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AGRICULTURAL MECHANISATION

This is the application of machines to all types of agricultural operations making the farmer less dependent on physical labour.

This discipline covers; manufacture, distribution, repair, maintenance, management and use of agricultural tools, implements & machines for agricultural production.

ADVANTAGES OF AGRICULTURAL MECHANISATION

1. It increases output by putting into use, land that was idle due to lack of labour.
2. It enables farmers to undertake jobs that would otherwise be impossible eg' uprooting big trees.
3. It ensures timely farm operations e.g. timely opening up of land which increases yields.
4. It eases and speeds up many farm operations making it possible to change from one section to another.
5. It increases yields, per acre and work per person which increases production.
6. It improves on the soil physical properties e.g. structure, capillarity, infiltration etc.
7. It releases labour for other operations since one person with a machine can do a job that would otherwise have been done by several people.
8. It exploits the economy of scale i.e. cheaper per unit area in large scale operation.
9. It allows better combination of enterprise; with the use of farm machinery it eases to diversify agricultural sector.
10. It solves the increasing problem of farm labour shortage and the rise of wages
11. It leads to production of better uniform products other than the use of hands.
12. It reduces drudgery i.e. doing unpleasant work.

FACTORS FACING THE ADOPTION OF AGRICULTURAL MECHANISATION /LIMITATION OF AGRICULTURAL MECHANISATION

1. Lack of technical knowledge on how to operate and maintain machinery and equipment
2. Inadequate demonstration centers to show farmers the operation and benefits.
3. Poor land tenure system, much land is fragmented making mechanization uneconomical.
4. The topography of the land in some areas is not suitable for tractor use since it is too steep

5. Shortage of spare parts .The importation of spare parts requires a lot of foreign exchange which is in most cases scarce.
6. Presence of thick and tall vegetation in some parts of the country which makes tractors unsuitable for use.
7. Some cropping systems e.g. growing of perennial crops and intercropping discourage the use of tractors especially after planting.
8. Some farmers are conservative hence fear to take the risks involved in the use of new technology.
9. Importation of unsuitable machines to environmental conditions.
10. Lack of power .Lack of electricity in villages limits the application of power to run some agricultural machines
11. High investment costs .Initial cost of purchasing farm machinery has been a big drawback .Many small scale farmers have low levels of income and cannot afford to buy tractors and tractor-drawn implants.
12. Poor transport and communication .Due to poor transport and communication infrastructure, many farmers are unable to reach towns and trading centers where tractor hire services may be available.

DISADVANTAGES OF FARM MECHANISATION

1. Clearing large pieces of land exposes the soil to erosion.
2. It creates unemployment since one person with a machine may be able to do a job of several people.
3. It is uneconomical to small plots and therefore may be expensive to use in fragmented plots.
4. Some parts may be expensive to purchase.
5. It may result into soil capping for example the use of bull dozers.
6. Some operations can't be mechanized e.g. coffee picking, cotton and tea picking.
7. The quick operations may be carried out at the expense of careful good work by hand.
8. It leads to excess planting resulting in over production thus creating storage problems.
9. Some machines may be idle in the course of the year.
10. Tractors and ox ploughs cannot be used on steep slopes.
11. Mechanization requires a high initial capital.
12. Exhaust fumes from engines cause environmental pollution.

PRE-REQUISITE OF MECHANISATION.

(HOW MECHANISATION CAN BE INCREASED IN UGANDA)

1. Educate the farmers towards accepting the change from peasant farming to modern farming systems.

2. An effort should be made to develop simpler and less expensive machines.
3. Farmers should be encouraged to own and operate farm machinery collectively.
4. Loans and subsidies should be organized to assist farmers wishing to purchase suitable agricultural implements.
5. Encourage land consolidation to create large pieces of land that are economical to operate.
6. Mechanization should be gradual, starting in those areas where it is economically feasible and with crops where farmers can obtain considerable benefits from higher production.
7. Effective mechanization requires large areas; the land tenure system by which farmers work a few areas has to be modified.
8. Educate the farmers on the benefits of mechanization and establish demonstration farms.

FACTORS TO CONSIDER WHEN BUYING/CHOOSING TOOLS AND EQUIPMENT/TRACTOR.

1. Ease of operation and adjustment. The tractor make in mechanization should be easy to use by the farmers i.e. knowledge on the use and maintenance of the tractor should be available.
2. Adaptability of the machine to work. The tractor should be versatile and able to perform a range of jobs.
3. Cost of machine. The benefits to be obtained from use of the machine should over weigh the financial cost of the machine.
4. Power of the tractor as measured in horse power. The power of the tractor should be adequate to satisfy the power requirements of the farm.
5. Size of the farm. Big farms require tractors with larger horse power.
6. Availability of spares and after sales services. The more available the after sales services, the better the machines.
7. Operating costs of the machine. The machine should be relatively economical in as it operates in the field.
8. Efficiency at work. The tractor should be of proven competence in the local condition prevailing in the field.
9. Durability of the machine. The more durable the machine, the better for the farmer.
10. Ease of maintenance the machine should be relatively easy to maintain.
11. Type of job/enterprise to be performed by the machinery. Lighter jobs require lighter machines and vice versa.

MAINTENANCE OF TOOLS AND EQUIPMENT.

The following services may be offered;

1. Keep the tools and equipment in a safe place to avoid loss of some parts.
2. Keep the tool box in a dry (leak proof) store to avoid rusting or damage of tools.
3. Sharpen the blades regularly to ensure efficiency.
4. Replace worn out blades and old parts to increase efficiency.
5. Replace broken handles to facilitate handling while using the tools and equipment.
6. Oil/grease joints (movable parts) to reduce friction.
7. The equipment should be used at the recommended speed to avoid damage.
8. Tighten the bolts and nuts to avoid loss.
9. Replace the lost bolts and nuts to increase efficiency.
10. Make necessary adjustments to improve efficiency.
11. After use, clean tools and equipment to increase efficiency.
12. Keep tools and equipment away from fire/corrosiveness to avoid damage.
13. Use skilled labour to operate and maintain tools.
14. Use a tool for its recommended work.

SOURCES OF FARM POWER.

Power;

Power is defined as the rate of doing work/Rate of expenditure of energy. Power is measured in watts/kilowatts.

Engine power is measured in horse power or kilowatts. The sources of power on a farm include;

ANIMAL POWER.

This is where animals are used to provide power to do work on the farm.

The animal powered machines include ox-ploughs, planters, seeders, weeders and carts.

FACTORS THAT AFFECT THE AMOUNT OF POWER PRODUCED BY DRAUGHT ANIMAL.

1. Breed of the animal. Some breeds have tough muscle and short legs that make them more suitable for draught purposes than others. Also humped breeds are more suitable than hump less ones for the ease of harnessing the animal.

2. Training. Well trained animals do better quality work than untrained ones because they are easier to guide.
3. Feeding. The nature of work requires a high energy intake and so the animals that are fed better are in better capacity to provide power.
4. The yoke used for hitching. A yoke that has a collar encircling the neck of the animal is the best since the straight wooden yoke exerts a lot of pressure on only a small portion of the animal's body and is injurious to the animal.
5. Age. The ability of the animal to provide power increase with age before finally decreasing.
6. Body weight of the animal. A draught animal can pull 10-20% of its own body weight for six to eight hours and its own weight for a few minutes.
7. Harnessing of the animal. A properly harnessed animal will be comfortable and this enables it to work for longer hours.
8. Health of animals.

CONDITIONS NECESSARY FOR THE SUCCESS OF ANIMAL POWER/REASONS WHY OX-CULTIVATION SUCCEEDED IN EASTERN UGANDA.

1. Availability of animals in a mixed farming system where the animals provide draught power and the crops provide food for the animals.
2. The areas are relatively flat; when animals are ploughing they don't get strained as when they are ploughing uphill.
3. Soils in these areas are light which enables the animals to pull the plough through while ploughing easily.
4. Relative absence of serious diseases that can cause death to animals or seriously reduce their performances.
5. Relatively light and short vegetation that enables the movement of the animals as they plough.
6. Availability of adequate pasture lands and water to provide adequate feeding for the animals.

REASONS WHY OX-CULTIVATION IS NOT WIDELY PRACTICED IN UGANDA.

1. Topography; hilly areas with steep slopes hinder movement of ox-plough.
2. Vegetation; areas with thick vegetation tend to block ox-plough.
3. Soil type; clay soils are not suitable for ox-ploughing.
4. Prevalence of tsetse flies; these hinder rearing of work type animals to pull ox-ploughs.
5. Inadequate pastures; some areas do not have adequate pasture.
6. Lack of extension services to train farmers in ox-cultivation.

7. Inadequate capital; farmers cannot afford ox-plough.

ADVANTAGES OF ANIMAL POWER.

1. It does not require much skilled labour.
2. Animal power can be used in fragmented areas.
3. It is cheaper than manual power for large acreages.
4. It has low maintenance costs.
5. Animal drawn implements are locally available.
6. Animal power is less tiresome compared to manual power.
7. Initial costs are low.
8. Animal power can easily be used in steep areas.

DISADVANTAGES OF ANIMAL POWER.

1. It cannot be used in areas with thick vegetation.
2. The animals require training.
3. Diseases and parasites can easily attack the animals and this reduces their performance.
4. It cannot be used in areas with a lot of obstructions such as stones and tree stumps.
5. A large piece of farm land is required for grazing the animals as part of maintenance.

SOLAR POWER.

This type of energy is obtained freely from the sun.

ADVANTAGES OF SOLAR POWER.

1. It is free and does not increase in price.
2. It is available.
3. It is environmentally friendly since it produces no dangerous emissions.
4. It has no fuel requirements unlike the internal combustion engine (ICE).

DISADVANTAGES OF SOLAR POWER.

1. Equipment is very expensive.
2. It will not operate where there is no sunshine.
3. Some solar panels may not supply enough power to heavy machines.

HUMAN POWER/MANUAL POWER.

Humans provide manual power (muscle power) to accomplish various farm tasks.

Muscle power is provided when human being is in good condition, healthy, fully grown and well fed.

ADVANTAGES OF MANUAL POWER

- 1.It is widely available in many developing countries
- 2.It is more flexible than other sources of power and can do a wide range of jobs
- 3.It is relatively cheap for the small operations that characterize subsistence production
- 4.Produces more quality work if carefully done
- 5.It can be used where other sources have failed

DISADVANTAGES OF MANUAL POWER

- 1.It is easily affected by parasites and pests eg mosquitos
- 2.It is easily affected by weather conditions eg rain
- 3.The efficiency decreases as the hours worked per day increase
- 4.The performance of human labour depend on their motivation which is very unpredictable
- 5.It is not good for large scale farming
- 6.Relies on level of skill of the worker
- 7.Many demand high payment for work done making the source of power expensive and increasing cost of production

WIND POWER

This is got from the movement of wind.The wind drives a rotating shaft which generates power to other machines to do work eg water pumps

ADVANTAGES OF WIND POWER

- 1.It is cheap ie wind is available(free)
- 2.It doesn't require much technical skills to operate
- 3.The components and accessories of such equipment can all be made locally

DISADVANTAGES OF WIND POWER

- 1.It is not reliable ie may not be available when needed

2. Installation costs are high
3. It only suits simple machines
4. Its direction can't be controlled

WATER POWER(H.E.P)

This is power derived from water flowing from one level to another

The generation of power depends on;

- i. Volume of water flowing per minute
- ii. Vertical distance of the water fall
- iii. The speed and strength of water flow

ADVANTAGES OF WATER POWER

1. It is a steady and uninterrupted source of power
2. It is environmentally friendly
3. It can be used on a wide range of machines ie heavy machines

DISADVANTAGES OF WATER POWER

1. It is expensive
2. May be dangerous if not carefully used

CHEMICAL POWER

This is power got from the combustion of organic compounds(chemicals). The combustion to get the energy(power) on the farm is done by an internal combustion engine eg tractor engines.

An Internal Combustion Engine(ICE) is one that converts chemical energy from fuel in the presence of air into heat energy and later the heat energy into mechanical energy.

The function of converting chemical energy into mechanical energy is to move machines to do work.

THE TRACTOR AS A SOURCE OF POWER

The tractor provides power for many activities, both mobile and stationary.

FUNCTIONS OF A TRACTOR

1. It provides a pull from the rear of the tractor for draw bar machines ie ploughs and trailers.
2. It provides rotary power from the PTO(Power Take Off) shaft used to drive implements ie sprayers, rotary cultivators, mowers etc.
3. It provides hydraulic power to the three point linkage and can also power external hydraulic vans used for many purposes such as tipping trailers and front mounted fork lifts.
4. To provide a push at the front of the tractor for equipment such as bull dozer blades.
5. Provide power to a belt pulley for machines such as threshers and pumps.
6. It provides a means of transport in conjunction with trailers or any other device.

TYPES OF FARM TRACTORS

Tractors can be classified according to;

1. Number of wheels set on the ground as;
 - i. Two wheeled farm tractor. Which runs on two wheels or tyres. It is designed to do simple cultivation on the farm.
 - ii. Four wheeled farm tractors. This runs on four wheels and it is designed for heavy work.

2. Maximum power output from the tractor as;
 - i. Small tractors that give output of 18.5kw(25 horse power/hp)
 - ii. Medium tractors that give 13.5kw(25-50h.p)
 - iii. Large tractors that give over 37.3kw(50h.p) eg bull dozers

CLASSIFICATION OF ENGINES

1. According to the type of fuel used: under these we have;
 - i. Spark ignition/petrol engine
 - ii. Compression ignition engine/diesel
2. According to the number of strokes per cycle ie two stroke cycle engines and four stroke cycle engines

MAJOR PARTS OF AN INTERNAL COMBUSTION ENGINE

Engines may differ in model or construction but have same parts that have same function

THE DIAGRAM OF AN INTERNAL COMBUSTION ENGINE

Please reserve this space for a drawing

1. CYLINDER HEAD

This seals off the top of the cylinder. Normally a cylinder head gasket is placed between the cylinder head itself and cylinder block

2. CYLINDER BLOCK

This houses the cylinder

3. COMBUSTION CHAMBER/ENGINE CYLINDER

-This is an air tight chamber where fuel is burnt to produce power.

-It is where the piston moves up and down for power to be produced.

NB: A single cylinder engine has one cylinder while a multi cylinder engine has got many. The more the number of cylinders the more the power produced

4. PISTON

A piston is a cylindrical piece of metal that moves up and down inside the cylinder

Functions of a piston

- 1.It moves up and down in the cylinder to compress air in diesel engines and fuel air mixture in petrol engines
- 2.Transmits the power to crankshaft via the connecting rod
- 3.Pushes out burnt gases during exhaust stroke
- 4.It forms an air tight seal within the cylinder so as to compress the fuel air mixture
- 5.It draws fuel-air mixture in petrol engines cylinders or air into the diesel engine cylinders during intake/induction stroke

ILLUSTRATION

ADAPTATIONSOFTHE PISTON TO ITS FUNCTIONS

- 1.It has a cylindrical head which make it to easily move through the cylinder
- 2.It has a resistant crown that resists high temperature
- 3.It has pressure rings that reduce power loss
- 4.It has air rings that allow free circulation of oil
- 5.It has a gudgeon pin and a big bearing that facilitate connections

5.PISTON PRESSURE RINGS

These seal off the gap between the piston and the cylinder wall to prevent fuel leakage and power loss during compression and ignition strokes.

They also transmit heat from the piston to the cylinder walls to enable the cooling of the piston

ILLUSTRATION OF PRESSURE RINGS

6.OIL RINGS

These allow free circulation of oil to the various parts of the engine

DIAGRAM OF OIL RING

7.VALVES

The inlet valve allows entry of fuel air mixture into the cylinder of petrol engines or air alone in diesel engines while the exhaust valves allows exit of burnt gases

8. SPARK PLUG

This provides an air gap across which current passes to produce/form a spark to ignite fuel air mixture in the cylinder of a petrol engine

ILLUSTRATION

CARE AND MAINTAINANCE OF A SPARK PLUG

1. Avoid rough handling when removing and resetting to reduce damage on the insulator
2. Lightly lubricate the thread with oil before replacing it
3. Never over tighten the spark plugs to avoid difficulties in removing them
4. When replacing plugs, ensure that they are of recommended heat ranges of the engine
5. Clean the sparking joints with wire brush
6. Adjust/reset clearance gap where spark jumps

9. SUMP

This is a reservoir for oil

It collects oil after the oil has passed through the engine

10. INJECTOR PUMP

This is where fuel is subjected to very high pressure

11. INJECTOR NOZZLES

It atomizes the fuel into mist- like spray

12. LIFT PUMP

It is responsible for continuous pumping of fuel to the injector pump at constant pressure and help to bleed out air bubbles

13. CAM SHAFT

This is concerned with the opening and closing of the valves. As the cams rotate, because of their shape, they make the push rods go up and down

NB: The top of the cylinder is known as the top dead center (TDC) while the bottom is known as the bottom dead center

The movement of the piston from the BDC to the TDC or from the TDC to BDC is known as the **stroke**

The different movements (strokes) are termed as;

-Induction/inlet stroke

-Compression stroke

-Power stroke/ignition stroke

-Exhaust stroke/outlet stroke

According to the number of strokes a piston makes to complete a cycle, engines may be classified as;

-Two stroke cycle engines

-Four stroke cycle engines

Two stroke engines complete the cycle in two movements

TWO STROKE CYCLE ENGINES

These are engines found in small machines eg lawn mowers, power saws, motorcycles, small generators, motorized sprayers, water pumps etc. They are used to do light jobs.

These engines complete four events ie induction/compression and power/exhaust in two strokes.

They have no valves but instead have ports and their closure or opening is done by the piston movement

MECHANISM OF OPERATION OF A TWO-STROKE ENGINE

INDUCTION/COMPRESSION STROKES

-During this stroke, the piston moves upwards

-As the piston moves upwards it is on its compression stroke but at the same time it creates a vacuum in the crank case and allows the fuel mixture from the carburetor to flow into the crankcase

-The inlet port remains open to allow in the fuel mixture from the carburetor

-A spark is produced at the end of the compression stroke

ILLUSTRATION

POWER/EXHAUST STROKE

At the end of compression stroke a spark is produced to ignite the fuel mixture. Then power produced from the explosion, force the piston downward thus affecting the power stroke

At the same time the downward movement of the piston makes the exhaust port open so that burnt gases escape. This affects the power stroke as well. Therefore both power and exhaust stroke are taking place at the same time.

During this same downward movement, the piston closes the inlet port. This forces the fuel mixture which is already in the crank case to move up through the transfer port to the cylinder with the help of the deflector.

The fuel is deflected to the upper part of the cylinder thus giving a chance to the burnt gases to escape through the exhaust port without mixing with the new mixture from the transfer port

ILLUSTRATION

ADVANTAGES OF TWO STROKE CYCLE ENGINE

1. They are cheap to buy and maintain
2. They use little fuel
3. They can do small jobs e.g. in horticultural gardens where the 4 stroke engine would be too expensive
4. They can be used in a wider range of farmland e.g. in hilly areas

DISADVANTAGES OF TWO STROKE CYCLE ENGINE

1. They produce less power and are therefore weak for heavy work
2. They are inefficient in fuel and oil utilization
3. They are mainly air cooled and this limits their size
4. They are slow at work and cannot satisfactorily operate under fluctuating loads

FOUR STROKE CYCLE ENGINES

These make 4 movements/strokes by the piston in order to produce power

They are used in big machines which do heavy work

TYPES OF 4 STROKE ENGINES

1. Spark ignition/petro engines
2. Compression ignition/diesel engines

PRINCIPLE OPERATION OF A FOUR STROKE SPARK IGNITION ENGINE

1. INDUCTION/INTAKE STROKE/INLET STROKE

- Inlet valve opens and outlet valve closed
- The piston moves downwards to BDC creating a partial vacuum in the cylinder
- The fuel air mixture is drawn into the cylinder through the open inlet valve mean while the outlet valve is closed
- When the piston reaches the BDC the inlet valve closes and the stroke ends

Reserve space of seven lines wherever you see a space

2. COMPRESSION STROKE

- Both inlet and outlet valves are closed
- The piston moves upwards to TDC compressing the fuel air mixture
- Temperature of fuel air mixture rises due to compression

3. IGNITION/POWER STROKE

- Both the inlet and outlet valves are closed
- A spark from the spark plug is introduced as the piston reaches TDC to ignite the fuel air mixture
- The power produced due to explosion of burning gases pushes the piston to move downwards
- The piston and connecting rod turn the crank shaft

4. EXHAUST STROKE /OUTLET STROKE

- The piston moves upwards
- The inlet valve is still closed but the outlet valve is open
- As the piston moves upwards , it expels the burnt gases through the outlet valve

PRINCIPLE OPERATION OF A FOUR STROKE COMPRESSION IGNITION ENGINE

1. INTAKE STROKE

- Piston move upwards,air enters into the cylinder through the inlet valve. The exhaust valve is closed.
- The air into the cylinder is sucked due to the partial vacuum created inside the cylinder
- When the piston reaches the BDC the inlet valve closes and the exhaust valve remains closed
- The air is trapped inside the cylinder and cannot escape anywhere

2. COMPRESSION STROKE

- The piston moves upwards. Both valves are still closed
- The piston compresses air and its volume is reduced considerably
- The temperature of the air rises and this helps to quicken ignition in the next stroke
- The stroke ends when the piston is at TDC

3. POWER/IGNITION STROKE

- At the end of compression stroke,a spray of atomized fuel is injected on hot air and it explodes due to ignition
- The power from explosion of fuel pushes the piston downwards 'both valves remain closed
- The descending piston and connecting rod helps to turn the crankshaft . the poer is transmitted to crankshaft and then to rest of transmission system

4. EXHAUST STROKE

- The piston moves upwards from BDC
- The inlet valve remains closed while the exhaust valve opens
- The upward movement of the piston expels the exhaust valve and finally to the atmosphere

ADVANTAGES OF A 4-STROKE ENGINE

- i. It produces a lot of power and can do heavy work
- ii. It is efficient in fuel and air utilization
- iii. Performs a wide range of farm operations

- iv. Exhaust gases are sufficiently expelled from the cylinders
- v. It is cooled efficiently by water hence a larger size of the engine
- vi. It is heavier so it can absorb vibrations of the engine better

DISADVANTAGES OF A 4-STROKE CYCLE ENGINE

- i. They have a high initial cost
- ii. They are very expensive to maintain
- iii. They need very skilled operators and support services eg servicing
- iv. Their use is limited in hilly areas

SIMILARITIES BETWEEN 2 AND 4 STROKE ENGINES

- i Both use spark ignition
- ii The strokes are still 4 though combined in 2-stroke cycle engine

DIFFERENCES BETWEEN 2 STROKE CYCLE ENGINE AND FOUR STROKE CYCLE ENGINE

	2 stroke engine	4 stroke engine
1	Two strokes are carried out at a time	Each stroke is carried out independently
2	It has no flywheel	A flywheel exists
3	Engine is small and light since it has more parts	Engine is big and heavy since has more parts
4	Mainly air cooled	Usually water cooled
5	Engine produces less power since fuel is not burnt completely	Engine produces more power since fuel is burnt completely
6	Uses less fuel	Uses more fuel
7	Engine produces more noise due to absence of water jackets to absorb noise	Produces less noise due to presence of water jackets to absorb excess noise
8	Ports are used instead of valves	Valves are used
9	It has a transfer port and deflector	Transfer port and deflector absent
10	Uses petrol only	May use both petrol and diesel
11	There is a power stroke for every two strokes of the piston	There is one power stroke for every four strokes of the piston
12	Fuel enters the cylinder via the crank case	Fuel never enters the crank case
13	There is inefficient expulsion of exhaust gases	Expulsion of exhaust gases is efficient

MAJOR SYSTEMS IN A TRACTOR

Tractors are heavy duty machines. They are therefore composed of a number of

systems for effective performance

These systems operate frequently and coordinate in order for the tractor to work well and produce power to do work

These systems include;

- Fuel and air system
- Cooling system
- Transmission system
- Lubrication system
- Hydraulic system
- Electrical system etc

THE ENGINE FUEL AND AIR SUPPLY SYTEM **AIR SUPPLY SYTEM**

The system ensures that air and fuel entering the engine is very clean to promote long life and good performance of the machine

The parts making up the air and fuel system include

TANK

This part stores the fuel and keeps it clean .fuel entering the tank is cleaned primarily by means of a vented cap or tank filter at the entrance of the tank

AIR CLEANER

This part cleans the air before it reaches the carburetor in petrol engine or the engine in diesel engines

NB diesel engines do not have a carburetor

There are two types of air cleaners namely;

(a) DRY TYPE AIR CLEANER

This is a simple device made of perforated metal casing and a paper element which attracts dust particles then clean air is directed to the cylinder through the vent

The dry type air cleaner performs well on a small cylinder which works in less dusty conditions

Efficiency of the system can be improved by waxing or providing a more hairy textured

Paper

Illustration

Maintenance

- Tap it gently or blow air through it at a high pressure
- Avoid compressed air when filter is wet
- Use correct air pressure to avoid damaging the filter
- Do not wash, as the paper can get destroyed by water
- Check its connection to ensure it is tight

(b) WET TYPE AIR CLEANER

The wet air cleaner uses oil as a medium to absorb dust and dirt and other impurities in the air

DIAGRAM SHOWING FEATURES OF A WET TYPE AIR CLEANER

MECHANISM OF OPERATION OF A WET TYPE AIR CLEANER

The incoming air enters through the pre-cleaner. The pre-cleaner causes the air to swirl (move quickly in circles) through the vanes or stabilizers

As the air swirls, it throws out some heavier dust and small particles through the ejection slot on top of the pre-cleaner

The light particles are then allowed to move to the oil bath through the central pipe. Much of the dust gets stuck in oil before the air reaches the wire mesh which is wetted with oil

The wire mesh retains the smallest dust particles which stick on it as air passes to the engine through the air outlet

MAINTENANCE OF A WET AIR CLEANER

1. Check the oil bath weekly and keep the oil level on the indicated mark in the oil bowl
2. Periodically remove any trapped dirt in the wire mesh by swilling it in paraffin /kerosene and after drying, it should be dipped in clean oil and drained to provide a thin film of oil adhering to the wire mesh to collect more dust
3. Check the oil daily if the machine works in dusty conditions and replace with clean oil
4. Change oil when it becomes dark or discoloured and thick with clean engine oil
5. Use the correct grade of oil
6. Ensure that all joints are tight to prevent any leakages
7. Clean the pre-cleaner off the large particles

FUEL SYSTEM

The major aim of the fuel system is to supply regulated amounts of fuel and air, in accordance to the operational need of the tractor

There are two types of fuel systems i.e. petrol and diesel system

PETROL FUEL SYSTEM

Please reserve this space

THE WORKING PRINCIPLE OF THE PETROL FUEL SYSTEM

Fuel from the tank runs through the filters and enters the float chamber of the carburetor via a cutoff valve operated by a brass float. The float maintains fuel at the level required by the jet

The fuel and air emerge and meet at the venturi. Air is drawn in with the help of the induction stroke from the air cleaner to the carburetor

Fuel from the float chamber is sprayed and mixed with the air and this is achieved by the narrowness of induction tube at the venturi

The fuel-air mixture goes to the throttle which controls the volume of the mixture entering the combustion chamber hence the speed and power of the engine

CARE AND MAINTENANCE OF PETROL FUEL SYSTEM

1. Clean the filters by washing them petrol
2. Keep the hole in fuel tank cap clear of dirt

THE CARBURETTOR

FUNCTIONS OF THE CARBURETTOR

1. It mixes the vapourized fuel in correct proportions with the air
2. It controls and varies the amount of petrol drawn in the engine depending on the opening of throttle valve

3. It controls the speed of the engine
4. It breaks up the fuel into tiny droplets /atomizes fuel before sending it to the engine

DIAGRAM OF A CARBURETTOR

THE WORKING OF A CARBURETTOR IN THE ENGINE

The float chamber receives fuel from the fuel tank. The entry of fuel into the float chamber is controlled by means of a brass float and a needle valve

When the chamber is full, the float raises and causes the needle valve to shut and prevent any further flow of fuel

Once the fuel has been used, the float falls and the valve opens thereby maintaining a constant fuel in the chamber.

The fuel passes from the float chamber to the nozzle or jet which is located in the narrow constricted tube called the venturi. The venturi increases the velocity of the air and creates a partial vacuum which helps to pick up the fuel from the nozzle and break it down into droplets

The piston movement on induction stroke creates a vacuum in the cylinder and their offset air to rush through the carburetor and so doing, it picks up the fuel from the venturi in the form of a spray

The fuel air mixture is then taken to the cylinder, the choke valve controls the amount of air entering the carburetor

The throttle valve (butter fly valve) controls the amount of fuel /air mixture entering the cylinder from the carburetor

MAINTAINANCE OF A CARBURETTOR IN GOOD WORKING CONDITION

1. Service the carburetor every 250 hours of operation /monthly

2. It should be regularly cleared using petrol
3. The moving parts should oiled
4. Ensure that the needle valve is replaced if worn out
5. The float chamber should be maintained free from leakage
6. Adjust the butter fly valve
7. Ensure that the fuel and filter and air cleaners are in good condition so that only clean air and fuel enters the carburetor to avoid blockage of the jet air passage
8. Ensure that there is no blockage along the air and fuel supply

THE DIESEL FUEL SYSTEM

THE WORKING PRINCIPLE OF DIESEL FUEL SYSTEM

Fuel flows by gravity from the tank to the sediment bowl .the sediment bowl indicates whether the fuel is dirty or clean and traps dust big particles .The fuel then goes to the fuel lift pump, which supplies fuel to the injector pump at constant pressure and helps to bleed out air bubbles which have entered the fuel

From the fuel lift pump,the fuel is pumped up through fuel filters where any form of dirt is trapped so that the fuel enters the injector pump when extremely clean

When the fuel enters the injector pump,it is subjected to very high pressure and it drives the fuel to enter at a very high pressure into the cylinder through the narrow injector nozzles

The injector nozzles break the fuel into very small droplets to make it easier to ignite

In this condition, the fuel readily explodes once it comes in contact with the compressed air

The leak off pipe collects any overflow of fuel from the injectors and returns it to the tank for recirculation through the system

HOW TO ENSURE EFFICIENT PERFORMANCE OF DIESEL ENGINE FUEL SYSTEM

1. Keep the cap on fuel tank always closed
2. Keep the connection along the fuel line tight
3. Clean or replace fuel filters regularly
4. Ensure cleanness of air cleaner
5. Bleeding of fuel system to remove the air
6. Clean the sediment bowl when dirty
7. Replace worn-out injectors

DIFFERENCES BETWEEN PETROL AND DIESEL ENGINE

Petrol	Diesel
Use petrol as fuel	Use diesel as fuel
Fuel is ignited by an electric 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 ratio of 5:1-8:1	Has a high compression ratio of 14:1 - 20:1
Air and fuel first meet in the carburetor	Air and fuel first meet in the cylinder (air goes 1 st then followed 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	It is Heavy in weight and suited for heavy work.
It uses more fuel per unit area	It uses less fuel than petrol engines per unit area
Petrol engines cost less money	Diesel engines cost more money
Has no injectors	Has injectors

Have many starting problems and cannot do without a battery	Have few starting problems and may not need a battery
It is less efficient in fuel utilization	It is more efficient in fuel utilization
Flow of fuel into the cylinder is regulated by carburetor	Fuel entering the cylinder is regulated by fuel pump
Air and fuel mixture is compressed during compression stroke	Only air is compressed during compression stroke
Maintenance is more frequent	Maintenance is less frequent

CARE AND MAINTANANCE OF FUEL SYSTEM

1. The fuel tank should always be kept clean and dry with the cap closed
2. The tank should be filled with fuel daily
3. The sediment bowl should always be checked and cleaned where necessary
4. Often check and clean the fuel lift pump
5. Fuel filters should regularly be serviced and replaced with filter elements or follow manufactures instructions

6. The injector pump should always be kept clean and serviced by a qualified mechanic for diesel engines
7. The carburetor should also be cleaned regularly by a qualified mechanic for petrol engine
8. Keep all the pipe connections tight
9. Keep all injectors and jets tight and replace worn out injectors for diesel engines
10. Injector pump should be checked and serviced if necessary by a trained mechanic after 6 months because they wear out
11. Injection pump should be lubricated periodically according to the manufactures instructions

TRANSMISSION SYSTEM

The main function of this system is to transfer power from the engine to the rear wheels so that the machine /tractor can move and perform some work.

The major components of the transmission system are;

- Fly wheel
- Clutch assembly
- Gear box
- Differential unit
- Drive axles
- Wheels and tyres

TRACTOR TRANSMISSION LAY OUT

FLY WHEEL

FUNCTIONS

- Stores power used to drive the engine during idle strokes
- It provides a point of attachment of the clutch plate
- It acts as a gear for engagement of the starter motor during starting
- It connects the drive from the engine to the rest of the transmission system

CLUTCH ASSEMBLY

FUNCTIONS

- It connects and disconnects the drive shaft to or from the engine respectively ,thus it engages or disengages the transmission
- It helps the operator to take off gradually and smoothly
- It allows the engine rotary motion to be disconnected and connected to the gear box and differential
- It helps to provide power from the engine to the power take off shaft (PTO)
- It helps the tractor to stop without stopping the engine

GEAR BOX

FUNCTIONS

- It helps in selecting a suitable working speed
- It can be used when breaking /stopping the vehicle without suddenly stopping the engine
- It adjusts the speed of the engine to the speed at which it is required to drive the tractor
- It enables the power from the engine to be applied to the work being done by the tractor
- It allows forward and reverse movements

DIFFERENTIAL

This is a unit, which connects two rear axles and propeller shafts.

FUNCTIONS

- It changes the direction of the drive to right angles so that power is transmitted to the rear wheels
- It makes it possible for tyres /wheels to run at different speeds. This enables the machine to turn corners
- Allows the tractor to move in a straight line on slippery grounds using the differential lock
- It adjusts the speed of the drive even further so that the operator works at a slower speed than the engine speed

FINAL DRIVE

This is an additional reduction gear between the differential and the wheels

POWER TAKE OFF SHAFT

The PTO shaft provide power outlet from the tractor for driving stationary machines or implements pulled behind the tractor in the field such as combines and mowers

DESCRIPTION OF HOW POWER PRODUCED IN THE ENGINE IS TRANSMITTED TO THE REAR WHEELS OF A TRACTOR

Power is produced in the cylinder and transmitted to the crankshaft by the piston rod
The crankshaft transfers the up and down motion of the piston rod into a rotary motion

The rotating crankshaft motion is controlled by the clutch assembly which connects or disconnects the rotary motion to the gear box

The gear box has gears to allow for selection of rotary speed

From the gear box, the rotary power is transmitted to the differential through the propeller shaft

At the differential, power is distributed to the rear wheels by the bevel gear through the axle

WHEELS AND TYRES

The wheels comprise of tyres, rims, tubes, nuts and bolts. The wheels propel the machine forward or backwards and this enables it to move and perform work

The tyres allow maximum possible grip called traction

TRACTION

Traction refers to the ability of the tyres to allow maximum possible grip to the ground

CONDITIONS UNDER WHICH TRACTION MAY BE REDUCED IN A FARM TRACTOR

1. Worn out tyres with no or shallow treads reduce grip
2. Overinflating the tyres reduces the grip surface area
3. Wet surface reduce grip
4. Lack of ballasting reduces weight of tyres thereby reducing grip or traction
5. Fewer number of wheels reduces surface area of grip hence reducing grip
6.
7. Over speeding reduces impact of tyres on the ground thereby reducing traction
8. Small tyres have less grip than big tyres

HOW TO INCREASE TRACTION

1. Reducing the tyre pressure appropriately
2. Addition of weights ,these may be heavy pieces of metal put in front or behind of the tractor or on wheels .these weights increase stability as the tractor move
3. Ballasting the tyres .this involve adding water to the inner tubes of the tyres .salt and lime may be added together with water to prevent freezing
4. Increasing the number of rear tyres or adding more wheels especially on the inner axles
5. Using metallic tyres or wheels (these are not recommended on public roads)
6. Using tyres with chains .metallic chains are wound round the tyres and are fastened onto the tyres
7. Using large tyres to increase the surface area available to grip the ground
8. Retreading the tyres with larger treads or using new tyres
9. Use of twine wheels especially on very wet land .This prevents the tractor from sinking
10. Use of retractable stakes which can be bolted to the wheel dish

FACTORS THAT AFFECT THE LIFE SPAN OF TYRES

- Level of inflation of the tyres. low or very high inflation causes deterioration of the tyres
- Handling .during removal and fitting of tyres using sharp aids may cause piercing of the tyres
- Driving surface. Surfaces covered with sharp objects cause piercing of the tyres and reduce their life span
- Exposure to oil and other petroleum products also cause deterioration of rubber and so,tyres should not be exposed to these products
- Loading. Overloading or uneven loading shorten the lifespan of the tyres
- Driving habits .some drivers apply the brakes suddenly and cause the vehicle to skid .the excessive friction encountered causes rapid wear of the tyres
- Protection from sunlight .sunlight causes deterioration of the tyres and so the tyres should be protected from sunlight to increase their life span
- Distance covered
- The longer the distance the more wear and tear of tractortyres
- Make of the tyres .Some tyres are reinforced and made to resist damage more than others,such tyres therefore last longer

CARE AND MAINTENANCE OF WHEELS AND TYRES

- Trees must be inflated to the pressure recommended by the manufactures
- Fit the caps on the valve to prevent entry of dirt
- Check tyres regularly for damages, deep cuts and bulges that may result in the tyre exploding periodically
- Nuts and bolts should be checked and refastened daily
- Keep vehicles out of the sun to prevent deterioration of the rubber tyres
- Keep tyres away from petroleum products to avoid absorption of oil and swelling of tyres
- Tyres should be changed or retreaded periodically

MAINTENANCE OF THE TRANSMISSION SYSTEM

- The oil should be kept at the correct level in the gear box ,back axle /final drive depending on the construction of the tractor
- Change the oil at specific intervals as specified by the manufactures
- Ensure that all the parts are oiled except the non-friction oriented parts
- The clutch should always have some free play at the pedal
- The oil level should be regularly checked using a deep stick and refilled to the correct level
- Use the correct grade of oil
- Clear the filters regularly

THE COOLING SYSTEM

The burning of fuel air mixture inside the cylinder of an internal combustion engine results into tremendous rise in temperature of up to 1600°C , which if unchecked , would be sufficient to melt parts of the engine .

The temperature therefore has to be reduced to about 90°C and this is achieved by means of a cooling system.

Unless cooling done,overheating leads to;

- Expansion of the engine components that damage their shapes
- Cracking of the cylinders
- Burning of valves
- Pre-ignition of fuel due to hot parts of the engine
- High fuel consumption,dilution and contamination of lubrication oil

CAUSES OF OVERHEATING THE ENGINE

- Overworking the engine
- Over speeding of the tractor
- Overloading of the tractor
- Poor lubrication of the moving parts
- Lack of water in the radiator
- Loose fan belt
- Faulty water pump
- Broken hose pipe leading to water leakage
- Accumulation of dirt and dust inside the radiator and radiator tubes

b) Explain(uneb) 2016.....

- Lack of fuel in the fuel tank
- Air bubble in the fuel line
- Low battery charge
- Faulty injector pump/lift pump
- Faulty spark plugs
- Faulty injectors
- Poor/faulty setting of the timing unit
- Worn out compression rings
- Worn out /broken piston head
- Faulty switch
- Faulty ignition coil
- Engine knock
- Engaged gear
- Loose battery connection
- Faulty starter motor
- Dirty battery terminals
- Faulty distributor
- Broken electric cable
- Burnt out fuses

- Poor electrical wiring

TYPES OF COOLING SYSTEM

AIR COOLING SYSTEM

This system is confined in small or light machines or engines which are cooled by air as the machine moves

ADVANTAGES OF AIR COOLED ENGINES

- Air cooled engines operate extremely well in both hot and cold climates
- Air cooled engines operate at a much higher working temperature than the water cooled engines
- Air cooled engines rapidly reach their working temperature
- Air cooled engines are marginally lighter than similar sized water cooled engines
- Air cooled engines have no leakage or freezing problem
- They have fewer parts that need repair/maintenance

DISADVANTAGES OF AIR COOLING SYSTEM

- The cooling fins can vibrate and amplify noise under certain condition
- They get hot quickly
- They are inefficiently cooled especially when carrying heavy loads
- They use heavy lubrication oils only.

WATER COOLING SYSTEM

In this system, water is used to cool the engine

REASONS WHY WATER IS USED TO COOL THE ENGINE

- It has high specific heat capacity ie a lot of heat has to be absorbed by water to raise its temperature
- It has low viscosity ie can easily flow
- It is a solvent and has cleaning properties
- It is readily available /easy to get for use
- It has a high latent heat of vapourizationie it requires a high amount of heat to change to vapour
- It has low freezing point hence does not solidify while in the engine
- It is relatively cheap compared to other coolants
- It is relatively less corrosive

DISADVANTAGES OF USING WATER AS A COOLANT

- Water can freeze
- Coolant passages tend to get blocked
- Water coolant joints are subject to leakages

A DRAWING SHOWING THE MAJOR PARTS OF THE WATER COOLING SYSTEM

MAJOR PARTS OF THE COOLING SYSTEM

FAN

- It draws cool air to the radiator fins
- It cools the water in the radiator

MAINTENANCE OF THE FAN

- It should be fixed well by the help of fixing bolts
- Check for its physical conditions to ascertain cracks

WHAT MAY RESULT IN THE MALFUNCTION OF FAN WITH BLADES

- Presence of cracks on it
- Loose fan belt tension
- Very tight fan belt tension
- Bent fan blades

FEATURES THAT ENABLE THE FAN WITH BLADES TO FUNCTION

- Has fan blades that helps to suck air from the environment towards the engine through the radiator fins so as to cool the hot water received from the engine
- It is made up of a base of fan blade where the fan blades are attached to give them strength so as to rotate well as they blow air over the radiator fins
- Has a shaft to provide rigidity for attachment of pulley where fan belt sits

FAN BELT

This transfer the turning force of the crankshaft to dynamo or generator,water pump and fan

MAINTENANCE

- Keep proper tension of the fan belt
- Check its condition for cracks and warping

FEATURES THAT ENABLE THE FAN BELT TO FUNCTION

- Has fan belts that help to suck air from the environment towards the engine through the radiator fins so as to cool the air received from the engine
- It is made up of a base of fan blade where the fan blades are attached to give them strength so as to rotate well as they blow air over the radiator fins
- Has a shaft to provide rigidity for attachment of pulley where fan belt sits

THERMOSTAT

- Controls the opening and closing of the valve
- Regulates the temperature of the engine/ regulates temperature of water

RADIATOR

- Stores water for cooling the engine
- Cools water by providing a large surface area

TEMPERATURE GAUGE

This indicates the engine temperature

IMPELLER WATER PUMP

This part promotes and maintains circulation of water throughout the system as the impeller pump rotates,it draws cooler water up from the bottom of the radiator thus helping in circulation

WATER JACKETS

This is an area surrounding the cylinder in which water circulates. The water jackets are connected to the water hoses

MAINTENANCE OF THE COOLING SYSTEM

- The radiator should always be filled with clean water before starting a day's work
- The fan belt tension should not be either too loose or tight to avoid poor performance of the fan

- Clean the radiator according to manufactures instructions
- Keep the radiator free of dirt,dust of other materials like grass and insects, these interfere with water and air circulation
- Lubricate the water pump weekly using the water pump grease
- Check for leaks and make sure that the hose connections are tight and replace destroyed hoses
- Replace worn out fan belt

LUBRICATION SYSTEM

The purpose of the lubrication system is to establish a film of lubricating oil between all the moving parts where dangerous friction is likely to arise

FUNCTION OF THE LUBRICATION SYSTEM /LUBRICANTS

- Lubricants help to reduce friction between moving parts there by reducing tear and wear
- Lubricants cool off some of the heat generated by the moving parts there by avoiding unnecessary expansions that would cause jamming of the moving parts
- Lubricants help to absorb some shocks that would affect the engine parts and cause unnecessary wear
- Prevents rusting of metals /engine parts that would otherwise lead to breakdown of the engine
- Forms a seal between the piston and cylinder there by increasing compression efficiency, this increase power output of the engine
- Lubricants absorb the noise of the engine
- Lubricants trap dust particles from air that goes to the engine
- Lubricants clean out sludge and iron fillings from the combustion chamber into the sump

LUBRICANTS

These are substances that reduce friction between two moving surfaces in machinery

OIL

This is used to lubricate the gear box and other parts of the transmission system

The correct level of engine oilis determined using a dip stick. It is also able to show the condition of oil in the engine

CONTAMINATION OF OIL

Oil can be contaminated by;

1. Sludge .This forms from carbon, water and other substances when fuel is burnt in the engine ,it blocks oil ways and bearings
2. Metallic particles. These result from wear of engine parts and bearings
3. Unburnt fuel which gets past the pistonand mixes with oil especially when the engine remains below its working temperature
4. Water produced when fuel is burnt and also from condensation adding to oil contamination
5. Paint from the engine parts may fall in the tank
6. Dust and grit may come from air especially if the air cleaner is faulty

GREASE

This lubricant is semi solid and is used to lubricate the steering system, belt bearing parts , sprockets, axles, and all slow moving parts

Application of a grease gun is achieved by use of a grease gun

PROPERTIES OF LUBRICANTS THAT MAKE THEM SUITABLE FOR USE IN ENGINE PARTS (QUALITIES OF GOOD LUBRICANTS)

- High flash point to enable them lubricate moving parts without igniting
- Good film strength ie the ability to resist pressure
- Should have a low viscosity ie able to flow
- Should have a high specific heat capacity
- So as to play a role in absorbing engine heat
- Have cleaning properties
- Should be oily ie smooth and slippery
- Low melting point to keep its properties of viscosity and maintain its structure

TYPES OF LUBRICATION SYSTEM

1. CIRCULATING SPLASH LUBRICATION SYSTEM

Lubrication in this system is achieved by oil splash and for this splashing to take place a dipper is provided on the end of the big end cap

When the engine is running, the dipper dips into a narrow trough of oil which is positioned directly between it and throws/ splashes oil up into the moving parts

The big end, cylinder, crankshaft bearings, timing gears al being inside the crankcase are lubricated by the splash

DIAGRAM TO SHOW THE MAIN COMPONENTS OF THE CIRCULATING SPLASH SYSTEM

2. OIL MIST LUBRICATION

This is commonly used in the two stroke cycle engines where oil is mixed with petrol, usually in the proportion of 16:1 (petrol: oil) for larger two stroke engines or 24:1 for small engines

The oil mist produced when a mixture of fuel and oil is burnt is used to lubricate the moving parts

3. FORCE FEED LUBRICATION

An oil pump driven by the engine cam shaft drains oil from the sump through a strainer and filter elements.

From the filters, oil goes to the main bearings, crank shaft and the valve gears

The piston and cylinder walls are lubricated as oil runs back to the sump

PARTS OF THE FORCE FEED LUBRICATION SYSTEM

MAINTENANCE OF THE LUBRICATION SYSTEM

- Change the engine oil according to manufacturer's instructions
- Change the oil filters whenever you change the engine oil
- Drain the oil when it is still hot, because when it cools it sticks on the walls of the sump
- Seal off the leakages in the system to prevent loss of engine oil
- The level of oil in the crankcase should be checked daily with a dip stick and refill if necessary.
- Use the correct grade of oil and refill to the correct level
- Clean the crank case breather according to the manufacturer's instructions
- If the engine oil becomes old, it should be drained out and replaced with fresh clean fresh clean oil

ELECTRICAL / IGNITION SYSTEM

The main function of the electrical system is to provide an electric spark to ignite the fuel air mixture in a spark ignition engine

The electrical system also supplies power to the battery to;

- Start the engine
- Operate meters on the dash board
- Light various lights eg head lamps, indicators, and brake lights
- Operate radios
- Operate wind screen wipers
- Operating domestic appliances eg television

There are two types of electrical systems ie

- i. Magneto system. This uses rotating magnets to produce current
- ii. Battery and coil system. This uses a battery to produce current

DIAGRAM SHOWING THE COMPONENTS OF THE ELECTRICAL IGNITION SYSTEM

BATTERY

- This supplies a low voltage current to the induction coil
- It stores DC/ chemical energy which is converted into electrical energy to supply the flow of current

DIAGRAM OF A BATTERY

CARE AND MAINTENANCE OF A BATTERY

- Keep the casing and terminals of the battery clean and dry
- Check for the level of the electrolyte , if low top up with distilled water
- Replace the electrolyte if the specific gravity falls less than 1.27
- Recharge the battery regularly
- When not n use for a long time, empty the cells and the battery on a piece of wood upside down
- Vent holes should be kept clean
- Ensure that the fan belt tension is correct enough to keep the battery charged
- Keep the battery tightly fixed in its box to prevent spillage and damage due to vibration of the engine
- Grease /oil the terminals to avoid corrosion

IGNITION COIL

This induces a high voltage in the secondary winding after current is interrupted in the primary winding ie it steps up low voltage to high voltage

DISTRIBUTOR

This gets current from the coil and divides /distributes it to the spark plug in the cylinder according to the firing order

STARTER MOTOR

Uses power from the battery to start the engine by turning the fly wheel

DYNAMO / GENERATOR

This generates electricity for recharging the battery

VOLTAGE CONTROL BOX / CUT OUT

It controls the charge from the dynamo to the battery and disconnects when the engine is stopped

SPARK PLUG (refer to previous notes)

IGNITION SWITCH

Provides connection to the battery

CONTACT BREAKER POINT

This interrupts current supply to the coil at the desired time

MECHANISM OF OPERATION OF THE IGNITION SYSTEM

The low voltage from the battery is drawn from the battery when the ignition switch is switched on and the engine is turned over by the starter motor

Current from the battery to the primary circuit (thick wire with few windings) and creates a magnetic field in the primary windings

The cam which is driven by the camshaft opens contact breaker points causing the primary circuit to break

The break in the primary circuit induces a high voltage of 1000 volts in the secondary circuit because of its lower resistance

Current of high voltage flows through heavily insulated wires via the distributor to the spark plugs in the cylinder in which compression is taking place

The high voltage creates a spark across the plug points /electrodes and the fuel air mixture in the cylinder is ignited

The engine starts to run

GENERAL MAINTENANCE OF THE IGNITION SYSTEM

1. Ensure that the battery is firmly secured to avoid spillage and damage due to vibration of the engine
2. Keep the battery terminals clean ,dry and tight on cables and smear them with Vaseline or grease to avoid corrosion
3. Keep the vent holes open and clean /free from blockage
4. Ensure that the electrolyte is at the a correct specific gravity of 1.280
5. Check that the generator fan belt is of correct tension to ensure that the battery is kept fully charged
6. Charge the battery regularly and periodically
7. Replace all the broken and worn out cables
8. Adjust the contact breaker points according to the manufactures recommendations
9. Empty the battery and keep it on a piece of wood and upside down before long storage
10. Keep the battery plates always covered to prevent the electrolyte spilling and to avoid contamination
11. Lubricate the bearing of the dynamo regularly
12. Check the tightness of fan belt which runs the dynamo and adjust accordingly
13. Clean the points of spark plug with a wire blush and reset the gap to 0.1 cm
14. Lubricate under the rotor arms every 100 hours of operation
15. Wires should be firmly attached to the terminals to avoid short circuits

FACTORS THAT CAUSE A FAILURE IN THE BATTERY IGNITION SYSTEM

- Wrong clearance gap of the spark plug
- Burnt plug gap electrodes
- Discharged battery so that there is no flow of current from it
- Poor connections and broken wires which create gaps and no flow of current
- Battery terminals in poor condition
- Faulty ignition coil
- Dirty spark plugs