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AGRICULTURE CLASS NOTES

AGRICULTURAL MECHANISATION AND FARM MACHINERY

Agricultural mechanization is the application of power or mechanical aids to all types of agriculture operations making farming less dependent on physical labour.

Mechanization in broad sense includes the manufacture, distribution and operation of all types of tools, implements and machines for agriculture land development. Furthermore it includes operations such as land preparation; spraying to control pests and using machines; processing of crops and animal products.

Benefits of Agricultural Mechanization

It helps to increase agriculture output by increasing the amount land under cultivation.

1 It helps farmers to do jobs which would be impossible to do by hand e.g. uprooting big trees, ploughing in dry weather etc.

2 Releases human labour to be used in farm operations that cannot be mechanized

3 It ensures timely farm operations, e.g. quick seed bed preparation leads to early planting and harvesting.

4 It discourages land fragmentation which is uneconomical for mechanization.

5 It encourages quality production e.g. products harvested mechanically are more uniform than those done by hand

6 Eases problem of labour shortage during farm work since one machine can do work for many people.

7 It is faster hence saves time for other job on the farm.

8 It helps to reduce human drudgery by enabling farmers to do difficult and unpleasant jobs more easily hence making agriculture dignified and attractive profession.

9 Allows better combination of enterprises through saving time for different operation.

10 Encourages proper planning and management of the farm.

Limitations of Agricultural Mechanization

1 Most farmers have small plots which make it uneconomical to mechanize

2 Farmers lack adequate capital to purchase or have machinery.

3 There is always free/cheap human labour from family members; therefore many farmers would not go for machines.

4 It may lead to over production which eventually leads to lowering of market prices.

5 It requires skilled man power i.e. there are few people who can operate and maintain machinery.

6 Clearing land by machines exposes soil to effects of rain water and thus soil erosion.

7 Some farm operation such as coffee picking is not easily mechanized.

8 Some areas are hilly and mechanization cannot work properly.

9 Some farmers are very conservative and cannot adopt mechanization.

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10 It decreases job opportunity for the masses which leads to unemployment.

11 Encourages quick farming which compromises careful farming leading to poor yields.

Factors limiting mechanization

- Unavailability of machines/tractors for use.
- High costs for hire of machines and use
- Inadequate money to purchase machines.
- Inadequate skills to operate machines that could have been used in mechanization.
- High maintenance costs for agriculture machines
- Poor land tenure system which discourages use of machines.
- Tall vegetation which impedes machine movement
- Lack of enough demonstration centers where machines are tested before adoption.
- availability of excess cheap human labour in the community
- Land fragmentation which discourages use of machines

Factors limiting use of draught animals

- Heavy/sticky soils making it difficult to work by animals
- Absence of work animals that can provide the needed power
- Prevalence of pests and diseases
- Inadequate advisory/extension services on use of animals
- Topography-Hills and steepy areas do not easily encourage animal power
- Lack of capital for purchase of animals and Ox-ploughs.
- Nature of crops grown-broadcasting does not easily a mechanization
- lack of enough grazing land for animals
- presence animal pests like tsetse flies that discourage rearing of animals

Factors that encourage agriculture mechanization

1 Extension service; farmers needed to be educated about machines and their importance in agriculture mechanization.

2 Land tenure system; mechanization requires large piece of land for it to be economical.

3 Cost of machine; Cheaper and simple machines are needed that are affordable to the farmer.

4 Formation of cooperatives/Farmers organisation; this encourages farmers to own machines as a group which is relatively cheap.

5 Flexibility of machine; farmers will prefer a machine that performs more than one ob to reduce costs that would have been handled on other machines.

6 Presence of engineering workshop; These are important in repairing machines and giving advice to farmers on machines

7 Availability of loans and subsidies; these will make it easy for farmers to obtain expensive machines.

Steps taken towards agricultural mechanization

1 Need to educate farmer as the importance of mechanization

2 Large areas of land are needed to make mechanization economical.

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3 provide loans to farmers that can be used in purchasing machinery

4 develop simple and less expensive machinery for use

5 provide machines that are suitable for the prevailing environmental conditions

6 encourage farmers to own and operate machinery collectively to reduce individual costs

7 the process of mechanization should be gradual beginning with areas that are economically viable

8 agricultural engineering workshops should be provided in districts to handle farm machinery

9 taxes on farm machinery should be reduced so that it becomes affordable

Qn. Explain the factors that have favoured the use of ox-ploughs/ animal power in Teso region

Levels of Agriculture Mechanization in Uganda

The size of the farm and the kind of agriculture production on it determines the extent of mechanization on the farm. There are three levels to the application of mechanization;

1st level

1 This level involves the use of hand tools e.g. pangas, hoes, slashers, wheel barrows etc. It is a subsistence level of agriculture production.

The problem facing farmers at this level it's the low output i.e. yields are very low.

The following factors have contributed to the continuous use of hand tools or persistence of level one in agriculture.

i) Peasant farmers and other low income earners who are interested in farming cannot afford to buy machinery

ii) High prices and taxation imposed by government on farm machines making it unaffordable

iii) Land tenure system like land fragmentations do not justify the use of such sophisticated machines.

iv) Farmers are conservative i.e they are unwilling to adopt new methods of technology.

v) Farmers lack the skills and training to handle modern machines.

vi) Illiteracy has hindered effective advertisement and demonstration of use of machines to farmers.

vii) Availability of cheap human labour making it uneconomical to use machines.

The need to move to level 2 is justified by;

1. Increase in demand for food as human population increases
2. Reductions in family labour as children go to school under free primary and secondary education
3. Introduction of new farming techniques like row planting that may require a more powerful source of power
4. Availability of enough grazing land for animals

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5. Increased profits in agriculture availing capital required for use

2nd Level

This involves the use of animal power, particularly where land and other facilities are available.

This involves the use of animals like oxen, horses, donkeys, camels and buffaloes. Special harnesses and yokes are used to clutch various equipment to the animals.

Animals generally have the capacity to be over loaded however for a short period of time. They provide good traction/grip even in difficult conditions.

The output available from farm animals depends on;

i) Feed intake

This naturally affects power output; normally animals are in their poorest condition after dry season. Soon after that their conditions change when the rain starts and that's when their load should be increased

ii) Animal health

Sick animals are always weak hence cannot carry out work as expected

iii) Breed of the animal

The breed of the animal should be chosen such that it's adapted to harsh environmental conditions such as high temperatures; Long drought seasons; therefore local breeds are preferable to exotic breeds.

iv) Load of work available; this strains animals making it less efficient at work

v) Training given

Training can also yield better performance. Its said that donkeys are easier to train for farm than bulls.

vi) Yoke used for hitching

The influence of the yoke on power output is quite significant. A good yoke should be able to cover animals adequately that are hitched together.

vii) Type of animal; big animals like cattle may provide more power than the small animals

viii) environmental conditions; working under harsh conditions may reduce the amount of power provided by animals

Advantages of using Animal power

i) It does not required skilled workers as compared to the engine power.

ii) It can transport heavier loads than hand power

iii) Animals can operate well in land fragmentation areas.

iv) Initial cost of buying and maintaining animals and their implements are lower than that of tractors.

v) A fairly large area of land can be cultivated

vi) animal power is faster than hand labour

vii) They have good traction ability in any area hence increase in efficiency

viii) Animals can work and survive well in harsh climatic conditions

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ix) Animals are more reliable than human power

Disadvantages;

i) A big piece of land is required in grazing the animals
ii) Animals cannot manage to plough very hard and dry soil.
iii) The amount of work done depends on the health of the animals.
iv) Performance decreases with increase in hours worked
v) Animals need training and farmers must have experience of animal husbandry
vi) In cultures that doesn't permit use of animal power, the power potentials is not exploited e.g. in Ankole where animals are treasured
vii) Animal output is reduced by environmental factors such as high temperatures, excessive rainfall.
viii) animal parasites like tsetse flies may limit use of animals in some areas

3rd Level

In order to increase production and efficiency and reduce hand labour a good number of farmers have changed from the previous two levels to engine power production

Advantages

i) It saves the farmer hand labour which is expensive
ii) Increases efficiency and ensures timely farm operations
iii) Machines can work continuously without suffering from fatigue
iv) Machines are more economical for large areas in the long run
v) Big areas of land can be cleared.
vi) They produce quality work

Disadvantages

i) They require skilled man power to operate
ii) They have very high initial and maintenance cost
iii) They may create unemployment.
iv) they produce fumes that pollute the environment
v) may require a lot of skill to be operated
vi) maintenance costs are high
vii) they can destroy soil structure exposing soil to erosion

Factors considered before selecting machinery and equipment for use

1. Nature of work; every machine is made for a particular purpose which it must do
2. Financial status of the farmer; some machines are too expensive for the farmers hence cannot be purchased
3. Type power used; machines using electricity may not be used where power is not available
4. Topography; hilly place may not favour use of machines like tractors due to steepness of land
5. Skills of the farmer; highly skilled farmers can use a number of machines and equipment.
6. Flexibility of a machine, machines that can perform more than one type of work are more economical to use
7. Adaptability of the machine to different environmental conditions

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8. Level of production; large machines are required for a high level of production due to their power production
9. Efficiency of the machine at doing the work to be done

SOURCES OF POWER ON THE FARM

Power is the major driving element in mechanization it's needed on the farm for a variety of operations which maybe mobile or stationary.

Mobile operations include transportation of produce, field operations like ploughing, weeding etc

Stationary operation includes pumping water, extracting oil, drying, threshing etc

Common power sources on the farm include human power, animal, wind, solar, electric, hydro, biogas, fuel power, thermal power and engine power, nuclear power

WIND POWER

Its power provided by wind and can be used in doing light farm work like; Pumping water, winnowing crop produce and generating electricity.

Advantages

- It's a cheap source of power since it is free
- Wind is free
- does not pollute environment
- Can be used sustainably
- Clean source of power.

Disadvantages

- Has high initial cost for purchasing and installing a wind mill
- Wind is unreliable/unpredictable
- Wind cannot be controlled
- Its power is limited to stationary work

HUMAN POWER/HAND POWER

This is also known as human power i.e. it is a power produced by human beings. It's the main source of power on a farm using simple machines, tools and implement.

Advantages

- Has low initial capital hence sustainable for peasant farmers
- Very flexible i.e. can be used for a number of farm operations
- Can perform work in the absence of a farmer in the field
- Human labour is readily available in Low Developing Countries
- Cannot be limited by land tenure system and size of land
- Poses no pollution threats to the environment
- Family and causal labour can provide man power

Disadvantages

- It's slow in operation
- Cannot cope with large amount of work
- Efficiency declines with increase in number of hours worked
- Performance is influenced by health; maturity etc
- It's expensive in the long run.
- Does not provide uniform work hence less efficient.

NB: The extent to which human power can be used as a source of power depends on the degree of mechanization e.g. some parts of the world where mechanization is high man acts as a control device but where mechanization is low man acts as source of power

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SOLAR POWER

Its power got through harvesting the sun's energy by special devices. It can be used in; drying farms produce, pumping water, lighting and on farm fences.

Advantages

- Has low maintenance costs
- Does not pollute the environment
- Light energy is freely produced by nature and cannot be exhausted
- Produce clean power for farm jobs.

Disadvantage

- Light may be unpredictable since it depends on weather
- Has high initial cost for buying and installing the materials for trapping light.
- May not be used in performing heavy work in farm like grinding grains

Qn. Describe the factors that affect the use of ox cultivation (animal Power in Uganda).

ENGINE POWER

This comes from engines sparked by gasses from burning fuel like kerosene, petrol, diesel and coal. It can also come from steam of boiling water heated by burning fuel such as fire wood and coal.

The engine is fitted with a piston which converts kinetic energy of the gasses from burning fuel to useful mechanic energy that drives machines like grinders, millers, tractors etc.

Engines can perform the following functions on the farm

1. Drive the tractor to carry out a number of operations like ploughing, mowing, harrowing etc.
2. Provide transport on the farm by pulling a trailer
3. Operate a water pump for farm water
4. Drive a grinding mill
5. Operate a milking machine
6. Drive a generator that produces power
7. Drive grass cutters
8. Drive crop sprayers and harvesters

Types of engines

1 **External Combustion** engine power; this is where the burning of fuel is done out side the combustion chamber e.g. in a steam engine

2 **Internal combustion** engine power; this is where the burning of fuel is inside a combustion chamber.

Internal combustion engines are of two types namely, **4 stroke** engine and **2 stroke** engine. Both use either diesel or petrol as a source of fuel.

Differences between a 2 stroke and 4 stroke engines

	4 stroke engine	2 stroke engine
1	Gives one power stroke in four strokes i.e. in 2 revolutions of the crankshaft	Power stroke takes place in every two strokes i.e. one power stroke for a revolution of the crankshaft
2	Due to more idle strokes and non uniform load on the	Engine has more uniform as every time the piston comes down it is

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	crankshaft, a heavier flywheel is required	power stroke hence a light flywheel is required
3	Engine is heavy since it has more parts	Engine is light since has less parts
4	Engines are more expensive since they have more parts	Engine is cheap since has less parts
5	Engine produces more power since fuel is burnt completely	Engine produces less power since fuel is not burnt completely
6	Uses less fuel due to reduced wastage	Uses more fuel due to increased wastage
7	Engine produces less noise some of it is absorbed by water jacket	Produces more noise due to absence of water jacket to absorb excess noise
8	Produces less smoke due to complete combustion of fuel	Produces more smoke due to incomplete fuel combustion
9	Engine is big hence occupies more space in the vehicle	Engine is small hence occupies less space
10	Consumes less oil as it gets recycled in the engine	Uses more oil since there is no recycling
11	It has valves that allow in fuel air mixture or air	It has ports that allow in fuel air mixture

Advantages of using internal combustion engine

- Its faster ands saves time and labour
- It can work continuously without fatigue unlike man and animals.
- It enables farm operations to be achieved in time.
- It's economical in the long run.

Disadvantages

- It requires skilled man power to operate, maintain and prepar
- It needs high initial capital
- It's expensive to maintain, prepare and buy spare parts.
- It depends on petrol, diesel and oil which are expensive.

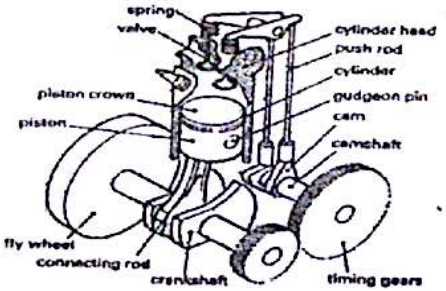
The principle source of mechanical power on a farm is the engi gives power to the tractor.

TRACTOR

A tractor is versatile machine since it provides power for many e both mobile and stationary jobs, these include;

- Provides a pull from the rear for machines e.g. ploughs and t
- Provides a push at the front for equipment
- Provides a drive to the PTO shaft (power take off) for machi as mower and grinders etc.
- It provides hydraulic power to a three point linkage f equipment
- It provides a means of transport.

Parts of an engine



COMPONENTS OF AN ENGINE

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Components of the combustion engine and their function

Engine block; it's the foundation block on which all components are directly or indirectly attached.

Cylinder; it is the nucleolus of all activities but principally its for receiving and burning the fuel.

Connecting rod; it transmits power to the crankshaft and assists in changing the up and down ward motion of the piston to rotary motion of the crankshaft

Piston; it receives power from burning gasses to move down wards taking power to the connecting rod and crankshaft

Functions of a piston

- Mix air and fuel for those with combustion chamber on top
- Transmits power produced in power stoke to crankshaft.
- Pushes exhaust gases out during exhaust stoke
- Works as a guide for upper part of connecting rod.
- Carries compression rings which seal the combustion chamber from sump.

Crankshaft; this is responsible for converting the up and down movement of pistons into rotary motion a usable form of power.

Cylinder head; this covers the top of the cylinders and houses other components such as a spark plug, injector nozzles and valves

Inlet valve; it allows in fuel air mixture or air into the cylinder,

Exhaust valve expels the burnt gases.

Gasket; its used to make a gas and water tight seal between the cylinder head and the cylinder or oil sump and engine block.

Gudgeon pin/piston pin' it attaches the piston to the connecting rod

Crank case; It covers the bottom of the cylinder and holds the lubricating oil and other components like crankshaft

Combustion chamber; this is where the actual combustion of fuel/air mixture takes place.

Camshaft; it's a pump on which the cams are mounted on. It enables the valves to open only once per cylinder. The camshaft is driven at half the crank shaft space

Cams; these are mounted on the camshaft to control opening and closing of the valves which must coincide with particular movement of the pistons.

Piston rings

- Seals the combustion chamber and does not allow gases to escape to the sump (pressure ring)
- Carries away heat from piston to cylinder wall (pressure ring)
- Lubricate cylinder walls (oil ring)
- scrap oil from cylinder wall and return it to the sump (oil ring)
- Resist high pressure and high temperature (pressure ring)

The valves are always working together with the movement of the piston. The timing gears also drive the injector pump that injects diesel into the combustion chamber.

Fly wheel; this one is fitted onto the crankshaft just to absorb power during the power stoke. It is a heavy wheel that runs by its inertia during the idle stroke

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It maintains the speed of the crankshaft

Piston rod; transmits power from the piston head to the crankshaft

Engine Terminology

1. Bore

   It's the diameter of the cylinder

2. Stroke

   It's the maximum length of travel of the piston from one extreme position to the other in one direction.

3. Top dead centre (TDC)

   It's the highest point a piston can move towards the cylinder head.

4. Bottom dead centre (BDC)

   It's the lowest point a piston can move towards the crank case.

5. Piston displacement

   It's the volume displaced or covered by the piston when it moves from TDC to BDC

6. Clearance volume (CV)

   It is the space/volume between top of the piston and the engine cylinder head when the piston is at the top dead centre

7. Compression ratio

   Is the ratio of total cylinder volume to clearance volume

8. Total cylinder volume

   This is the volume designated by the sum of the piston displacement and clearance volume ~~(PF+CV)~~ (PD + CV)

TYPES OF INTERNAL COMBUSTION ENGINE

There are two types of internal combustion engines namely;

1 Spark ignition (petrol) engines.

2 Compression ignition (diesel) engines.

Petrol Engines

These engines are equipped with a device for ~~ingination~~ ignition called the spark plug which produces an electric spark to ignite the compressed gases and fuel in the cylinder. Most of to day's petrol engines have a **carburetor** which atomizes fuel and mixes both air and fuel. It then injects the mixture into the cylinder but others that do not have the carburetor but inject fuels directly into the cylinder for ignition.

Diesel Engines

In diesel engines, ignition is produced by the heat of compressed air in the cylinders where fuel is mixed with compressed air unlike in the petrol engine where by air and fuel is mixed in the carburetor.

Difference between Petrol and Diesel ~~ingination~~ engines

Petrol	Diesel
Use petrol as fuel	Uses diesel as fuel
Fuel is ignited by a spark from the spark plug	Fuel is ignited by hot compressed air
Has a carburetor to mix air and fuel	Has an injector pump to drive fuel into the cylinder.
Has a spark plug	Has an injector nozzle
Has low compression ration of 5:1-8:1	Has a high compression ratio of 14:1 - 20:1
Air and fuel meet first ~~meet~~ in the carburetor	Air and fuel first meet in the cylinder (air goes 1st then followed

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	by fuel)
Produces less smoke	Produces more smoke
Petrol engine produces less noise	Produces more noise
A petrol engine is light in weight and is suitable for light work	Heavy in weight and suited for heavy work.
Petrol engine consumes fuel very fast per minute work done	Diesel engine consumes less fuel per unit work done
Petrol engine is too expensive to purchase but expensive to maintain	More expensive to purchase but maintenance cost is low

KINDS (MODELS) OF INTERNAL COMBUSTION ENGINES

Depending on the number of cylinders the engine has there are two kinds;

1 Two stroke cycle engines

2 Four stroke cycle engines

2 Stroke cycle engines

This is an engine in which all the events/strokes are completed in two strokes of the piston. It combines **induction and compression, power and exhaust strokes**

Induction and compression (1st stroke)

- The piston moves up
- Exhaust and transfer ports are closed
- Inlet port is opened
- Fuel air mixture is compressed in the combustion chambe
- Fresh supply of fuel air mixture and oil is allowed into t case
- At the end of the stroke, fuel air mixture is ignited

Power exhaust stroke (2nd stroke)

- Inlet port is closed by the piston moving upwards
- Fresh fuel air mixture is trapped in the crank case
- Exhaust and transfer ports are opened
- Exhaust gases are expelled through the exhaust port

2 STROKE POWER CYCLE

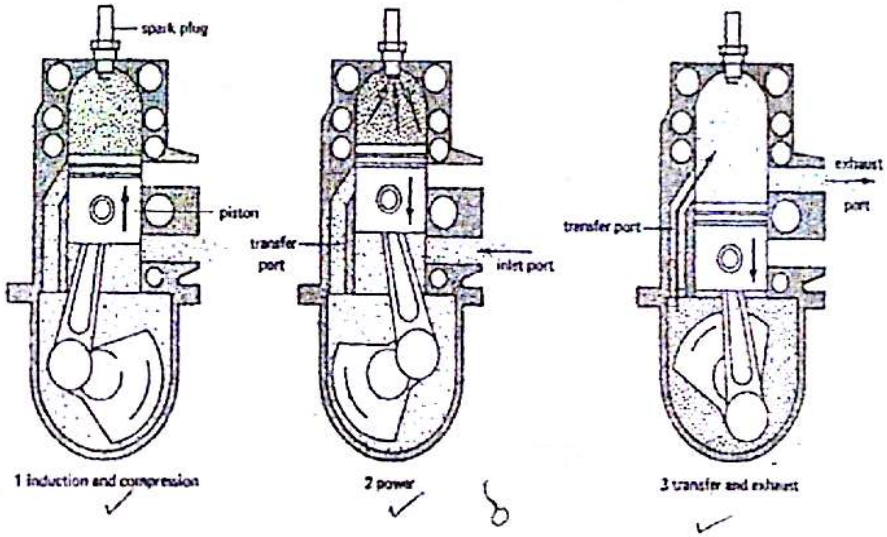

fig 20.8 A two-stroke engine cycle

2 STROKE ENGINE CYCLE

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Four stroke cycle engines

All engines with 4 strokes have the following

a) Intake (Induction) stroke

b) Compression stroke

c) Power / ignition stroke

d) Exhaust stroke

a) Intake (Induction) stroke

Petrol engine

- The air fuel mixture is drawn into the cylinder through the inlet valve
- The piston moves down the bottom dead centre as initiated by the movement of the crank shaft.
- At this time the exhaust valve is closed.

Diesel engine

- The air is drawn into the cylinder through the inlet valve
- The piston moves down the bottom dead centre as initiated by the movement of the crank shaft.
- At this time the exhaust valve is closed.

b) Compression stroke

Petrol engine

- The piston moves up to compress fuel air mixture
- Inlet and exhaust valves are closed

Diesel engine

- The piston moves up to compress air
- Inlet and exhaust valves are closed

c) Power

Petrol engine

- Inlet and exhaust valves are closed
- A spark is introduced into the cylinder by the spark plug to ignite compressed fuel air mixture
- Burnt gases expand and force the piston down wards

Diesel engine

- Inlet and exhaust valves are closed
- A jet of diesel is introduced into the cylinder by the injector nozzle to be ignited by hot compressed air
- Burnt gases expand and force the piston down wards

d) Exhaust

For diesel and petrol engines

- Exhaust valve is opened to allow exhaust gasses out
- Inlet valve is closed
- Piston moves up to expel burnt gasses

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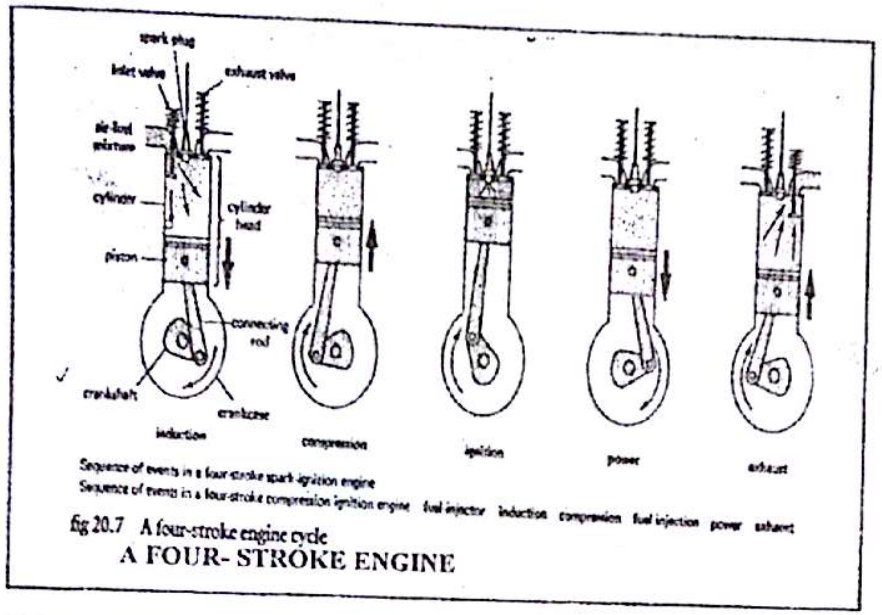

fig 20.7 A four-stroke engine cycle

A FOUR- STROKE ENGINE

Advantages of using a 4 stroke engine

i) They produce a lot of power and therefore do heavy work.

ii) They are efficient in oil and fuel utilization

iii) Exhaust gasses are sufficiently expelled from the cylinder reducing pollution

iv) They are efficiently cooled with water

v) They have heavier crank that absorbs the vibration of the engine.

vi) They perform a wide range of farm operations.

Disadvantages

i) Initial costs buying the engine are very high

ii) They are very expensive to maintain

iii) They need very skilled operators and support serv servicing, repairing and installing spares

iv) Their use is limited to flat areas

Advantages of a two stroke engine

i) They are cheap to buy and easy to maintain

ii) They use little fuel

iii) They do small jobs which cannot be done by 4 stroke eng

iv) They can be used in a wide range of farm land e.g. in hilly

Disadvantages

i) They produce low power therefore cannot do heavy work.

ii) They are insufficient in oil and fuel utilization.

iii) They are mainly air cooled thus limited in size.

iv) There are slow and cannot satisfactory operate under fl loads

Firing order

This is the order/sequence in which the power stroke occurs i cylinder engine. The order of cylinders firing minimizes stres crankshaft. A 4 cylinder engine would have any of the followin orders. **1,2,3,4** or **1,3,4,2,** and **1,2,4,3**

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Compression ratio

Not all air in the combustion chamber is compressed but some remains. The ration of the total air in the cylinder and that which is compressed is called compression ratio.

In petrol engines it ranges from 5:1- 8:1 and in diesel engines 14:1-20:1. Diesel engines are therefore more efficient and economical that petrol engines.

ENGINE SYSTEMS

Internal combustion engines have a number of interrelated functions each of which have to work efficiently. The engine systems of a tractor include ;

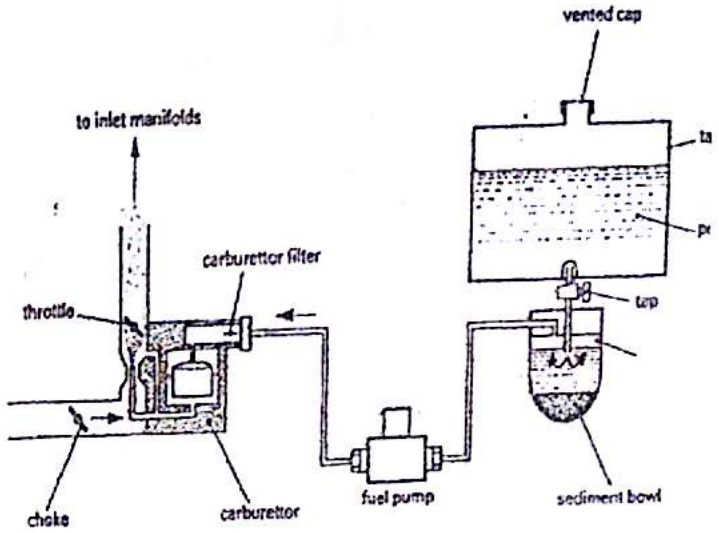
- Air and fuel system.
- Cooling system
- Lubrication system
- Electrical system
- Transmission system

1. THE AIR AND FUEL SYSTEM

The commonest fuels used in farm engines are petrol and diesel. Diesel has almost replaced other petrol engine as the power unit of the farm tractor .why; diesel has high power output compared to petrol.

Although the diesel engine is more expensive to buy and maintain the advantages of compression ignition will quickly compensate this high costs.

A) Fuel system in a petrol engine



The main function of the fuel

PETROL FUEL SYSTEM

the engine with clean fuel in cor over a wide range of engine speed and load.

The fuel air ratio is normally 14:6:1 it's for every one part of pet But by native it contains more than a part of petrol in 14:6 par therefore it's called a rich mixture.

The carburetor

This performs two main factors;

i) It maintains fuel air mixture under all operational conditior

ii) It breaks the fuel dropouts into fine mist to be carried cylinder by a stream of air. This is called atomization.

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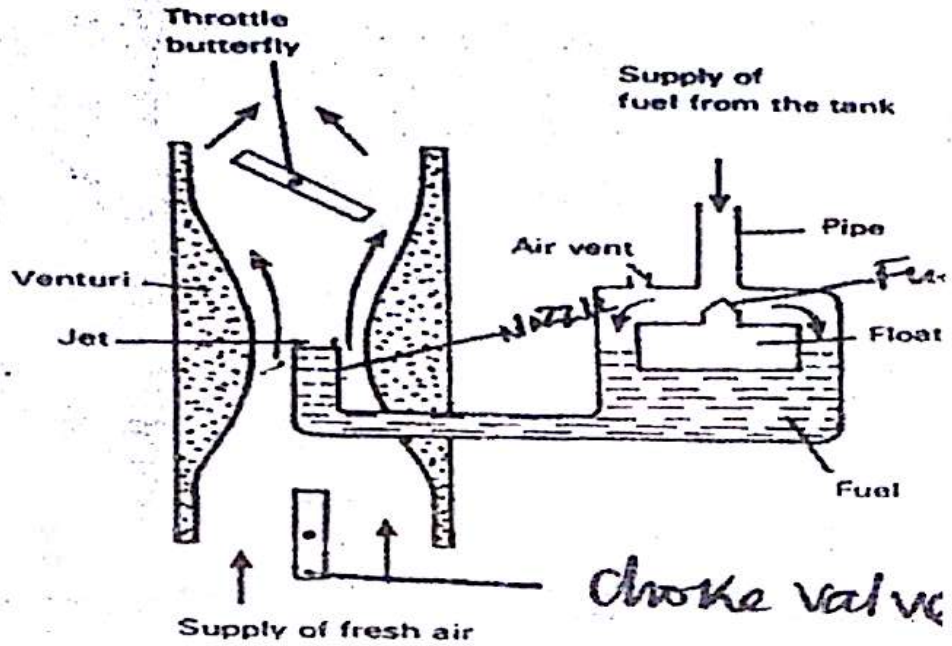
Diagram of a carburetor



CARBURETTOR

Working of a carburettor in petrol fuel system

- During the inlet stroke, a fuel air mixture is drawn into the cylinder.
- The petrol leaves the fuel tank through the fuel inlet pipe situated at the base of the tank.
- It's then filtered by the fuel filter and enters the float chambers by way of the needle valve or **fuel intake valve** on the carburettor.
- The **float** has the function of maintaining a constant level of fuel in the float chamber.
- From the bottom of the **float chamber**, fuel is fed thro **discharge tube/ nozzle** to the venturi.
- When the engine is running the downward movement of t in the induction stroke causes suction pressure in the cyli
- The result is that air rushes in and passes through th valve to the venturi which mixes fuel with the air.
- The fuel air mixture which is in vapour form enters the through the throttle / butter fly valve.
- The **choke valve** (strangler) controls the air supply carburettor and is normally closed when starting the e enrich the fuel mixture.
- The **throttle/butterfly** valve helps to adjust the quantity mixture going to the combustion chamber hence contr speed and power generated by the engine. This valve connected to the accelerator.

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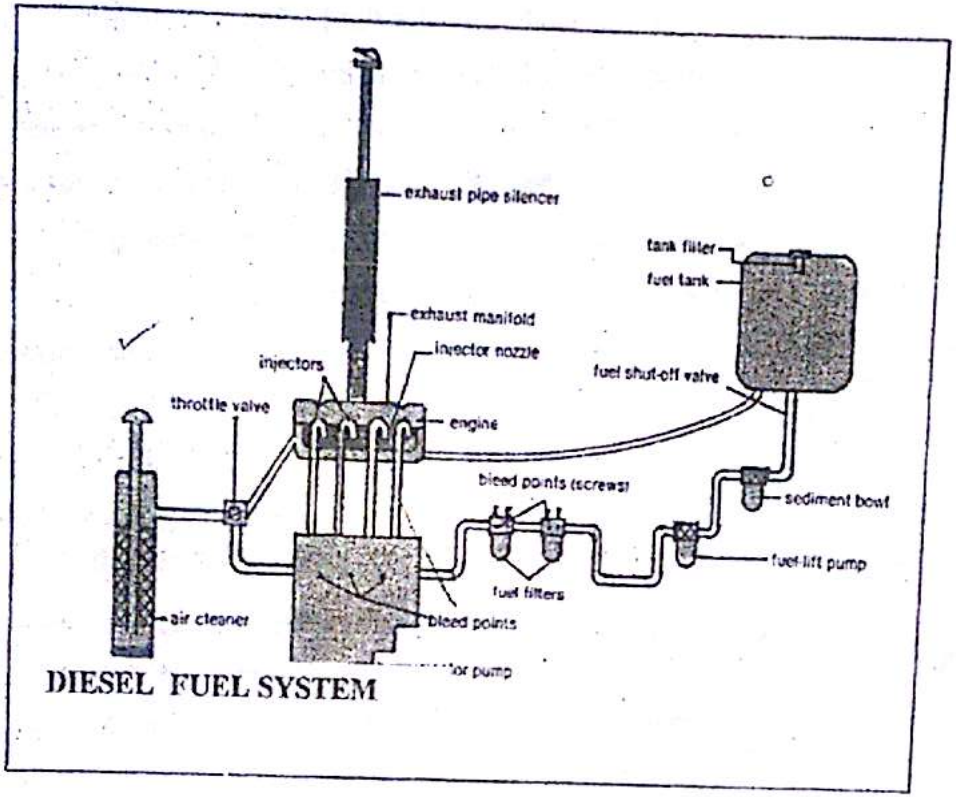
FUEL SYSTEM IN THE DIESEL ENGINE.



DIESEL FUEL SYSTEM

Description

The fuel flows from the **tank** situated above the engine that acts as storage. The fuel tap should always be left open to prevent an **air lock** forming in the system.

The flow of diesel from the tank may be by **gravity** or by **lift pump**. All petrol engines in a tractor usually rely on gravity flow to the engine but in the case of diesel engine by use of lift pump provides fuel at a constant pressure to the **injector pump**

The lift pump is operated by the means **cams** on the camshaft pumps continuously as long as the engine is running.

Priming lever

This is a manually controlled button which is used to supply fu starting the engine or when removing an air lock.

Fuel filter

Some tractors have two filters for cleaning the fuel as it moves fuel tank to the inject plump.

Injector Pump

This is a very important and expensive part of the diesel engine deliver fuel accurately and in small quantities to the injector n atomizes diesel fuel

Injectors/ injector nozzles

Their work is to inject into the cylinder small quantities of f amount of fuel injected controls the engines speed.

Leak off pipe

This returns any over flow of fuel back to the tank for recirculatio

Governor

It controls the speed of a diesel engine by regulating fuel supply speed is beyond a certain level. This will prevent damages helps to maintain speed for any particular machine that the eng be driving.

Maintenance of fuel systems;

i) Fuel Filters need regular replacement for every service
ii) here try to follow manufactures instructions during use

iii) The sediment bowl should be cleaned regularly to remove dirt

iv) Bleed the system to get rid of trapped air /air lock for diesel engines

v) Ensure that the fuel tank cap is tightly placed to avoid spillage of fuel

vi) Tighten the pipes of injector and fuel delivery tube to reduce fuel loss

vii) Use the correct type of fuel for the engine always

viii) Always use clean fuel from a reliable source so that the system is not blocked

ix) Seal off all the leakages in the system to reduce fuel loss

x) The injector pump or carburettor should be cleaned regularly by removing dirt

Air supply system

a) The air supply system is similar in both petrol and diesel engines. Clean filtered air is drawn into the cylinder during the induction stroke.

b) During the course of operation, tractors and other machines used for farm work suck in quite a lot of air which may contain a large proportion of dirt.

c) Whether an engine uses petrol or diesel as fuel, an air cleaner is an essential component of a complete fuel system.

d) An air cleaner does its job of preventing dust, dirt and other foreign particles from entering the engine.

e) Air must be cleaned because dust, sand particles a similar materials can cause rapid wear of valves, cylinders and all rings

f) There are also rapid build up of carbon in the co chamber and on the valves. This carbon will glow red affecting the running of the engine.

g) Two types of air cleaners are sued and both types are c removing up to 95% of the harmful particles from the enters the engine.

a) **Wet type/oil bath air cleaner**

This type is very popular because it can be fully clea serviced regularly moreover cheaply because only ne needed during servicing.

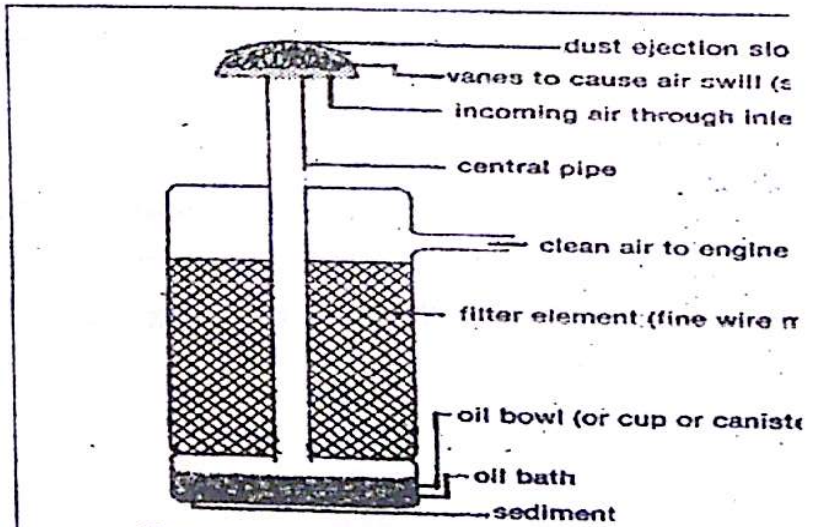


Figure 9.10. The wet air cleaner (oil bath air c

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WET AIR CLEANER

Description/ mechanism of operation

i. The dirt laden (heavy) air enters the **pre cleaner** where it meets the vanes that cause swirling.

ii. The swirling helps to throw out the dust particles through the dust **ejection slots** on top of the pre-cleaner. These particles may include leaves, insect and other big particles.

iii. Air passes rapidly down the **stack/ central pipe** to the **oil bowl/cup/canister** container carrying the lighter dirt.

iv. Much of the lighter dirt gets stuck in the **oil bath** as air passes through it

v. From the oil bath, air passes through the **wire gauze** (filter element) which traps any dirt that may have escaped the oil bath

vi. Apart from the cleaning effect, the filter element dries the air and prevents any oil from reaching the engine.

vii. Finally, clean air goes through the outlet to the engine cylinders.

Care and service of the oil bath air cleaner

1. Under normal working conditions the oil bath cleaner should be checked weekly.
2. If there is more than $^1/_2$ cm of dust in the oil bath then it should be cleaned out and refilled with fresh clean oil.
3. If a tractor is working in very dirty or dusty conditions then the oil bath should be checked daily for the thickness of dirt.
4. Periodically the wire mesh should be thoroughly [illegible] paraffin to remove trapped dirt.
5. Use the recommended type of oil for the bath that is [illegible] trap dirt
6. Sediment bowl should be washed regularly to remove dirt

b) **Dry type Air cleaner**

This type does not contain an oil bath but a replaceable element made of wash paper material.

This must be changed when it becomes dogged with dirt. But the changing interval will depend on the conditions in which the tractor is operating.

Some tractors have a visual check monitor fitted on the engine induction system to warn the driver when the filter is becoming clogged. It can be cleaned by tapping it gently with the palm of the hand or by blowing compressed air through it in a normal air flow direction.

Mechanism of operation

1. An air current is created when the tractor is in motion
2. air is drawn into the dry air cleaner
3. the dry paper on the cleaner removes dirt from air
4. the air current inside the container is forced to swirl
5. air enters the dry paper filter
6. dust particles are filtered out by the paper
7. clean air passes through the manifold to the combustion chambers

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dust and dirt using compressed

r with water

luced in the engine. A lot of heat
t to be turned into a useful work.
and the remaining is reduced by

reventing over heating of the

. engine cracking.
engine within specific range for

parts thus distorting the shape
power, valve burning and even
ne knock).

he parts of the cylinder surface
e fuel reducing fuel efficiency.
of lubricating oil.

There are two types of cooling systems.

1 Combined water and air cooling system.
2 Air cooling system.

Most machines are water cooled especially heavy machinery only few are air cooled.

Combined Water and air cooling system;

It uses cool water to saturate round the engines while air takes away excess heat from the hot water. Water as a coolant has the following advantages;

i) It absorbs heat at a reasonable rate.
ii) It saturates freely at a big range of temperatures because of having a low freezing point.
iii) It's readily available everywhere.

However, water can cause rusting of the radiator parts more especially the water jackets

The major components of this system are radiator fins, H_2O hoses, cap, water pump/ impeller, water jackets, and fan and thermostat.

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iii) **Water pump**

Pumps cool water from the bottom tank to the engine cylinders

iv) **Fan**

Sucks cool air from the out side over the radiator fins to cool hot water

v) **Thermostat**

It's an automatic device which regulate engine temperature by controlling circulation of water in the water jackets

vi) **Temperature gauge**

It indicates to the driver engine temperature so as to avoid overheating of the engine.

vii) **Fins**

They increase the surface area for cooling of water in the radiator

Adaptation of the radiator to its factions

1 It has fins which provide large surface area for cooling of water

2 It has thin pipes/tubes for easy movement of water from the top horse pipe to the bottom.

3 Its made of copper which is a good conductor of heat

4 It has a fun which drives away the heat using air it blows.

5 it has a water pump that pumps cool water into the water jackets

6 it has a drain tap used to get rid of dirty water in the radiator

Maintenance of water cooling system

i) Fill the radiator always with clean water before starting a day's work.

ii) Repair any linkages in the radiator to reduce water loss

iii) Remove all rubbish from the radiator fins that may reduce cooling surface.

Iv) Remove dirty water from the radiator through the drain tap and should be cleaned thoroughly after 60 hours of work.

v) A radiator cap should be firmly secured to prevent water spillage

vi) Ensure that the fan belt is not broken for proper function

vii) Check the tension of the fan belt i.e. it should neither be too loose nor too tight which can lead to poor performance.

viii) Water pump should be greased periodically for efficiency

ix) Hose pipes should be tight to reduce water loss through leakages

x) The thermostat should be checked to ensure it's in good condition.

Advantages of using a combined air and water cooling system

- Water takes heat away quickly since its in direct contact with cylinder walls
- Water circulates freely between freezing and boiling points
- Water jackets damps down sound of engine
- Engine working temperature can be controlled
- Engine with water cooled system can be fitted in any position of the vehicle

Disadvantage

- Radiator increase the dead weight of the vehicle
- Water boils and evaporates early at 100^0C
- Radiator fitted infront of the vehicle increases air resistance hence slowing down speed

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- Water corrodes metal parts in the cooling system
- Overheating of the engine may result knocking due to carelessness
- Warming up of the engine may be slow leading to cold running which accelerates sludge formation
- Water frees at zero degrees which is a disadvantages in temperate regions

Causes of overheating in engines

- Leaking radiators
- Leaking water pump
- Choked or leaking hose pipe
- Leaking head tank
- Loose fun belt which fails to blow air for cooling water
- Chocked radiator fins
- Rusty water jackets
- Defective thermostat
- Low engine oil level
- Choked air cleaner

Air cooling system

It uses air to circulate round the engine block while carrying away excess heat.

It is used mainly on small engines like water pumps, motor cycle, sprayers etc.

The cylinder end is provided with fins through which heat is lost to the surrounding air.

Characteristics of air cooling engines

- They have a fan and blade usually fitted on the fly wheel to a... are circulation over the fins
- They are light in weight because they do not need radiator, H_2... jackets, hoses etc.
- They are of simple construction.

Problems of air cooled engines

- They get hot quickly and use heavy lubricating oils
- It's impossible for them to get adequate cooling under all conditions.

Maintenance

- Remove rubbish and dirt from the fins
- Check the tension of the fun belt

LUBRICATING SYSTEM

Is a system that reduces friction as well as wear and tear of rubbing parts.

Functions of a lubricating system

- It reduces friction by establishing a film of lubricating oil between the moving parts
- It acts as a cleaning agent i.e. washes off all dirt, soot and dust from metal surfaces.
- It acts as a sealing agent i.e. seals the piston rings and cylinder walls preventing loss of compression.
- It acts as hydraulic fluid.
- It's a cooling agent i.e. carries away heat from working surfaces.
- Prevents rusting of metals.
- Reduces noise as engine parts move against each other.

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Classification of lubricating oil

Lubricants are classified according to thickness or viscosity. Viscosity is the measure of ability of lubricants to flow at various temperatures. The classification is based on a numbering system adopted by USA society of automobile engineers (S.A.E).

The numbering system is such that $S.A.E_{10}$, $S.A.E_{20}$, $S.A.E_{30}$ and $S.A.E_{40}$ are used for fast moving parts of an engine higher number i.e. $S.A.E_{50}$, $S.A.E_{60}$, $S.A.E_{70}$, $S.A.E_{90}$, and $S.A.E_{140}$ are for transmission gears where the parts move slowly. Lower numbers indicate lower viscosity oils suitable in cold areas whereas higher numbers suitable for hot areas.

Detergent oils

Certain oils contain additives designed to prevent formation of carbon inside an engine. Such oils are called HD (heavy Duty) and these are usually recommended for diesel engines. If non detergent oil has been used in an engine, care has to be taken before switching to a detergent type of oil as the carbon that may be washed out by the detergent oils may clog the oil ways and filters.

Flush the engine with special flashing oil before switching from a non-detergent to a detergent type of oil.

Grease

This is a semi solid combination of petroleum products and soap. Grease is applied through the grease nipples by means of a cylinder pressure greasing gun.

Properties of a good Lubricant

1 **Low viscosity** i.e. should have low ability to flow at either high or low temperatures

2 **High flash points**

This is the point at which explosion occurs when a enough vapour has been given off by oil after which the vapour ignites

3 **Ability to pour**

This is the lowest temperature at which aoil will flow freely i.e. low pour point is required

4 **Good body**

Should be thick enough to prevent contact between two moving parts

5 **Good film strength** i.e. should be able to resist pressure.

6 **Detergents quality**

It should have a substance which have cleaning properties

7 **Oiliness**

It should be smooth and slippery.

Sources of oil contamination

- Dust which passes the air cleaner and crank case breather
- Products of combustion like water and carbon
- Products of compression e.g. acids on metallic parts.
- Unburnt fuel due to uncompleted combustion.
- Metallic particles as a result of engine wear and tear
- Moisture produced as a result of condensation
- Acids which are formed when oil decomposes.

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Changing engine oil

Procedures

i) Clean the area around the dipstick, withdraw the dipstick from the sump and clean it with white paper.

ii) Replace the dipstick in the position, withdraw it again.

iii) Hold it almost horizontally and take the reading at the level to find out the oil level in the sump.

iv) If the level is at a low mark, more oil should be added.

v) Examine the conditions of oil and if the oil has become very dark or thick it is necessary to drain the sump and replace the oil.

LUBRICATION SYSTEMS

1 Flash system

2 Internal force feed

3 Oil mist system

Oil Mist system

This is known as petrol lubrication and is specifically used for small 2 stroke cycle engine. The system involves mixing oil with petrol in proportions of 16:1.

Lubrication occurs as part of engine operations. The cranks case of this type of engine must be drained periodically to prevent build up of oil in order to lower the difficulties involved in starting the engine.

Flash system

The lubricating oil is splashed over the moving parts by an e (tube) on the big end bearing cap of the crankshaft. the system have an oil pumps

Force feed lubrication system;

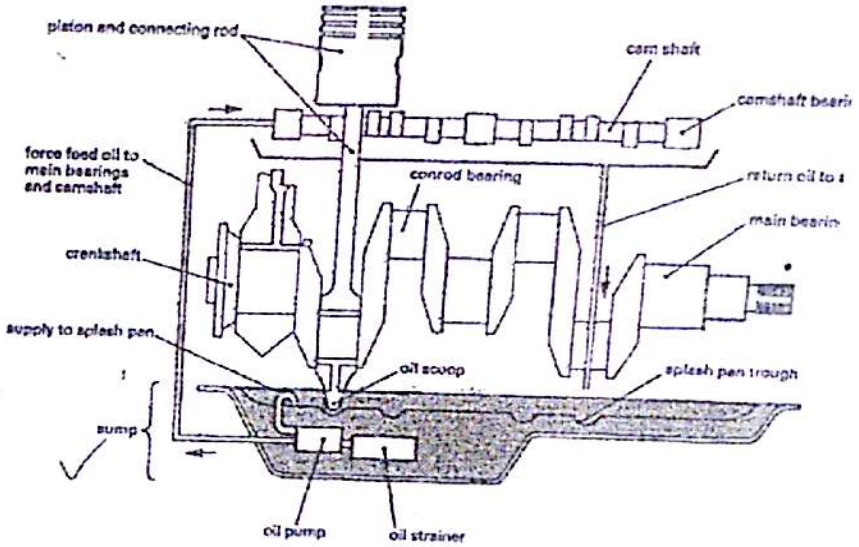

Fig. 17.7 *Lubrication system*

a) Most modern tractors use the system and the main con include oil pump, oil filter, oil strainer and oil ways.

b) Oil whic **FORCED FEED LUBRICATION SYSTEM** through the strainer and than pumped to the oil ways a bearing surfaces such as crankshaft, cylinders, camsha and pistons.

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c) It circulates around the engine through the oil ways under pressure maintained by the **oil pump** that derives power from the **camshaft**

d) After circulating around the engine, it drips back into the sump and the cycle continues

e) Continuous circulation make the oil dirty reduces in volume. This can be checked using a dip stick that is inserted in the oil sump

Functions of the main parts

1 Oil sump

It stores oil

2 Strainer

Ensures that clean oil is taken by the oil pump by removing dirt

3 Oil pump

This is driven by the camshaft and ensures oil is distributed to all parts of the engine.

4 Oil filter

Ensures oil is cleaned again before it's supplied to bearing and oil ways.

5 Oil ways

These are pathways that assist in the distribution of oil to all different parts of the engine.

Maintenance

1 Check the level of the oil with a dipstick daily. If it is b recommended level fill it up to the mark of the dipstick.

2 Change engine oil periodically according to manu instructions

3 Use the correct grade of oil for the engine.

4 Change the oil filter at every change of oil.

5 Clean the crank case breather as directed by the manufac

6 Drain the oil when it's still hot to avoid it sticking on the the sump.

7 Avoid using contaminated or old oil in the engine

ELECTRICAL SYSTEM:

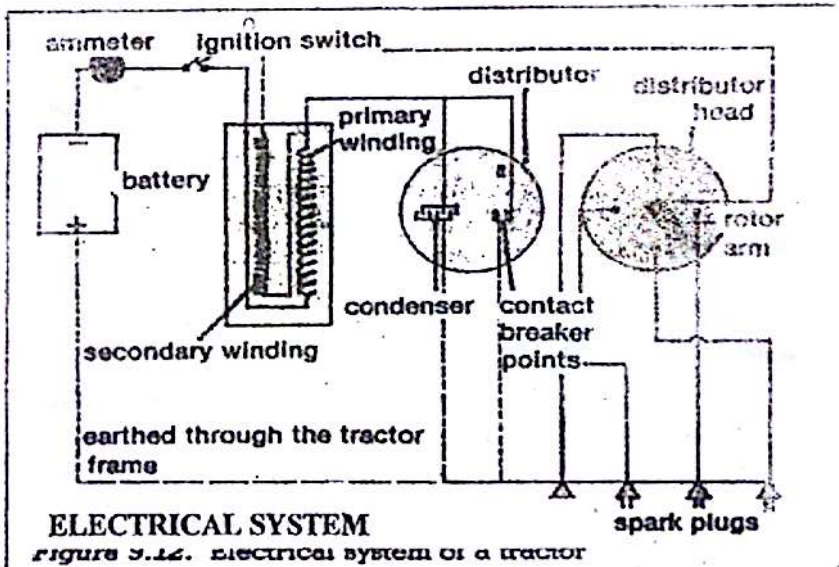

Figure 9.12. Electrical system of a tractor

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This is a system that provides electric current for igniting fuel air mixture in a petrol engine. It also provides current for lighting tractor indicators etc.

The major parts of the electrical systems include the following;

- voltage control box
- Battery
- Starter motor
- Ignition switch
- Induction oil
- Spark plugs
- Connecting wires
- Dynamo
- Distributor

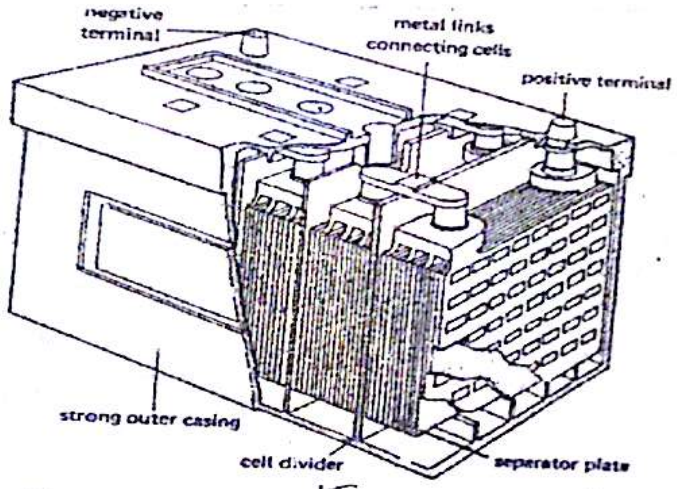

fig 20.14 A lead-acid battery

Battery; it's made up of bakelite; it has the following compone plates, concentrated sulphuric acid, terminals, vent holes and water.

Functions

1 It stores electricity (6-12V)

2 It provides current used for igniting fuel mixture in a petrol

3 It provides current for lighting in vehicles.

Care and maintenance of the battery

i) Check and if necessary correct the level of the electroly low add distilled H_2O up to required level.

ii) Ensure that the battery is firmly secure (fixed) onto the prevent splashing of the electrolyte due to the engine vibr.

iii) Keep the casing and terminals of the battery clean an using petroleum jelly and a wire brush to clean.

iv) Keep the ventilation holes free from blockage allow eas of gases from the battery.

v) Grease terminals to avoid corrosion.

vi) Empty the battery and Keep it up side down when not in u

vii) Place the battery on an insulator or wood but not direct ground to avoid power loss once out side the tractor.

viii) Replace all the acid with new conc acid when power redu

ix) Never bring naked flame near the battery

x) Battery cable should remain clipped up with chassis sin cables may get their insulation peeled off due to engine vi

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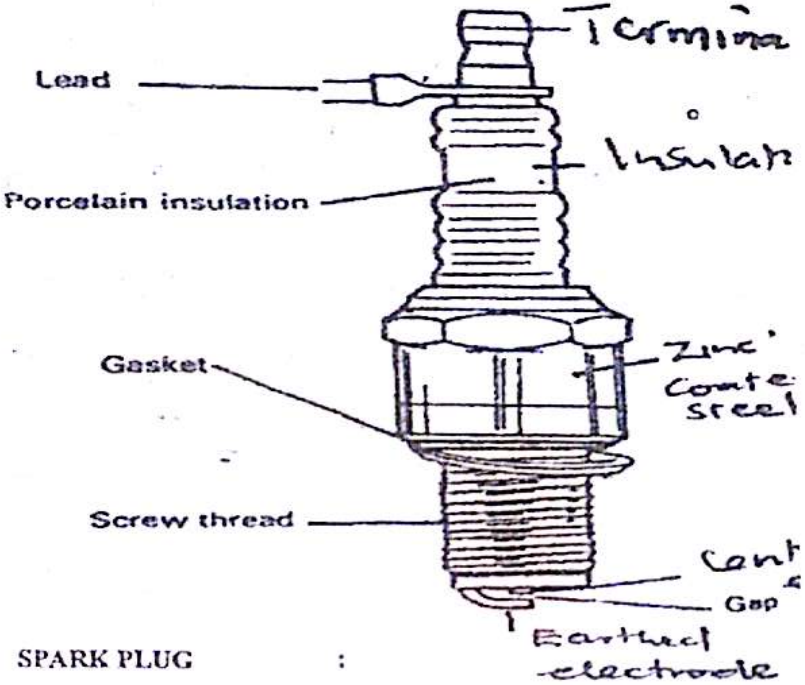
Sparking device

The major sparking device is the spark plug. It's made up of special alloys of steel, chromium and nickel.

Chromium is important in that it allows the spark plug to withstand high temperature.



SPARK PLUG :

Functions

It provides a spark necessary for ignition of compressed fuel/ air mixture in petrol engines

Ignition in a petrol engine takes place with aid of a spark plug. It's always fixed on the combustion chamber. A spark plug has electrodes between which a spark is transmitted. One electrode is on the body of t plug and it's earthed

The second one which receives high voltage is in the centre of t plug, its connection passes through a direct resistant insulator.

A spark plug has an open air gap of 0.0012-0.1cm betw electrodes. It's across the gap that the spark developed is able t

There are two ways in which fuel can be ignited especially engines

1. **Magneto-ignition;** it occurs in small engines e. cycles. It generates power by rotating a magnet stationary wiring. This creates current due to infiux

   It is this current which is supplied to the spark for i compressed fuel air mixture
2. **Battery ignition;** it occurs in big petrol engines battery is the sole source of current for ignition

Description

1. When the ignition switch is turned on and the engine over by the starter motor.
2. Current from the battery flows to the primary circuit magnetic field in the primary windings of the induction coil
3. When the contact breaker point is interrupted or is opene cam it causes the primary circuit to break.
4. This induces a high voltage (7000-10,000) V. in the s circuit / winding.

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5 The current flaws through heavily insulated wires to distributor head via the rotor arm which supplies it to each spark plug.

6 The high voltage creates a spark across the plug units and the mixture in the cylinder is ignited.

7 The engine then starts to run.

Summary of electrical system

Parts	Function	Maintenance
Battery	Stores electricity	- Keep terminals clean on top up electrolyte. - Secure it firmly.
Induction oil	Steps up voltage from 12v-10,000v	- Keep it clean - Secure the connections tightly.
Distributor	- Activates induction oil - Distributes electric current to each sparkplug at correct time	- Keep the top clean - Lubricate under rotor arm every 100hrs of work. - Adjust contacts every 3 days
Sparkplug	- Provides a spark to the ignition chamber	- Clean po spark ter using wire bru - Reset the ga regularly. -
Starter motor	- Uses electricity from the battery to turn the fly wheel which starts the engine.	- Keep it tightl fixed. - Fit new carbo bushes. - Clean the armature
Dynamo/generator	- Generates electricity for recharging the battery	- Lubricate the bearing usin grease ever 100 hours o work. - Check tightnes of the fan bel within ever 200hrs o operation.
Voltage control box / cut out	- Adjust the charge from generator to battery and disconnect it when the	- Keep wires clear and tightly fixed.

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	engine is not working	
Contact breaker point	- Stops - Interrupt the flaw of current from primary to secondary circuit to raise voltage	Ensure it is properly fixed

TRANSMISSION SYSTEM

It is the system that transfers power from the engine to rear wheels so that the tractor can move or perform some work.

Components of the transmission system include; clutch, gearbox, differential, tyres of the wheels, PTO (Power Take Off shaft)

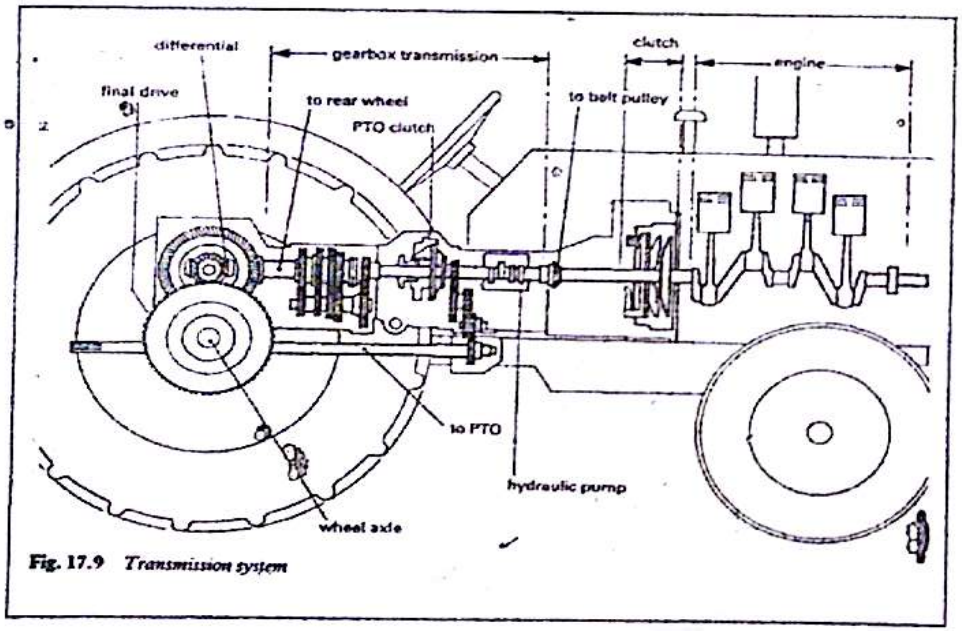

Fig. 17.9 *Transmission system*

1. **Clutch**

It is a device used to connect or disconnect the source of Power from the rest of the transmission system. It consists of a disc-clut
The clutch plate is aligned on both sides with friction surfaces which drives other plates when in engaged position. When not engaged the clutch plate is disengaged from other plates and no transfer of Power takes place.

Un Factions

i) It connects or disconnects the engine from the rest of the transmission system.

ii) It helps to provide power to the PTO

iii) It helps the operator of the tractor to take off gradually & smoothly.

iv) It allows the engine motion to be disconnected or connected to the differential and the gear box

v) It helps the tractor to be stopped without stopping the engine.

Gear Box

i) It allows for selection of different speeds to the differential and the rear wheals.

ii) Helps the driver to select forward or reverse gear to suit a given operation.

iii) It enables power from the engines to be moved and applied to the work that the driver may be doing.

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iv) It enables the driver to stop the vehicle without suddenly stopping the engine.

2. **Differential**

i) It changes the direction of the drive to right angles when power is transmitted to rear wheels.

ii) It adjusts the speed of the engine so that the operation works at a lower speed than the engine speed.

iii) It enables each of the rear wheels to travel at a different speed when turning a corner.

3. **Wheels and tyres**

i) They enable the tractor to move forward or backward so that it can do useful work.

ii) Tyres allow maximum possible grip (traction) because they have a large surface area.

4. **PTO**

i) It is the part which permits tapping of power from the tractor engine to drive other machines like pumps, mowers and thrusters

ii) It's a shaft found at the rear of the tractor body which provides power out from the tractor for driving stationary machines.

iii) It is an extension of the shaft in the gear box.

iv) It's operated by a separate clutch to make it independent in that it can be disengaged without affecting the forward motion.

Other transmission accessories include breaks, belt pullies, hydraulic system, and these works together with the system.

Breaks

These are basically safety features although on a tractor they can be used for turning a wheel but the most common types are; disc breaks; breaks on a tractor operate independently of each wheel.

Tractor tyres and wheels

Important features of the rear tyres.

i) They are generally larger and wider in diameter.

ii) Bars on tyres are arranged in a V pattern to improve grip and self-cleaning property.

Important features of front tyres

iii) They are generally narrow and smaller in diameter

iv) The tyres are thin.

v) They have a continuous band of rubber around the tyre to be able to support the weight.

Problems of under inflation (low pressure)

i) Damages the body of the tyre.

ii) It tends to crack on the tyre wall.

iii) reduces the tractor speed

iv) wastes fuel

Problems of over inflation

i) Tyre punctures can easily occur

ii) Loss of traction (grip)

Ways of improving traction

i) Ballasting the tyres (by adding water and pumping in pressure)
ii) Use of metallic wheels this increases grip.
iii) Twining of tyres (use double tyres)
iv) Adding weights (heavy metal bars on the tractor) to increase stability by lowering the centre of gravity
v) Reducing pressure of the tyres
vi) Using 4wheel drive.
vii) using flat tyres with high grip
viii) using tyres with big treads

Factors that reduce the life span of a tractor tyre

i) Over or under inflating the tyres.
ii) Driving over the sharp objects like nails, glasses and sharp stones exposing tube resulting into loss of pressure.
iii) Over loading of the tractor beyond their capacity of the tyres
iv) Pouring less corrosive chemicals on tyres like paraffin, acids.
v) Careless driving through abrupt breaking and sliding over glasses that may cause tearing.
vi) Increased/long hrs of operation increasing wear and tear of tyres.
vii) Nature of the surface on which they are driven. Driving on rough surface increases wearing out of the tyres.
viii) Quality of the tyres i.e. poor quality tyres wears out faster as they are made from poor quality material unlike those of good quality.

Daily Serving points of the tractor

i) Make sure the fuel tank is filled with the correct fuel reduce time wastage during work as a result of refilling.
ii) Check the level of water in the radiator and fill with clean water if necessary.
iii) Check on the tension of the fan belt and if not tight, it should be tightened for efficiency in the cooling system.
iv) Clean fuel filter bowl to remove dirt.
v) Check on the level of oil using a dipstick and add fresh oil if necessary.
vi) Check on the battery to know the strength of electrolyte
vii) Grease all greasing points using a greasing gun
viii) Make sure that the tyres have the correct pressure.
ix) Check on nuts and bolts and ensure that are tight prevent accidents.
x) Run the tractor to check on break system and hydraulics before work.
xi) Check on the oil level if air cleaner and top up if necessary.

TILLAGE IMPLEMENTS

Tillage refers to cultivation (Ploughing) of soil

Reasons for initial tillage (primary tillage)

i) Provides a good seed bed for proper seed germination and growth.
ii) To provide sufficient depth of soil for good water percolation and retention.

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iii) To destroy insect pest, eggs and their breeding places

iv) Control soil erosion as there is more water infiltration

v) To kill weeds that is already in the field.

vi) It breaks the hard soil surface to encourage proper establishment of the crops.

Types of tillage implements

There are two types i.e. primary and secondary tillage implements.

Primary tillage implements

These are mainly implements used for opening up land through bush clearing and first ploughing

They are usually heavy and deep cultivating implements. They include disc ploughs, tractor mould board ploughs, ox-mould board plough subsoilers, rotary cultivators and chisel ploughs.

Disc plough

Functions of parts

1 **Beam;**

It supports the whole implement and provides attachment unit for all parts of the plough.

2 **Disc;**

They are connected to the beam by disc hangers and they cut, turn and invert furrow slice.

3 **Disc hangers;**

They support the discs and provide room for disc bearings

4 **Bearings;**

They facilitate the rotary motor of discs

5 **Scrappers**

They keep the discs clean by scraping soil that sticks on them. They also help in inverting furrow slices.

6 **Furrow wheel;**

Balances the plough in a steady condition during ploughing, it also determines the level of ploughing.

7 **Cross shaft;**

This is for attaching the plough to the tractor.

8 **Top link bracket**

Together with the cross shaft mount the plough on to the tractor

Hitching a disc plough on a three point linkage of the tractor

1. Start the engine of the tractor so that it can be moved near the implement and ensure that the hydraulic system is working
2. Reverse the tractor so that the linkage arms on the tractor are aligned correctly with the disc plough top link
3. Fix the left linkage point of the implement on to the attachment arm of the tractor
4. Fix the top linkage point of the implement on the tractor
5. Lastly, fix the right linkage on to the tractor
6. Use the adjustment gear to lower or raise the right linkage on the tractor so that it is well aligned with the implement
7. Fix bolts and nuts and tighten it using the required spanner

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8. Carry out proper adjustments of the discs for proper ploughing in depth and width

Advantages of using a disc plough

i) Its faster at doing work

ii) Its discs ride over obstacles without damage due to their rolling action.

iii) It can be used in hard dry soils which are too difficult for the mould board ploughs.

iv) It works well in both light and sticky oils.

v) It has low maintenance cost especially replacement of parts because most parts take long to be worn-out.

vi) It has a poor ability to cover trash, which is a good condition for soil and water conservation.

vii) It requires less tractor pull power as compared to mould board ploughs.

viii) It has got a heavy beam which allows for deep ploughing.

Disadvantages

i) Does not cover trash properly which call for secondary cultivation increasing costs for cultivation.

ii) Leaves the land or field rough calling for second ploughing.

iii) It's heavier than the mould board ploughs thus requiring a high HP (horse power) tractor.

NB: Disc ploughs are used for

i) Deep ploughing

ii) Opening virgin land

iii) Construction in water conservation practices.

iv) Cultivation of loose soils

Care and maintenance

i) Lubricate the bearing regularly to facilitate proper rolling of the discs

ii) Check regularly and tighten loose bolts and nuts to reduce loss of parts.

iii) Clean the discs every after work to reduce rusting.

iv) Repair damaged parts and replace worn out ones regularly to reduce further damage and improve efficiency.

v) Smear the implement with oil to prevent rusting when not in use.

Reasons for poor disc plough penetration / ploughing

i) Bluntness of the cutting edge

ii) Low Weight of the implement that cannot plough deep.

iii) Poor adjustment of furrow wheel will not facilitate good cutting depth.

iv) Inefficient hydraulic system which fails to lower the plough properly

v) poor hitching of the implement making it difficult to achieve deep ploughing

vi) driving the implement faster so that it cannot easily achieve the required level of ploughing

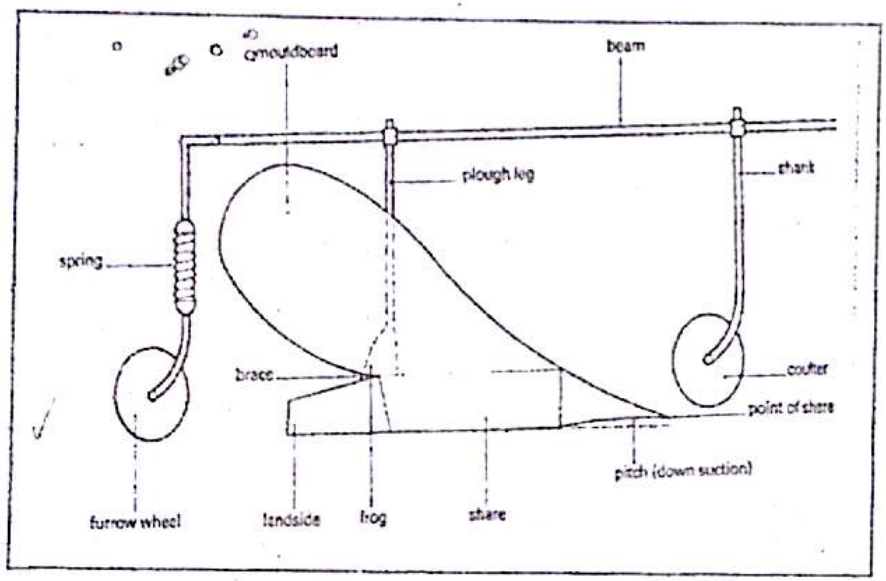
vii) poor adjustments of the discs before ploughing reducing width and depth of ploughing

viii) faulty disc scrappers that fail to remove soil and trash on the discs for efficiency

ix) use of low power tractors that may fail to provide adequate pull for the implement during work

TRACTOR MOULDBOARD PLOUGH

a) **Tractor Mould board plough**



Comparison between a mould board plough and disc plough

Disc	Mould board
- Has disc that can rotate during ploughing - Disc cuts furrow slice but does not bury trash completely - Can ride over buried obstacles hence cannot be easily broken. - Can operate well in heavy sticky soils. - Can plough places with a lot of trash. - Has low maintenances costs since the disc blades are durable and do not require sharpening. - Requires less tractor pull for the implement. - Produce a rough field that requires secondary cultivation.	- Has a rigid mould board that cannot rotate - Cuts, inverts and buries trash completely - Very rigid hence cannot ride over buried obstacles therefore ca break - Cannot easily work in hea sticky clay soils. - Does not plough easily in pla a lot of trash. - High maintenance cost frequent sharpening and r shares. - Requires more tractor po pulling the implement. - Produces a fairly smooth fi may not require secondary cu

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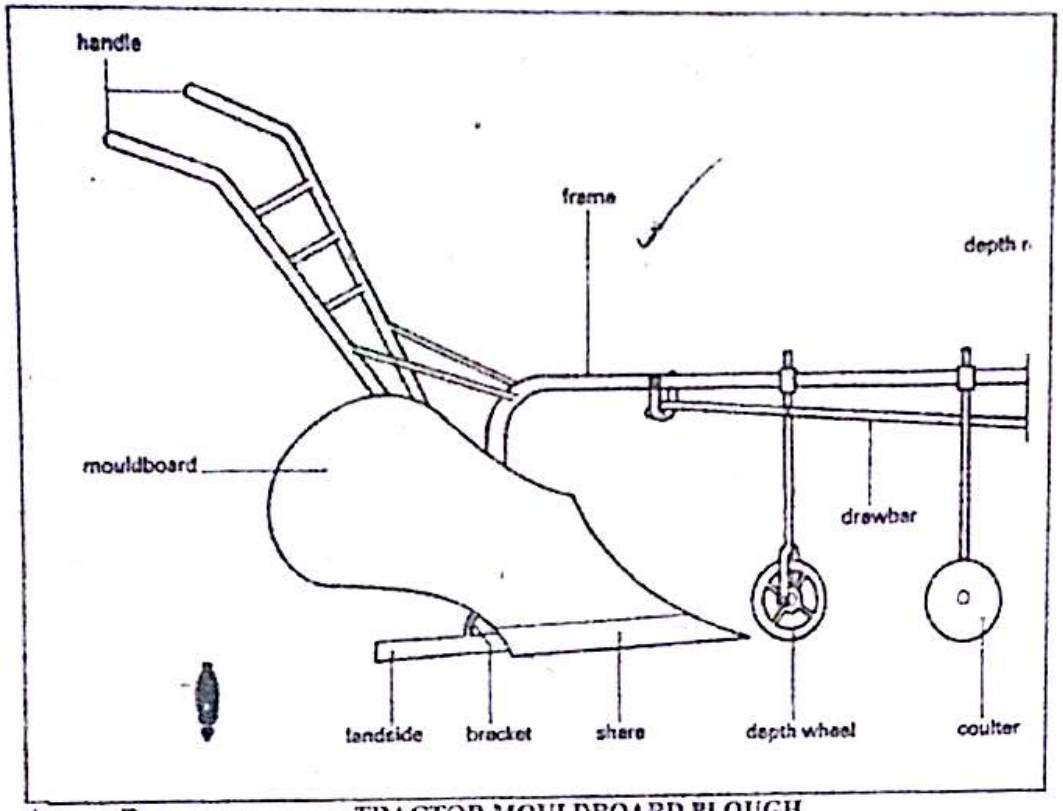
b) Ox Mould Board plough (ox-drawn)



TRACTOR MOULDBOARD PLOUGH

1 Beam;
It holds other parts of the plough.

2 Mould board;
Inverts the furrow slices and covers the vegetative materials

3 Share;
It cuts the furrow slides and passes it to the mould board.

4 Land side;
Presses against the furrow wall to separate furrow slices ploughed land and make the plough stable during ploughi

5 Frog;
It connects all parts of the mould board plough to the mair

6 Disc coulter;(for tractor mould board)
It's a disc mounted above the plough. It makes a ve separating the furrow slice from the unploughed land.

7 Skim coulter,(for tractor mould board)
It assists in burring surface materials and is useful in ç areas

8 Land wheel (depth wheel);
It helps to regulate the depth of ploughing and ena operator to gauge a furrow slice within a reasonable dista the previous furrow line.

9 Depth rod,
It is used for Adjusting width and depth of operation.

10 Hake;
It provides an attachment on the beam for fixing the pai plough which are adjusted before and during ploughing

11 Link;
It's for linking the plough onto chain pulled by oxen.

12 Handle braces;
They stabilize the plough.

Advantages of mould board plough

i) It completely inverts the soil bringing up fresh soil to the surface.
ii) Planting can be done after first ploughing without the need for secondary cultivation.
iii) It buries surface trash completely.
iv) The furrows do not have deep depressions.
v) The depths of the furrows are uniformly the same.
vi) Its lighter than the disc plough
vii) It can be used for inter row weeding.

Disadvantages

i) It cannot work in areas with obstacles since it be easily damaged.
ii) It is rigid hence can break easily.
iii) It cannot work in hard and waxy soils.
iv) It can easily create a hard soil pan due to uniform depth of ploughing.
v) It has a high maintenance costs than a disc plough.

Maintenance of a mould board ploughs

i) Check on the conditions of the shares and tighten as required.
ii) Lubricate all moving parts e.g. land wheel.
iii) Clear the plough off soil and vegetation after work.
iv) At the end of ploughing session wash the mould board, shares and other soil touching surfaces and coat it with grease to prevent rusting.
v) Repair the damaged and replace worn out parts.
vi) regularly sharpen the shears for efficiency

TERMS USED IN PLOUGHING

i) Back furrow, these are raised ridges left behind after ploughing.
ii) Furrow wall, it's a wall separating the cultivated area from uncultivated land.
iii) Dead furrow; It's an open trench left after ploughing.
iv) Furrow slice; It's the soil that is cut , lifted and inverted by the plough

CHISEL PLOUGH AND SUBSOILER

These are deep tillage implements that are able to stir the top soil and sub soil without bringing the soil to the surface.

They are imported in that;

i) They break hard pans in topsoil.
ii) Facilitate breaking up deep rooted weeds.
iii) They improve drainage and aeration of the soil.

A chisel plough is a tool with rigid tines points covered by shove like points at the end. These at times are strong to withstand the stress when they are working at a depth and in hard soil conditions.

One disadvantage with a chisel plough is that it requires a lot of power to pull. Also the soil tilth produced is rough.

Maintenance of chisel ploughs

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1. Replace points on tines if they are blunt
2. Clean the implement by removing soil after work
3. Make sure the tine have the right curvature
4. Make sure the springs on the tines have the right tension
5. Paint the implement with waste oil to prevent rusting
6. Replace broken parts immediately to prevent further damage
7. Moving parts should be greased to control friction

ROTAVATORS /ROTARY CULTIVATOR:

A rotavator consists of a series of L-shaped blades moulded on a horizontal shaft. The L-shaped blades rotate while cutting the soil.

The implement receives power from the tractor power take off shaft.

A rotor drive has a cushioning device that prevents direct damage to the implement in case the blades hit any obstacles.

It has an adjustable rear shield that protects the operator from flying stones and debris. The soil cut is thrown against the shield and cut downed to a fine tilt.

Shattering of soil also depends on the speed of the tractor; the higher the speed the more soil is broken. Parts of the implement

1. Gear box; It houses gears that get power from the engine from the tractor through the power take off shaft.
2. Chains casing; it contains chains and chain lubricating oil. The chain is moved for transmitting power from gear box through a connecting shaft to the rotor where the L-shaped blades are attached.
3. Rotor, this provides attachment for L-shaped blades and rotates with the blades
4. Blades; they are used for cutting and throwing up the soil. The direction to throw is usually upwards or backwards.
5. Hood; It is used as a shield to protect machine operators from flying stones.

Maintenance of a Ratavator

i) Keep correct level of oil in the chain casting and gear box.
ii) Replace warn out blades.
iii) Ensure that the rotavator shaft is covered
iv) The forward speed should be related to the type of seed bed required.

Merits of using rotavators

1. Provides a fine tilth one operation good for small seeds
2. Cuts vegetative material and mixes it with soil thoroughly
3. It can incorporate manures and pesticides into soil
4. Can improve soil aeration

Problems associated with the use rotavators

1. Continuous use in the same area leads to destruction of soil structure
2. May cut rhizomes into tiny parts that may produce more weeds
3. Blades wear out quickly increasing maintenance costs
4. It requires very powerful tractors to provide power

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SECONDARY TILLAGE IMPLEMENTS

These are implements used for subsequent seed bed after primary cultivation.

Objects of secondary cultivation

i) To break soil clods to obtain a firm tilth
ii) To turn vegetative material and crop residues and mix it with soil.
iii) To control weeds they may have come up after primary cultivation
iv) To improve soil aeration
v) To control pest by destroying their habitats
vi) To cover broadcasted seeds
vii) Facilitate application of fertilizers by mixing it with soil.
viii) To level and firm top soil surface for easy planting
ix) To provide a conducive environment through which air and moisture accumulates and promote germination.

Examples of secondary tillage implements

1 Disc harrow
- Single action
- Double action
- Offset action

2 Spring-Tined harrow
3 Zigzag harrow
4 chain harrow
5 spike toothed harrow

Disc harrow

i) The most commonly used.
ii) They have smooth and matched edges
iii) Easy to maintain and can work in poor soil conditions
iv) Disc harrow are composed of two or more sets (gangs) of disc mounted on a horizontal shaft
v) Each disc is separated from the nearby disc by a spacer.

Parts of a disc harrow

1 Discs; round smoothed edged or notched concave blade. Notched discs work where there is a lot of trash to be cut. Notched discs are mounted on the fore gang and rear gang
2 Leveling gear; it levels the implement so that it can work at a good depth
3 Harrow boxes; it provides attachment of the implement to the tractor.
4 Weight boxes, they provide added weight to assist the implement to penetrate deeper especially in hard ground
5 Disc gang; it is a set of disc harrows set in a shaft varying from 13-15. The setting of the gangs can be done manually or by hydraulic
6 Scrappers; they keep the implement clear of soil which sticks on discs.

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Uses of disc harrows

i) They chop up vegetative matter on the surface of soil by ploughing.

ii) They are used for final seed bed preparation after ploughing.

iii) They run over a seed bed in dry season to control weeds.

iv) They cover up broadcasted seed on seed beds.

Penetration of the disc harrow depends;

1 On the angle of the disc gang; the wider the angle the deeper the penetration.

2 Adjustment of the top link; the longer the top link the more the disc gang penetrates deeper; the front gang is raised and vise versa when the top link is too short.

3 Weight of the disc harrow; heavier harrows penetrate deeper.

4 Size of the discs; bigger disc may penetrate deeper

5 Soil conditions i.e. hardness, moisture or argument. Amount of trash on the ground.

6 Speed of harrowing; the faster the speed the slower it penetrates.

Maintenance of a disc harrow,

i) Lubricate and grease nipples and bearings.

ii) Repair or replace damaged or worn out plates.

iii) Tighten all bolts and nuts before and after work.

iv) Oil and grease the implement after the working season to prevent rusting.

Advantages of a disc harrow

i) Produces good seed bed in good ploughing conditions

ii) It works top soil without bringing vegetation to the top surface.

iii) works well In heavy soils

iv) has a good compacting cutting effect on soil

v) good for preparing arable land where deep cultivation is not required

vi) can prepare a good seed bed in one operation reducing loss of soil moisture

Disadvantages of a disc harrow

i) It multiplies the weed population of rhizomatous weeds e.g. coach grass, spear grass by cutting rhizomes into small parts.

ii) can destroy soil structure

iii) they are very expensive to buy

iv) maintenance costs are very high

PLANTERS

They are also called row crop planters

There are three types of planters

1 Drill type planters

2 Hill drop Planters

3 Check row

Row crop planters are designed to plant seeds in row far enough to permit other management practices of the crop. They can be used for planting crops like Sorghum, Soya beans, cotton etc.

Features of a good row planter

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i) It should be able to handle a wide range of seed bed
ii) Should be able to handle a wide range of seeds.
iii) It should be able to plant seeds at a uniform depth and width
iv) It should be able to plant seeds of the same quantity but not depending on the amount of seeds in the seed hoper / box.
v) It should be able to work at a reasonable speed without damaging the seed.

Operation

i) The opening of furrows is done by a furrow opener.
ii) Metering of seeds and fertilizers is done by seed metering and fertilizers metering unit respectively. This ensures correct seed rate and fertilizer application
iii) Seeds are placed to the ground through the delivery tube.
iv) A press wheel ensures proper coverage of the seeds with soil

Harvesting & processing implements

Crop harvesting refers to the collection of crop in a crude form from the field. It could involve cutting with a knife or lifting for the case of cassava and other root crops.