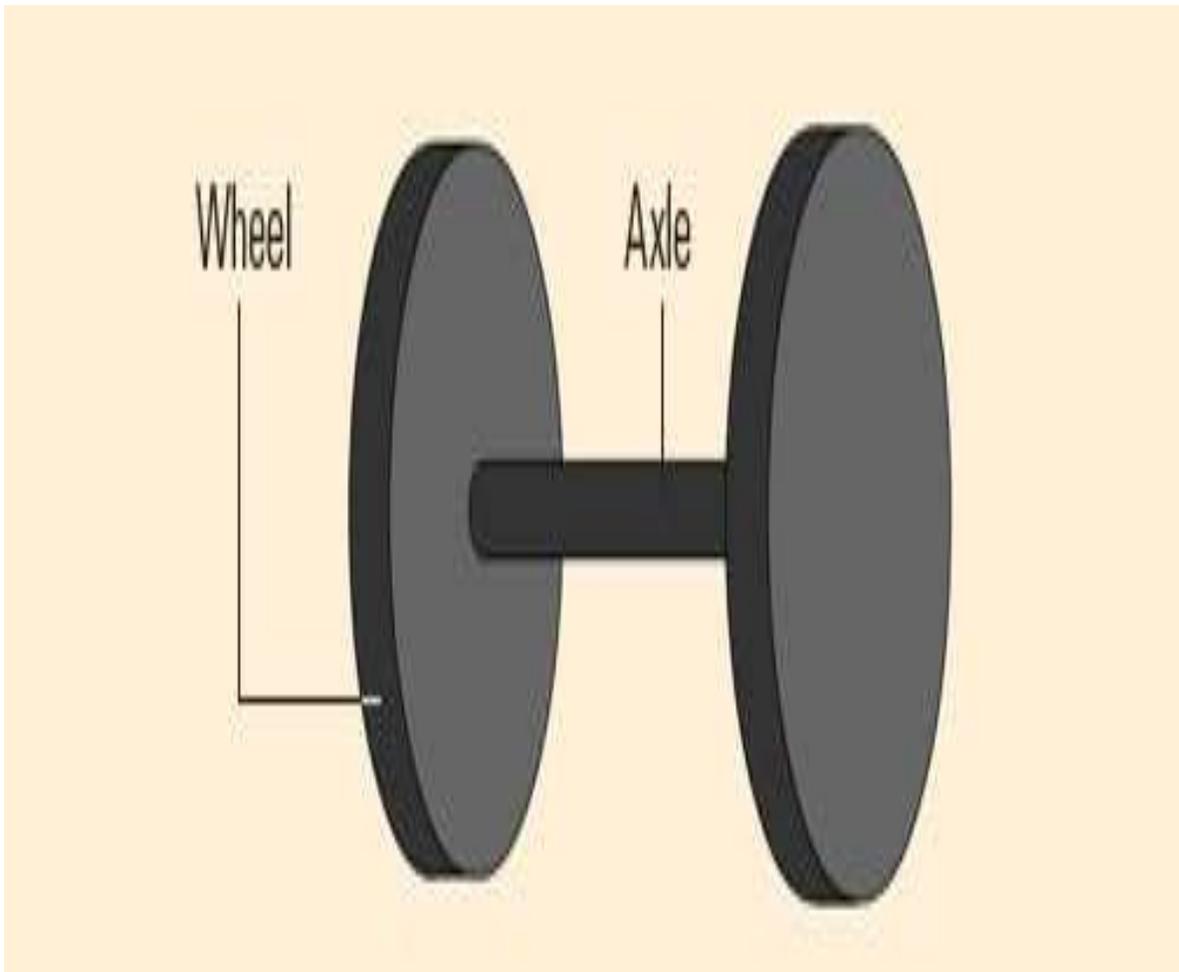
### 1. The Wheel and Axle

This is one of the most significant inventions in the world. Before then humans were limited in how much and how far they could transport goods over land. “Wheeled carts facilitate agriculture and commerce by enabling the transportation of goods to and from markets and easing the burden of travelling long distances. The wheel greatly reduces the friction encountered when an object is moved over a surface.

The other five machines all help humans increase and or redirect the force applied to an object. “machines provide mechanical advantage” to assist in moving an object. Thus to accomplished work force must move a certain distance. Mathematically; Work =

$$\frac{\text{force}}{(kg)} \times \frac{\text{distance}}{(m)}$$

For example: to lift object we must do work to overcome the force of gravity and move the object to a certain distance.



Thus the main benefit of machines is that they allow us to do the same amount of work by applying a smaller amount of force over a greater distance.

The mechanical advantage of the wheel and axle can be calculated as the diameter swept by the handle divided by the diameter of the axle or load divided by the force applied:

$$M. A = \text{Load/effort}$$

$$M. A = W/F$$

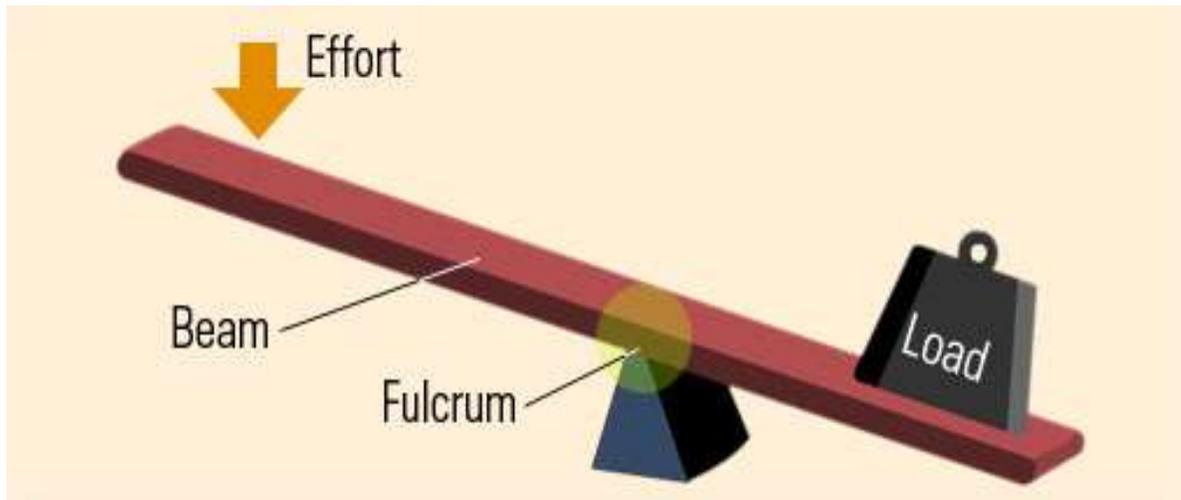


## 2. The Lever

This consists of a long beam and a fulcrum, or point. The mechanical advantage of the lever depends on the ratio of the lengths of the beam on either side of the fulcrum. Thus, mechanical advantage can be calculated as

$$M. A = \text{Load}/\text{Effort}(\text{force})$$

$$=W/F$$



### Class One Lever

In this class, the Fulcrum is between the Effort and the Load. The mechanical advantage is more if the Load is closer to the fulcrum. Examples of Class One Levers include seesaws, boat oars and crowbar.

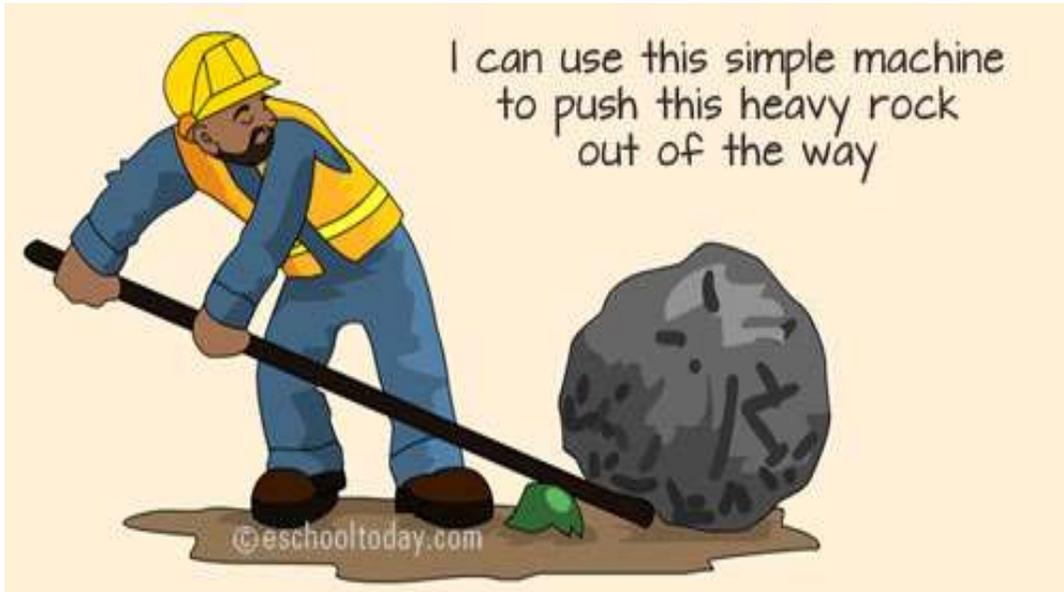
### Class Two Lever

In this class, the Load is between the Effort and the Fulcrum. The mechanical advantage is more if the load is closer to the fulcrum. Examples of Class Two Levers include wheelbarrows. [TRY THIS SIMPLE EXPERIMENT](#)

### Class Three Lever

In this class, the Effort is between the Load and the Fulcrum. The mechanical advantage is more if the effort is closer to the load. An example of Class

Three Lever is a garden shovel.



### **The inclined Plane**

This is simply a flat surface raised at an angle like a ramp. Thus, an inclined plane is a way of lifting a load that would be too heavy to lift straight up. The angle (steepness of the inclined plane) determines how much effort is required to raise the weight or load. The mechanical advantage of the inclined plane is calculated by dividing the length by its weight

$$M. A = L/W$$

$$L(m)$$

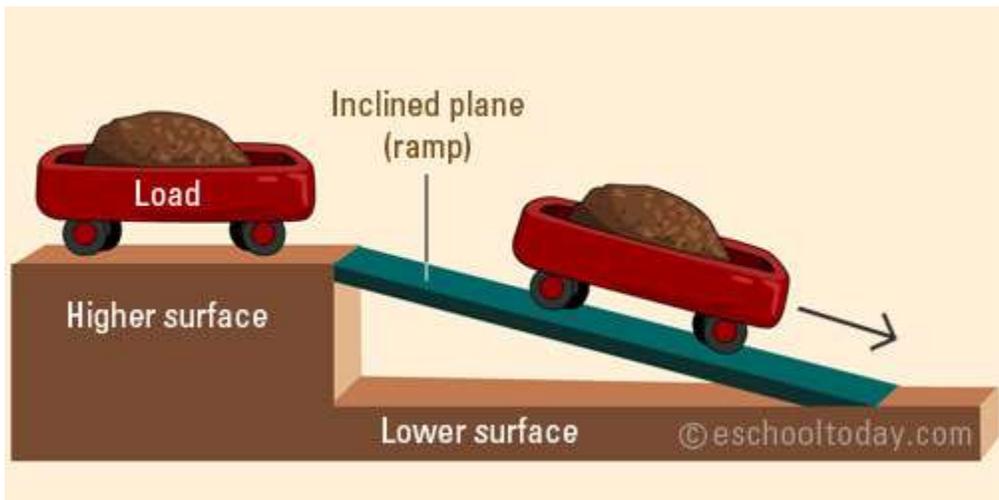
$$W(kg)$$

The velocity ratio of the inclined plane can be calculated as:

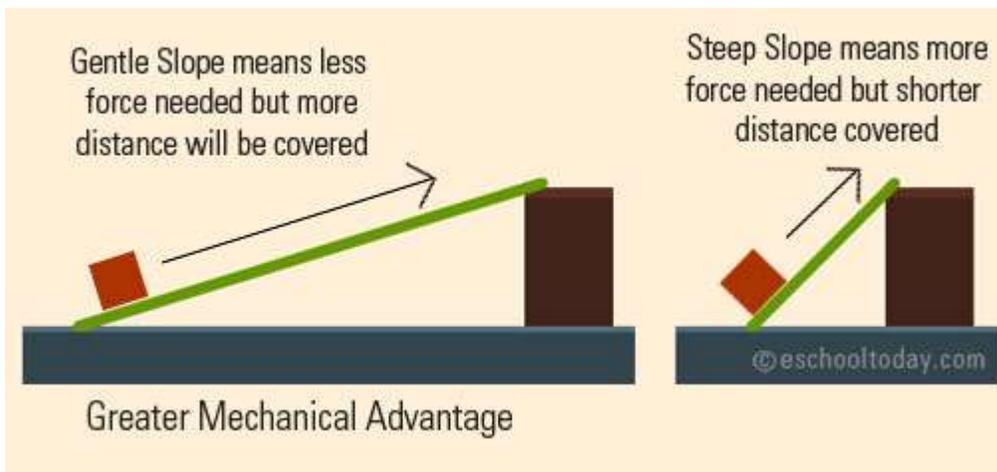
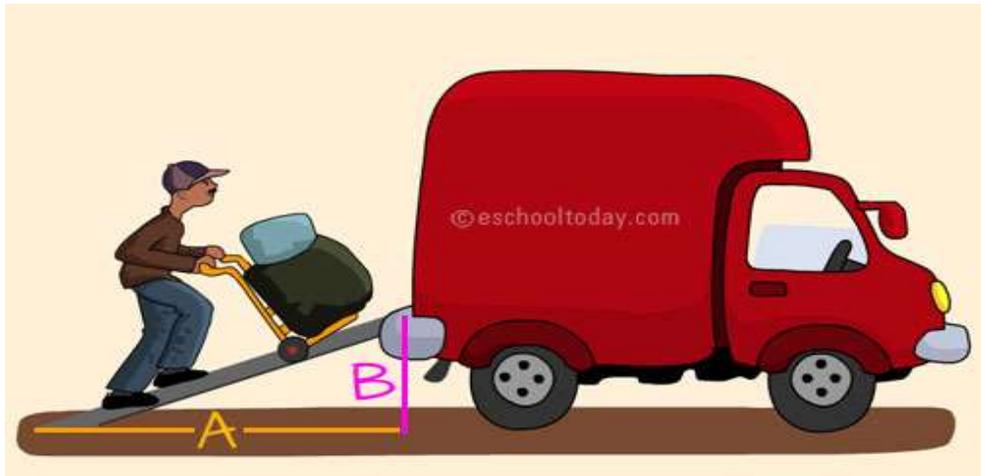
$$V. R = \text{Distance moved by effort} / \text{Distance moved by load}$$

$$V. R = F/W$$

$$L (M)$$



In the illustration below, the man uses a piece of metal as a ramp to move the hand-truck into the van.



### 3. The Pulley

These are used for moving heavy load. Pulleys are nothing but gears without teeth and instead of running together directly, they are made to drive one another by cords, ropes, cables or belts. In a pulley, instead of an axle, a wheel could also rotate a rope, cord or belt. In a pulley, a cord wraps

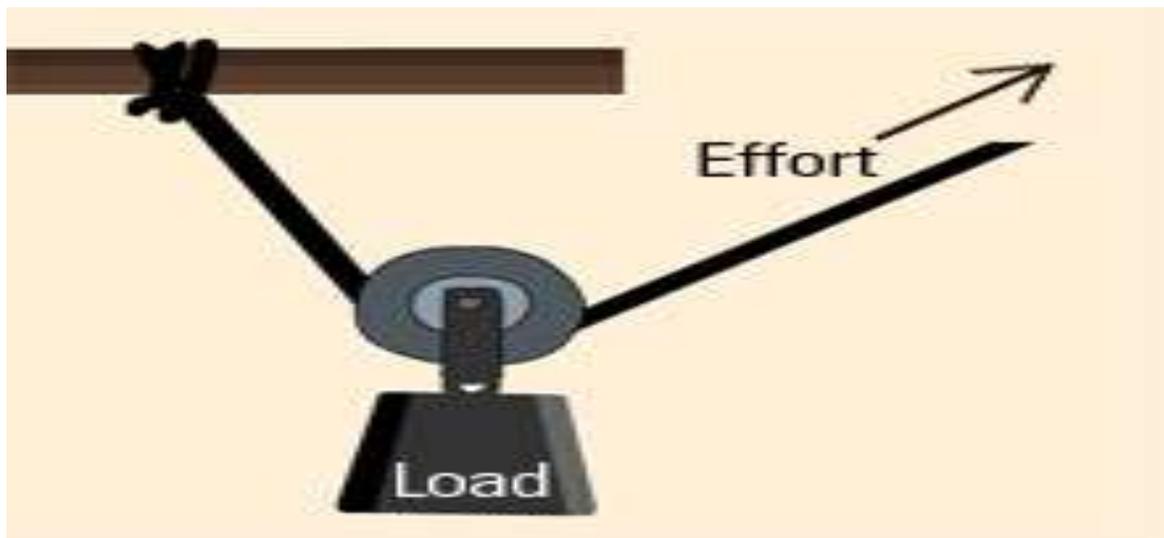
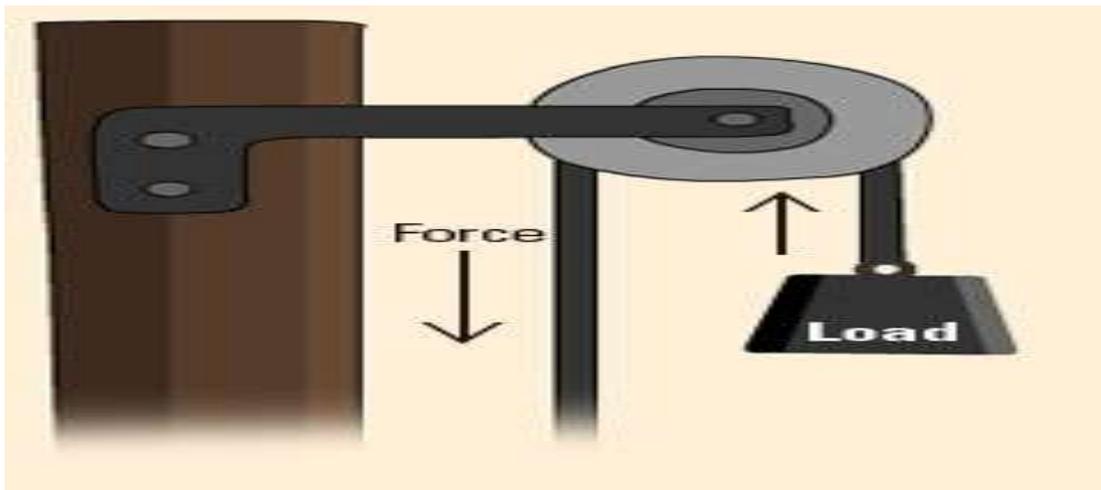
around a wheel. As the wheel rotates the cord moves in either direction. Attach a hook to the cord and you can use the wheel rotation to raise and lower objects, making work easier

The mechanical advantage of the pulley is calculated thus

$$M. A = \text{Load} / \text{Effort}$$

$$M. A = W / F$$

M(kg)





#### 4. A Screw

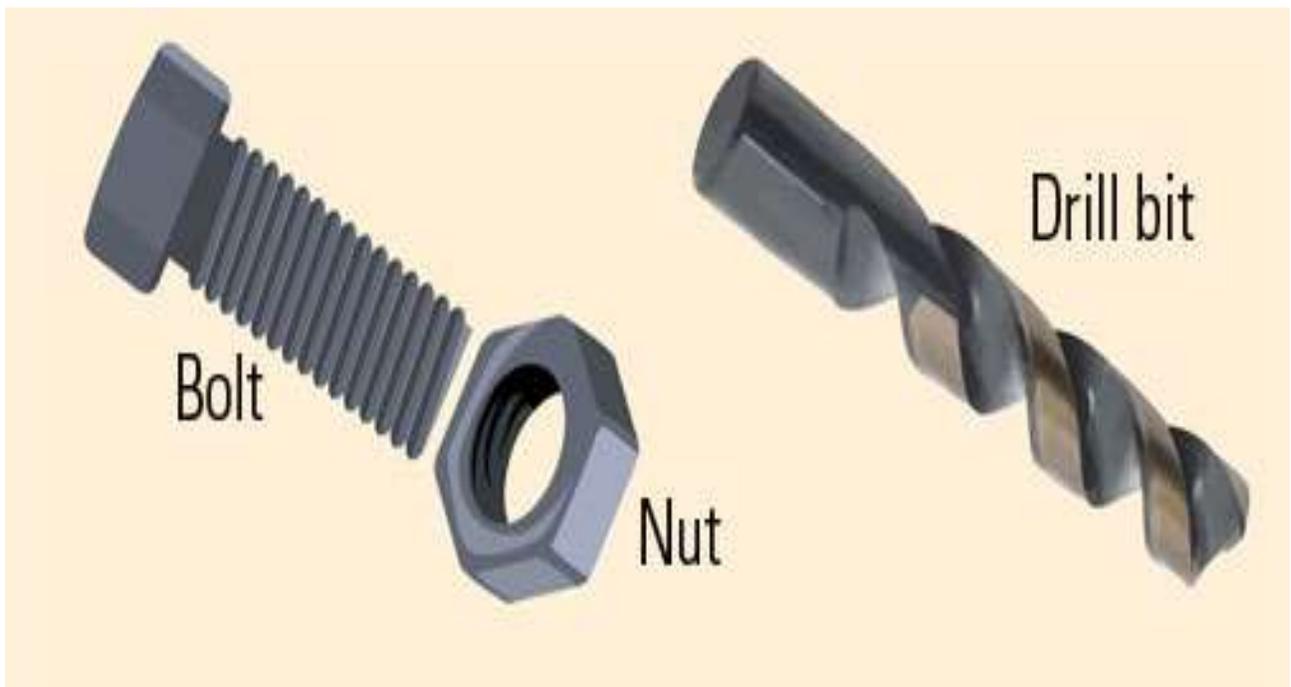
This is essentially a long inclined plane wrapped around a shaft, so its mechanical advantage can be approached in the same way as the inclined plane.

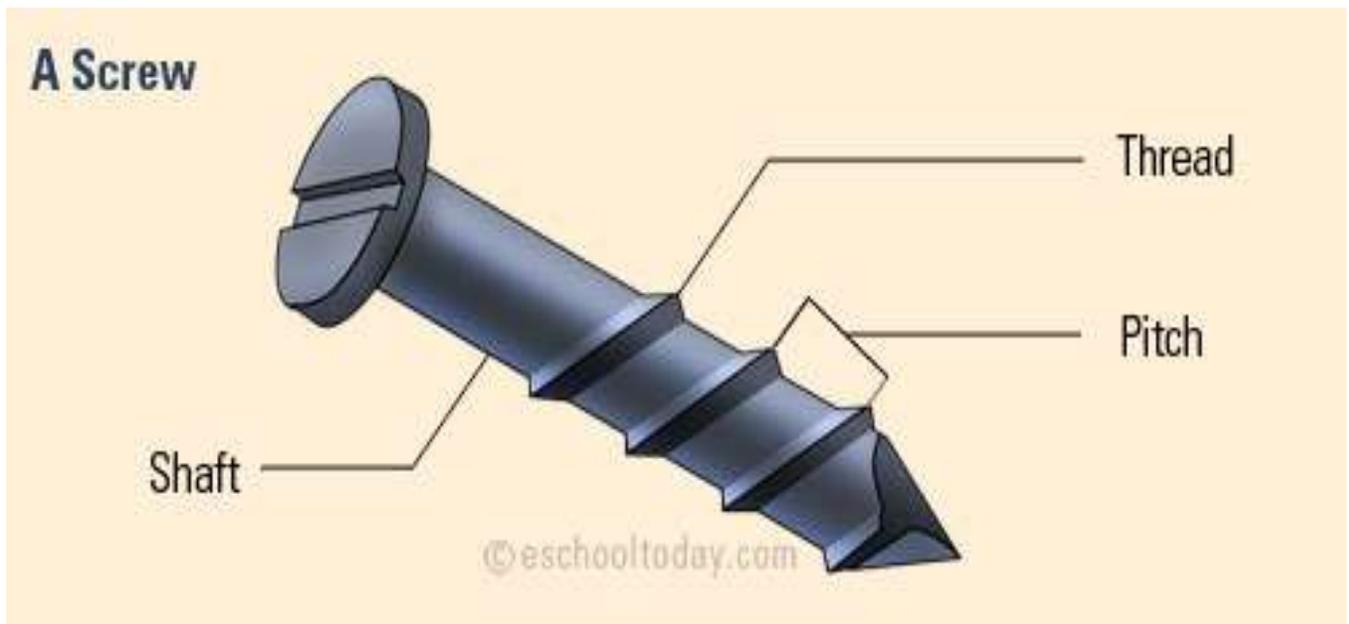
Mechanical advantage: Distance moved by effort divided by distance moved by load.

$$M. A = F/W$$

F(kg)

W(m)





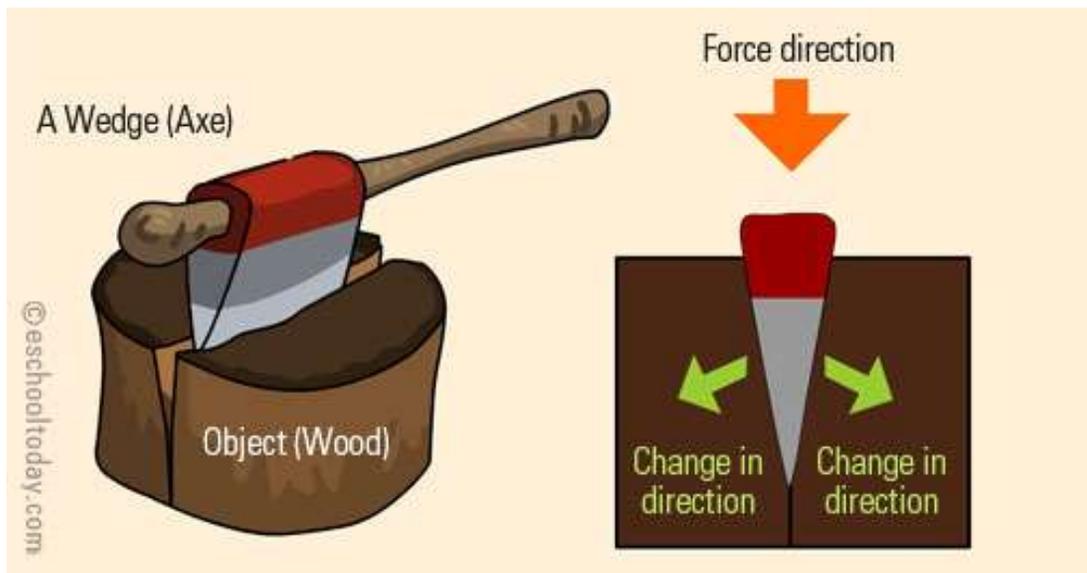
### 5. The Wedge

This is like a moving inclined plane that is driven under load to lift or into a load to split or separate. The main function of a wedge is to change the direction of the input force. Below are examples of a wedge.



A wedge can be used in many ways:

- To cut (knife)
- To split (axe)
- To tighten and to hold back (doorstopper)
- To hold together (nail)
- To scrape (blades on the snowplough or farm grader)
- Wedges work by changing direction and force applied to it. Here is an illustration: Diagram of change
-



From the above, you will notice that the force applied to the thick end of the wedge overcomes the resistance of the wood. The force is directed downwards, but the wedge directs the force sideways as it drives into the wood.

A wedge may be a single wedge or double wedge. Each does a slightly different job. An axe is a double wedge (see diagram above) and a chisel is a single wedge.

### Summary

A machine is a mechanical device that changes the direction or magnitude of a force. In agricultural mechanization, the use of machines have become an integral part of all agricultural activities to achieve much greater work without stress. The six classes of simple machines in used include

- Lever
- Wheel and Axle
- Pulley
- Incline Plane
- Wedge

### PRACTICAL ASSIGNMENT

1. Students are to visit a typical agricultural workshop or any workshop and identify the six types of simple machines.
2. Students should engage each of the machines by trying to carry, lift or move a load with the machines and note how easy they allow work to be accomplished.

### WORKSHOP TOOLS

#### Introduction

There is an adage that says “anything worth doing is worth doing right”. A corollary to that statement is the recognition that doing the job right requires the right set of tools.

The tools in your workshop will depend on your areas of specialty, interest and level of experience.

### **Typical Problems and Concerns of Students**

1. Why should a farmer have a home-farm shop?
2. How can a home farm shop be established?
3. What are the essential requirements of a home farm shop?
4. What tools and equipment are needed?
5. How should the equipment be arranged in a shop?
6. How should the shop and equipment be maintained?
6. What safety precaution should be observed?

### **Why Have a Home-Farm Shop?**

One of the objectives of farm mechanics is the establishment of home-farm shops. A farmer should take pride in maintaining properly the equipment on the farm and in the home and in keeping the farmstead neat and attractive in appearance. It is very important that a farmer keeps his farm machinery and other equipment in satisfactory working condition for efficient operation. By being proficient in the use of tools and having suitable facilities to perform the needed jobs, a farmer can save time, inconvenience and money.

### **Why a Home-Farm Shop**

For the following reasons:

1. To provide a suitable place for storing and for using tools and equipment.
2. To provide suitable space for working farm equipment.
3. To provide storage space for shop supplies.
4. To provide adequate facilities for performing the shop jobs which can be done on the farm and in the home?

### **Requirements of a Farm- Shop**

A home-farm shop should:

1. Provide simple space

2. Be of desirable construction
3. Have a suitable floor
4. Have a large main entrance
5. Have adequate lighting and ventilation

### **Objective of Workshop Tools**

Workshop tools are necessary pieces of items that are needed in the farmstead. They make minor repairs easy (except for specialized repairs) they save time, inconveniences and money.

In a typical agricultural engineering workshop, there are two categories of tools commonly found. These are (1) tools for wood working(carpentry) and (2) tools for metal working.

Find below are some examples of the various tools used in the workshop. Students are encourage to go to the workshop and familiarize themselves with these Also, figures show the proper arrangements of tools in the workshop for safe keeping and for easy access anytime a tool is needed.

### **Wood working Tools**

The choice of wood working tools (hand and power) reflects personal choice and activities to be carried out. Common wood working tools usually found in the farm include:

- Hand tools
- Saw
- Planes
- Grading and sharpening tools

In woodworking and carpentry, hand saws, also known as "panel saws", "fish saws", are used to cut pieces of wood into different shapes. This is usually done in order to join the pieces together and carve a wooden object. They usually operate by having a series of sharp points of some substance that is harder than the wood being cut. The hand saw is a bit like a tenon saw, but with one flat, sharp edge.



## Importance of Tool Classification

Every student should familiarize himself with the name of the different kinds of tools and their uses. Much of a farmer's success in farm mechanics depends on the proper selection of tools and their proper use.

## Importance of Proper Care of Tools

Know how to care for tools is very important because it helps keep the tools last longer.

- Keep tools well cleaned, oiled and free from rust
- Keep tools always in their cabinet when not in use.
- Tools must be properly sharpened for good results

## Precaution in the Care of Tools

- Do not drop tools
- Keep tools clean and free from rust
- Keep tools sharp
- Don't bring cutting edge in contact with metal

Choose the proper tool

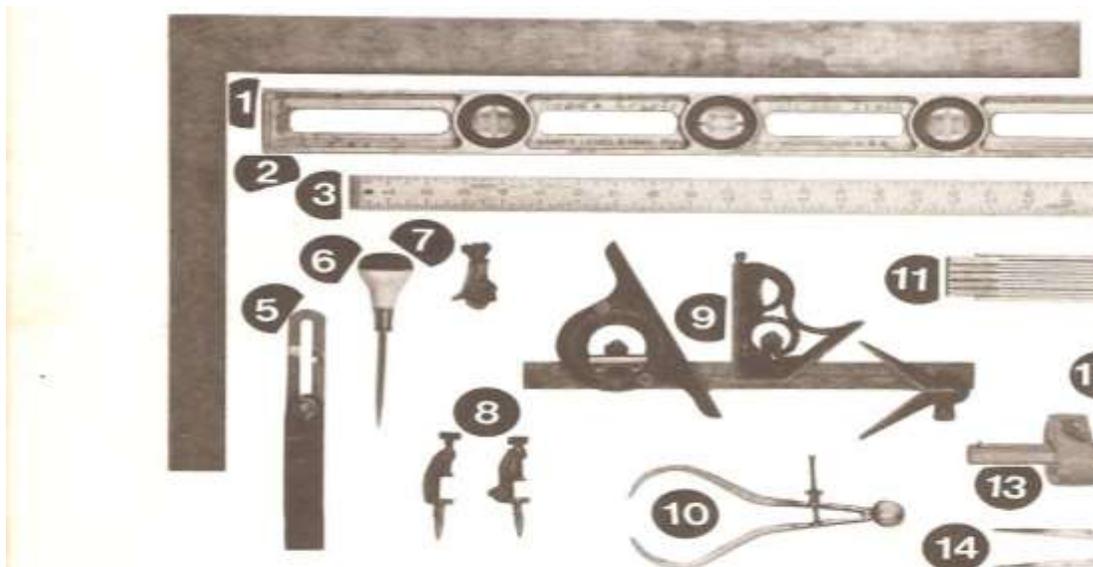


Fig. 10-5. Carpentry tools: 1. Framing square. 2. Two-foot aluminum carpenter level. 3. Steel tape. 4. T-bevel. 5. Scratch awl. 6. Auger bit gauge. 7. Trammel points. 8. Miter head, b. 9. Try square. 10. Outside calipers. 11. Six-foot folding rule. 12. Marking gauge. 13. Spring dividers. 14. Spring dividers.

Below are three types of ball pen wood hammers. They are use for driving nails or screws into a wood

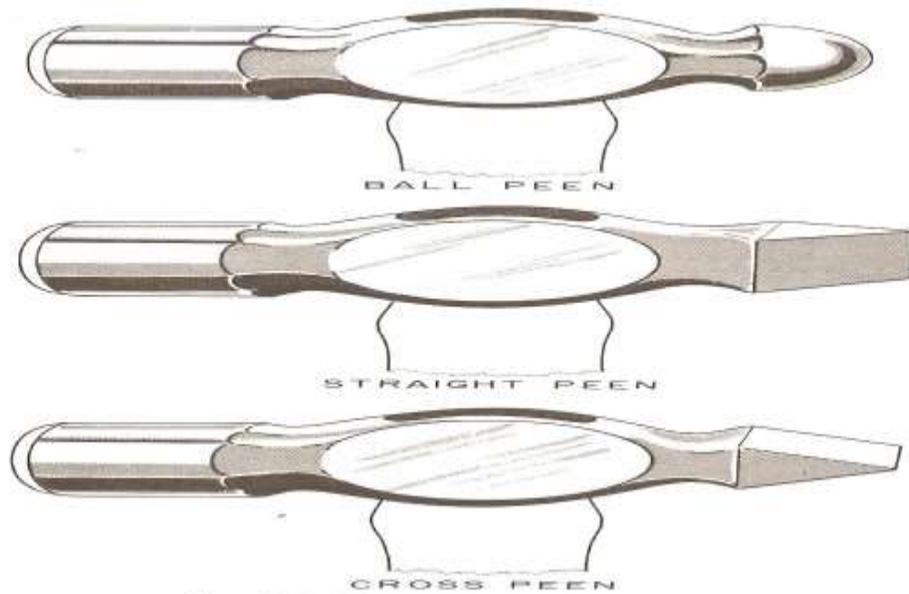


Fig. 6-3. Three kinds of peens.



Fig. 11-7. 1. Jack plane. 2. Smooth plane. 3. Block plane. 4. Wood chisel. 5. Spokeshave. 6. Cabinet scraper. 7. Wood rasp. 8. Jointer plane. 9. Hand scraper.

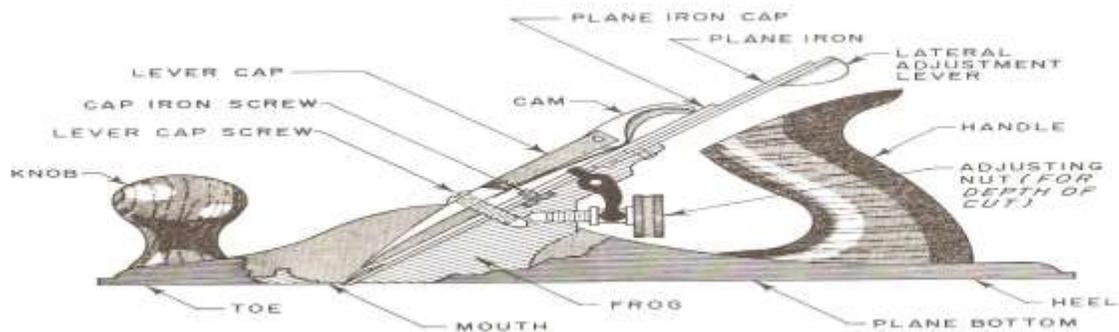


Fig. 11-8. Parts of a plane.

**Plane:** is a fool for shaping disk plow wood using mosle power to force the cutting blade over the wood surface.

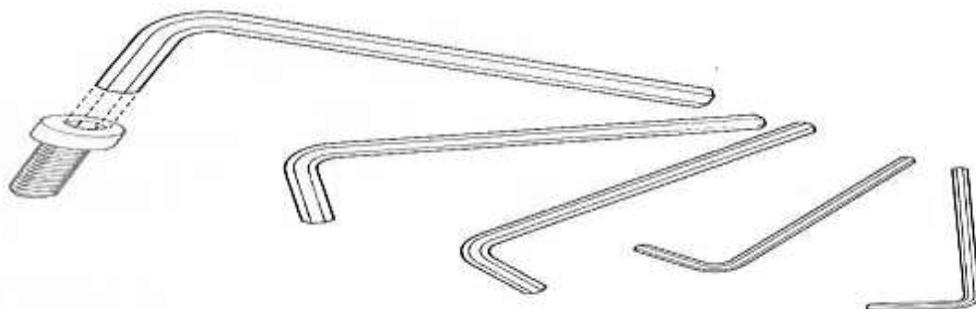


Fig. 76. A selection of "Allen keys".

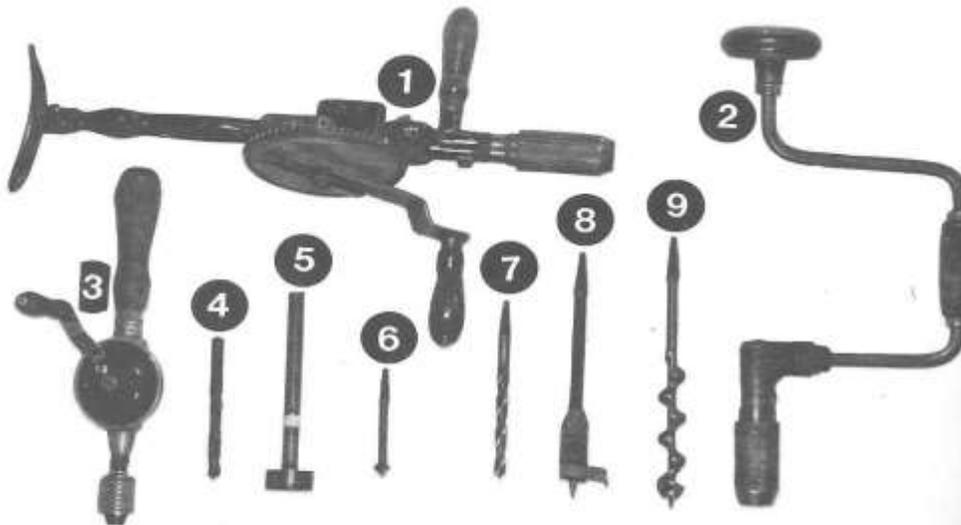


Fig. 11-19. Wood boring tools: 1. Breast hand drill. 2. Ratchet bit brace. 3. Hand drill. 4. Straight shank twist drill. 5. Straight shank Forstner bit. 6. Bit stock countersink bit. 7. Bit stock twist drill. 8. Expansive bit stock auger bit. 9. Bit stock auger bit.

**Allen Keys:** Are used to fasten bolts and screws with hexagonal socket. They are hand tools and often come in set with a range of sizes.

## SCREW

**Screw:** A screw is a type of fastener sometimes it looks like a bolt. This is used for holding object together and to position objects. It has a head on one end that allows it to be turn with a screw driver.

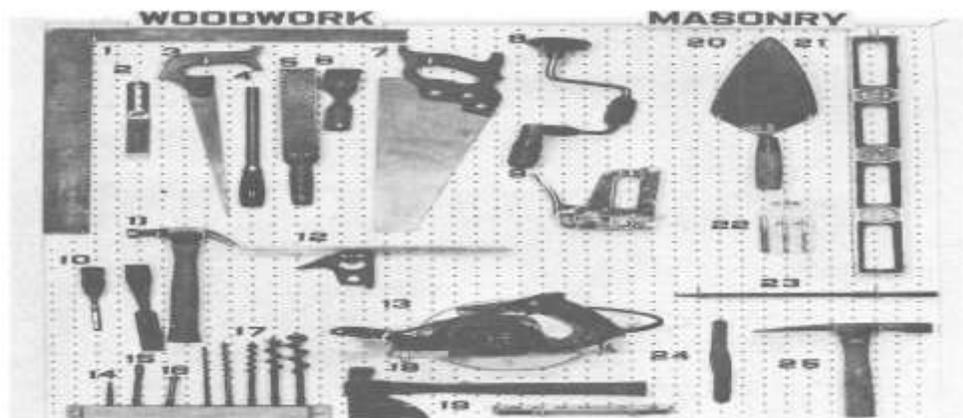


Fig. 2-8. A simple arrangement on peg board of woodwork and masonry equipment needed for the average home shop.

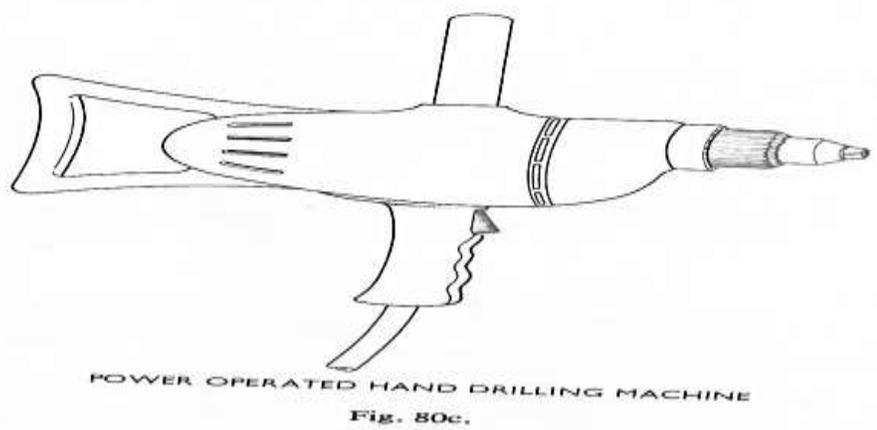
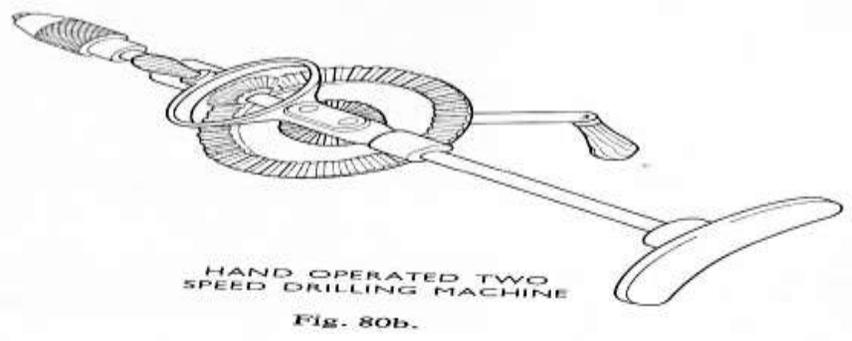
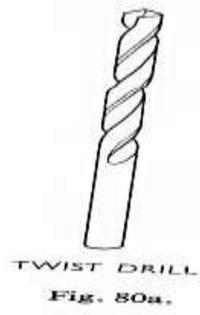


Fig. 77. Flat and cross-cut chisels for general work.

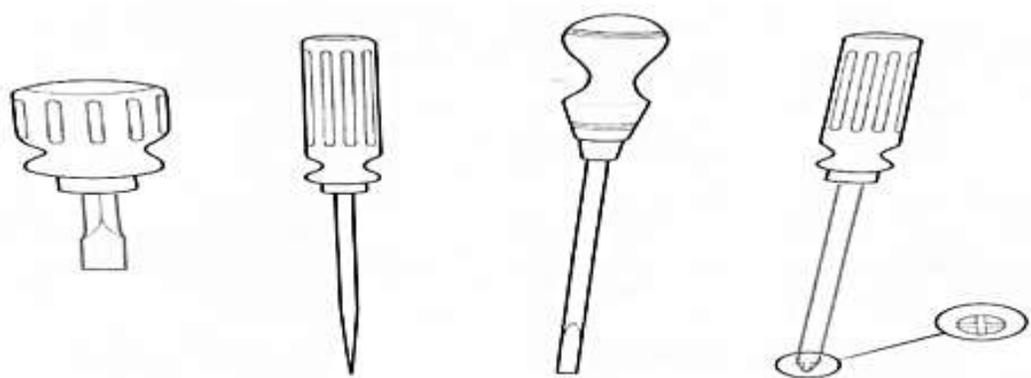


Fig. 78. A selection of screwdrivers.

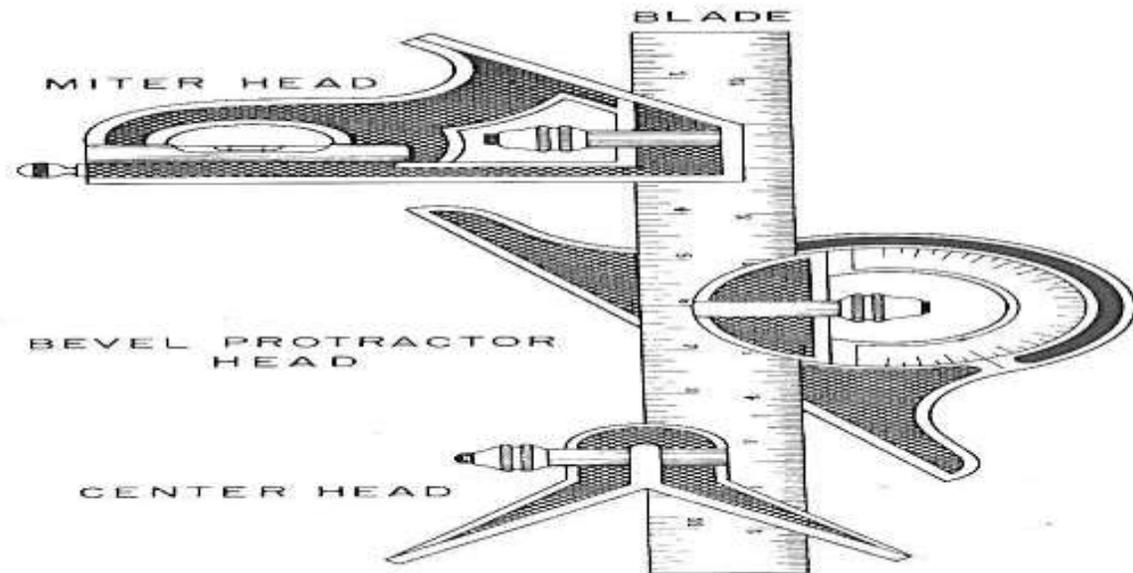


Fig. 6-2. Heads for combination-square blade.

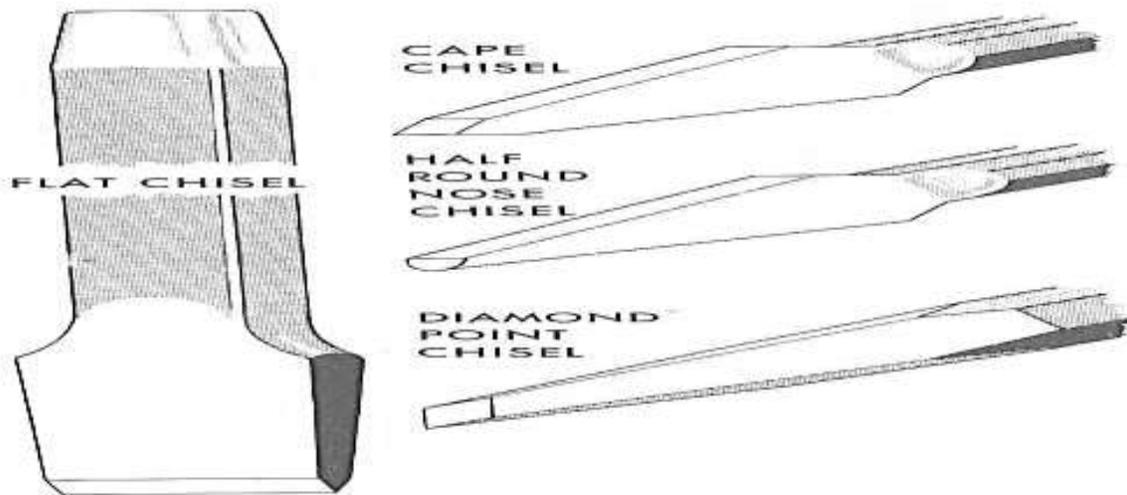


Fig. 6-5. Shapes of cold-chisel cutting points.

**Hack Saw:** It is a fine toothed saw originally and mainly made for cutting metal. Most handsaw are made with a C-shape frame that holds a metal blade.



These are grooved in two directions and have sharp, triangular teeth. They cut faster than, but not as smoothly as, the single-cut file. File teeth usually

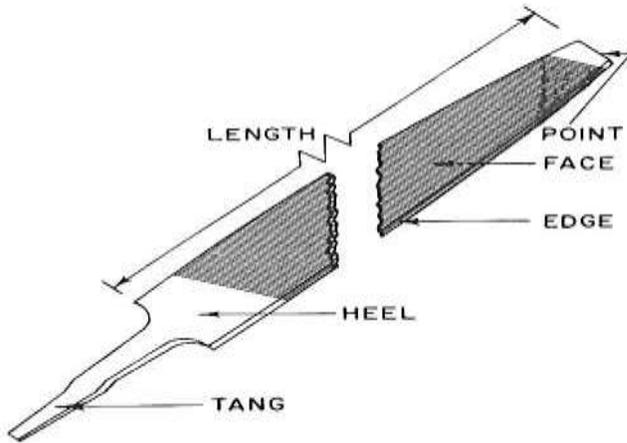


Fig. 6-8. The parts of a file.

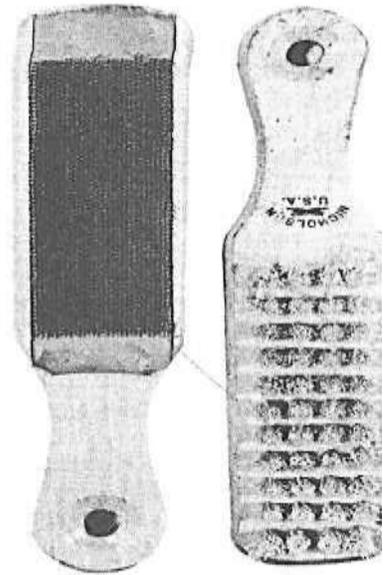


Fig. 6-9. Left, file card. Right, file

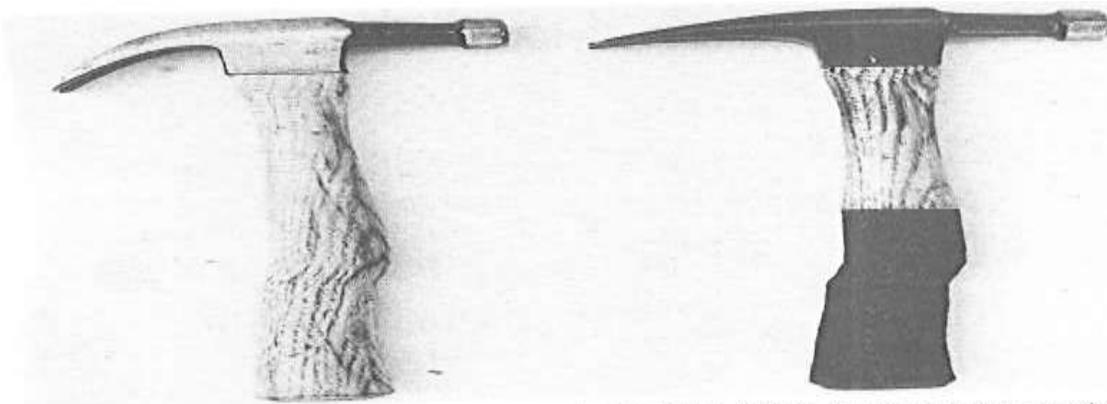
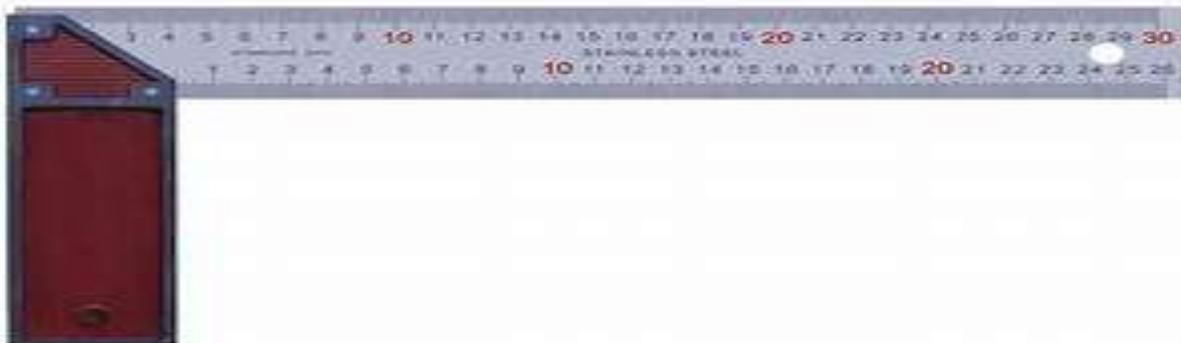
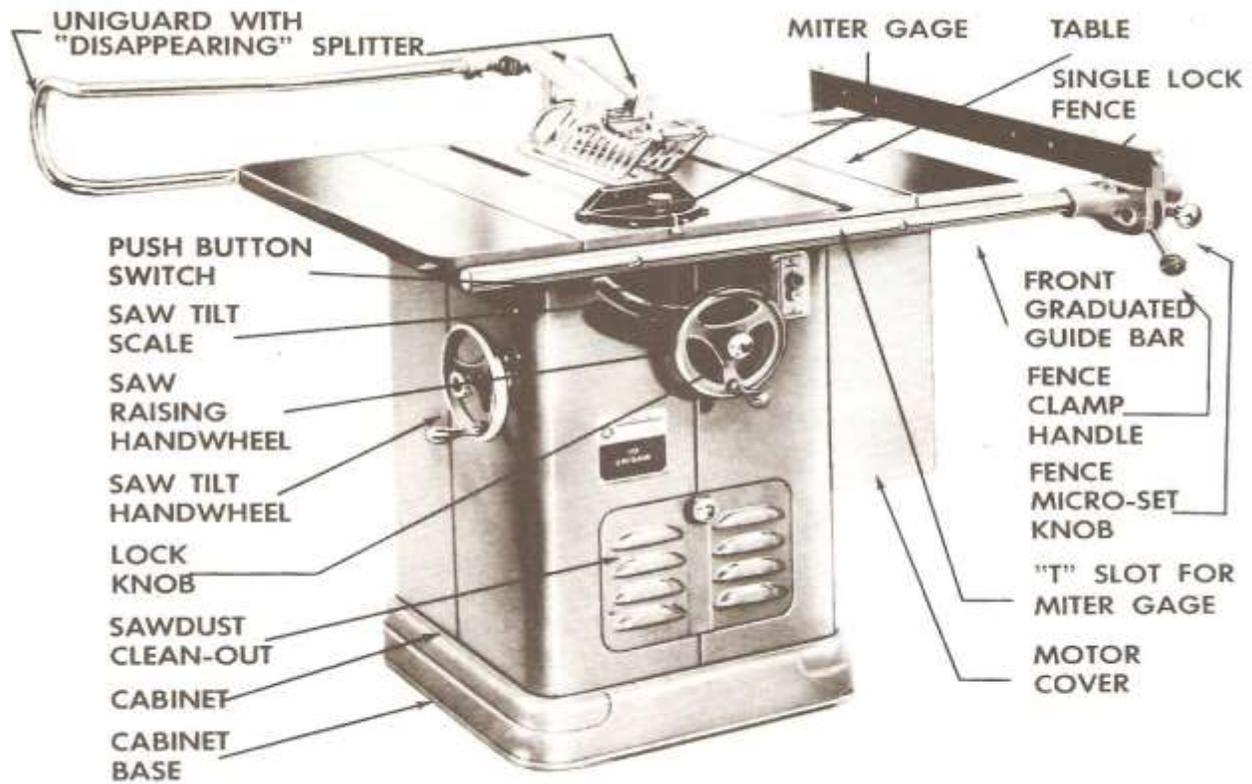


Fig. 10-35. Left, a claw hammer for general carpentry. Right, a straight claw for dipping.

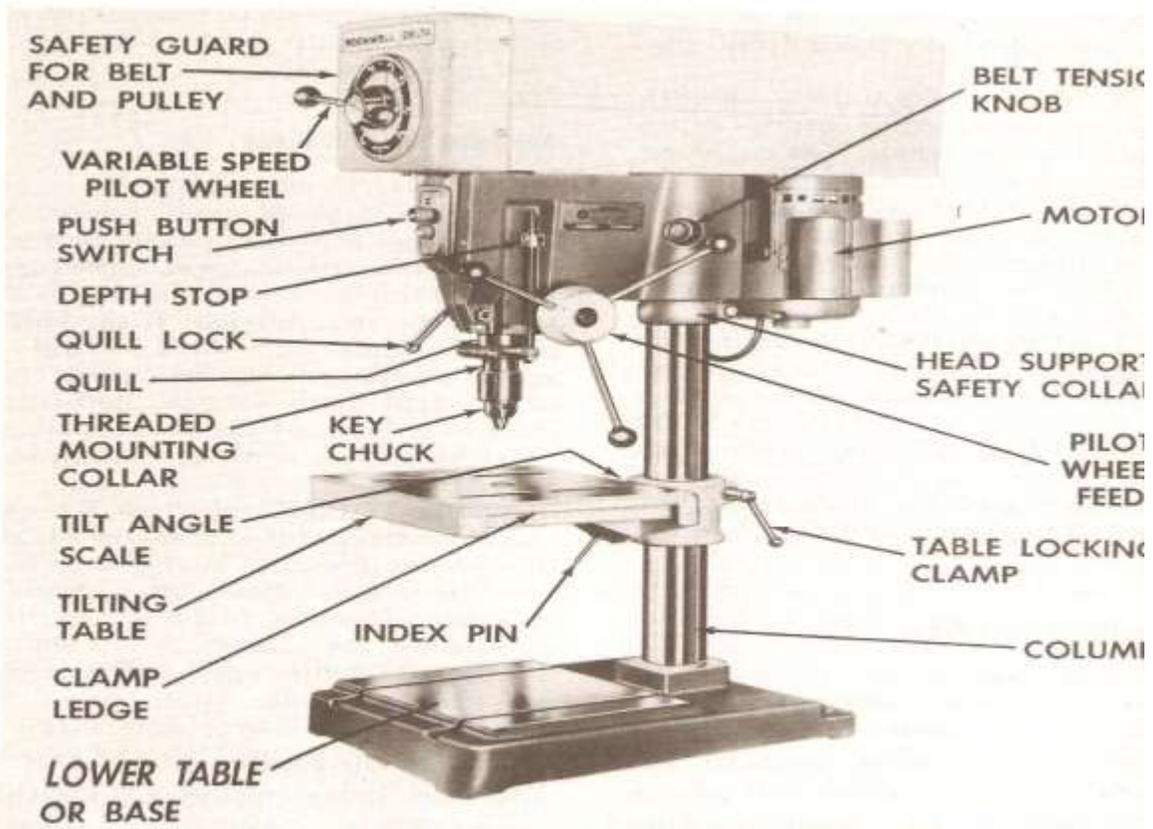
**Try Square:** Is a woodworking or a metalworking tool used for marking and measuring a piece of wood. The *square* refers to the tool's primary use of measuring the accuracy of a right angle (90 degrees)





### ROCKWELL DELTA 10" TILTING ARBOR UNISAW

Fig. 12-1. Tilting arbor table saw. Notice unique "floating" guard.



### ROCKWELL DELTA 15" DRILL PRESS

## **PRACTICAL ASSIGNMENT**

1. Students should know the different tools and their uses.
2. Students should be taught practically how to maintain and store tools.
3. Students must visit a typical agricultural engineering workshop and see how tools are kept/stored.
4. Students must learn to use simple workshop tools by engaging in constructing a simple wood project.
5. A demonstration of how to plane, cut, nail and chisel a piece of wood is good for a practical.

### **Summary**

Tools for farm mechanization come in handy and varied ranging from hand tools to power tools. They carry out different functions in the farm and so must be well kept especially in a tool box or cabinet. Common workshop tools for the repair of agricultural machines and other activities include wood working and metal working tools, for example wood working tools such as saws, screwdriver, planes, try square, ruler, nails, drills chisel calipers are common in the farm workshop. Tools must be kept sharp and handle with care.

## **PRINCIPLES OF INTERNAL COMBUSTION ENGINE (ICE)**

### **Introduction**

Motor and or machines on farms have steadily increased in number and in importance. In fact modern agriculture depends heavily on the internal combustion engine for most of its activities. The farm tractor and auxiliary engines for farm machinery are used to till the soil, plant and cultivate crops, harvest food and fiber and process products for human or livestock use. The work on the farm depends on the application of power. The power of the machine relieves farmers of much physical labor. There are some maintenance jobs, a farmer with little training and practical experience should be able to do.

### **Types of Farm Power**

- Animal power
- Wind power
- Solar power

- Water power (Hydro)
- External combustion engine – steam engines
- Internal combustion engine – gas engine

## Engine Operation Principles

The internal combustion engines generate power by utilizing the force created by running a mixture of fuel and air. This force is confined or trapped in a combustion chamber. The expanding gases force the piston downward in the cylinder. Because the piston is connected to crankshaft by a connecting rod, this downward motion is changed to a rotating motion. Gasoline, diesel and liquefied petroleum gas (.LPG) engines use many of the same principles.

### Four-stroke Cycle Engine

The four stroke cycle engine is the most common type found on farms. An engine stroke is commonly thought of as the movement of the piston from Top Dead Center (TDC) to Bottom Dead Center (BDC). Top Dead Center (TDC) is reached when the piston is at the end of the inward stroke. BDC is reached at the end of the outward stroke.

A stroke can be defined as one-half of a revolution of  $180^{\circ}$  of crankshaft travel .

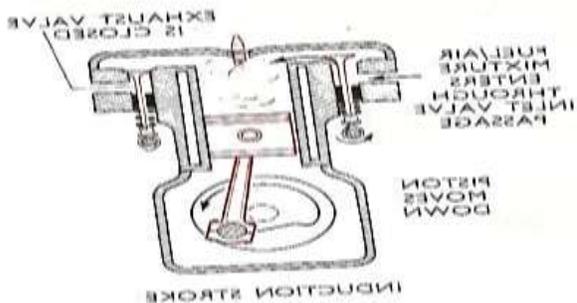
An engine cycle is the complete set of movements necessary to generate engine power.

The four stroke in a cycle are intake, compression, power and exhaust.

### Working Principles of the Internal Combustion Engine.

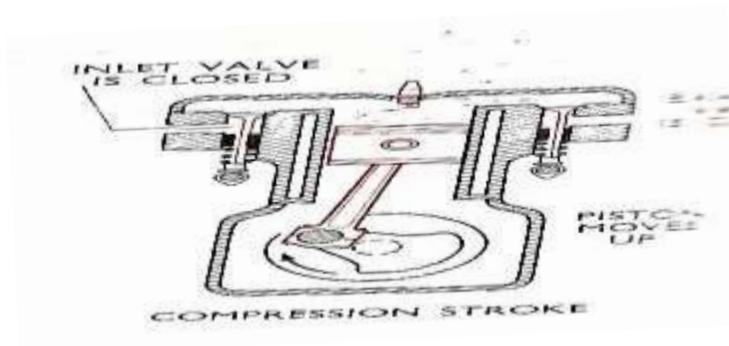
#### Intake stroke

With the intake valve opens, the piston moves outward in which draws a mixture of fuel and air into the cylinder (in a diesel engine, only air is taken in).



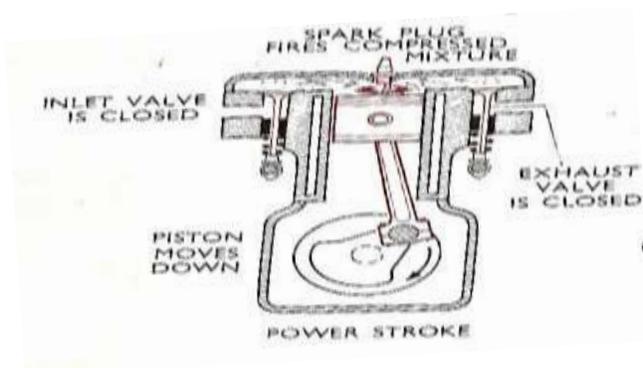
## Compression stroke

As the piston reaches BDC and begins its inward motion (toward the cylinder head) both valves intake and outlet are closed and the piston compresses the mixture between the piston and the cylinder head (only air is compressed in the dies)



## Power Stroke

As the piston nears TDC and electric spark ignites the compressed mixture, pushing the piston downward with great force (in the diesel engine fuel is injected into highly compressed air, causing self-ignition).



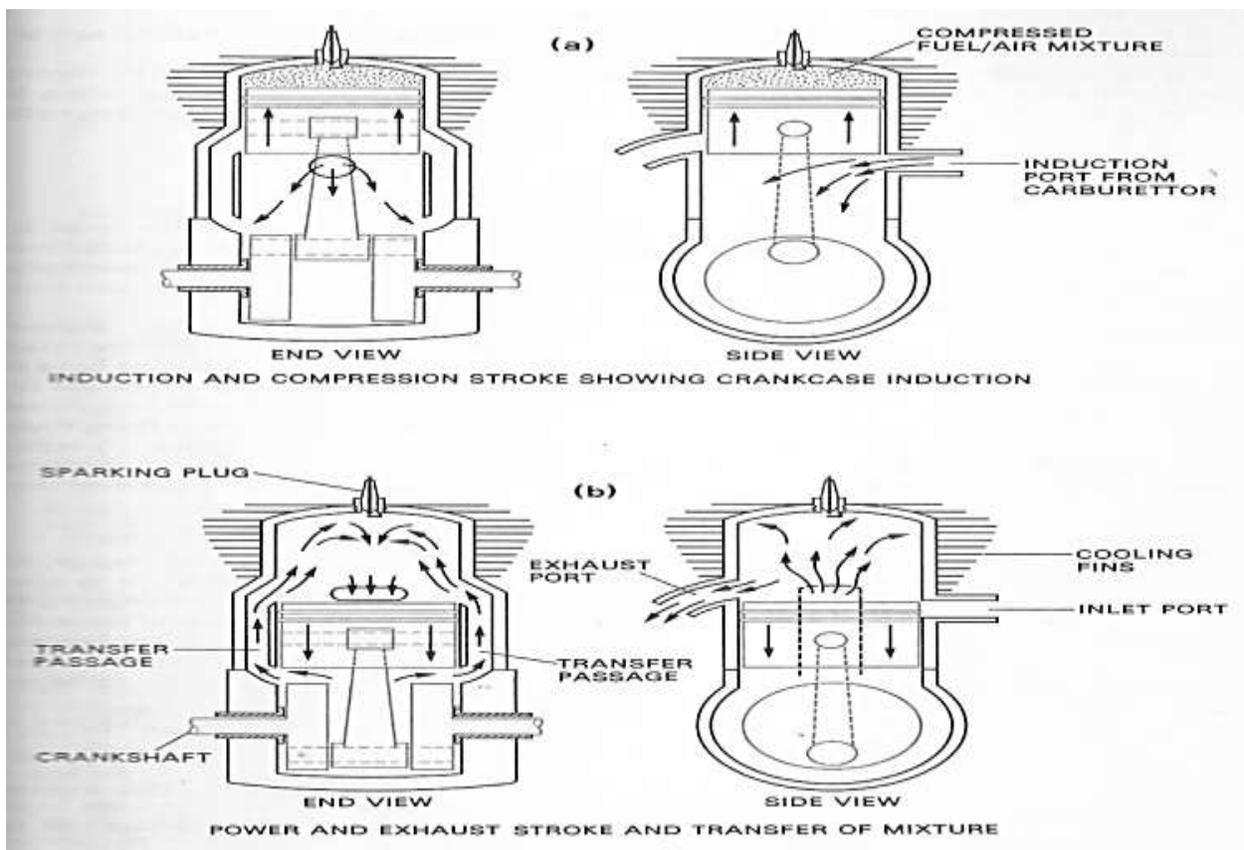
## Exhaust stroke

The exhaust stroke occurs when the piston begins to move upward. The exhaust valve opens, allowing the piston to force out the burnt gasses; cleaning the cylinder for the start of another cycle. This is repeated severally until engine stop.



## Two –Stroke Cycle Engine

A two-stroke cycle engine completes its cycle of operations in one revolution of the crankshaft. There is only a compression stroke and a power stroke between or during these events the intake of fuel and exhaust of gasses are accomplished, there is a power stroke every revolution



## Summary

Most farm engines are of the four-stroke cycle engine. The smaller engines are 2-stroke cycle type. To get the farm engine work efficiently, proper servicing and maintenance are most important.

## Practical Assignment

Students should study the 2-stroke and 4-stroke cycle engines in order to determine differences in construction and principles of operations.

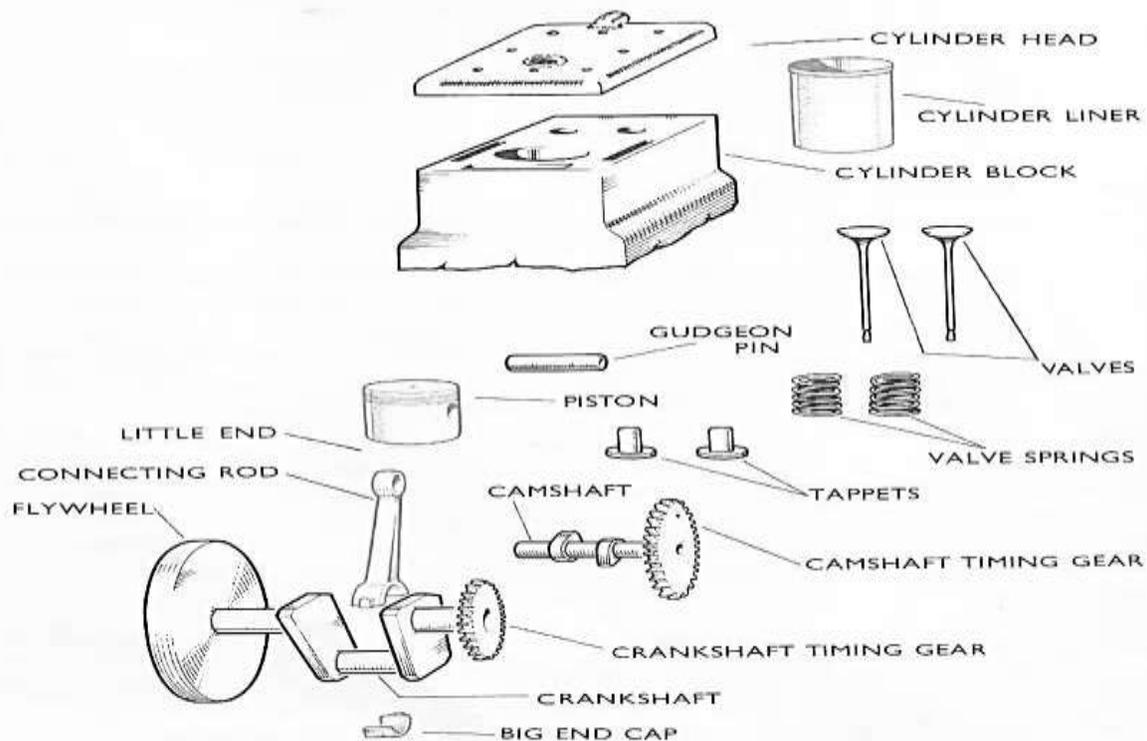
- a. Use small one-cycle engine for the study, one 4-stroke cycle engine and one-two-stroke cycle engine.
- b. Study the construction of the two engines.

Note: the location or positioning of:

- a. Fuel system
- b. Valves and
- c. Ports
- d. Know the parts of d engine

Find below are the various parts that make up an engine and the working principles as discussed above.

For any engine that has a piston whether one or more, that piston must go through the events of intake, compression, power, and exhaust.



**Fig. 3. Some of the main working parts of a side valve water-cooled single-cylinder engine.**

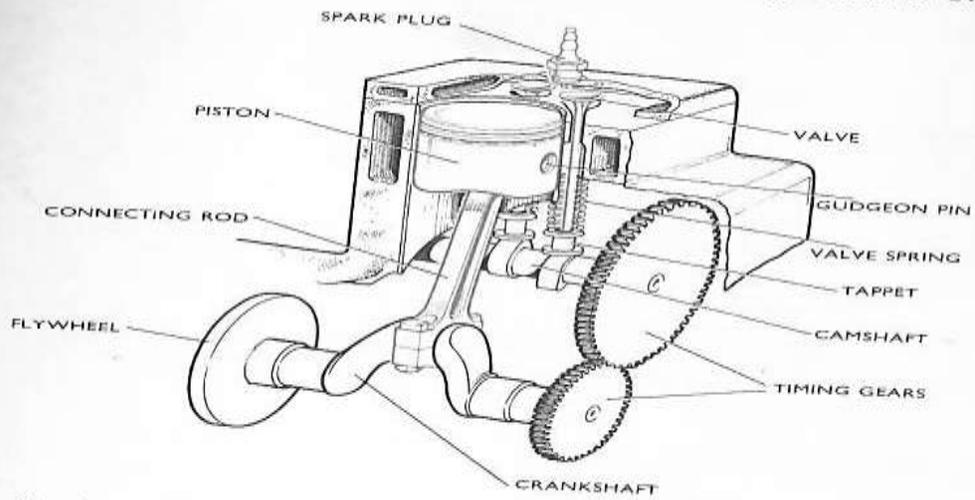


Fig. 4. A section through a single-cylinder engine showing the relative position of the working parts.

Fig. 5. Engine layouts and terminology.

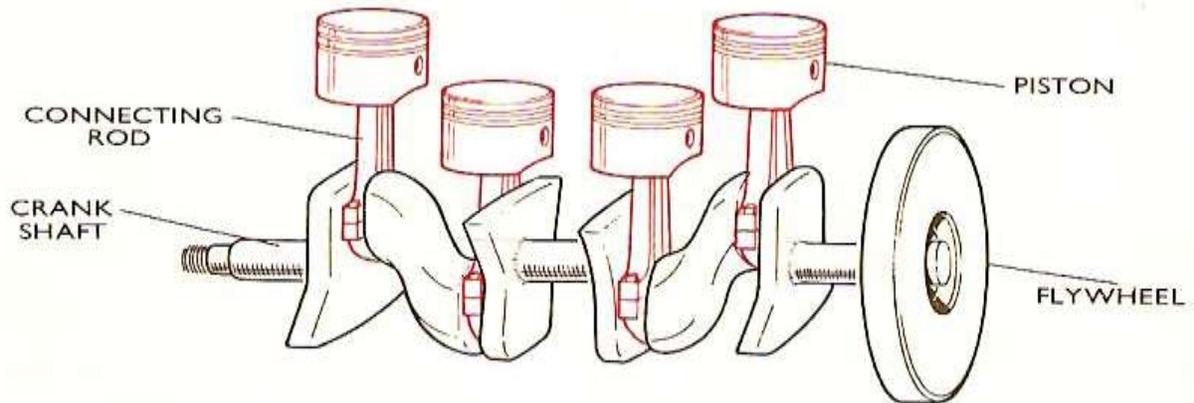


Fig. 6. A four-cylinder engine crankshaft with connecting rods and pistons.

## FARM MACHINERY USE FOR TILLAGE.

### TRACTOR TYPES AND TRENDS

#### Introduction

Modern farm tractors have undergone continual changes and improvements to become the up-to-date and effective agricultural power units today. New developments have helped to make tractors more efficient, versatile, safe, convenient, and powerful. The agricultural tractor provides a great source of power which has almost entirely replaced the power of the horse or human for the many heavy and time-consuming tasks carried out in the farm.

Current tractors may be classified according to traction, use and size of the tractors.

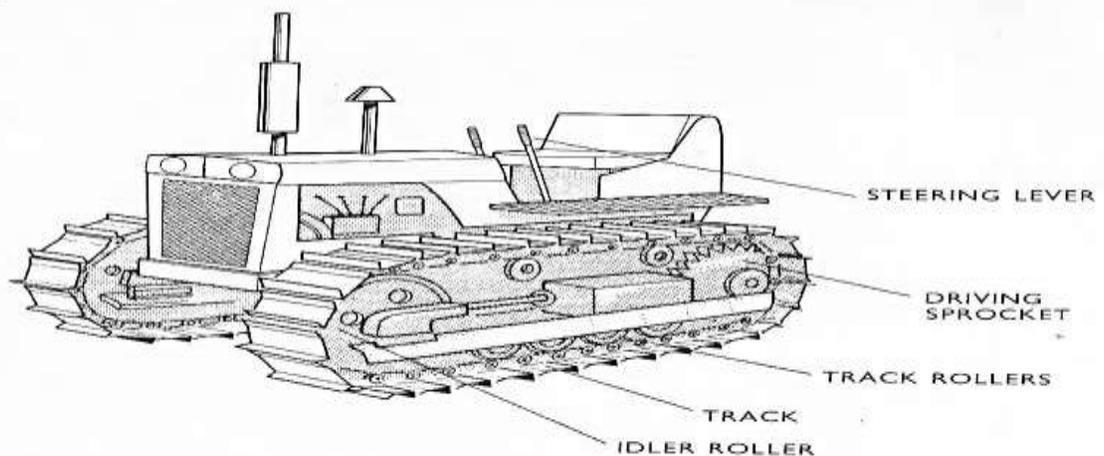


FIG. 1. A track-laying tractor.

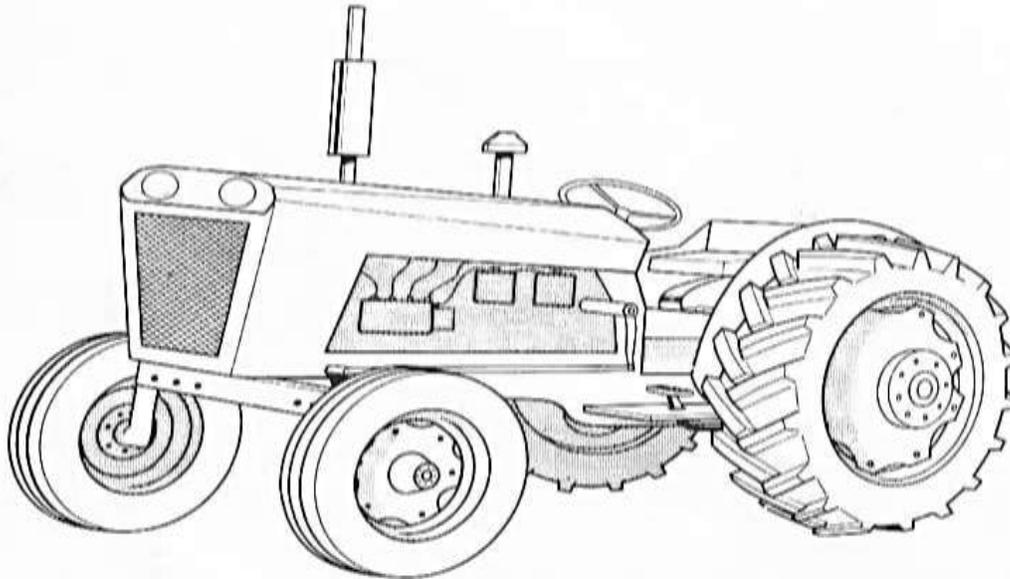


FIG 2. A general-purpose tractor.

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### **Tractors Types According to Traction Member**

Tractors types may be classified according to wheel or track systems and these include:

1. Wheel tractors
  - a. Triangle or 3-wheel
  - b. Four wheel (20 wheel drive)
  - c. Four wheel drive
2. Track type tractors

The wheel type tractor is by far the most widely used tractors for agricultural purposes. The 4-wheel type is most common with both front and rear (back) wheel treads adjustable for use in row crops.

### **Track – Type Tractors:**

They are propelled by heavy metal devices known as tracks not widely used in agriculture but are well adapted to hilly areas and for earth moving and land clearing.

### **Tractors Types**

Tractors may be classified according to use and/or size as follows:

1. Utility tractors
2. Large field tractors
  - 2-wheel drive
  - 4-wheel drive

3. Orchard and vineyard tractors
4. Lawn and garden tractors
5. Industrial tractors



FIG. 16-1. Small utility tractor. (Courtesy International Harvester)



FIG. 16-2. Utility tractor, 70 h.p., pulling baler. (Courtesy Deere and Company)



FIG. 16-3. Utility tractor, 65 h.p.; can be used for row crops. (Courtesy International Harvester)



1. Large 2-wheel tractor doing tillage. (Courtesy Allis-Chalmers Manufacturing Company)



2. Tractor with extra-high clearance for sugar cane. (Courtesy Deere and Company)



FIG. 16-6. Large 4-wheel drive tractor doing field work. (Courtesy Steiger Tractor Inc.)



FIG. 16-7. Two-wheel drive tractor with optional front wheel power drive. (Courtesy Deere and Company)



FIG. 16-8. Four-wheel drive tractor cultivating row crops. (Courtesy J. I. Case)



FIG. 16-9. Orchard tractor with low profile. (Courtesy Deere and Company)



FIG. 16-10. Vineyard tractor, narrow with low profile. (Courtesy Deere and Company)



FIG. 16-11. Lawn and garden tractor. (Courtesy FMC Corporation, Outdoor Power Equipment Division)



FIG. 16-13. Grounds maintenance tractor. (Courtesy Ford Motor Corporation)



FIG. 16-12. Diesel powered garden tractor. (Courtesy FMC Corporation, Outdoor Power Equipment Division)



FIG. 16-14. Low center of gravity tractor for highway mowing. (Courtesy J. I. Case)

## **Summary**

The present day farm tractor is a most useful machine, capable of supplying its power to numerous farm tasks. The most absorbing of these power is usually the basic cultivation or tillage of the land. The type of tractor on the land depends on the type of work to be done. Tractor types include both wheel and track-type tractors. Wheel types include utility size tractors, large 2-wheel drive tractors and four-wheel drive. Four wheel drive tractors are equipped with adjustable wheel treads for row crop use. Specially designed tractors are available for orchard, vineyards, lawn and garden, industrial and other specialty uses.

## **Practical Assignment**

- a. Field trip to tractor dealership to view and discuss tractor types available.
- b. Study a 4-wheel tractor and know the different parts
- c. Learn how to drive the tractor
- d. Learn the simple maintenance service..

# **FARM MACHINERY USE FOR TILLAGE**

## **Introduction**

Tillage is a mechanical manipulation of soil to provide favorable conditions for crop growth or production. This can be achieved by the use of certain specialized machines or implements.

Tillage machinery or implement is therefore use to till or stir the soil (loosen the soil) to make it suitable for the seed which is normally planted in the soil to grow well. A conducive environment of a soil for crop growth means having the following available

1. Water
2. Air
3. Good soil texture and
4. Good temperature

In order to achieve these, there are certain tillage machinery are used. The tillage machines used are categorized according to the classification of tillage which are:

1. Primary tillage and
2. Secondary tillage

## **Primary Tillage**

Primary tillage is the initial major soil working operation which cuts and shatters the soil with relative deep penetrating tools and leaving a rough surface texture.

## **Primary Tillage Machinery**

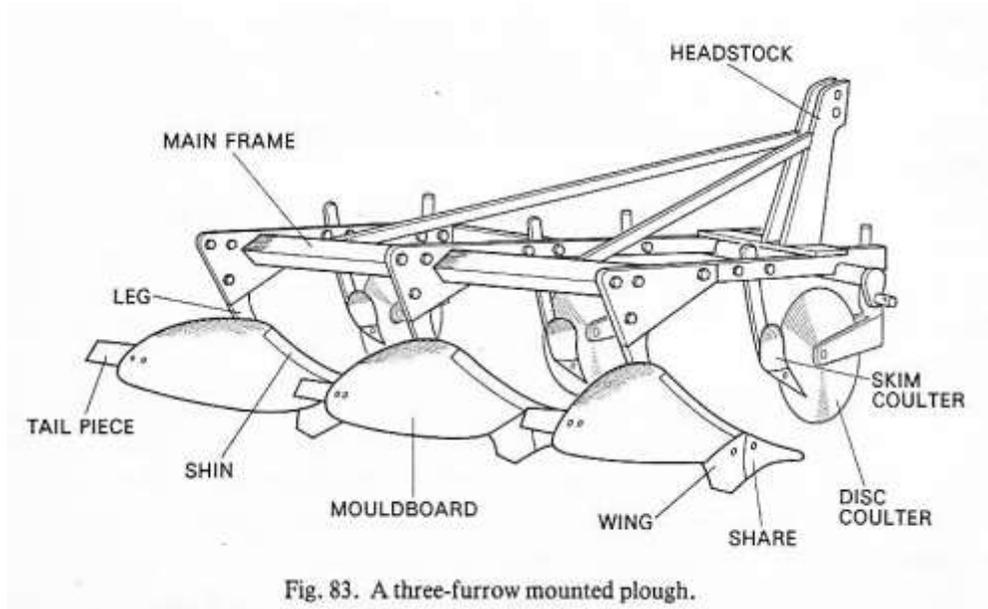
For decades animals have been used to work in the farm. They are engaged in tillage of all kinds and in carrying farm products and other goods to and from distances places. They have specialized kind of tillage implements use for tillage. This implement is like the mouldboard plow and has wood attachments (fig)

The tractor drawn implement include:

- Moldboard plows
- Disk plows and
- Chisel plows

## MOULDBOARD PLOW

This is designed to cut, lift and invert a lamp of soil (approximately 36-to-51 centimeters). This action burries the trash and crop residue. The moldboard lift twins, and pulverizes the soil.



## DISK PLOW

It has three or more individually mounted concave disks that are inclined backward to achieve maximum depth. They are particularly adapted for use in hard dry or sticky, shrubby or bushy land or on rocky land. Generally these plows are specialty and specifically designed for rough ground and heavy trash conditions where complete trash coverage is nor desired. There aggressive action chops and mixes trash into the soil.



## CHISEL PLOW

The chisel plow is equipped with narrow double-ended shovels or chisel points, mounted on long shanks. These plows rip through the soil and stir it but do not invert and pulverizes as well as the moldboard and disk plow. These plows work best when the soil is firm and dry



## THE SUBSOILER

A subsoiler is a tractor mounted implement used to loosen and break hard pan soil, It works up to the depth of 12"() The sub soiler is a because roots penetrate primary tillage tool which will improve growth in all crops where soil compaction is a problem. Subsoiler helps crops perform well during hot and dry seasons because roots penetrate soil layer deeperto reach

moisture and nutrients. In wet condition, the water passes easier through the shattered areas reducing the possibility of crop drowning.

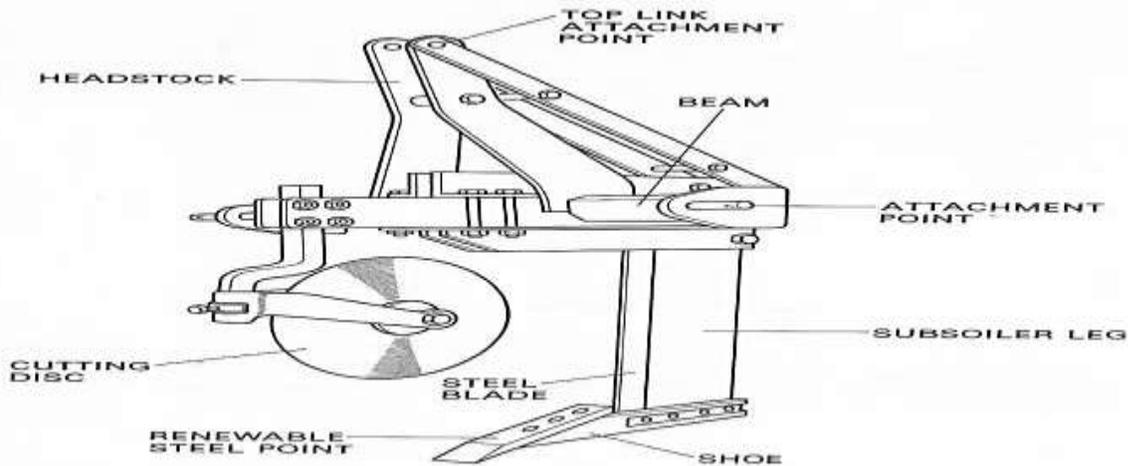


Fig. 94. A typical sub-soiler.

## SECONDARY TILLAGE MACHINERY

Secondary tillage tools are grouped into the following types:

1. Disk harrows
2. Cultivators and
3. Rotary tillers

These implements pulverize, level and firm the soil to prepare good seed bed, control weed and conserve soil moisture.

### DISK HARROW:

Disk Harrow: very effective in penetrating hard soil and in rocky or root or stump infested land. It cuts left over crop residue into pieces and with other trash mixes them well with the soil.



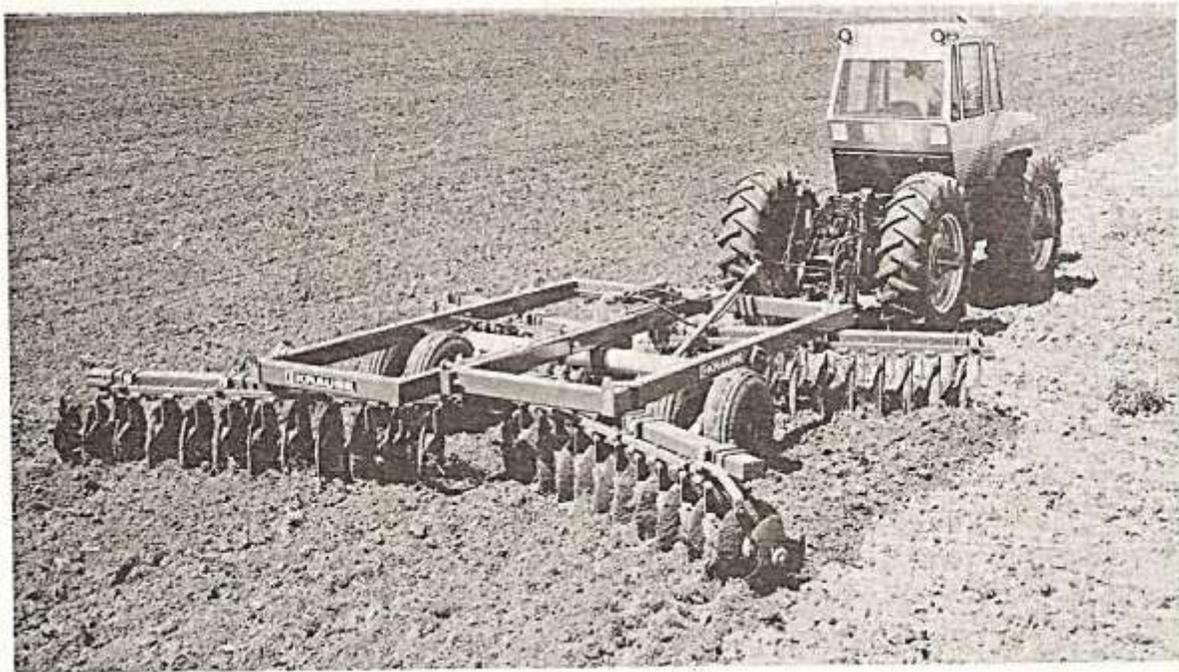
## **CULTIVATORS:**

Generally, these implements are used to control weeds in crops. They help stir the soil, aerate and to improve water intake into the soil.

### **Practical Assignments**

Students should go to any agricultural machinery dealer to see the different types of tillage implements.

Students should be taught or see a demonstration of how these tillage implements work. Students should learn the proper maintenance culture of these implements.



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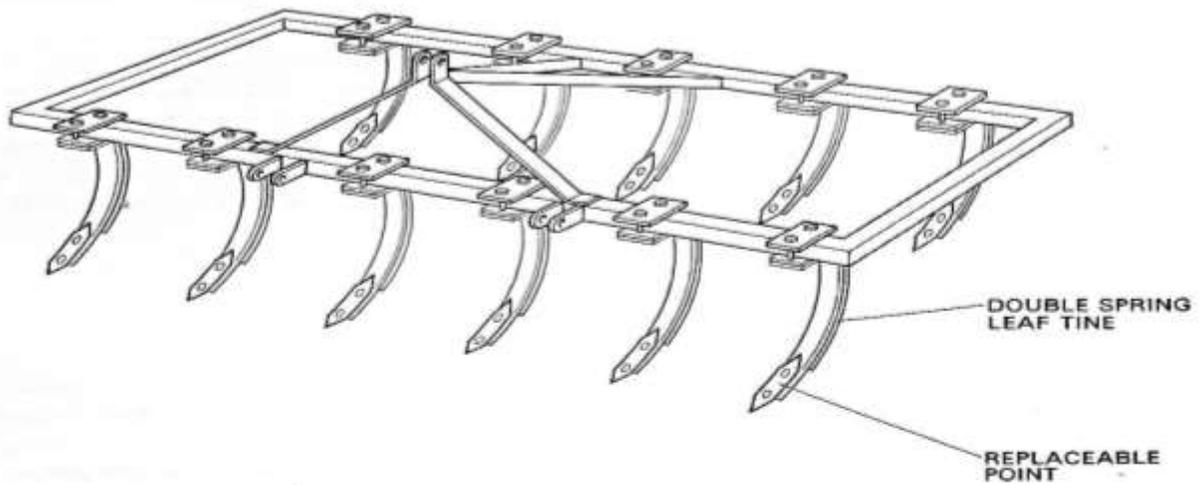


Fig. 98. A mounted spring-tine cultivator.



Fig. 99. The action of different types of cultivator tines.

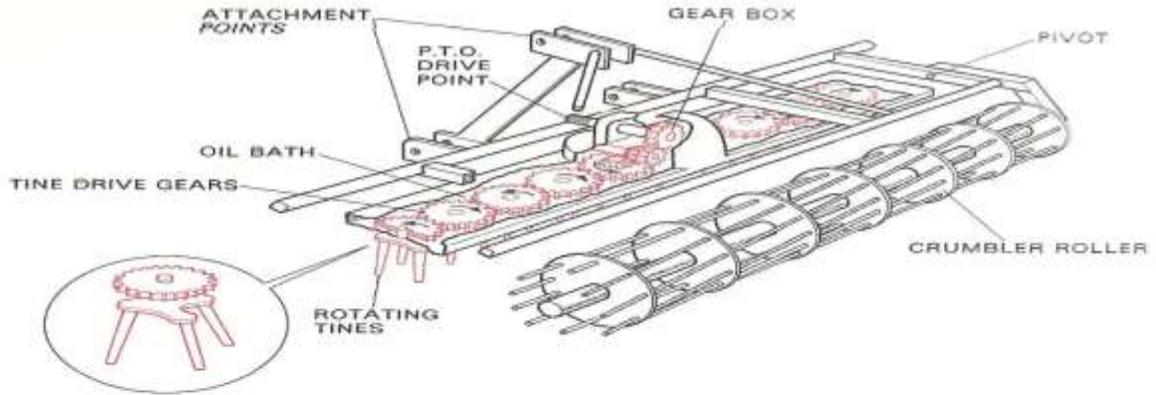


Fig. 104. Working components of a mounted rotary cultivator.

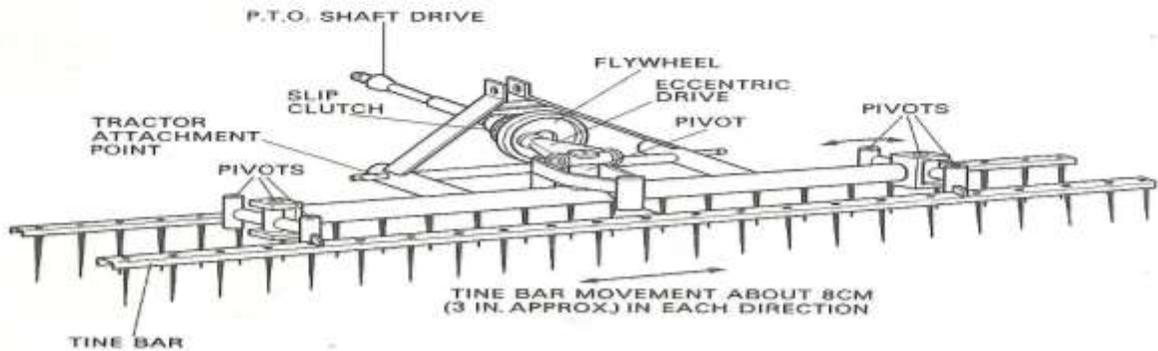


Fig. 105. A power harrow.



Fig. 18-26. Row-crop cultivators: (a) rear-mounted and (b) front-mounted. (International Harvester Co.)

connected to a tool bar. The tool bar may be rear- or front-mounted (Fig. 18-26). Control of the cultivator on hillsides is easier with the front-mounted type.

**Field Cultivator** Field cultivators are similar in use and appearance to chisel plows, except that the frame is much lighter and they are intended to operate at a depth of approximately 4 in [102 mm] (Fig. 18-27). In contrast with a row-crop cultivator, they are used for preparing a seedbed in soil that has been previously worked with a plow disk or chisel plow. In some instances planting equipment is mounted on a field cultivator for till-plant operation.

The shank of a field cultivator is spring-cushioned. The spring provides aggressive, vibrating action for excellent trash clearance (Fig. 18-27a).

Special coil spring shanks equipped with anhydrous ammonia soil points or knives are used to apply fertilizer and other chemicals 4 to 5 in [102 to 127 mm] below the surface, where it will be accessible to plant roots (Fig. 18-28).



Fig. 18-28. A special type of mounted field cultivator equipped for anhydrous ammonia fertilizer application. Note the coil shank with ammonia points or knives. (Orthman Manufacturing Co.)



Fig. 18-27. Pull-type field cultivators have become very popular secondary tillage tools for field finishing or seedbed preparation working 2 to 5 in [50 to 125 mm] deep. Outside wings fold for transport and flex for even penetration across the full width of the unit. (a) Shanks are spring-cushioned (insert) for vibrating action and trash removal. Shank points are  $1\frac{3}{4} \times \frac{1}{4} \times 11$  in [44.45  $\times$  6.35  $\times$  279.4 mm] and are used for shattering crust ahead of planting. (b) V-sweeps are 4 to 12 in [101.6 to 304.8 mm] wide and are used for weed control, leaving crop residue on or near the surface. (Deere & Co.)

## **Harvesting and Processing Machines**

When crops matured in the field and have reached the stage where they can be harvested and taken home for storage and later further processing depending on the end use. There are several crops that are harvested when still maturing in the farm. In all, harvesting machines are used.

In Nigeria most crops are harvested locally either by locally made hand tools e.g. sickles, cutlass, axe, knife etc. This type of harvesting makes the work easier but takes longer time to get the work done.

However, there are improved machines made that help to drastically reduce the hours spent in harvesting. With the modern machines, the harvesting work is made easier or simpler, drudgery is reduced to the barest minimum and the work of harvesting is accomplished faster thus saving time that can be used for other productive activities.

After crops are harvested they have to be processed either to be used immediately or kept in storage for later use. Processing of crops can be done locally or with hand machines or modern machines. The equipment for processing are varied and many.

### **Harvesting Equipment (Machines)**

Machines for harvesting can be classified on the basis of the crops to be harvested

#### **1. Animal feeds**

These are majority grasses (dried or wet). There are three forms of grasses fed to animals.

- Fresh grass
- Dried grass (hay)
- Process or fermented grass/and other crops (silage)

### **Machines for Harvesting Animal Feed**

In general, most animal feeds in the field are harvested locally and by modern machines.

#### **Types of Machines for Harvesting Animal Feed**

- 1. Fresh grass:** these are harvested by hand using a cutlass or sickle and by a machine called a mower. Mowers are of two types:
  - Cutterbar mower and
  - Rotary mower
- 2. Dried Grass or Hay:** this is harvested by a machine called a Hay baller

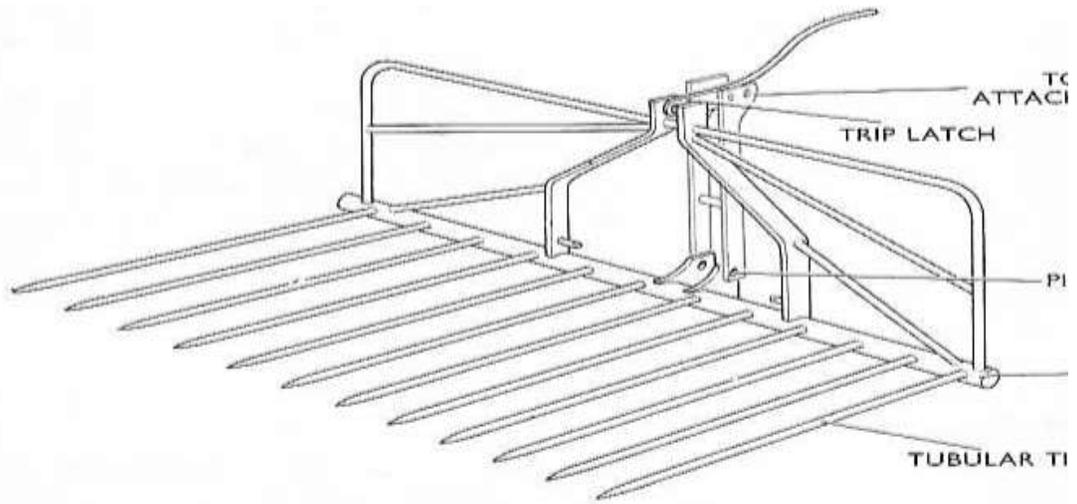


Fig. 145. A tractor buckrake.

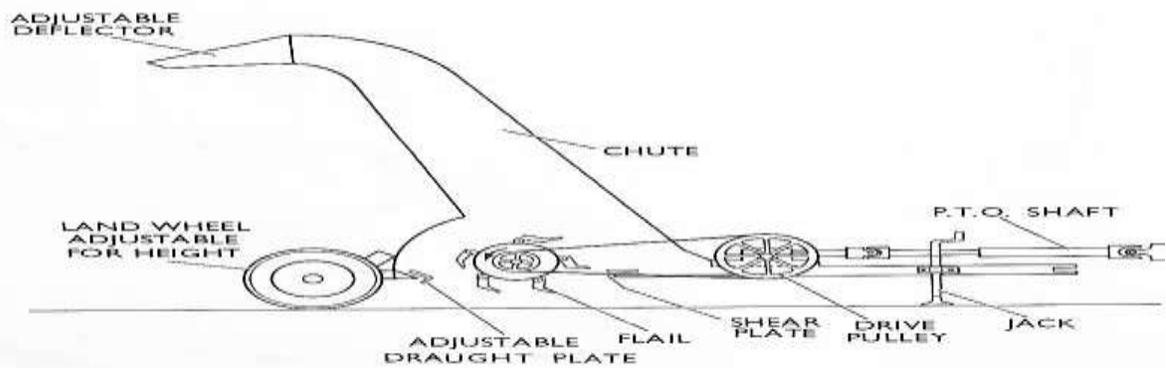


Fig. 149. Side view of a flail-type forage harvester.

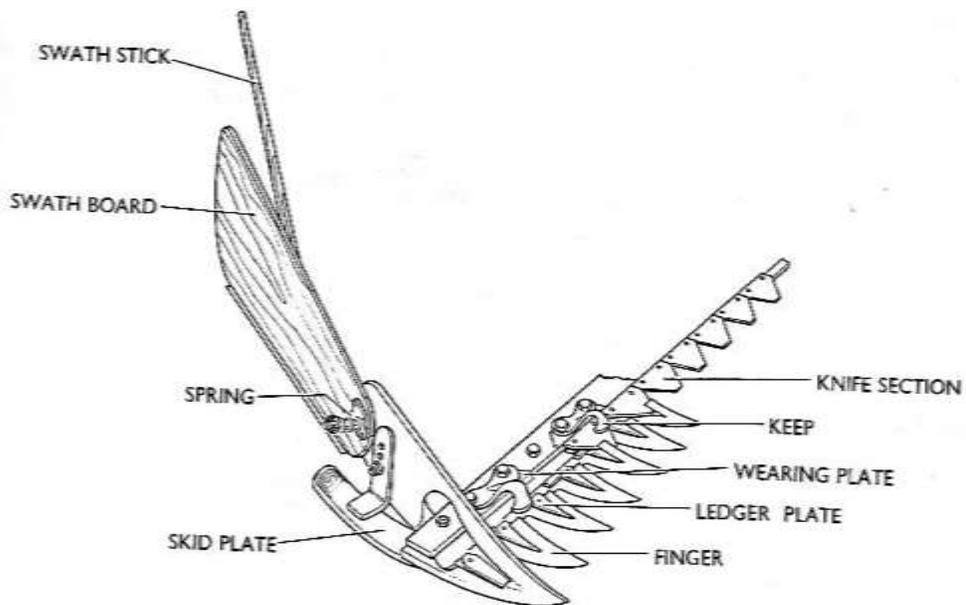
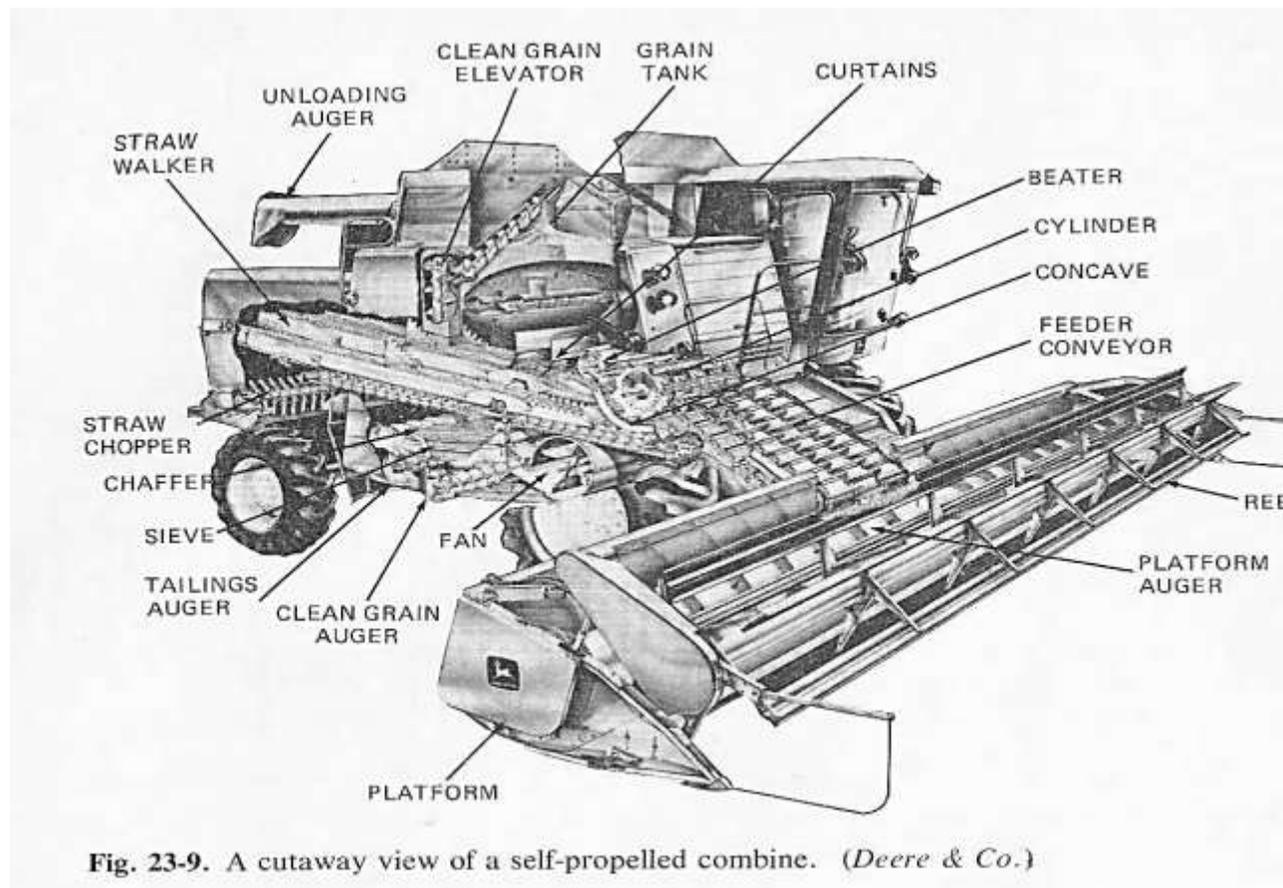


Fig. 122. Cutting mechanism of a mower cutter-bar.

## OTHER CROP HARVESTING MACHINES

These are harvesting machines made for all the kinds of crop produced in the farm. The most talked about is the one called the combine harvester. The combine harvester does the following jobs all at the same time in the farm during operation.

1. Cuts the crop
2. Feeds the crop to the cylinder
3. Threshes the seed from the seed head
4. Separates the seed from the straw.
5. Cleans the seed
6. Handles the clean seed or grain until it is taken by the truck or trailer for safe storage.



### Types of Combine Harvester

Several types of combines are available to meet the various needs of agriculture producers. Selection of these machines will depend on the crop grown the terrain of the farm, number of hectares of farm to be harvested and capital available. These combines are classified as:

1. Self-propelled combined

2. Hillside combined
3. Pull-type combined
4. Special combined

### **PRACTICAL ASSIGNMENT**

1. Students should visit a modern agricultural and /or a major market or dealer of agricultural machines to enable. They see these types of harvesting machines.
2. If possible the farmer can demonstrates the use of any of the combined AVAILABLE.

### **SUMMARY**

Most crops are harvested by either a simple locally made harvesting machines or by a more sophisticated harvester or combine harvester. A combine harvester performs five major functions.

1. Cutting the crop and feeding it to the cylinder
2. Threshing the crop
3. Separating the crop from the straw
4. Cleaning the crop
5. Handling the crop

### **PROCESSING MACHINES**

When crops are process after harvesting they may take various forms or shape. The machines or equipment to do these changes into forms and shapes are available. They range from locally made to more complex modern one. These complex ones are mostly found in industries. The local ones are usually hand mills or hand sieves using such local equipments as pestle and morta, grinding stones, and the local sieve

Processing involves:

1. Size reduction
2. Threshing
3. Milling
4. Preparing feeds for animals.

### **PRACTICAL ASSINGMENT**

Students are to visit any farm where they can see these machines.

Students may request for the demonstration of these machines

