MEENAKSHI RAMASWAMY ENGINEERING COLLEGE

M.R. Kalvi Nagar, Thathanur, Ariyalur (Dt) – 621 804.

DEPARTMENT OF AGRICULTURAL ENGINEERING

LABORATORY RECORD BOOK

B.Tech Practical Examination

Name :

Roll. No. :

Branch :

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BONAFIDE CERTIFICATE

Certified that this is the Bonafide record of the Practical work done by Mr. /Ms. ……. Register Number ……..……

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Signature of Staff In-Charge **Signature of HOD**

Submitted for the University Practical Examinations held in…….

INTERNAL EXAMINER **EXTERNAL EXAMINER**

V SEMESTER

LIST OFEXPERIMENTS

Expt.No.1 **Date:----------**

IDENTIFICATION OF MAJOR SYSTEMS OF A TRACTOR AND GENERAL GUIDELINES ON PRELIMINARY CHECK MEASURES BEFORE STARTING A TRACTOR - PROCEDURE FOR STARTING, RUNNING AND STOPPING THE TRACTOR

Aim: To Identify and study major systems of a tractor and to learn general guidelines on preliminary check measures before starting a tractor - procedure for starting, running and stopping the tractor

Tractor components and functions

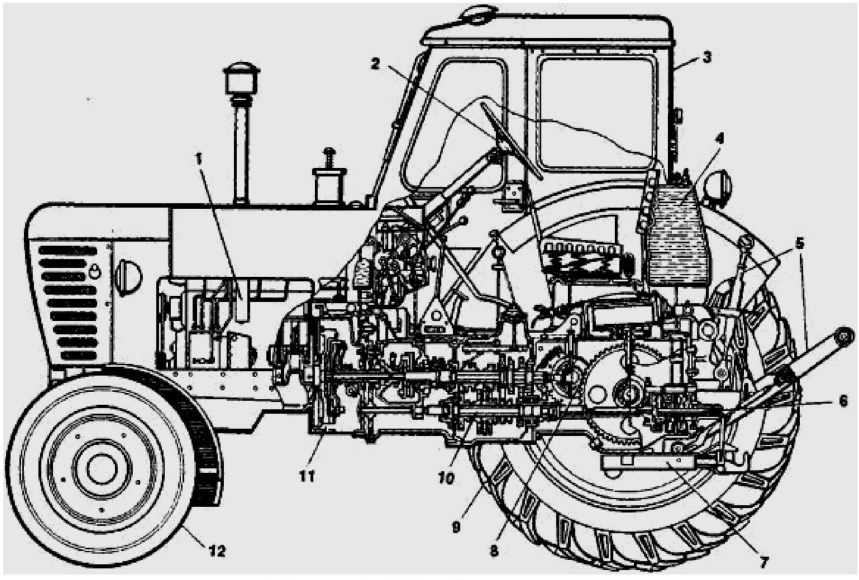


Figure 1. Wheel type tractor:

(1) engine, (2) steering wheel, (3) cab, (4) fuel tank, (5) levers of toolbar assembly. (6)power takeoff shaft, (7) hitch, (8) main drive, (9) driving wheel, (10) gear box, (11) clutch, (12) front (steerable) wheel

Engine- Engine converts heat energy obtained during burning of fuel into mechanical energy. The energy obtained from engine is used to i) move the tractor ii) to pull the implements and trailer iii) to operate rotary machines like rotary tiller, pumping devices etc.

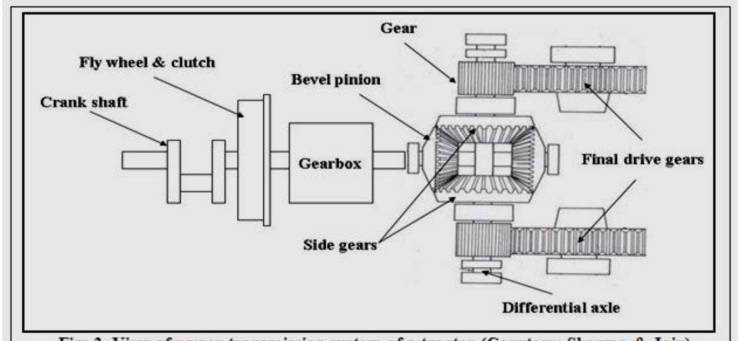
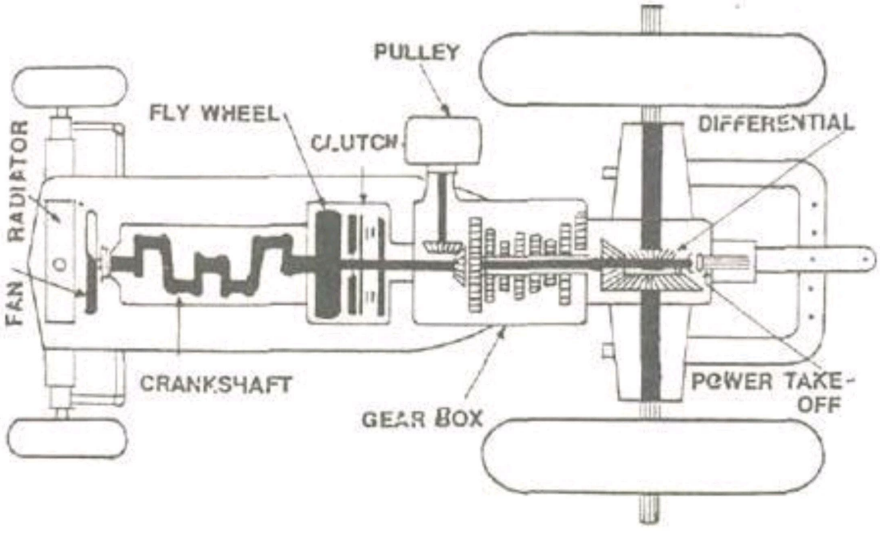


Fig: 3. View of power transmission system of a tractor (Courtesy: Sharma & Jain)



Clutch- It is used to connect or disconnect engine power to the gear box of the tractor.

Gear box- Gear box contains many pairs of gears to provide different speeds to the rear wheels. This system consists of components that are used to transmit the torque developed by the prime-mover or the engine to the driving wheels and to vary the torque and direction of rotation of the ground wheels. The greatest difference between transmission for farm tractors and those for highway vehicles is that in the tractor most of the gears may be used continuously under full load. Automobile transmissions would fail if they were run in low gear at full power for any length of time. All transmissions convert the engine torque and speed into a more useful combination of torque and speed at the drive wheels.

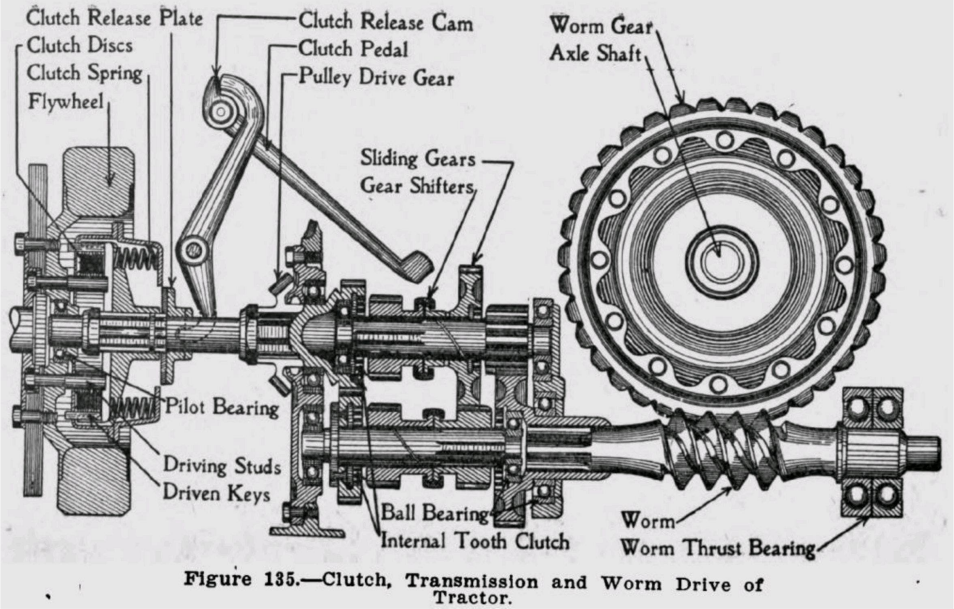


Figure 135.—Clutch, Transmission and Worm Drive of Tractor.

Differential unit- This is also an assembly of gears in a special way. It provides differential speeds to rear wheels during turning of the tractor

Final drive- This constitutes a pair of gears connecting the half shaft and the rear wheel axle so that the speed of the half shaft is very much reduced at the rear wheels and by this way the torque axle is increased

PTO shaft- Its full name is power take of shaft. It gets it drive from the gear box of the tractor. Rotating type of implements such as rotary tiller, water pumps, chaff cutter etc can be operated using the PTO shaft drive. It is available at the rear /side of the tractor. The power available at the PTO shaft is about 87 % of engine power.

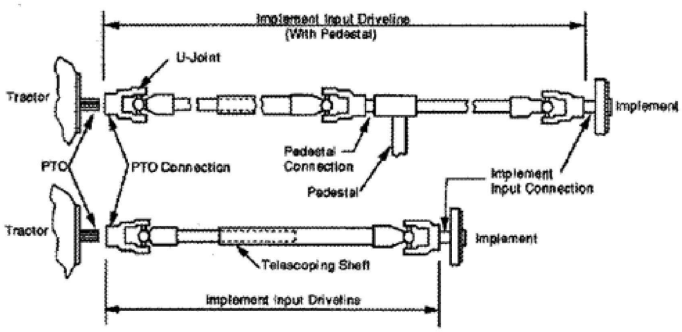
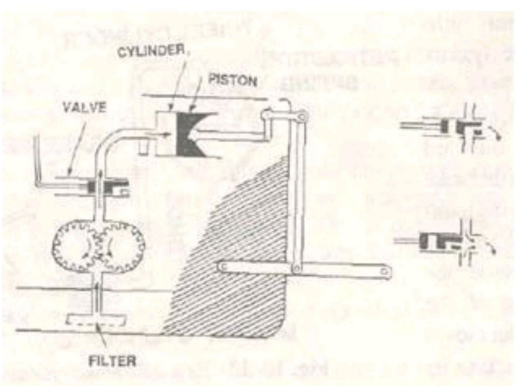


Figure 1. The major components of PTO systems

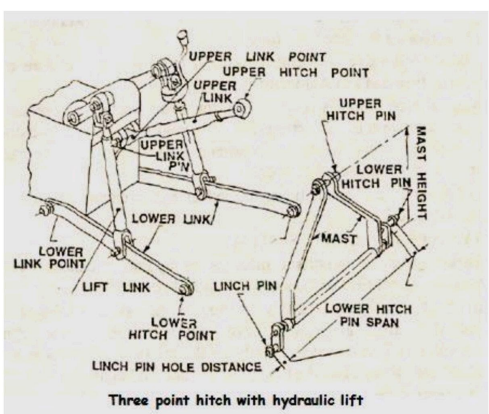
Draw bar- It is a bracket located to the rear of the tractor to which trailed implements and trailers can be connected and worked. The power available at the draw bar is about 50-60 % of engine power. Because the maximum speed of a tractor is regulated by a governor, the potential maximum drawbar power of the tractor is nearly constant regardless of the forward speed, except for the lowest speeds when the maximum power is limited by traction.

Hydraulic system- Hydraulic system operates the hydraulic cylinders which in turn actuate the lower links of the tractor so that the implements hitched to the lower links are lifted orlowered

Three point hitch system- The three links- one upper link and two lower links- available at the rear of the tractor constitute the three point hitch system for the tractor. The lower links are actuated by the hydraulic system . An implement connected to the three links is called a mounted implements and an implement connected to the two lower links is called semi mounted implement.

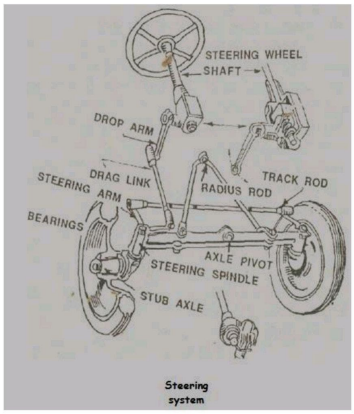


Schematic diagram of hydraulic system

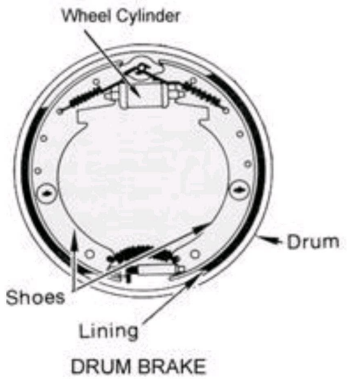


Three point hitch with hydraulic lift

Steering system-It is useful to turn the front wheels either right side or left side so that tractor turns right or left.



Brakes- when brakes are applied , brake drums located in the rear wheel drums stops the rotating wheels and the tractor stops

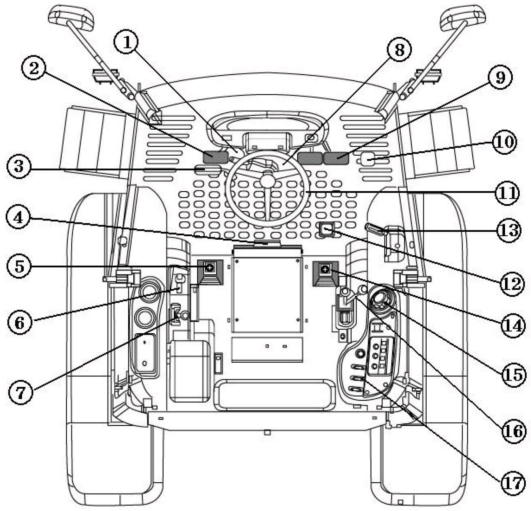


Cooling system- It cools the engine by removing heat with the help of water. It contains radiator, water pump, thermostat . Cool water is pumped into the water jackets of the engine, heat from engine body is transferred to water by conduction and the hot water is cooled in theradiator.

Lubricating system- All the moving parts in the engine are lubricated by lubricating oil. Lubrication is necessary to reduce wear and tear of the moving parts of the engine. This system consists of oil sump, lubricating oil, and pipe lines.

1 Parking brake pedal

2 Clutch pedal
3 Shuttle shift lever
4 Hydraulic flow control knob
5 Sub shift lever
6 WD shift lever
7 PTO shift lever
8 Tilt pedal (steering column)
9 Brake pedal
10 Acceleration pedal
11 Steering wheel
12 Diff-lock pedal
13 Throttle lever
14 Main shift lever
15 Position control Dial knob
16 Joy stick lever for hydraulics.



TRACTOR CONTROL

Control Meters / Panel:

Temperature gauge- It indicates the temperature of water in the radiator. When it reads with in green band, the engine is cooled properly. When it reads in the red band it means engine cooling in insufficient, may be due to defects in the cooling system components. This should be corrected.

Oil gauge- It indicates the pressure with which oil is circulated in the engine parts. High pressure indicates blockage in the oil line and to be checked for correctness.

Hour meter- It indicates the running hours of the engine

Speedometer- It indicates the vehicle speed in km/h

Ampere meter- It indicates the condition of the battery as well as charging of the battery by dynamo.

All the above meters are placed in the panel board located in front of the driver

Before Starting the Tractor:

1. Check engine oil level, fill upto the mark on the dipstick
2. Clean and refill air cleaner bowl to level mark on lip of the canister
3. See that radiator is filled with water
4. Every day after completion of the work, fill up the fuel tank, make sure no water gets into it
5. Do not attempt to start the engine other than from the driver's position
6. Ensure that the dual range selector is in the S'S position and that the gear lever and PTO lever are both in their positions.
7. Check whether both brake pedals are locked together
8. Set the hand throttle lever half the way down
9. Ensure that the fuel cut-off control is pushed fully in
10. Turn the starter switch key clockwise to operate the starter
11. When the engine fires, release switch key which will run to the OFF position and push hand throttle lever position to a fast idle position

Running the Tractor:

1. Make sure the brakes are released
2. Depress clutch pedal fully and shift gear lever to the desired gear and dual range selector either high or low
3. Increase engine speed slowly and release clutch pedal slowly
4. Remove foot from clutch pedal and slowly increase throttle setting until desired speed is obtained

5. Check whether ammeter, fuel meter, temperature meter and engine speedometer are working
6. Do not rest foot on or ride the clutch pedal, as this may cause premature wear of the clutch
7. Do not change the dual range selector lever when the tractor is moving

Stopping the Tractor:

1. First press the clutch pedal for stopping the power transmission from the engine flywheel and simultaneously apply the brake pedal.
2. Bring the throttle lever to the minimum position
3. To stop the engine, pull the fuel cut-off control lever

Parking the Tractor or Tractor with Trailor:

1. Always park the vehicle in the left side of the road
2. Do not park in neutral gear position
3. Engage the hand brake while parking

Safety Precaution

1. Do not shift speed unless the tractor comes to a full stop. Otherwise, it may damage the gear teeth.
2. Always move the main clutch lever to “stop” when shifting speed.
3. Use a low range speed in the 1st speed when traveling on narrow or slippery paths.
4. While traveling down a slope, do not disengage the main clutch, or use the “Neutral” position because accidents may occur.
5. The trailer that hitches to the tractor should sport a braking system

Driving instructions for driving the tractor on the road

1. Follow the procedure explained earlier and start the tractor.
2. Select the require gear say low first and move the tractor by following the procedure explained in the previous exercise.
3. While moving increase the throttle, decrease the throttle, depress the clutch and see what happens to the movement of the tractor.
4. After pertaining in low first gear try to run the tractor low second gear and feel the difference.
5. Then try to move the tractor in low third gear and observe the performance. While running the tractor practice in turning towards left side and right side. Practice in reversing the tractor. Always use low gear while reversing.

6. Follow the traffic and safety driving rules while operating the tractor on road.

7. While stopping and parking the tractor follow the procedure explained in the previous exercise.

Driving instructions for driving the tractor off the road

1. Before start check the inflation pressure required for operating the tractor in off road. Follow procedure as explained earlier.

2. At each gear positions notice the difference between the tractor running on road and off the road and record your observations.

3. Do you feel any difference in the operator convenience during driving in on road and off road?

4. Apply the brake when both the brake pedals are locked together.

5. Release the brake pedal lock lever and apply the brake pedals individually and record what happens.

6. Turn the tractor left or right, with and without loading the brake pedals and measure the minimum turning radius.

Practical Exercise: 1

i. Identify the major components of tractor.

ii. Write the Tractor driving procedures to be followed on-road and off-road.

iii. List out the preliminary check measures before starting a tractor - procedure for starting, running and stopping the tractor.

ExptNo.2 Date:----------

IDENTIFICATION OF COMPONENTS OF POWER TILLER, THEIR MAINTENANCE AND STUDY ON PRELIMINARY CHECK MEASURES AND SAFETY ASPECTS BEFORE STARTING A POWER TILLER - PROCEDURE FOR STARTING, RUNNING AND STOPPING THE POWER TILLER

Aim: To identify components of power tiller and study about their maintenance ,preliminary check measures and safety aspects before starting a power tiller - procedure for starting, running and stopping the power tiller.

Components of power tiller

A power tiller consists of the following main parts i) Engine, ii) transmission gears, iii) Clutch, iv) Brakes, V) Roatry unit.

All the power tillers are fitted with an IC Engine. At present most of the power tillers are fitted with diesel engine. Only “Iseki” make use of kerosene engine. Other makes like Kubota, Mitusbishi, Krishi, Yanmar and Satoh all have used diesel engine in India. Manufacturers supply counter weights and ballast weight as optional accessories for balancing and increasing the drawbar power of the power tiller

Power transmission in power tiller

For operation of power tiller, the power is obtained from the I.C. engine, fitted on the power tiller. The engine power goes to the main clutch with the help of belt or chain. From main clutch, the power is divided in two routes, one goes to transmission gears, steering clutch and then to the wheel. The other component goes to the tilling clutch and then to the tilling attachment.

Main clutch

Power goes from the engine to then main clutch. Clutch may be i) friction clutch or ii) V Belt tension clutch.

The main functions of clutch in a power tiller are i) to transmit engine power to transmission gears, ii) to make power transmission gradual & smooth. When clutch lever is in “ON” position, the power is transmitted to the wheels.

Transmission gears

Transmission box consists of gears shafts and bearings. The speed change device may be a) gear type, b) belt type.

Brakes

All power tillers have some breaking arrangements for stopping the improvement. Most of the power tillers use inner side expansion type brakes.

Wheels

Usually 2 to 4 ply pneumatic tyres are used in power tillers. The pressure of the tyres ranges from 1.1 to 1.4 kg/cm^2.

Rotary unit

Power tiller has a rotary unit for the field operations rotary tines are used in rotary unit for soil cutting & pulverization purpose.

Steering clutch lever

Steering clutch is provided on the grip of the right and left handles. When the left side gripped, power is cut off on left side of the wheel and the power tillers turns to the left. Similarly, when the right side is gripped, the power tiller turns to the right.

Operation:

The main clutch is a lever on the handle. The lever can be shifted to on or off position while operating in the field. When the lever is shifted to on position, the power from the engine is transmitted through the main clutch to the various parts ofpower tiller. When the lever is shifted to off position, the power from the engine is cut-off from the rest of the transmission.

Power transmission in power tiller:

Speed Changing: 3 forward and 1 reverse speeds are available to match each specific requirement.

Neutral speed: the engine runs, but the power tiller is not motion.

1st speed: the power tiller moves forward at a low range speed. Suitable for plowing, Soil leveling with implements such as disc plow, moldboard plough, harrow, etc..and for transport.

2nd and 3rd speed: the power tiller moves forward at medium and high range speed, respectively, Suitable for towing a trailer backwards

Safety Precaution

1. Operate the clutch slowly to avoid the power tiller jerking forward and stopping.
2. Do not move the main clutch lever to the "stop" position abruptly, power tiller may come to an abrupt stop and be out of control.

Starting the Power Tiller engine

1. Check engine oil level, fill up to the marks on dipsticks.
2. Clean and refill air cleaner bowl to level marks or tip of the canister.
3. See the radiator is filled up with water if the engine is water cooled.

4. Every night fill up the fuel tank; make sure no water gets into it.
5. Ensure that the gear shift lever is in neutral.
6. Set the hand throttle lever half way, depress the decompression lever and crank the engine. When the engine attains a good speed, the lever is released and the engine starts.
7. Select the gear shift position according to type of work.
8. Slowly release the clutch lever for operation.

Stop the engine

1. Pull the throttle lever to minimum position to stop the engine.

Driving the power tiller

1. For turning the tiller, the steering clutch lever is to be engaged as required on the left or right.
2. The gear position is to be so selected that it is opt for that particular operating condition.
3. While the tiller is operated with trailer, the brake pedal on the trailer may be used for control.

Important

1. 1.Crank the engine with 10 times before starting.
2. 2.While the power tiller operates in wetland with cage wheels care should be taken to avoid water getting into the air cleaner.
3. 3.When stopping the engine, never use the decompression lever.
4. 4.When the tiller is started with the trailer, care should be taken to hold the handle of the tiller low enough while releasing the clutch;
5. 5.While maneuvering field channels and undulation care should be taken, not to upset the stability of the tiller;
6. 6.In very cold temperature use a few drops of 30 grade oil (or petrol) in the inlet manifold (i.e)through air cleaner to facilitate easy starting

Practical Exercise: 2

i. Identify the components of power tiller and explain about its power transmission system.

ii. Write the driving procedures to be followed for power tiller.

iii. Write the precautions and important measures to be taken while driving power tiller.

ExptNo.3 Date:----------

FIELD OPERATION AND ADJUSTMENTS OF PLOUGHS

Aim:

i) To study the various components of M.B. plough and their function

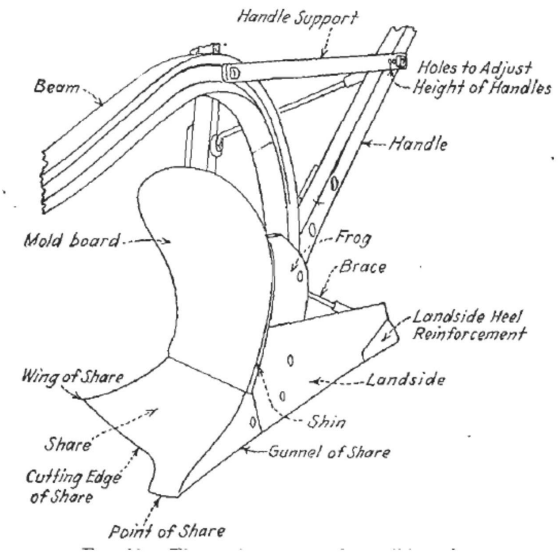
ii) To study the various adjustments of M. B.Plough

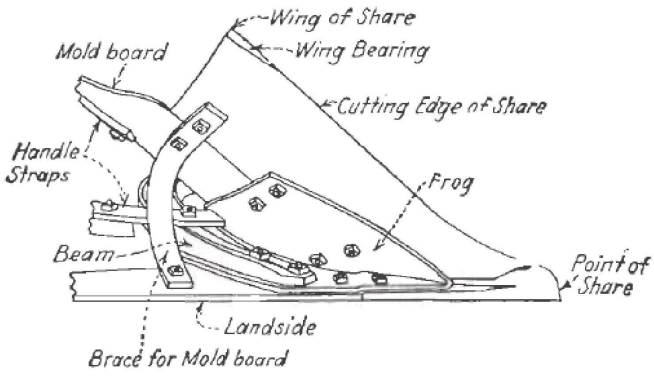
Introduction: Mould board plough cuts, loosen, invert the furrow slice and provide a deep seed bed of good structure for seed bed preparations. The main functions of M.B. plough are:

Main Function: (i) cutting the furrow slice (ii) lifting the soil (iii) Turning the furrow slice and (iv) pulverising the soil.

Components

M.B. plough consists of Share, Mould board, Land side, Frog and Tail piece.





Operation of mould board plough

1. Connect the mould board plough to the three point linkage of the tractor.
2. Take the tractor to the field and park the tractor at one end of the field.

3. Set the implement close to one end of the field and lower the implement using hydraulic control lever in the tractor.

4. Using clutch engage the gears (low range gear and first or second speed gear), rise the throttle and slowly release the clutch.

5. Tractor moves pulling the implement.

6. By adjusting the hydraulic lever adjust the depth of operation of the plough and plough the field.

(A 35 HP tractor pulling a 30 cm, 2 bottom mould board plough can plough to a depth of 25-30 cm. The coverage will be 0.15 ha/h at a speed of 2.5 km/h)

Operating a Mould Board Plough with Tractor:

Tractor wheel settings

The best wheel track for ploughing is that which will allow the tractor to travel in a straight line without side draught when the plough is operating at normal depth. If the wheel track is too wide, there can be a pull to the right and if too narrow, there can be a pull to the left.Generally, however, for most conditions, wheel track settings can be made as follows: For 2 furrow plough: front and rear 52" and For 3 furrow plough: front 52"; rear 56"

Attaching the plough with tractor

1. Ensure that the top link is in position on the plough. Back the tractor so that it is square with the plough cross-shaft, and the tractor and plough top and lower link connections are inline.

2. Attach left lower link to plough cross-shaft. Secure with linchpin.

3. Attach right lower link to cross-shaft in a similar manner, lining up by using the leveling lever. Secure with linchpin.

4. Mount the tractor, start the engine and place the forward end of the top link in the tractor top link connection. Using the position control lever or moving the tractor slightly forward, the top link pin can be entered. Secure with linchpin.

(Important: When transporting the plough, wind up the leveling lever fully to reduce the slack in the check chains and to stop the implement from swinging excessively).

Plough settings:

1. **Cross shaft setting:** The cross shaft is set to the nominal width of cut, i.e., 12" and this can be varied by rotating the cross shaft by 1/8" forward or rearward to decrease or increase it by1"

2. **Leveling:** For a good performance, the implement should be in level with the land when viewed from the rear and sides while ploughing. Incorrect leveling will result in uneven furrows and improper turning of the soil.

3. **Top link settings:** Set the top link to its standard length. These length are clearly indicated on the top links for Massey-Ferguson tractors. Standard dimension between ball joint centres is 25". It can be adjusted between 24 ½ to 26 ½"steps.

4. **Leveling lever:** With the plough at working depth, the lateral leveling is done by using the leveling lever provided in the right hand side of the tractor.

5. **Coulter and jointer settings (if provided):** The coulter and jointer settings are most important. The best rule is to put the plough to work and set the rear coulters to it. Ensure that coulters are kept really sharp and positioned just deep enough to do the work. A disc coulter that is too deep will act as a wheel and carry part of the plough weight. This must be avoided. Adjust the jointers so that the point lightly touches the coulter blade and is just deep enough to roll a slice of soil and trash into the bottom of the furrow. A set screw on the bracket provides for this adjustment.

6. **Depth of work:** Set the plough to work at the depth require, using the draft control lever. If, on commencing work, having carried out all previous settings as detailed, the check chains are not of equal slackness, rotate the cross shaft manually to correct this fault. Then move the cross-shaft laterally (to the left if front furrow width is too wide and vice versa) to establish correct front furrow width. For adjustment loosen the cross shaft cap bolts that secure the cross shaft to the plough and mark both cross shaft and the bracket so that amount of turn is observed.

7. **Final top link settings:** Adjust length of top link to get all bases working at even depth. If insufficient traction is a problem, shortening the top link slightly to increase the pitch of the plough can result in improved penetration and weight transference.

Field operation:

8. **Headland furrow:** When laying out a piece of ground preparatory to ploughing, do not fail to open headland furrows. These furrows should always be shallow and turned toward the land to be ploughed. Headland furrows make it possible for the plough to penetrate quickly and to make an even finish at the end. The headland furrow should be a single furrow, and can be accomplished when using a two or more furrow plough, by tilting the plough to the left with the leveling lever and ploughing with the rear body only. The amount of tilt is largely determined by experience in the field.

9. **Entering the furrow:** When entering, look over the shoulder and lower the plough just as the rear wheels enter the headland furrow. This will ensure uniform depth from the headland onwards.

10. **Leaving the furrow:** When leaving the furrow, look over the shoulder and raise the plough just as the rear wheels climb out the headland furrow.

(Note: Always be sure that the tractor is straight with the line of work when entering and leaving. This ensures both furrows being full width from the start and also makes finishing the land very much easier).

Practical Exercise:3

1. Draw sketch of tractor drawn mould board and. Label the parts
2. Measure and sketch the horizontal & vertical suctions of the mould board plough
3. List the steps involved in attaching, adjusting, operating and detaching a tractor mounted mould board plough.
4. **Plough size :** The size of the mould board plough is expressed by width of cut of the soil.
5. Measure the following **parameters of a M.B. Plough**

S. No.	Parameters	Value (mm)			Mean (mm)
		R_1	R_2	R_3	
1	Plough size				
2.	Vertical clearance				
3.	Horizontal clearance				
4.	Throat clearance				
5.	Depth of cut				

6. Write down the functions of following components of M. B. Plough

Components	Function
1. Share:	
2.Mouldboard:	
3. Landside:	
4. Frog:	
5. Tail Piece:	
6. Jointer	
7. Coulter:	
8. Gauge wheel:	
9. Land wheel	
10. Furrow wheel:	

Expt.No.4 Date:----------

FIELD OPERATION AND ADJUSTMENTS OF HARROWS

Aim:

i) To study the various components of disc harrow and their function

ii) To study the various adjustments of disc harrow

Theory: It is a harrow, which performs the harrowing operation by means of a set, or a number of sets of rotating slat discs, each set being mounted on a common shaft. Disc harrow is found very suitable for hard ground, full of stalks and grasses. It cuts the lumps of soil, clods and roots. Disc are mounted on one, two or more axles which may be set at a variable angle to the line of motion. As the harrow is pulled ahead, the discs rotate on the ground. Depending upon the disc arrangements, disc harrows are divided into two classes a) Single action and b) Double action.

The purpose of harrowing:

Harrowing is often carried out on fields to follow the rough finish left by ploughing operations.

1. To break up clods and lumps of soil and to provide a finer finish, a good tilth or soil structure that is suitable for seeding and planting operations.
2. Coarser harrowing may done to remove weeds and to cover seed after sowing.
3. Harrowing is also done to remove small weeds in growing crops and to loosen the inter-row soils to allow for water to soak into the subsoil.

Fig.1. Types of disc harrow

Disc harrow-animal drawn:

Animal drawn disc harrows are only single action disc harrows. There are two gangs of discs each gang consisting of three to four discs mounted on a gang bolt. The gang bolts rotate in bearings with ease. There are weight boxes to add stones or sand bags to improve depth of operation. The disc diameter varies from 30 to 40 cm with concavity of 3 to 4 cm. The width of operation varies from 50 to 70 cm. They are used for breaking the clods and cutting the weeds

Single action disc harrow- Power tiller drawn:

It is a harrow with two gangs placed end to end, which throw the soil in opposite directions. In one run the soil is handled once only. It is used to break the clods, cut the weeds and prepare a good seed bed..The disc gangs are mounted with bearings for easy rotation of the gangs. There is a main frame to support the discs and a hitching bar to connect the implement with the power tiller. Disc angle adjusting lever is provided to adjust the disc angle (disc angle = 20-22□). Tilt angle is zero.

Tandem Disc Harrows- Tractor Drawn:

It is a secondary tillage implement. It can be used to break the clods and lumps of soil to provide a good tilth, finer finish and good seed bed suitable for seeding and planting operations. It canal so be used for coarser harrowing to remove weeds and to cover seeds after sowing. Tandem disc harrow is a double action disc harrow with four gangs arranged in two rows. It consists of a) four disc gangs b) scraper blades c) Gang angle adjusting lever d) main frame e) hitch frame and f) weight box.

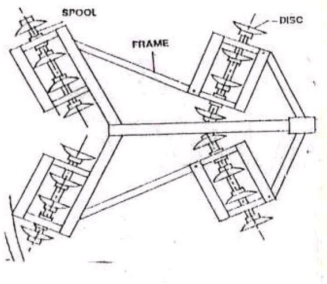


Fig 1. Tandem disc harrow

The front gangs throw the soil outward and the rear gangs throw the soil inward. The gang angle is adjusted from 15-22°. The depth of operation is managed by adding weights on the weight box and also by using hydraulic system of the tractor.

Off-set disc harrows- tractordrawn

It is also a double action disc harrow with two gangs in tandem, capable of being off-set to the centre line of pull. The two gangs are fitted one behind the other. The soil is thrown in both directions because discs face in opposite directions. It is very useful in orchards and gardens. It travels right or left of the tractor. The line of pull is not in the middle, that's why it is called off-set disc harrow.). Off-set disc harrow is based on the basic principle that side thrust against the front gangis
opposed by the side thrust of the rear gang. Hence the gangs are arranged at suitable angles so that both thrusts are counter balanced with each other.

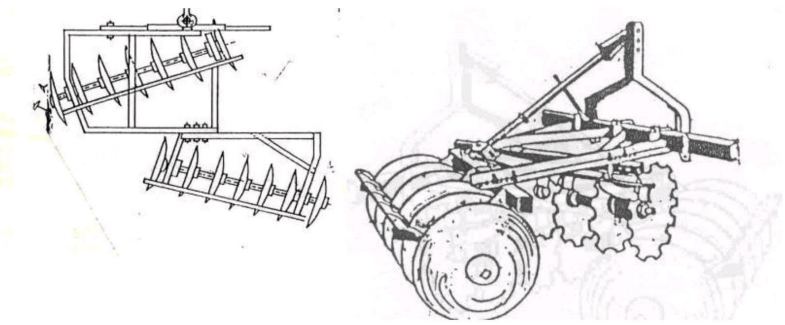


Fig.2. Off-set disc harrow

Parts of off-set disc harrow

i. **Disc:** It is a circular concave revolving steel plate used for cutting a inverting the soil. Disc is made of high glass heat-treated hardened steel. Tractor drawn disc harrows have concave discs of size varying from 35-70 cm diameter. Concavity of the disc affects penetration and pulverization of soil. Usually two types of disc are used in disc harrows, plain disc and cut away disc. Plain discs have plain edges and they are used for all normal works. Most of the harrows are fitted with plain discs only. Cut away discs have serrated edges and they cut stalks, grass and other vegetation. They are not effective for pulverization of soil but it is very useful for puddling the field especially for paddy cultivation.

ii. **Gang :**Each set of discs that are mounted on a common shaft is called the gang.

iii. **Gang bolt or arbor bolt :**It is a long heavy of square headed bolt from the other end, a set of discs are mounted on the gang bolt. The spacing between the discs on the gang bolt ranges from 15 to 25 cm for light duty and 25 to 30 cm for heavy duty harrows. The angle between the axis of the gang bolt and the direction of travel is called the gang angle.

iv. **Gang control lever:** A lever, which operates the gang mechanisms of the disc harrow, is called the gang control lever.

v. **Spool or spacer:** The flanked tube, mounted on the gang bolt between every two discs to prevent the lateral movement of the disc on the shaft is called the

`spool' or `spacer'. It is just a device for keeping the discs at equal spacing on the gang bolt. It is usually cast in special shapes and sizes and is generally made of cast iron.

vi. **Bearing:** Bearing is essential to counter at the end thrust of the gang due to soil thrust. The harrow bearings are subjected to heavy radial and thrust roods chilled cast iron bearings are used to heavy radial and thrust loads and they are also used due to their durability.

vii. **Transport wheel:** In trailing type disc harrow, the transport wheels are provided for transport work on roads and for preventing the edges of the discs from damage. Mounted type disc harrows do not require wheels for transport work.

viii. **Scraper:** It prevents disc from clogging. It removes the soil that may stick to the concave side of thedisc.

ix. **Weight box:** A box like frame is provided on the main frame of the harrow for putting additional weight on the implement. Additional weight helps in increasing the penetration of the disc in the soil.

There are several factors which affect the penetration of disc harrow in the field.

The following are a few adjustments for obtaining higher penetration

i. By increasing the discangle

ii. By adding additional weight inharrow

iii. By lowering the hitchpoint

iv. By using the sharp edged discs of small diameter and losses concavity

v. By regulating the optimumspeed.

Introduction/Procedure:

Disc harrow is secondary tillage equipment designed for harrowing / land preparation of rough soil (Secondary tillage/ finer operation). It is generally used for breaking the clods and partially inverting the soil. Regular and satisfactory operation together with economic and long lasting use of the implement depends on the compliance with instructions provided by the manufacturers. Thoroughly read the instruction manual before proceeding with the various operations and maintenance.

Operational guidelines for disc harrow

Instructions for the driver

1. When Disc harrow is ready for use don't stand between disc harrow & the tractor.
2. Properly fit the three point linkage as mentioned above & lock with lynch pin.
3. In case of scrapper touching the discs, loosen the scrapper bolt and readjusts the scrapper.
4. Never turn the tractor to the right or left when the harrow is engaged in the soil.
5. Never reverse the tractor when the harrow is engaged in the soil.
6. To get good results from the harrow, disc should be replaced when its diameter is reduced by 5" (125mm) from its original size.

Field operation:

a) Lift the harrow on turning for effective independent breaking of soil.
b) Adjust internal/ external check chains to obtain implement swing range within 50 mm (2") when raised.
c) Always maintain the correct tyre pressure to avoid wheel slippage.
d) Adding of wheel weights/water ballasting or combination of both is recommended when excessive rear wheel slippage is experienced.
e) Always set hydraulic levers correctly for draft and position control operation.

The following settings are necessary to ensure that uniform working depth is maintained:

i) **Side draft:** The offset disc harrow will trail correctly behind the tractor provided the side thrust of the front gang is equal to that of rear. In case it is different there will beside draft. To set it correctly the gang angle should be changed
ii) **Severe side draft:** In case of severe side draft the cutting depth of rear disc gang should be increased or decreased with the help of tractor top link. For instance when tractor pulls to right, lower the rear gang and when tractor pulls to left, raise the rear gang.

f)Warning for driver:

1. Before harrowing check all nuts & bolts of the harrow disc.
2. Before harrowing with harrow disc take care that nobody stands near it.
3. Be vigilant about the tree roots and stones. Don't harrow on stony soil.
4. Tractor should be in first high or fourth low gear.
5. Do not allow anyone to come across the harrow.
6. Lift the disc harrow on every turn.
7. Lift the harrow before approaching the road.

g) Precautions during transportation:

1. When transporting the harrow, shorten up top link to minimum length.
2. Set hydraulic lever in top raised position and lock levers.
3. Maintain the speed to avoid jump.
4. Watch while overtaking on road.
5. Always use SMV (Slow Moving Vehicles) symbols.

Adjustments in disc harrow

a) Adjustment before use:

1. Before mounting of disc harrow make sure that all nuts & bolts are properly tightened.

2. Also determine soil and trash conditions of the field and make the preliminary adjustments as discussed below:

1. **Disc gang angle adjustment:** -

   Gang angle (Angle between two gangs) ranges from 0° to 50°. The angle can be increased for better penetration in dry soil while it should be reduced to avoid plugging in wet soil.

2. **Disc harrow leveling:** -

   To eliminate uneven penetration and side draft, leveling is done by means of top link& bottom adjustable link. While tractor pulls to right the rear gang should be lowered a little. When the tractor pulls to the left the rear gang should be raised.

3. **Scrapper adjustment: -**

   The scrapper can be adjusted by loosening the bolts atthe scrappers clamp.

4. **Depth control: -**

   The depth at which the implement is required to work is controlled hydraulically by raising or lowering the left control lever.

5. **Disc harrow penetration:-**

   Factors affecting disc harrow penetration are:-

   - Angle of the gangs
   - Weight of the harrow
   - Disc diameter
   - Disc sharpness (Blunt disc increases the draft considerably, check the disc sharpness)
   - Angle of hitch

Maintenance of disc harrow

a) Maintenance instructions

If the harrow is used in the stony land then maintenance of disc harrow also increases.

1. If the soil has entered the grease nipple, then change the nipple.

2. If disc harrow is new, then after initial working of first two hour, tighten all nuts & bolts.
3. After every fifty hours of use, grease all greasing points with grease gun and tighten all nuts & bolts.
4. After fifty hours of use, open the bracket spool of disc harrow & clean with diesel oil & pump in new grease.

5. Trouble shooting chart for disc harrow

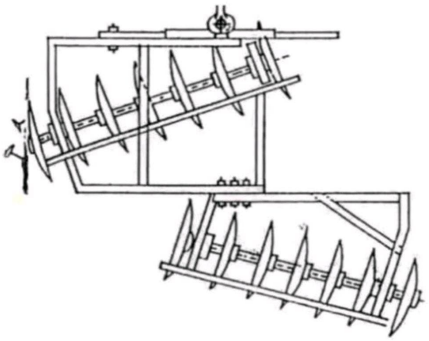
Sr. No.	Possible cause	Possible remedies
A. Side draft		
1	Disc not running level.	Adjust using leveling lever
2	Gangs improperly angled	Set the gang angle properly
3	Too much left hand offset	Swing the hitch to the left
B. Excessive field slippage		
1	Tractor overloaded	Reduce angle, reduce depth
2	Not enough tractor ballast	Add wheel weight or liquid in tyres
C.	Not filling the furrow	
1	Too much left hand offset	Swing hitch to the right hand
2	Tractor wheel running in furrow enlarging it.	Drive the tractor in unworked ground
3	Discs too far from furrow	Keep the left front discs in furrow
4	Rear gang set wrong , laterally	Move the rear gang right or left. The left rear should be centered in the space between left

		front discs.
D. Poor penetration		
1	Hard ground	Swing hitch to the right. Increase angle in front and rear gang.
E	Disc unsteady	
1	Too much angle in gang	Reduce gang angle
F. Gang plugging		
1	Field too wet	Disc at shallow depth for first pass to speed up drying process
2	Gang set in maximum angle	Reduce the gang angle
3	Not using scrappers	Install scrappers
4	Scrappers worn out or not set properly	Replace worn ones, Adjust scrappers close to the disc
5	Discing too deep in damp soil	Reduce penetration of harrow

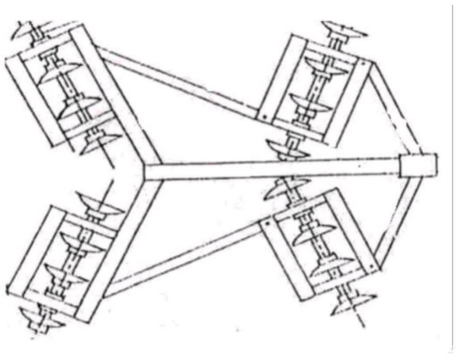
Practical Exercise:

1 Write the name of following types of disc harrow

1. _____ 2. _____ 3. _____



4._____

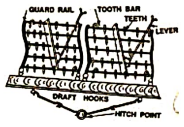
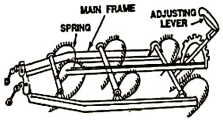
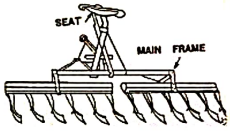
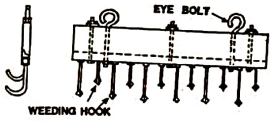
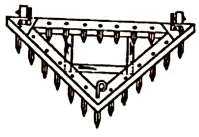
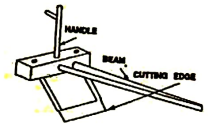
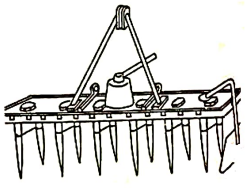


5._____

2. write down the functions of different components of disc harrow

Components	Function
1.Disc:	
2.Gang:	
3. Arbor bolt:	
4. Gang axle:	
5. Gang control lever:	
6. Weight box:	
7.Spool/spacer:	
8. Transport wheel:	
9.Bearing:	
10. Scraper:	

3. Write down the name of following types of harrow and their special use.

Picture	Name of harrow	Special use
		
		
		
		
		
		
		

Expt.No.5 Date:----------

FIELD OPERATION AND ADJUSTMENTS OF CULTIVATORS

Aim:

i) To study the various components of a cultivator and their function

ii) To study the different types of shovel and sweep used in a cultivator

Introduction: It is an implement for inter cultivation with laterally adjustable tines or discs to work between crop rows. The cultivator stirs the soil, and breaks the clods. The tines fitted on the frame of the cultivator comb the soil deeply in the field. A cultivator performs functions intermediate between those of plough and the harrow. Destruction of weeds is the primary function of a cultivator.

Functions:

- Inter culture the fields.
- Destroy the weeds in the field.
- Aerate the soil for proper growth of crops.
- Conserve moisture by preparing mulch on the surface.
- To sow seeds when it is provided with sowing attachments.
- To prevent surface evaporation and encourage rapid infiltration of rain water into the soil.

The cultivator can be 1) Disc cultivator, 2) Rotary cultivator, 3) Tine cultivator.

Depending upon the type of power used they are called as tractor drawn or animal drawn cultivator. Different types of shovels & sweeps namely 1) Single point shovel b) Double point shovel c) Spear head shovel d) Sweep e) Half sweep f) Furrower are used in the tynes depending upon the intended use

Tractor drawn Cultivator with spring loaded tines

Cultivator is a secondary tillage implement. Tines fitted on the frame comb the soil deeply in field. Cultivators perform intermediate between plough and harrow.

- The depth of operation is 10-12 cm.
- In mounted type of cultivators depth of operation is managed using the hydraulic system.
- It consists of a main frame, hitch frame, cross bars and tines fitted with shovels.
- Each tine is hinged to the main frame and loaded with a spring so that it swings back when an obstacle is encountered.
- Heavy duty coil springs are used for each tine.
- When the tynes strike roots or large stones the springs allow the tines to ride over the obstruction, thus preventing damage.
- On passing over the obstruction, the tines are automatically reset and work continues without interruption.

Practical Exercise:

1 Label the parts of following cultivator and write their function.

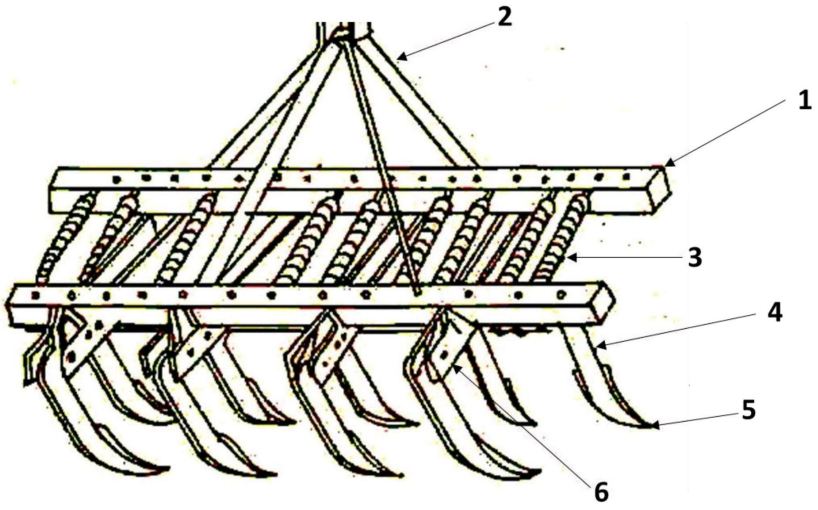
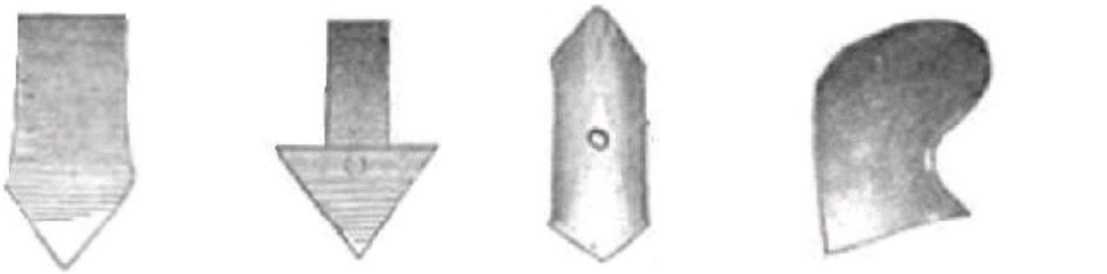


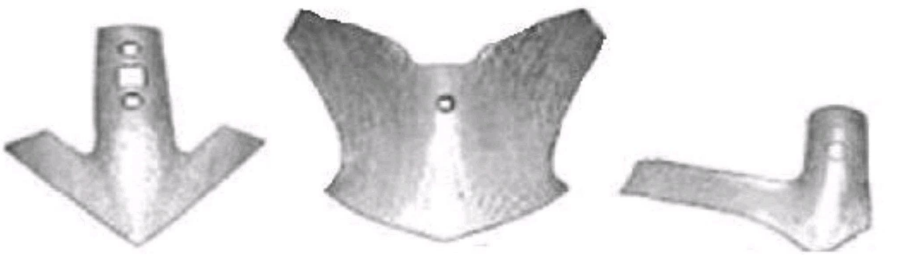
Fig. 7.1 Cultivator with spring loaded tynes

S.No.	Components	Function
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____

2 Write the name of following types of shovel /sweep alongwith their specific use.



1._____ 2._____ 3._____ 4._____



5._____ 6._____ 7._____

S.No. Name	Use
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____

ExptNo.6 Date:----------

FIELD OPERATION OF SOWING AND PLANTING EQUIPMENT AND THEIR ADJUSTMENTS

Aim:

i) To study the various components of seed cum fertilizer drill

ii) To study the calibration method of seed cum fertilizer drill

Introduction: Seeding or sowing is an art of placing seeds in the soil to have good germination in the field. A perfect seeding gives (a) Correct amount of seed per unit area. (b) Correct depth at which seed is placed in the soil. (c) Correct spacing between row-to-row and plant-to-plant.

Seed cum fertilizer drill : Seed cum fertilizer drill consists of dropping seeds in furrow lines in a continous flow and covering them with soil.

Components of Seed Drill :A seed drill with mechanical seed metering device mainly consists of: (i) Frame (ii) Seed box (iii) Seed metering mechanism (iv) Furrow openers (iv) Covering device (vi) Transport wheels.

Frame:

The frame is usually made of mild steel angle section and flats . It is strong enough to withstand all types of loads in working condition. All other parts of a seed drill are fitted to the frame.

Seed box:

It is a box like structure made up of either mild steel or galvanized iron and provided with a lid. In some designs a small agitator is provided at the bottom of the box which agitates the seeds while the drill in operation and prevents clogging of seeds. Seed metering mechanism is placed at the bottom of the box.

Seed Metering Mechanism: The mechanism of a seed drill or fertilizer distributor which delivers seeds or fertilizers from the hopper at selected rates is called *seed metering mechanism*. Seed metering mechanism may be of several types:

(a) Fluted feed type (b) Internal double run type (c) Cup feed type (d) Cell feed mechanism (e) Brush feed mechanism (f) Auger feed mechanism (g) Picker wheel mechanism (h) Star wheel mechanism.

Types of seed metering mechanisms:

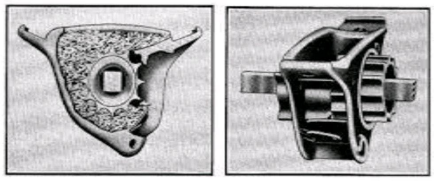


Fig. 11.7. Fluted-wheel type of seed-metering device. (Deere & Co.)

(a) Fluted feed type

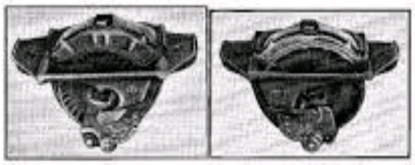
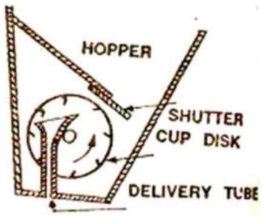
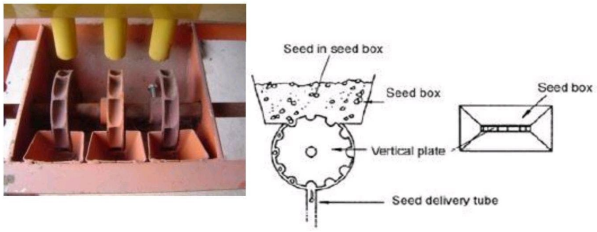


Fig. 11.8. Internal double-run seed-metering device, showing large and small sides of the wheel, for large or small seeds. (Deere & Co.)

(b) Internal double runtype



(c) Cup feed type



(d) Cell feed mechanism

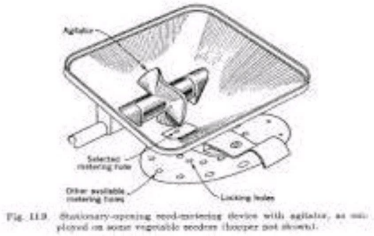


Fig. 11.9. Stationary-opening seed-metering device with agitator, as employed on some vegetable seeders (hopper not shown).

(e) Brush feed mechanism

(f) Auger feed mechanism

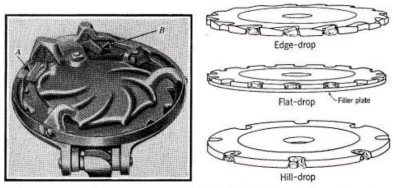


Fig. 11.4. *Left:* Hopper bottom for typical horizontal-plate corn planter. Note the spring-loaded (yielding) cutoff *A*, and the spring-loaded knockout pawl *B*. *Right:* Three types of edge-cell plates used interchangeably in this hopper bottom. (International Harvester Co.)

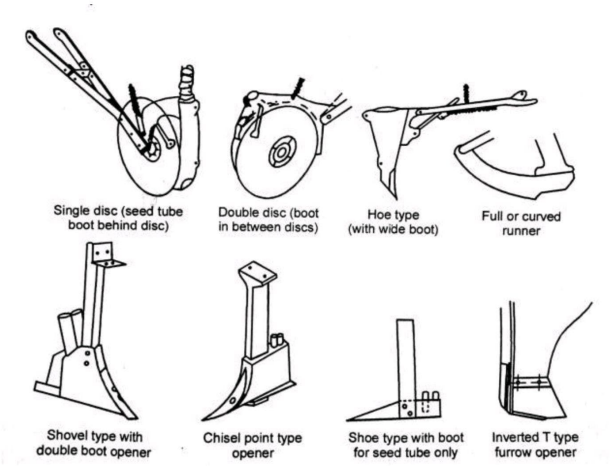
(g) Edge cells

Drive transmission system:

The drive transmission mechanism consists of a wheel, sprocket-chain assembly and a driven shaft that carry the seed picking discs. When the seed drill moves in the field, the drive wheel rotates due to its contact with soil and the sprocket wheel also rotes. The chain connecting the drive wheel sprocket and driven wheel sprocket rotates the shaft carrying the seed metering discs.

Furrow openers:

These are the parts which open up furrows in the soil for placing the seeds. Different types of furrow openers in use namely 1. Hoe type 2. Shoe type 3. Stub runner type 4. Full or curved runner type 5. Single disc type 5. Double disc type etc. In cultivator type seed drills the tines work as furrow openers.



Covering device or furrow closer

It is a device which closes the furrow with soil after the seed has been dropped in it. Covering the seeds is usually done by chains, bars, packers, rollers or press wheels, designed in various shapes and sizes.

Transport wheel

There are two wheels fitted on an axle for transporting the drill on roads. Iron wheels are used as transport wheels. Some manufacturers use pneumatic wheels. One of the transport wheels is fitted with a suitable attachment to transmit the motion of the wheel to the seed metering mechanism when the drill is inoperation.

1. Tractor drawn cultivator seed drill

It is a tractor drawn equipment used for line sowing of crops like groundnut, sorghum, maize and pulses. Tractor industry in India has grown and now about two lakh sixty thousand tractors are being produced per annum. Even small and medium farmers are hiring the tractor for different agricultural operations. Any farmer who owns a tractor is invariably having the tractor drawn cultivator. Seed boxes along with cup feed type seed metering mechanism are mounted on the cultivator frame and the seeds are dropped in furrows opened by the cultivator shovels. Detachable side wings are fixed to the existing shovel type furrow openers of the cultivator, which helps in placing the seed at the required depth. Power to operate the seed metering discs is taken from the ground wheel drive through a clutch. A square bar is provided at the back of the unit to close the furrows. An area of 4 ha can be covered per day. Suitable for sowing groundnut, sorghum, Bengal gram, maize, soybean and pulses. Results in 48 and 91% saving in cost and time respectively.

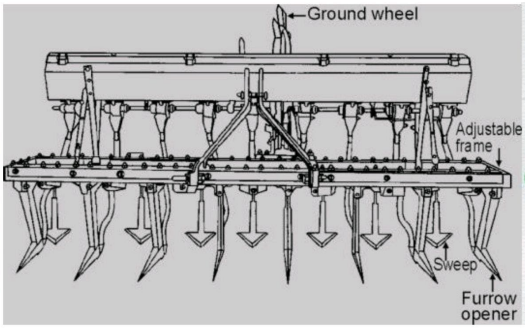
2. Tractor drawn inclined plate seed planter / hill drop planter:

The planting mechanism consists of a seed hopper having two compartments one for seed storage and other for seed metering. The seed metering mechanism is of cup feed type as it was found effective for various types of seeds. The cup feed mechanism also has the advantage of minimum seed damage compared to other common types of seed metering devices. A ground wheel with spikes is provided for driving the seed-metering device. A funnel like structure was provided in the seed-metering compartment for guiding the metered seeds to the seed placement device. On the lower side of the seed funnel a transparent flexible PVC hose is connected to the seed placement device. There a trigger mechanism at the lower level of all the seed tubes, which will be closed at all times. The trigger is actuated by a lever fitted to the side mounted ground wheel of the unit and allowing the collected seeds to fall in the furrow opened by the floating type furrow openers as shown in figure. This helps for maintaining the hill to hill distance uniformly. The number of seeds in each hill is adjustable. The planter is suitable for sowing cotton, soybean, black gram, green gram, maize, cow pea, etc.

3. Seed cum fertilizer drill

Seed cum fertilizer drills are used for sowing of wheat and other cereal crops in already prepared field. The seed cum fertilizer drill machine consists of seed box, fertilizer box, seed metering mechanism, fertilizer metering mechanism, seed tubes, furrow openers, seed rate adjusting lever and transport cum power transmitting wheel. The fluted rollers are driven by a shaft. Fluted rollers, which are mounted at the bottom of

the seed box, receive the seeds into longitudinal grooves of fluted roller and expel them in the seed tube attached to the furrow openers. By shifting the rollers sideways, the length of the grooves exposed to the seed, can be increased or decreased and hence the amount of seed sown is changed. The seed cum fertilizer drill is popular in northern region of the country.



Calibration of seed drill: The procedure of testing the seed drill for correct seed rate is called calibration of seed drill. It is necessary to calibrate the seed drill before putting it in actual use to find the desired seed rate. It is done to get the pre determined seed rate of the machine. The following steps are followed for calibration of seed drill.

Procedure:

i. Determine the nominal width (W) of seed drill

W = M x S,

Where,

M = Number of furrow openers, and S = Spacing between the openers, m

ii. Find the length of the strip (L) having nominal width (W) necessary to cover 1 ha (10000 m^2)area

L = 10000/W, meter

iii. Determine the number of revolutions (N) of the ground wheel of the seed drill required to cover the length of the strip(L)

$L = \pi \times D \times N = 10000/W$

$N = 10000/ \pi \times D \times W$ revolutions per minute

iv. Jack the seed drill so that the ground wheels turn freely. Make a mark on the drive wheel and a corresponding mark at a convenient place on the body of the drill to help in counting the revolutions of the ground wheel

v. Fill the selected seed in the seed hopper. Place a container under each boot for collecting the seeds dropped from the hopper

vi. Set the seed rate control adjustment for maximum position and mark this position on the control for reference

vii. Engage the clutch and rotate the ground wheel for N=10000/πxDxN, revolutions per minute

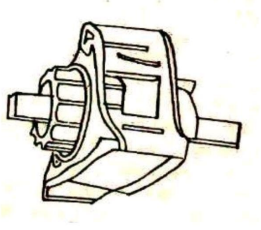
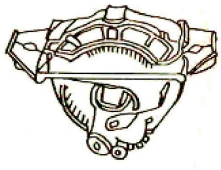
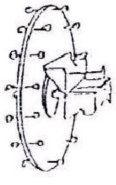
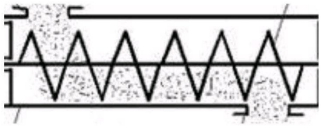
viii. Weigh the quantity of seed collected in the container and record the observation.

ix. Calculate the seed rate in kg/ha

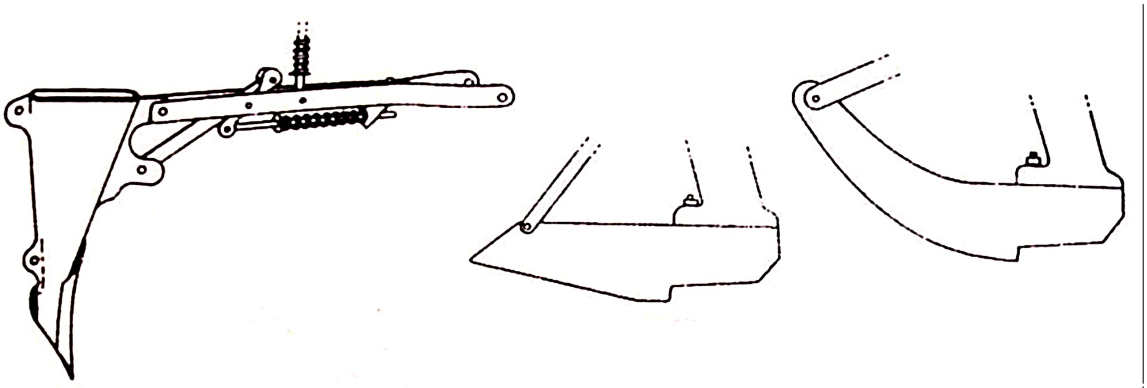
x. If the calculated seed rate is higher or lower than the desired rate of selected crop, repeat the process by adjusting the seed rate control adjustment till the desired seed rate is obtained.

Practical Exercise: 6

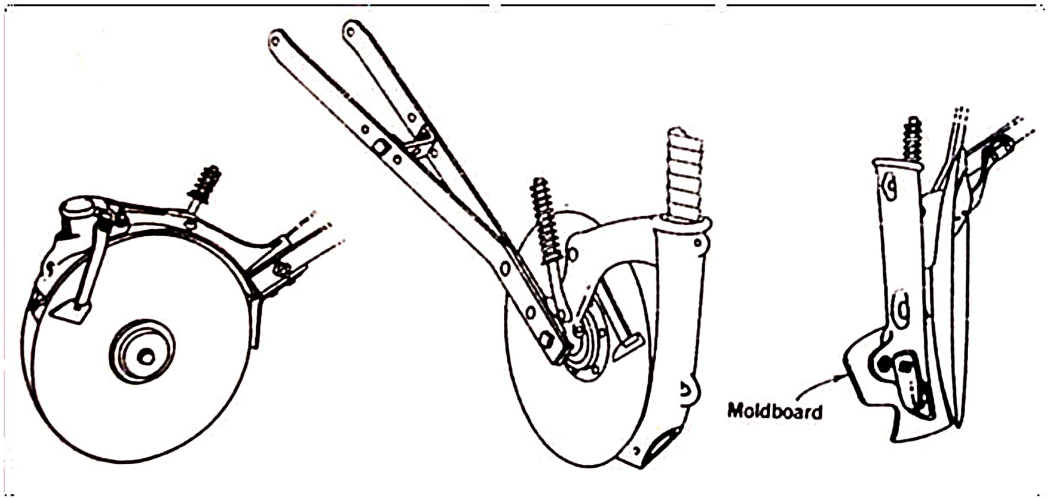
1. Identify the following seed metering mechanism.

Sketch of metering mechanism	Name of metering mechanism
	_____
	_____
	_____
	_____
	_____

2 Identify the type of furrow openers used in seed cum fertilizer drill as shown below.

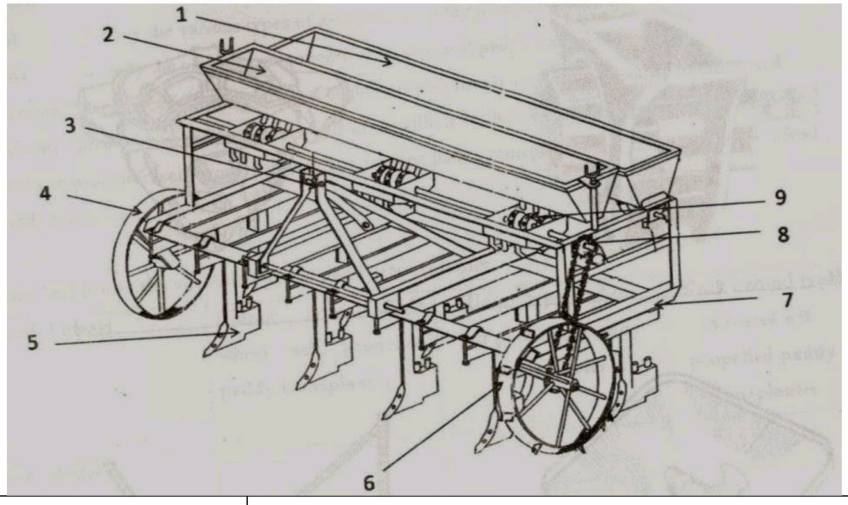


1._____ 2. _____ 3. _____



4._____ 5._____ 6._____

3 Label the component of the seed cum fertilizer drill and write their main function



S.No. Components	Function
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____
7. _____	_____
8. _____	_____
9. _____	_____

ExptNo.7 Date:----------

FIELD OPERATION OF PLANT PROTECTION EQUIPMENT

Aim:

To study the major components and their functions
To study the various types of sprayer and their application
To study the various types of nozzles and their applications

Introduction: Sprayer is a machine to apply fluids in the form of droplets. Sprayer is used for the following purpose.

- Application of herbicides to remove weeds.
- Application of fungicides to minimize fungus diseases.
- Application of insecticides to control insect pests.
- Application of micro nutrients on the plants.

The main function of a sprayer are

(1) To break the liquid droplets of effective size. (2) To distribute them uniformly over the plants. (3) To regulate the amount of liquid to avoid excessive application.

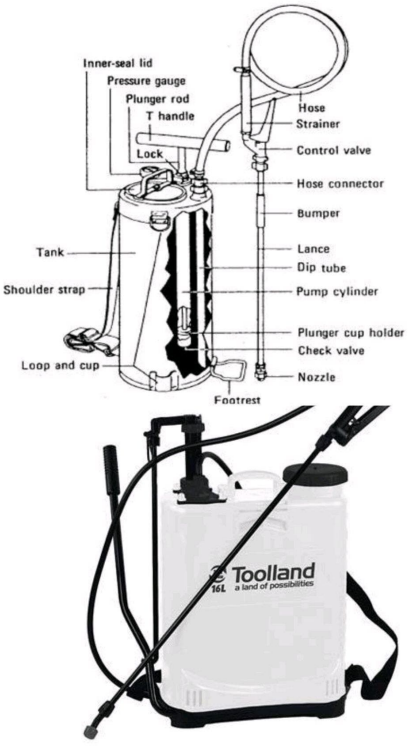
Basic Components of Sprayer: Components of a sprayer are as follows

(1) Nozzle body (2)Swirl plate (3) Filter (4) Over-flow pipe (5) Relief valve (6) Pressure regulator (7) Cut-off valve (8) Spray boom (9) Drop legs (10) Nozzle boss (11) Nozzle disc (12) Nozzle cap (13) Nozzle tip (14) Spray lance (15) Spray gun.

Knapsack hand operated sprayer;

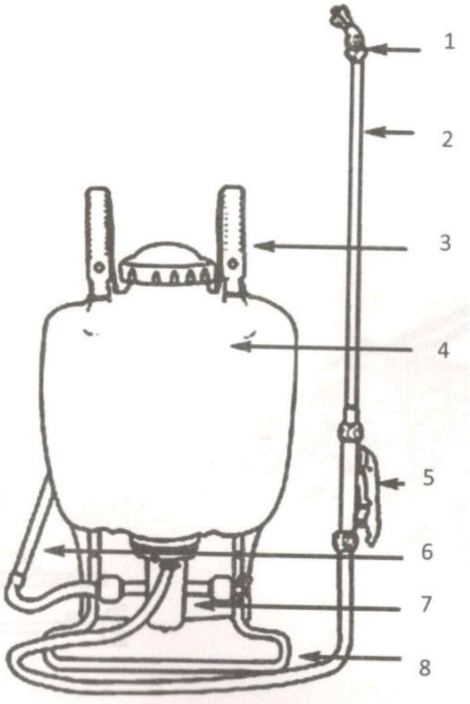
It has a flat or bean-shaped tank designed to fit comfortably on the back of the operator. The capacity of the tank is 10-20 litres. It is generally, made of galvanized, iron, brass or stainless steel. Recently, plastic material has also been used for the construction of the spray tank (Fig.3). The pressure developed in these sprayers depends on the pump and varies from 3 to 12 kg/cm^2 which are more than that developed in a

hand compression sprayer. However, a pressure of 3-4 kg/cm^2 can be maintained in most cases without much effort. The sprayer can be used for spraying row crops, vegetables and nursery stocks and shrubs and trees2- 2.5m high. It is also useful for spot treatment and residual indoor spraying. These sprayers are very commonly used in the rice-growing areas. With these sprayers, the job of the operator is tiring, especially over long period. The operator has to bear the weight of the sprayer containing the fluid and is simultaneously required to operate the pump lever with one hand and the spray lance with other hand. Under the situation, lighter the equipment and lever the effort needed for operation, the less troublesome would be the safe operation.



Practical Exercise:7

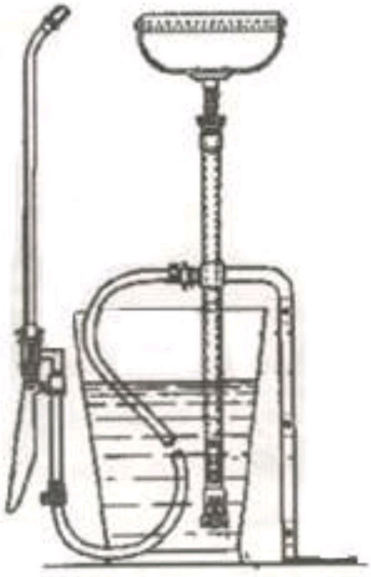
1. Label the major parts of knapsack sprayer shown below and write their function.



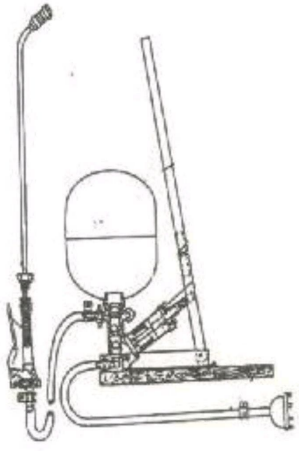
S.No.	Components	Function
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____
6.	_____	_____
7.	_____	_____
8.	_____	_____

2. Identify the following sprayers and write their specific use.

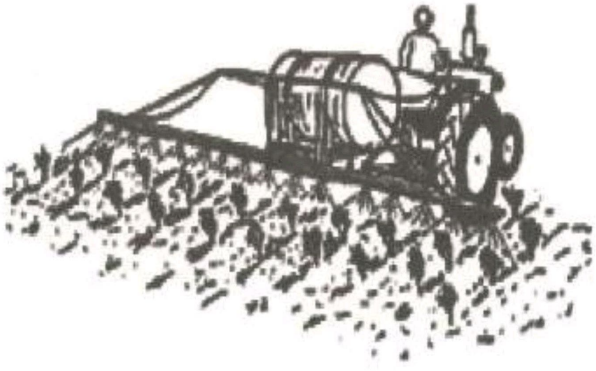
1._____



2._____



3._____



4._____

3. Identify the following nozzle and their spray pattern being used in agriculture

1. _____ **2.** _____ **3.** _____

4. Measure the discharge of different types of nozzle used in sprayers

Nozzle Type	**Discharge (*l*/min)**			**Average discharge (*l*/min)**
1._____				
2._____				
3._____				

ExptNo.8 Date:----------

FIELD OPERATION ON MOWERS AND REAPERS

Mower

The mower is a machine mainly used for harvesting grasses and forage crops. It cuts the stems of standing vegetation to make hay out of them. The mower cutter bar is capable of cutting the stems at 3-10 cm above the ground. There are different types of mowers used for cutting grass and forage crop such as cylinder, reciprocating, horizontal rotary and flail type mowers. According to the source of power, mowers can be classified as manually operated, animal-drawn, tractor-drawn and self-propelled. According to the mode of hitching, mowers can be classified as trailed type, semi-mounted and integral mounted type. Semi-mounted and integral-mounted mowers can be further classified as rear, mid and front-mounted. According to drive used, mowers can be classified as ground-driven, engine-driven and PTO driven. The conventional animal-drawn mower has the following main parts:

- A cutter bar to cut the crop and separate it from uncut portion.
- Power transmission unit to receive and transmit motion force.
- Frame to support moving parts.
- Wheels to transport and for operating the cutting mechanism, and
- Auxiliary parts to lift and drop the cutter bar.

Adjustments of mower reaper

Sr. No.	Part	Problem	Adjustment
1.	Reel	i) Does not rotate ii)Improper gathering of crop	i) Check tension of reel belt. Reel by hand to ensure that the drive pulley key and belt are secured. ii) Adjust height according to height of crop
2.	Cutter bar	Unsatisfactory cutting	i) Reduce forward speed ii) Correct the registration iii) Sharpen the knife sections or replace if worn out. iv) Check drive belt tension. If loose, tighten

Reaper

Harvesting of cereal crops especially wheat and rice is a serious problem. There is a tremendous crop loss when untimely rain is experienced. Delayed harvesting causes grain shattering due to over maturity. The standing crop in the field can be harvested with the use of reapers. A reaper may be classified as animal-drawn reaper, animal-drawn engine operated reaper, tractor rear mounted PTO operated reaper, power tiller operated or tractor front mounted vertical conveyer type reapers and tractor mounted reaper binder.

Reaper problems and adjustments

S. No.	Part	Problem	Adjustment
1.	Reel	i) Does not rotate ii)Improper gathering of crop	i) Check tension of reel belt. Reel by hand to ensure that the drive pulley key and belt are secured. ii) Adjust height according to height of crop
2.	Cutter bar	Unsatisfactory cutting	i) Reduce forward speed ii) Correct the registration iii) Sharpen the knife sections or replace if worn out. iv) Check drive belt tension. If loose, tighten
3.	Binding & tying mechanism	i) Broken or torn twine ii) Loose or untied knot iii) Frequent untied bundles iv) Improper cutting of	i) Remove twine and clean needle eyelet and pliers. Reduce tension on twine under the tension plate through fly-nut ii) Tighten the twine disc with the help of spring loaded screw-bolt provided for the purpose iii) Adjust spring tension and smooth face of pliers by emmary paper. Use twine of uniform thiclmen

		twine	
4.	Conveyor	i) Bundles keep collecting on conveyor ii) Conveyor slackened & bundles not conveyed at regular internal	i) Check the tension or the v-belt over the conveyor roller pulley. ii) Tighten the convas conveyor with help of the sum buckles provided
5.	Bundle size		Increase or decrease the size of bundles by increasing or decreasing the tension of trigger. For this the trigger spring is hooked on to different holes provided

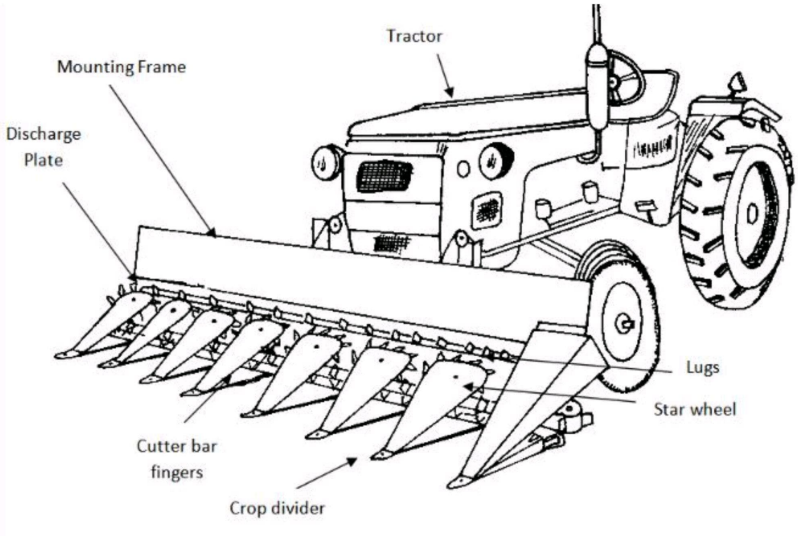


Fig. 3: Tractor front mounted vertical conveyer reaper windrower.

ExptNo.9 Date:----------

FIELD OPERATION OF COMBINE AND DETERMINATION OF FIELD LOSSES

Aim: A combine is farm machine that combines the reaper and thresher to harvest the standing crop, thresh it and clean the grain from straw in one operation. Various designs of combine harvester having 2 to 6 m long cutter bar are commercially available. The function of a combine harvester is to cut, thresh, winnow and clean grain/seed. It consists of header unit, threshing unit, separation unit, cleaning unit and grain collection unit.

Introduction:

The function of the header is to cut and gather the crop and deliver it to the threshing cylinder. The reel pushes the straw back on to the platform while the cutter bar cuts it. The crops are threshed between cylinder and concave due to impact and rubbing action. The threshed material is shaken and tossed back by the straw rack so that the grain moves and falls through the openings in the rack onto the cleaning shoe while the straw is discharged at the rear. The cleaning mechanism consists of two sieves and a fan. The grain is conveyed with a conveyor and collected in a grain tank.

ADJUSTMENTS IN HARVESTING EQUIPMENT:

Grain losses before and during field operation of combine:

There are different types of grain losses in the field before and during combining of crops. Moisture contents at the time of harvesting affects the grain losses. At low moisture content, grain losses are pre-harvest shattering loss, cutter bar loss and more breakage of grain. At low moisture the straw is broken finely by the cylinder and more material flows to the sieve resulting into separation problem. There is a risk of natural hazards like rain and hailstorm, which also leads to lodging of crop.

Due to delay in harvesting, more weed growth takes place that causes choking of combine. At high moisture content, grains are badly damaged by the cylinder action. The threshing is poor and good cleaning is also a problem. This leads to higher cylinder loss and lower cleaning efficiency. The grains get struck to moist straw and are carried away with straw and chaff. There might be choking problem at different stages in the combine due to high moisture content. As per BIS the combine losses should be maximum 2.5% for wheat, paddy and gram and 4.0% for soybean (IS: 8122 Part II – 1981).

Pre-harvest loss: It is determined at minimum of three places randomly selected in the field where combine harvester is to be operated. The sample should be collected from the area having one-meter length in the direction of travel and full or half width of cutter bar of machine depending upon its size. All the loose grains, complete and incomplete ear heads fallen in the marked area have to be picked up manually without vibrating the plants before the machine is to be operated. This will give pre-harvest loss.

Header loss: It is determined on those portions of ground, which are protected from combine afflux by the use of rolls of cloth. The loose grains and complete and incomplete ear heads fallen on the marked area, where pre-harvest losses were determined, shall be collected manually. This gives the header loss. It is also called cutter bar loss.

$$\text{Header Loss (\%)} = \frac{\text{Grain collected from 1 m}^2\text{ area after harvest – grain Collected from same area before harvest}}{\text{Gross Yield}} \times 100$$

$$\textbf{Cylinder Loss (\%)} = \frac{\text{Unthreshed grain collected from straw rack \& sieve}}{\text{Gross Yield}} \times 100$$

Rack and shoe loss: For determining the rack and shoe loss, the straw and chaff afflux is collected separately. To collect these, two rolls of cloth 30 m in length and one and half times the width of straw/chaff outlet is suspended on especially attached fittings beneath the rear of machine. As the sheets of cloth unroll, one sheet retains the afflux from straw walker and other from sieve for 20 m run length. Unrolling operation starts 5 m in advance and terminates 5 m ahead of end point.

$$\text{Rack Loss (\%)} = \frac{\text{Free grain collected from straw rack sample}}{\text{Gross Yield}} \times 100$$

$$\text{Sieve Loss (\%)} = \frac{\text{Free grain collected from sieve sample}}{\text{Gross Yield}} \times 100$$

Grain crackage: It is determined from the samples taken from grain tank. Only visible damaged grains are separated and expressed in percentage of sample taken.

$$\text{Grain Crackage (\%)} = \frac{\text{Damaged grain wholly or partially collected from sample}}{\text{Gross Yield}} \times 100$$

Net Yield = Grain collected in the bag from combine test area.

Gross Yield = Net yield + header loss + cylinder loss + rack loss + sieve loss

Total combine loss = Cutter bar loss + cylinder loss + rack loss + sieve loss

$$\text{Performance efficiency, \%} = \frac{\text{Net yield}}{\text{Gross yield}} \times 100$$

$$\text{Unthreshed (\%)} = \frac{\text{Unthreshed grain in tank + cylinder loss}}{\text{Gross Yield}} \times 100$$

$$\text{Cleaning efficiency, \%} = \frac{\text{Clean grain}}{\text{Total grain collected from main outlet}} \times 100$$

$$\text{Threshing efficiency, \%} = \frac{\text{Threshed grain from all outlets}}{\text{Grain output in tank}} \times 100$$

Expected range of losses: Losses, with the best combine adjustments, will vary greatly depending upon the type's variety and the condition of the crop. Total losses in clean crop of wheat oats and barley will vary from 1% to 4% of total yield. Under good harvesting condition the total loss should not be more than 1.5%.

(i) Cutter bar loss - 0.5 to 2%

(ii) Cylinder loss - 0.5 to 1%

(iii) Rack loss - 0.2 to 0.4%

(iv) Shoe loss - 0.2 to 0.4%

The losses could be minimized by running the combine at proper adjustment. Setting and performance of different parameters are discussed below:

Cutting and conveying: The height of cut can be adjusted from 5 cm to 75 cm in most of the combines. The rate of feeding can be adjusted by manipulating height of cut and forward speed of machine. Forward speed range of 2.5 - 4.5 km/h for standing crop and 1 - 1.5 km/h for lodged crop has been recommended by ISI. The speed of cutter bar varies from 400 to 550 rpm.

Reel adjustment (ISI): The horizontal positioning should be such that real bats have a distance of 50 to 100 mm in front of the cutter bar. The optimum value of reel index should be 1.10 to 1.25.

Problem 1: A combine was tested for harvesting jowar and following observations were recorded:

Total area harvested = 78 sq. m.

Total time required = 65 seconds.

Total material left over the rack =18 kg.

Free seed over the rack =150 gms.

Unthreshed seed over the rack = 120 gms.

Free seed over the shoe = 530 gms.

Unthreshed seed over shoe = 150 gms.

Total material left over shoes = 8 kg.

Net grain collected in the tank = 34 kg.

Calculate:

1. Seed yield and total loss in kg/hectare.
2. Cylinder loss, rack loss, shoe loss and total grain loss as percent of total yield.
3. Total feed rate in kg/hour.
4. Rates of straw and chaff over the rack and over the shoe in kg/hr.
5. Percentage of straw and chaff retained by r4ack.

Solution:

Total area harvested = 78 m^2
Total seed harvested =

So, seed yield = kg/hectare = kg/ha
Total seed loss = kg/ha

Cylinder loss is the un-threshed seed discharged from the rear of the machine, either in the straw or in the material from the cleaning unit.

Total un-threshed seed = g
Total cylinder loss =
Rack loss is the free threshed seed carried over the rack in the straw and discharged from the machine.
So, rack loss =
Shoe loss is the loss of free seed carried over the rack in the straw and discharged from the machine.
So, shoe loss =
Total loss of seed =

Total material fed including seed and straw =

So, feed rate = kg/h

Over the rack total material is 18 kg. Out of which free seed is 150 gm and un-threshed seed is 120 gm. So, net weight of straw in rack is

=

Rate of straw over rack =

Similarly net weight of straw over shoe =

So, rate of straw over shoe =

Percentage of straw and chaff retained on rack =

Basic Machine Settings

Type of crop	Drumspeed	Concave clearance	Sieves	Straw walker
	(rpm)			(rpm)
Wheat	900-1000 -	Front - 15mm	Upper - 16 -19mm	200
		Rear - 7mm	Lower - 6 to 8mm	
Paddy	600-800 "	Front - 17mm	Upper - 16 -19mm	180
		Rear - 14mm	Lower - 5 to 6mm	
Sunflower	*400-650	Front - 17mm	Upper-12.5-19mm	200
		Rear - 14mm	Lower-8mm Øhole	
Soybean	*250-600	Front - 15mm	Upper - 16 -19mm	200
		Rear - 11mm	Lower-8mm Øhole	
Mustard	*450-700	Front - 10mm	Upper - 16 -19mm	200
		Rear - 5mm '	Lower - 4 to 5mm	
Gram	*450 - 700 •.	Front - 15mm	Upper - 16 -19mm	200
		Rear - Ilmm	Lower- 7 to 10mm	

Source: Operator's Manual of Swaraj 8100 Combine

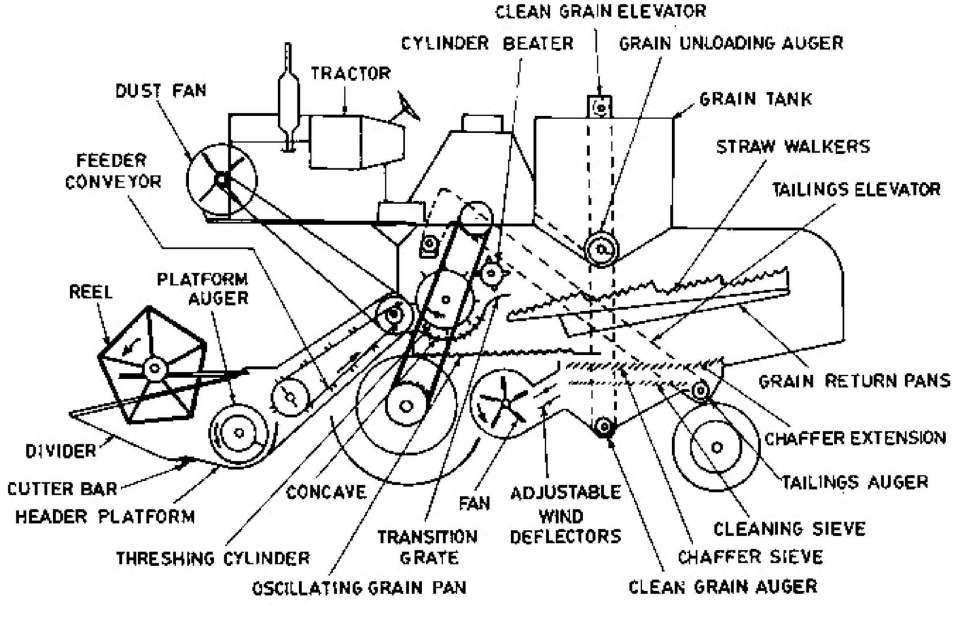


Fig. 4: Details of a tractor operated combine harvester.

ExptNo.10 Date:----------

FIELD OPERATION OF THRESHERS AND THEIR PERFORMANCE VALUATION

Introduction:

Threshing is an operation of detaching the grains from the ear heads, cobs and pods. Thresher is a machine to separate grains from the harvested crop and provide clean grain without much loss and damage. During threshing, grain loss in terms of broken grain, un-threshed grain, blown grain, spilled grain etc. should be minimum. Bureau of Indian Standards has specified that the total grain loss should not be more than 5 per cent, in which broken grain should be less than 2 per cent

Component of a thresher and Working principle:

A mechanical crop thresher mainly consists of the following component/ devices:

a) Feeding device (chute/tray/trough/hopper/conveyor)

b) Threshing cylinder (hammers/spikes/rasp-bars/wire-loops/syndicator)

c) Concave (woven-wire mesh/punched sheet/welded square bars)

d) Blower/aspirator

e) Sieve-shaker/straw-walker.

Threshing Unit: The threshing is accomplished by the impact of the rotating pegs mounted on the cylinder, over to the ear heads, which force out the grain from the sheath holding it. In the threshing of wheat crop, the straw is also bruised and broken up by the impact, thus converting it into 'bhusa' (straw). Threshing unit is mainly consists of a cylinder and concave. There are different types of threshing cylinders (Fig. 3) such as:

- Spike tooth/peg type cylinder
- Rasp bar type cylinder
- Angled bar type cylinder
- Wire loop type cylinder
- Cutter blade or syndicator type cylinder
- Hammer mill type cylinder

Spike tooth type cylinder: In this type of threshing drum, there is a hollow cylinder, made out of MS flat. Over to its entire periphery, a number of spikes/pegs of square /round bars or flat iron pieces are welded or bolted. Now days, in most of threshers, round peg with adjustable length are used. These spikes are staggered on the periphery of the drum for uniform threshing. The crop is fed along with the direction

of motion of the rotating drum. The spike tooth cylinders are available in various sizes. A spike tooth cylinder with spikes of flat front and streamlined back has lower energy consumption.

Rasp bar type cylinder: In this type of cylinder, there are slotted plates, which are fitted over to the cylinder rings, in such a way that the direction of slot of one plate is opposite to another plate. This type of cylinder is commonly used in threshers. It gives better quality of bhusa and it can be used for a wide variety of crops viz.-wheat, paddy, maize, soybean etc.

Wire loop type cylinder: In this type of threshing drum, there is hallow cylinder, over which a number of wooden or MS plates are fitted. On these plates, number of wire loops is fixed for threshing purposes. This type of cylinder is common in the manually operated paddy threshers. Holding the bundle against the loops of revolving cylinder does threshing of paddy crop.

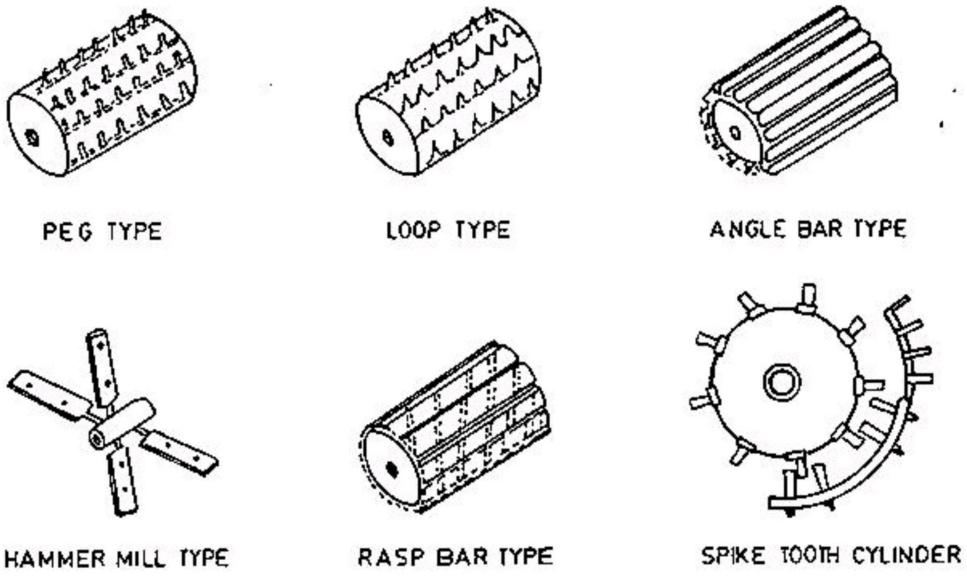


Fig. 3: Different types of threshing cylinders.

Adjustments in threshers:

Various adjustments are required before starting threshing operation. The machine is to be installed on clean level ground and is to be set according to crop and crop conditions. The adjustments necessary to get best performance from the machine are (i) concave clearance, (ii) sieve clearance, (iii) sieve slope, (iv) stroke length and (v) blower suction opening. Besides these, cylinder concave grate, top sieve hole size and cylinder speeds for threshing different crops are important for a multi crop thresher.

Setting of a spike tooth multi crop thresher having 500mm cylinder diameter and 720mm blower diameter are given below:

Following are some general guidelines for adjustments of a thresher. At all times, consult the user's manual that is provided by the manufacturer. Also, review the safety/ health precautions for threshing machines.

Adjustments before operating a thresher:

1. Position the thresher on a level area close to the crop stack to minimize handling and shattering losses.

2. Spread cloth, canvas, or mat underneath the thresher to collect spilled grain from the grain discharge chute or due to shattering during handling.

3. Install the cylinder, cover, and feed tray if dismantled during field transport.

4. Position the thresher so that the straw is thrown with the direction of the wind. This will eliminate the blowing of straw, chaff, and dust back toward the operator and the threshed grain.

5. Check each belt's alignment and tension. Adjust the idler pulley on the blower/cylinder belt to correct tension. Improper alignment and tension are the major causes of premature belt failure.

6. Check pulley surfaces. Rough grooves must be smoothened with a fine file if nicked. Cracked pulleys should be replaced immediately. (Fig: 5.)

7. Open the cover and check all pegs on the threshing cylinder for tightness. Loose pegs will damage the machine and can be dangerous to the operators. (Fig: 6.)

8. Examine the peg teeth for wear. Maximum wear occurs at the feed end of the cylinder and is more prominent at the leading side in the direction of rotation. Worn pegs must be rotated 180 degrees or interchanged with those located near the straw paddles. Badly worn pegs must be replaced or rebuilt by welding.

9. Rotate the threshing cylinder manually at least five revolutions to ensure that there are no obstructions or interferences.

10. Make sure there are no loose or missing bolts and set screws. Tighten or replace as necessary.

11. Lubricate all bearings with good quality grease (see maintenance and service section) the belt idler and oscillating screen eccentric bearings are lubricated for life, thus require no lubrication.

12. Check engine oil and fuel levels. Follow the engine manufacturer's recommendations.

13. Start the engine and allow it to warm up.

14. Feed the thresher with the crop to be threshed for performance checking. Increase cylinder speed if excessive amounts of unthreshed and unseparated grain are observed with the straw.

15. Optimum threshing and cleaning is obtained with cylinder speeds of 600 to 700 rpm.

Operating the thresher:

1. Start the engine.

2. Load the feed tray with the harvested crop. Three to four persons are required to operate the machine. One or two men load and the other feed the machine. Another person bags the threshed grain and insures that the cleaning screen is kept free of clinging straw especially when threshing wet material. Use a stick to remove clinging straw from the oscillating screen to protect hands from possible injury.

3. Harvested crops must be placed on the feed tray with the panicle away from the operator, so it is fed panicle first into the thresher.

4. Feed the crop at a uniform rate and maintain maximum feeding rate without overloading the engine. Adjust the feed rate to match the condition of the material being threshed. For wet crops or crops with decomposed straw, reduce the feed rate to avoid overloading the cleaning screen.

5. For higher threshing efficiency, briefly hold the crop bundles at the feed opening for partial threshing when the material is longer than 40-50 cm. longer cut material will reduce machine output and may result in poor threshing and clogging of the machine. Short, panicle-harvested materials (cutting just above the flag leaf) may result in high unthreshed losses because the panicles move rapidly through the thresher without receiving sufficient threshing. Recycling the straw is necessary in this case.

6. Adjust blower openings (shutters) to give the air flow needed for winnowing. Open slowly to provide more air for a cleaner output until a small amount of mature grain flows over the wind board.

7. The angle of the wind board and the blower opening must be adjusted to suit the threshing conditions. For dry paddy, the wind board should be set at its maximum inclination and the blower should be gradually adjusted until the desired grain cleanliness is obtained. For threshing wet paddy, the inclination of the wind board must be reduced and the air shutter opening increased to blow the heavier wet leaves and other impurities. To obtain extra-clean paddy, set the wind board at a low inclination and increase the air shutter opening. This process will blow more grain over the wind board, but this can be recovered by recycling the separated impurities through the thresher.

8. The stripper bars prevent straw from wrapping around the cylinder and aid in threshing hard–threshing varieties. Use of stripper bars reduces capacity and increases the amount of finely chopped straw that passes through the concave when threshing overly mature crops, thus they should be installed only when necessary.

9. Reduce feeding rate when threshing wet or partially decomposed materials to avoid overloading.

10. Open the cylinder cover periodically to remove straw and chaff accumulation at the lower concave.

Safety precautions in threshing operation: -

1. Leave all guards and shields in place when operating the machine
2. Before cleaning, servicing, or repairing the machine, disconnect the power to the unit.
3. Use only properly grounded outlet (electric only).
4. Keep hands out of threshing belt entry area.
5. Do not wear loose clothing when operating this machine. Clothing can be grabbed by chain drives or rotating shafts and severe injury can result.
6. Keep hands and feet away from chain drives and v-belts when machine is running.
7. Lock brake when using (if equipped).

Guide lines for maintenance of a crop thresher:

1. Lubricate cylinder and fan bearings with good-quality general purpose grease every 25 hours of operation. Periodically apply a small amount of oil to all hinge points.
2. Inspect the machine regularly for loose, worn, or damaged peg teeth, concave bars, cylinder, discharge paddles and other parts, and tighten, repair, or replace them immediately. Missing bolts or nuts must also be replaced.
3. Reduce belt tensions by loosening the idler pulley and engine mounting bolts when the machine will not be used for an extended period to minimize deterioration.
4. Check engine crankcase oil level at least every 4 operating hours and follow the engine manufacturer's recommendations for oil change intervals and oil grade. Be sure the recommended oil level is maintained.
5. Service the air cleaner, fuel filter, fuel line, carburetor, and spark plug regularly according to engine manufacturer's instructions.

Guide lines for storage of a threshing machine

1. Clean the machine thoroughly.
2. Remove belts and store in a dry place.
3. Store the machine in a clean, dry location and cover to reduce damage from dust accumulation.
4. Paint parts that need repainting.
5. Clean and apply oil to exposed metal surfaces to prevent rusting.
6. Follow the manufacturer's recommendations on engine storage.

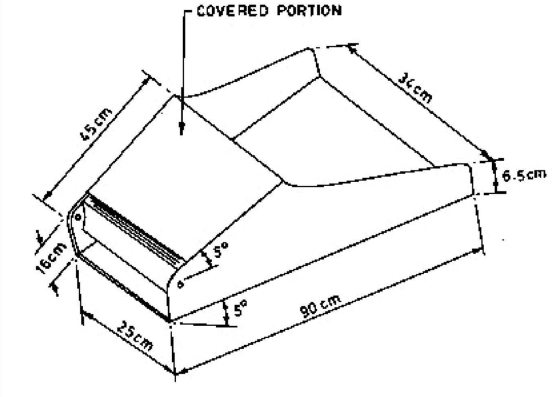


Fig. 1: Safe feeding chute.

ExptNo.11 Date:----------

STUDIES ON METHODS OF REPAIR, MAINTENANCE AND OFF-SEASON STORAGE OF FARM EQUIPMENT

Aim/General Maintenance Tips: All equipment should be thoroughly cleaned with a high-pressure washer to remove dirt and trash residue. Accumulated trash and dirt can create fire hazards, electrical malfunctions, corrosion and rust of equipment, which may result in breakdowns next season. Important areas to clean on all self-propelled machines are the engine compartment, heat exchangers/radiator fans and the area under the control centers. Once equipment is clean, farmers should thoroughly service and lubricate the machine. Also check for worn belts, loose bolts, oil leaks and the condition of all hoses, in addition to operational/ performance checks. Off-season is the time to make those necessary repairs and adjustments to avoid undue downtime during the next busy season. Oftentimes, implement dealers offer service specials during the off-seasons, which can mean real savings. Watch for them. This also is a good time to apply touch-up paint to scratched or corroded areas. Properly maintained equipment that looks good will command a higher trade-in value when die farmer decides to replace it. Many operators follow a good cleanup with a wax job to help protect the equipment from the elements, such as corrosion and oxidation. Most importantly, when equipment is checked carefully, small problems can be identified and corrected before they cause downtime next season.

Engine/Power Train: After cleaning the outside of the cooling system, check the coolant level amount of anti-freeze protection and its condition. Dependent upon your service interval, it may be necessary to drain the system, flush the radiator and refill with proper coolant and service the coolant filter as required, if so equipped. Harmful acids can accumulate in your equipment's oil pan, particularly during light-load applications. These acids can damage engine compounds over the long winter months. Farmers should pay particular attention to the condition of their crankcase oil during winter operation.

Keep in mind, lightly loaded engines during cold weather face one of the most severe engine applications. The engine never really reaches its proper internal operating temperature even though the coolant temperature may be normal. Regularly service your engine and replace both oil and fuel filters. There are several classifications of lubricants listed in the operator’s manual. We suggest owners read the operator’s manual thoroughly to ensure they are using the proper lubricant. We also suggest they utilize an oil sampling program to monitor wear/contamination levels in engines, transmissions and gear cases such as the Oil Laboratory Analysis. This is available at your dealerships. Contaminants can cause extensive damage to hydraulic systems. Dealership recommends that producers analyze the hydraulic fluid in all equipment regularly and replace it as recommended. Downtime can be avoided by timely action now by checking for small leaks. Condensation is the biggest threat to fuel systems next to using a poor grade of fuel

high in sulfur content. Equipment owners should check their tractor or combine fuel tanks, as well as their farm's bulk tanks, for condensation. Drain the condensation often and keep tanks as full as possible. Always filter the fuel and keep it clean and fresh for operation.

Electrical: During the busy spring season, electrical problems often are the most time-consuming to trace and repair. Winter is a good time to check for loose connections, frayed or broken wires and to repair broken gauges, lights and switches. Although modem batteries do not have to be removed from equipment, except in extremely cold regions, cleaning the battery, its posts and cable connections is advised. On an idle machine, the battery ground cable should be disconnected from the battery to avoid corrosive buildup and possible battery discharge.

Harvesting Equipment: Combine headers require special storage care. We suggest closely inspecting header units, both corn and grain types, for worn, bent or broken parts and replacing them as needed. Proper adjustment of belts and chains is critical to prolong wear.

Corn Heads: Stalk roll knives should be sharpened or replaced and lubricated, and auger systems checked for proper function. Top off your corn head check up by lubricating all main points including chains and other moving parts.

Grain Headers: Operators should check the reel drive, sickle wobble box drive, auger, retractable fingers and stripper bars of the grain header. Knife guards and other parts should be inspected for wear and replaced as needed. Round out the check up by lubricating and properly adjusting the grain header. Finally, equipment tires should be cleaned and inspected for possible cuts. Check tire pressures before storing equipment and inflate them as necessary.

Tillage Tools: Farmers are placing greater demands on their tillage equipment. As minimum tillage requiring chemical incorporation becomes more popular, tillage tools are growing larger and more sophisticated. Those demands have led to more sophisticated hydraulic systems. Today's multi-wing folding units require several hydraulic cylinders to properly perform their tasks. Many owners believe that since the hydraulic cylinder rods are chrome, they won't rust. Although cylinder rods are resistant to rust, they must be protected from the elements. Thoroughly coating all cylinder rods with a protective lubricant is advised. Rusted cylinder rods can quickly damage seals. Before storing the unit, all ground-working tools and mold boards should be cleaned and coated with a lubricant to guard against rust. Don’t forget to check the shanks on field cultivators. Worn shank bushings or pins should be replaced. Don't go into your next season with bent or worn shanks that can leave skips in the fields.

Planters/Drills: Like other equipment, planters and drills should be cleaned of any buildup, especially in the seed or fertilizer boxes. Make sure all movable parts are free and not stuck due to chemical corrosion. Operators should check all moving parts for excessive wear. On air planters, the condition of the cutoff brush is very important and should be adjusted properly. Finally, lubricate all moving parts and inspect all chains and other drive mechanisms for excessive wear or misalignment. Proper off-season storage will add value to your farm equipment, increase its lifespan and decrease your operating costs.

Off-Season Storage Checklist:

- Thoroughly clean all equipment with a high-pressure washer.
- Lubricate all points.
- Coat all parts that rust easily, such as plow shares or chrome hydraulic cylinder rods, with a high-quality protectant.
- Inspect all equipment for broken, bent or worn parts. Repair or replace as necessary.
- Apply touch-up paint to scratched or rusted areas.
- Apply a generous coating of wax to help equipment fight the effects of the elements.
- Store equipment in a shed or under a tarp or heavy plastic if possible.

Self-Propelled Equipment:

- Check or drain, flush and refill the radiator with correct coolant.
- Drain engine oil and analyze it to determine the presence of contaminants.
- Check hydraulic system fluid. Replace if needed.
- Check the transmission fluid level. If needed, drain and refill. Install new filters.
- Check fuel tanks for condensation. Fill tanks with high-grade fuel.
- Disconnect battery ground cables if the machine is idle for several months.
- Check fire pressure frequently during the winter.

OPENING AND REASSEMBLY OF DISC HARROWS, DETERMINATION AND ADJUSTMENT OF TILT AND DISC ANGLES

Aim/Introduction

Disc harrow is secondary tillage equipment designed for harrowing / land preparation of rough soil (Secondary tillage/ finer operation). It is generally used for breaking the clods and partially inverting the soil. Regular and satisfactory operation together with economic and long lasting use of the implement depends on the compliance with instructions provided by the manufacturers. Thoroughly read the instruction manual before proceeding with the various operations and maintenance.

Adjustments in disc harrow

a) Adjustment before use:

1. Before mounting of disc harrow make sure that all nuts & bolts are properly tightened.

2. Also determine soil and trash conditions of the field and make the preliminary adjustments as discussed below:

- Disc gang angle adjustment: - Gang angle (Angle between two gangs) ranges from 0° to 50°. The angle can be increased for better penetration in dry soil while it should be reduced to avoid plugging in wet soil.
- Disc harrow leveling: - To eliminate uneven penetration and side draft, leveling is done by means of top link& bottom adjustable link. While tractor pulls to right the rear gang should be lowered a little. When the tractor pulls to the left the rear gang should be raised.
- Scrapper adjustment: - The scrapper can be adjusted by loosening the bolts atthe scrappers clamp.
- Depth control: - The depth at which the implement is required to work is controlled hydraulically by raising or lowering the left control lever.
- Disc harrow penetration:- Factors affecting disc harrow penetration are:-

    - Angle of the gangs
    - Weight of the harrow
    - Disc diameter
    - Disc sharpness (Blunt disc increases the draft considerably, check the disc sharpness)
    - Angle of hitch

b) Attaching the harrow to the tractor

1. Place the harrow duly leveled on the flat piece of land.
2. Reverse the tractor to the harrow (Do not drag the harrow up the tractor).
3. Attach the left arm of the tractor to the harrow first.

4. Attach the central top link/ arm to the harrow. To attach, turn the screws on both side an equal length. If the arm is too short or too long, turn the screw to adjust both at the same time until aligned with the hole on the central arm.
5. Attach the lower right arm; turn the screw until the mounting pin is at the same level as the hole on the tractor arm. If the gap between the hole and mounting pin is too close or too distant turn the control arm in or pull it away to an appropriate distance. User may have to adjust both height and distance at the same time. When the hole attractor arm and mounting pin are even, insert the pin in the hole and lock it with the lynch pin.
6. After attaching the harrow, lift it and adjust the control arm parallel to the ground. When you looked from both rear or sideways the discs should all the touching the ground uniformly.

Trouble shooting chart for disc harrow

Sr. No.	Possible cause	Possible remedies
A.	Side draft	
1	Disc not running level.	Adjust using leveling lever
2	Gangs improperly angled	Set the gang angle properly
3	Too much left hand offset	Swing the hitch to the left
B.	Excessive field slippage	
1	Tractor overloaded	Reduce angle, reduce depth
2	Not enough tractor ballast	Add wheel weight or liquid in tyres
C.	Not filling the furrow	
1	Too much left hand offset	Swing hitch to the right hand
2	Tractor wheel running in furrow enlarging it.	Drive the tractor in unworked ground
3	Discs too far from furrow	Keep the left front discs in furrow
4	Rear gang set wrong , laterally	Move the rear gang right or left. The left rear should be centered in the space between left front discs.
D	Poor penetration	
1	Hard ground	Swing hitch to the right. Increase angle in front and rear gang.
E	Disc unsteady	
1	Too much angle in gang	Reduce gang angle
F	Gang plugging	
1	Field too wet	Disc at shallow depth for first pass to speed up drying process
2	Gang set in maximum angle	Reduce the gang angle
3	Not using scrappers	Install scrappers
4	Scrappers worn out or not set properly	Replace worn ones, Adjust scrappers close to the disc
5	Discing too deep in damp soil	Reduce penetration of harrow

ExptNo.13 Date:----------

HITCHING OF AGRICULTURAL IMPLEMENTS AND TRAILERS

Aim/Introduction: (a) Trailed - one point hitch. Here the implement is attached to the tractor at one (drawbar) hitch point. This represents the simplest arrangement, but it provides a minimum in the way of implement control and weight transfer. The implement, which is usually carried on wheels (for support and / or depth control), is free to move in both the horizontal and vertical planes as it follows the varying ground surface. Two common arrangements can be identified.
(i) where the implement is fully carried on its wheels and its drawbar is pivoted at both ends; the implement force is essentially horizontal, Figure 6.1 (a).

(ii) where the front of the implement (such as in an unbalanced trailer or similar two-wheeled implement) is carried on the tractor drawbar and the rear on a wheel or wheels, Figure 6.1(b).

There is usually a significant static vertical component in the implement attachment force and hence the weight transfer from implement to tractor rear wheels is greater than in (i) above.

The trailed hitch is least effective in terms of both weight transfer and implement control when compared with other systems . The former weakness has been overcome by the development of a weight transfer hitch for trailed implements in which part of the weight of the implement and / or the downward soil forces are supported by the tractor rear wheels.

(b) Semi-mounted - two point hitch In this arrangement the front of the implement is carried on the lower links of the tractor and the rear on a castor wheel as in Figure 6.2. In the vertical, longitudinal plane the implement is free to pivot about the outer ends of the lower links and hence it behaves as the one-point hitch above, ie, it is free to follow ground undulations. It is, however, rigid in the horizontal plane and is therefore frequently used for un-symmetrical implements having side forces, such as mouldboard or disc ploughs, or offset draught forces, such as forage mowers. There is usually a significant static vertical component in the implement attachment force because part of the weight of the implement and of the downward soil forces are supported by the tractor. Thus weight transfer would be greater than in a corresponding trailed implement;

c) Fully mounted - three point hitch Here the implement is attached to the tractor by means of the three-point linkage as shown in Figure 6.3. In this side view the lower two points are coincident; the upper point is midway between , but above the lower two. This system totally constrains and allows complete control of the implement. It is not free to swing in space like the trailed implement, nor in the vertical plane like the semi-mounted; it must operate in the position determined for it by the linkage. The exception to this statement is that the implement is usually free to rise, ie, it is not held down by the linkage. If it does rise, it will be due to the upward soil forces being greater than implement weight; it will, however, move in a way determined by the kinematics of the linkage. In the vertical longitudinal plane (Figure 6.3) the linkage has the form of a mechanism known as a 'four link chain', the characteristics of which are treated in books on kinematics. We can identify the four links as shown in Figure 6.4:

(i) the two lower links (which act as one in the vertical plane) (ii) the upper or top link (iii) the implement frame or pedestal (iv) the tractor chassis

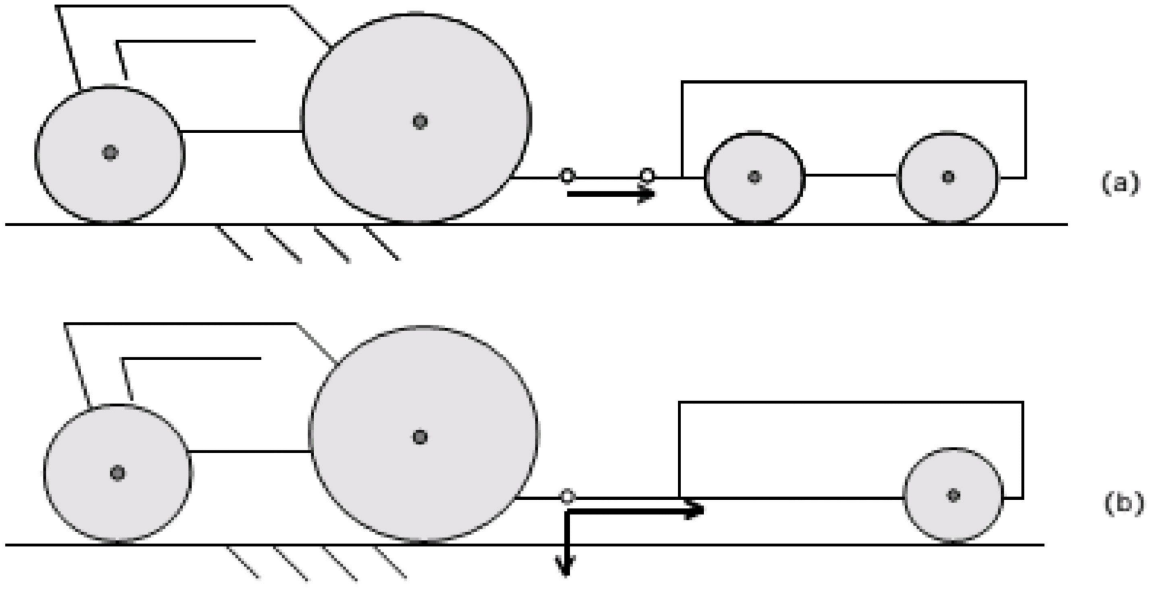


Figure 6.1: Trailed (one point) implement hitches (a) without and (b) with vertical force.

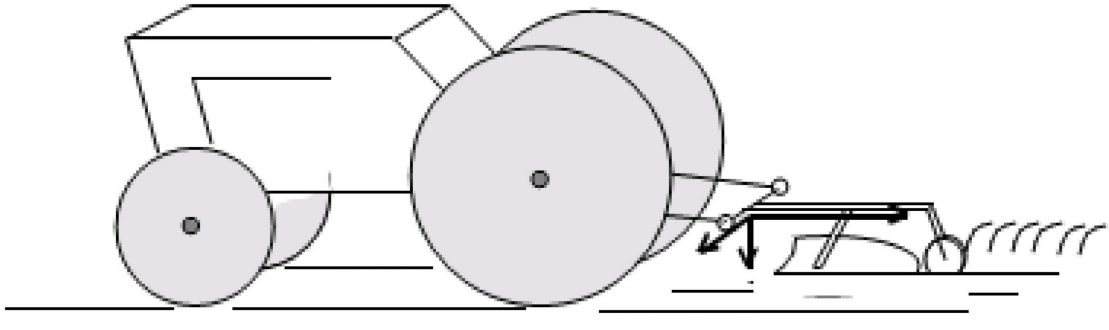


Figure 6.2: Semi-mounted hitch where the front of implement is carried on a horizontal pivot.

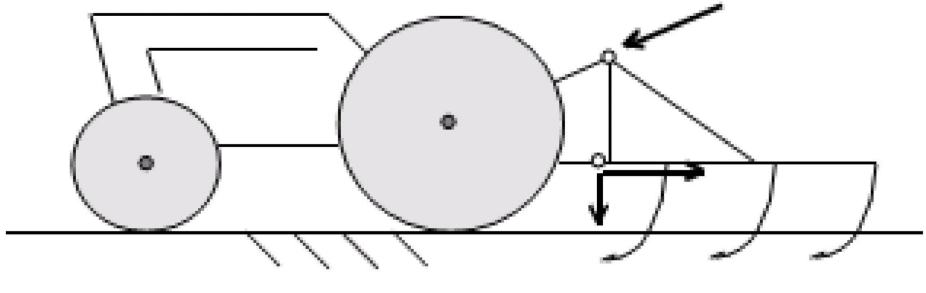


Figure 6.3: Fully mounted, rear three-point linkage hitch.

ExptNo.14 Date:----------

STUDY AND OPERATION OF BULLDOZER

Aim/Introduction:

A wheel bulldozer is a tractor having a heavy blade in front for pushing and excavating (shoving) earth and debris at mines, quarries and construction sites. The first engine driven tractors were steam powered ones. Second generation tractors were gasoline combustion engine driven, and third generation farm tractors were diesel and/or diesel electric driven ones. These tractors have got articulated frames and four wheel drive systems. Blade movements such as lowering, raising and tilting are controlled by hydraulic power.

By the advent of farm tractors, dozing plates are mounted in front of them for pushing the soil and earth. Normally, farm tractors are good in pulling farming (agriculture) tools like ploughs, cultivators, shredders band cutters, seeders and planters and sprayers and leveling accessories (farming machinery). So using farm tractors for pushing the earth was a new concept.

Type of terrain the dozer will be working; the specifics of the project; the size of the workspace and the type of material to be moved are the major factors to be considered in choosing a buldozer for the task.
Modern Bulldozers are strong machines that mainly assist with pushing, digging, excavating, and leveling materials like soil and debris at a work site. They come with large, heavy blades in the front that push material. Some come with other modifications like rippers in the rear to help break down tough ground.
Wheel dozers do not require trailers for travelling short and medium distances like tracked ones. Tyres make them mobile and hydraulic articulated steering makes them easy to maneuver, moves on a smaller axis.

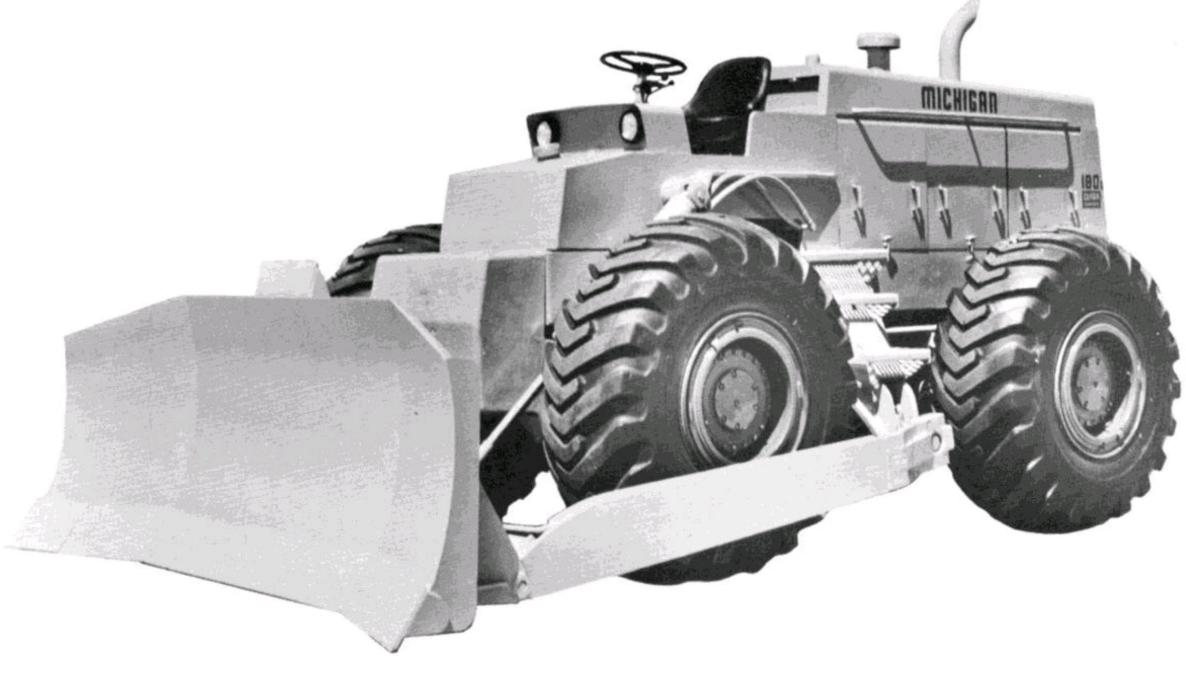


Table: Some wheel dozer blade capacities and dimensions

Blade (SAE), m^3	(S-Blade)-5m^3, (4,19 m x 1,22m)	(S-Blade) - 8m^3 (U-Blade)- 10,6m^3	(Semi U-Blade)-26m^3- Width-6,47m (Coal Blade)- 45m^3-Width-7,40m
Dimensions & Specs			
(A) Overall Length With Blade on Ground, m	7,69	9,83m	12,04
(B) Width Over (between) Tires, m	3,17	3,57m	6,47
(C) Height to Top of Cab.,m	3,96	4,25	5,22
(D) Wheelbase, m	3,53	4,10	5,45
(E) Ground Clearance, m	0,48	4,95	------
Turning Circle, m	13,96		18,42
Operating Weight, t	30-(S-Blade), Blade Dimension 4,19x1,22m	48,10 (S-Blade) 49,12 (U-Blade)	100
Max. Lift Above Ground, m	-------	5,10 (S-Blade) 1,34 (U-Blade)	Semi U-Blade-1,58 Coal Blade-1,56
Max. Drop Below Ground, m	-------	0,45 (S-Blade) 0,49 (U-Blade)	Semi U-Blade-0,68 Coal Blade-0,68
Articulated Steering Angle each direction	43°	43°	40°
Engine Power, kW	235	393	637

Operational Capacity of Bulldozer

Wheel dozers are physically larger than that of equivalent capacity tracked ones. Because of the fact that the pushing power (force) is a function of friction coefficient between the soil surface and the tyre, and weight of the dozer. The higher the friction and the heavier the buldozer, the higher the tractive force ie the higher the pushing force.

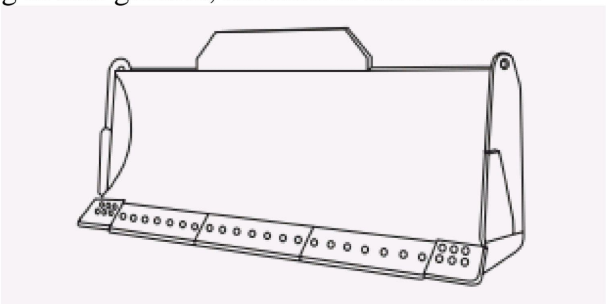
Surface type	Traction Coefficient for Wheel Dozer	Traction Coefficient for Crawler Dozer
Dry Rough Concrete	0,80-1,00	0,45
Dry, Clay	0,50-0,70	0,90
Wet, Clay	0,40-0,50	0,70
Wet sand & Gravel	0,30-0,40	0,70
Loose, Dry Sand	0,30-0,30	0,30
Dry Snow	0,20	0,15-0,35
Ice	0,10	0,10-0,25

In Wheel dozers, the weight of the equipment is transmitted to the surface of the ground at four points ie at four wheels, therefore, the pressure exerted to the surface of the ground is higher. Whereas, in tracked dozers the pressure exerted to the ground is comparatively lower because of the fact that equipment weight is distributed to a greater surface underfoot. For this reason it has a higher tractive force which implies higher pushing forces.

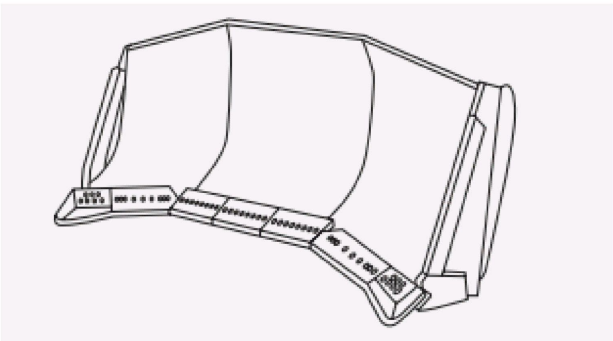
Another primary tool of the crawler bulldozer is the ripper. It is a claw-like device which can be seen at the back of a dozer. As its name implies, it rips, breaks, and shatters hard, earth materials for easy handling and transporting. Wheel bulldozers generally are not equipped with rippers because of the comparatively lower tractive power.

BULLDOZER BLADES

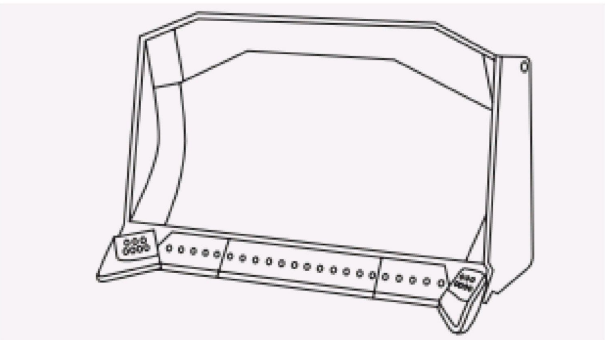
Straight Blade (S-Blade): It is a short blade that has no lateral curvature and side wings. It is used for fine grading, stripping and ditching in fine grained, medium to hard material.



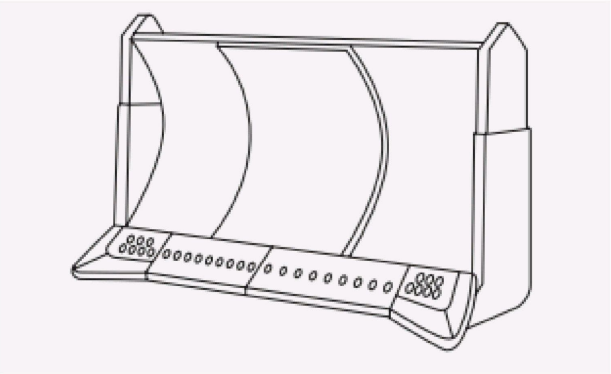
Universal Blade (U-Blade): It is tall and very curved laterally and has large side wings to carry more material. It is ideal for pushing and material handling tasks in soft to medium soil.



Semi-U Blade: It is the combination of Straight (S) blade and Universal (U) blade. It is shorter and less lateral curvature and smaller side wings. S-U blade is ideal for pushing piles of large rocks as in the case of quarries and mines



Angle Blade (A-Blade): It has the ability to push materials to lef tor right. Its' ideal application is in making windrows, digging drainage ditches, backfilling trenches and grading roads. A-blade is efficient in handling coarse materials, soils and gravel



BLADE-DOZER PERFORMANCE (Specific Blade Pushing Power)

A bulldozer's pushing potential is measured by two Standard ratios:

Specific Blade Penetration and Pushing Power, (HP/m)

Ratio of tractor's horse power to the cutting edge length of the blade, kW/m or HP/m, can be termed as specific cutting and pushing power of the buldozer similar to wheel loader's specific bucket penetration power. This ratio, specific blade penetration power, provides anindication of the ability of the blade to penetrate and obtain load. The higher this ratio is the more agressive the blade attacks to the earth.

Specific Loose Earth Retaining and Moving Power of the Tractor, (HP/m3)

Ratio of the tractor power to the loose cubic meter of material retained in front of the blade. This ratio (HP/m3) measures the blade's ability to push a load. A higher HP/m3 ratio implies that the buldozer can push a load at a greater speed.

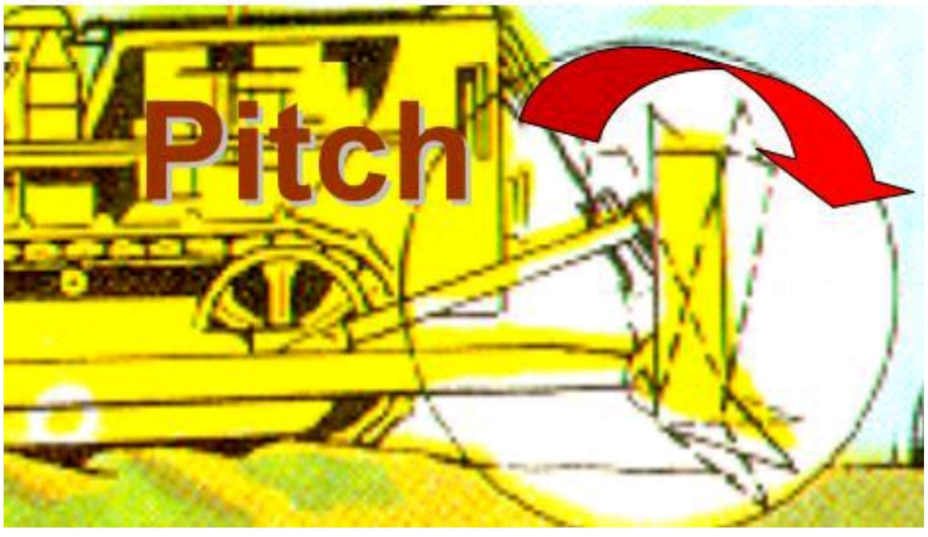
BLADE ADJUSTMENTS

Tilting:

Tilting is the vertical movement of the blade end. This movement is within the vertical plane of the blade. Tilting permits concentration of tractor driving power on limited length of blade.

Pitching:

The control which allows the operator to vary the angle of attack of the blade cutting edge with the ground is called pitch. It is the movement of the top of the blade toward or away from the tractor.



Angling:

Turning the blade so that it is not perpendicular to the direction of tractor's travel is called angling. This causes the pushed material to roll off the trailing end of the blade. Rolling material off the endof the blade is called "side casting".