

HARVESTING & THRESHING EQUIPMENT

HARVESTING

It is the operation of cutting, picking, plucking and digging or a combination of these operations for removing the crop from under the ground or above the ground or removing the useful part or fruits from plants.

Harvesting action can be done by four ways:

- 1) Slicing action with a sharp tool.
- 2) Tearing action with a rough serrated edge
- 3) High velocity single element impact with sharp or dull edge.
- 4) Two elements scissors type action.

Manual harvesting involves slicing and tearing action. Harvesting can be done by: (i) Manually operated tool (ii) Animal drawn machine (iii) Mechanically operated machine.

There are a few related terms in connection with harvesting, which are as below:

Mower: It is a machine to cut herbage crops and leave them in swath.

Reaper: It is a machine to cut grain crops.

Reaper binder: It is a reaper, which cuts the crops and ties them into neat and uniform sheaves.

Swath: It is the material as left by the harvesting machine.

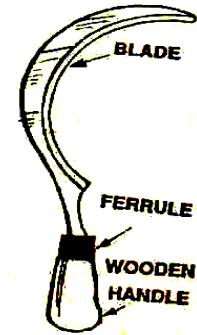
Sickle: It is a curved steel blade having a handgrip and used for harvesting by manually.

Windrow: It is a row of material formed by combining two or more swaths.

Windrower: It is a machine to cut crops and deliver them in a uniform manner in a row.

Sickle:

Sickle is a simple harvesting tool. It is used for harvesting crops and cutting other vegetations. It essentially consists of a metallic blade and a wooden handle. Sickles are classified into two classes: (i) Plain and (ii) Serrated. Blade is the main metallic part of the sickle. It is desirable to make the blade made of carbon steel. The blade is made in a curved shape. The teeth of serrated sickle are made sharp for efficient working in the field. The handle of the sickle is made of well-seasoned wood. The forged end of the blade for fixing the handle is called tang. The plain or serrated edge in the inner side of the blade is called cutting edge. Protective metallic bush fitted at the junction of the blade and the handle to keep the tang tight in the handle is called ferrule. Harvesting by sickle is a very slow and labour consuming device.



Sickle

Mower:

Mower is a machine to cut herbage crops and leave them in swath.

There are different types of mower used in different ways such as: (i) Cylinder mower (ii) Reciprocating mower (iii) Horizontal rotary mower (iv) Gang mower and (v) Flail mower.

Cylinder mower: It has rotating helical blades arranged in horizontal cylindrical form. With the rotation of blades, forage or grasses are cut continuously.

Reciprocating mower: It is a mower with a knife having sections that reciprocate against stationary fingers. It is most common type of mower used everywhere.

Horizontal rotary mower: It is a mower with high speed knife rotating in the horizontal plane. Due to rotation of knife, the grasses and forage are cut in uniform way.

Gang mower: It is an assembly of two or more ground driven cylinder mowers.

Flail mower: It is a mower with high speed swinging knives, operating either in a horizontal plane or around a horizontal cylinder.

Conventional Type of Mower

The conventional mower mainly consists of : (i) Frame (ii) Power transmitting unit (iii) Cutting bar (iv) Shoes (v) Ledger plate (vi) Wearing plate (vii) Knife (viii) Grass board and (ix) Pitman.

Frame

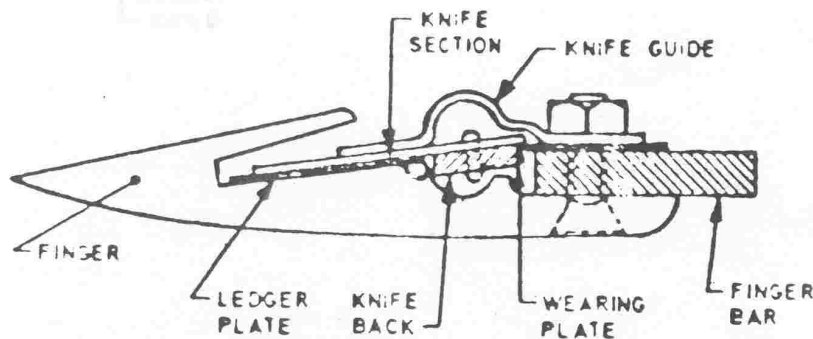
The frame provides space for gears, clutch and bearings. The lever for lifting the cutting bar is attached to the frame. A flywheel is used to store energy to provide steady speed to the cutting mechanism.

Power transmitting unit

The power-transmitting unit consists of axle, gears, crank wheel, crankshaft and pitman. Tractor drawn semi-mounted or mounted type mowers are operated by P.T.O. shaft. In this case, the cutting mechanism is driven independently of the forward speed of the mower. A shaft is connected with the P.T.O. shaft which drives a pulley with the help of an universal joint. This V pulley rotates another smaller pulley on the crankshaft of the machine and reciprocating motion is transmitted to the cutter bar.

Cutter bar

It is an assembly comprising of fingers, knife guides, on wearing plates and shoes. It is used for cutting grasses and forage. It is made of high grade steel. It works like a knife. The knife is a metal bar, on which triangular sections are mounted. The knife section makes reciprocating motion and cuts the plants. There are knife guards, provided on the cutter bar. The knife stops at the centre of the guard on each stroke. There are ledger plates provided with the knife guard, on which the knife moves. Knife clips hold the sections down against the ledger plates. Knife clips are placed with wearing plates spaced 20 to 30 cm apart.



Cutter bar

Shoe - A shoe on each end of the cutter bar is always provided to regulate the height of cut above the ground. The inner shoe is larger in section and is placed at the inner end of the cutter bar. The outer shoe is placed at the outer end and is smaller in section.

Ledger plate - It is a hardened metal inserted in a guard (finger) over which knife sections move to give a scissor like cutting action.

Wearing plate -It is a hardened steel plate attached to the finger bar to form a bearing surface for the back of the knife.

Knife - It is the reciprocating part of the cutter bar, comprising of knife head, knife back and knife sections.

Knife section - It is a flat steel plate (triangular shape) with two cutting edges.

Knife head - It is the portion of the knife which is connected to the pitman.

Knife back - It is the strip of steel to which knife sections are riveted and the knife head is attached.

Grass board - Grass board is provided at the cutter end of the mower which causes the cut plants to fall towards the cut material. Shoes are provided for easy and smooth sliding of the cutter bar.

Pitman -Pitman is a type of connecting rod which is pinned to the crankshaft with the help of a pin. It transmits reciprocating motion to a knife head. Wooden pitman is commonly used for the mowers.

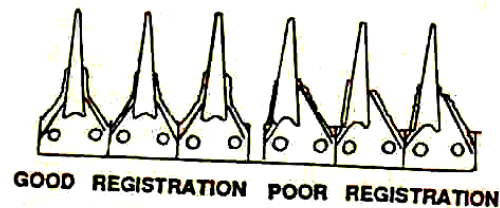
Breaking of knives - Breaking of knives is a common troubles in operation of a mower. It is caused due to play in bearings and worn knife head holders. Non-alignment is an important cause for breaking the knife because when the mower is out of alignment, it works on a certain angle which is always harmful.

Alignment of mower

Under working condition of the mower, the standing crops exert pressure on the cutter bar tending to push it backward. In correct operating position, the crankpin, knife head and the outer end of the knife should be in a straight line. This line should be at right angle to the direction of travel of the mower. For achieving this object, the cutter bar is set at about 88° to the direction of motion i.e. inward lead of 2° is given to it in order to overcome the back pushing action of the crops. When the cutter bar is properly aligned, the knife and the pitman run in a straight line. This gives better cutting in the field. Generally 2cm lead per meter length of cutter bar is recommended.

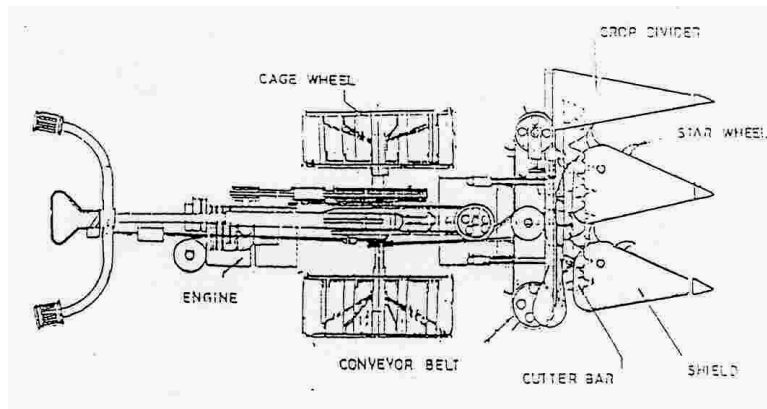
Registration of mower

A mower knife is said to be in proper *registration* when the knife section stops in the centre of its guard on every stroke i.e. the centre of the knife section is at the centre of the guard, when it is in operating condition. Adjustment is commonly made by moving the entire cutter bar in or out with respect to the pitman. If mower is not well registered, there is unbalanced load, uneven harvesting and excessive clogging of crops on the knife.



Registration of mower

Vertical conveyer reaper (Self operated/Tractor mounted): It is mostly used for harvesting paddy and wheat. The reaper is front mounted at the tractor, which can be lowered and raised by the hydraulic control. It is powered by the PTO of the tractor. Crop is guided by the star wheel to the cutter bar and held in vertical position by the springs. The crop is conveyed to the side by the conveyer belt. Its capacity may be 0.4-0.6 ha/h.



Self operated VCR

Vertical conveyer reaper (Power tiller operated): It can be used for harvesting wheat and paddy. The reaper is front mounted on the power tiller. Power is transmitted from the engine fly wheel to the reaper either through V belt or by providing gear box and propeller shafts. Crop is guided by the star wheels to the cutter bar and held in vertical position by the springs. The crop is conveyed to the side by the conveyor belt. Cutter bar length may be 100-160 cm. The capacity may be 0.25-0.35 ha/h.

Reaper binder: It cuts and binds the crop simultaneously. It cuts the crop at the height of about 10 cm from the ground level. The harvesting capacity is 0.25-0.35 ha/h.

Groundnut digger shaker: It is used for digging of groundnut crop. It is a tractor mounted PTO operated machine, suited for harvesting of both erect and spreading varieties of groundnut crop, grown in all types of soil. It consists of digging blade and a spike tooth conveyor.

Potato digger elevator: It is used for digging and windrowing the potatoes. The equipment is a PTO operated single row machine. The machine consists of cutting blade and elevator roller chain of iron bars. The potatoes are dug by the blade and lifted to a conveyor which is under periodic shaking. The potatoes are delivered at the rear of machine and collected manually. It is a tractor rear mounted PTO driven machine. Its capacity may be 0.15-0.2 ha/h. It can be operated by a 20-25 hp tractor. The groundnut vines are loosened by the blade and whole crop is lifted and Shaken by conveyor chain to remove all the soils. Thereafter the vines free of soil are dropped and windrowed behind the machine. The vines are collected manually.

THRESHING

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. Clean un-bruised grain fetch good price in the market as well as it has long storage life.

Traditional threshing methods

Trampling of paddy under feet, beating shelves of rice or wheat crop on hard slant surface, beating crop with a flail, treading a layer of 15 to 20 cm thick harvested crop by a team of animals are traditional methods followed by farmers depending upon capacity, lot size and situation. Tractor in many places is now used in place of animals for treading. Introduction of animal drawn olpad thresher reduced the drudgery of the operator and gave comparatively higher output per unit time. In all above methods the threshed materials are subjected to winnowing either in natural wind flow or blast from winnowing fan for separation of grain from straw. Threshing wheat by traditional method involves drudgery and takes more time to obtain required quality of bhusa. Due to these, mechanical threshers are widely accepted by the farmers.

Different parts of a thresher and their functions

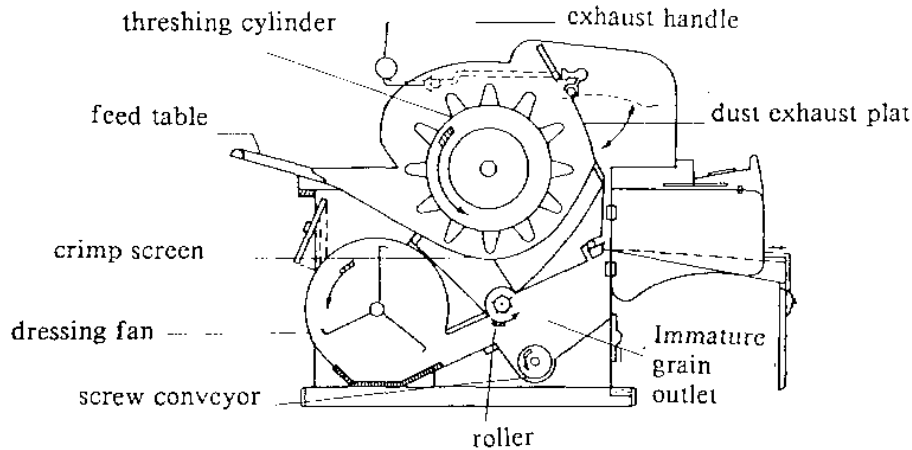
A mechanical thresher consists of the following parts i. Feeding device (chute/tray/trough/hopper /conveyor) ii. Threshing cylinder (hammers/spikes/rasp-bars/wire-loops/syndicator) iii. Concave (woven-wire mesh/punched sheet/welded square bars) iv. Blower/aspirator v. Sieve-shaker/straw-walker.

Working principle of a thresher

During operation, the crop material is slightly pushed into the threshing cylinder through the feeding chute, which gets into the working slit created between the circumference of the revolving drum having attached spikes and the upper casing. The speed of the spikes is greater than the plant mass due to which they strike the latter which results in part of the grain being separated from straw. Simultaneously, the drum pulls the mass through the gap between the spikes and the upper casing with a varying speed. The angle iron ribs on the other hand, restrain the speed of the travelling of stalks clamped by the spikes. Due to this the spikes move in the working slit with a varying speed in relation to the shifting mass of material, which is simultaneously shifted, with a varying speed with respect to the upper casing. As a result, the material layer is struck several times by the spikes against the ribs, causing threshing of the major amount of grains and breaking stalks into pieces.

As the material layer shifts towards the progressively converging slit of lower concave, its size reduces. The vibration amplitudes, therefore, decrease where as the speed of the layer increases. This causes mutual rubbing of the ear stalks, as well as rubbing of the ears against the edges of the concave bars and causes breaking of stalks depending on the concave clearance. Since the system is closed, the thicker stalk, which

cannot be sieved through the concave, again joins the fresh stalk and the same process is repeated until the stalk size is reduced to the extent that it can pass through the concave apertures. Thus fine bruised straw is produced. The effective threshing process means that the loss of un-threshed kernels ejected with the straw through the concave and the loss of grain damage should be low and the amount of the material passed through the concave should be high.



Power thresher

Adjustments

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.

Different type of thresher and their suitability for crops

The type of thresher is generally designed according to the type of threshing cylinder fitted with the machine. The major type of threshers commercially available is as follows:

i. Drummy type

It consists of beaters mounted on a shaft which rotates inside a closed casing and concave.

ii. Hammer mill type

It is similar to dummy type but it is provided with aspirator type blower and sieve shaker assembly for cleaning grains.

iii. Spike-tooth type

Spikes are mounted on the periphery of a cylinder that rotates inside a closed casing and concave. It is provided with cleaning sieves and aspirator type blower.

iv. Raspbar type

Corrugated bars are mounted axially on the periphery of the cylinder. It is fitted with an upper casing and an open type concave at the bottom of the cylinder. The cleaning system is provided with blower fan and straw walker.

v. Wire-loop type

Wire-loops are fitted on the periphery of a closed type cylinder and woven wire mesh type concave is provided at the bottom.

vi. Axial flow type

It consists of spike tooth cylinder, woven-wire mesh concave and upper casing provided with helical louvers.

vii. Syndicator type

The cylinder consists of a flywheel with corrugation on its periphery and sides, which rotates inside a closed casing and concave. The rims of the flywheel are fitted with chopping blades.

Factors affecting thresher performance

The factors which affect the quality and efficiency of threshing are broadly classified in three groups:

i. Crop factors: Variety of crop, Moisture in crop material.

ii. Machine factors: Feeding chute angle, Cylinder type, Cylinder diameter, Spike shape, size, number Concave size, shape and clearance

iii. Operational factors: Cylinder speed, Feed rate, method of feeding, Machine adjustments.

COMBINE

It is a machine designed for harvesting, threshing, separating, cleaning and collecting grains while moving through standing crops. Bagging arrangement may be provided with a pick up attachment. The main functions of a combine are:

- (i) Cutting the standing crops
- (ii) Feeding the cut crops to threshing unit
- (iii) Threshing the crops
- (iv) Cleaning the grains from straw
- (v) collecting the grains in a container.

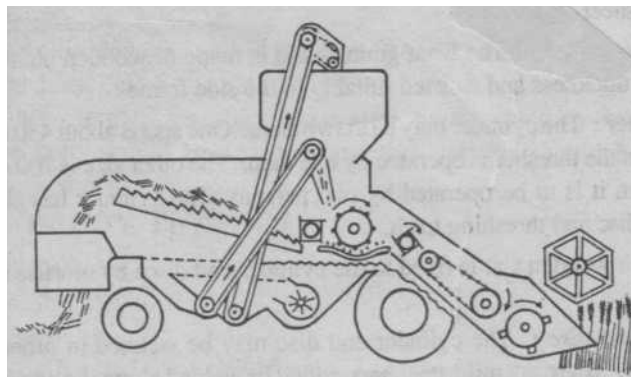
The whole machine is composed of the following components:

(1) Header (2) Reel (3) Cutter bar (4) Elevator canvas (5) Feeder canvas (6) Feeding drum (7) Threshing drum (8) Concave unit (9) Fan (10) Chaffer sieve (11) Grain sieve (12) Grain auger (13) Tailing auger (14) Tail board (15) Straw spreader (16) Return conveyor (17) Shaker (18) Grain elevator (19) Grain container.

Header is used to cut and gather the grain and deliver it to the threshing cylinder. The straw is pushed back on the platform by the reel. Small combines use *scoop type* headers, while large combines use T type headers with auger tables.

Harvesting is done by a cutting unit, which uses a cutter bar similar to that of a mower. The knife has got serrated edge to prevent the straw from slipping while in operation. There is suitable cutting platform which is provided with a reel and a canvas. The reel is made of wooden slats which help in feeding the crops to the cutting platform. The reel gets power through suitable gears and shafts. The reel revolves in front of the cutter bar, while working in the field. The reel pushes the standing crops towards the cutting unit. The reels are adjustable up and down as in or out. The cutter bar of the combine operates like a cutter bar of a mower. It cuts the standing crops and pushes them towards the conveyor. The conveyor feeds the crop to the cylinder and concave unit. The grain is swept underneath the augers and conveyed behind them. The threshing takes place between the cylinder and concave unit of the combine. The basic components of the threshing unit of the combine are similar to a power thresher. As soon as the crops are threshed, the threshed materials move to a straw rake. These rakes keep on oscillating and separating the grains. The cleaning unit consists of a number of sieves and a fan. The cleaning takes place on these sieves with the help of the fan. The un-threshed grains pass through tailing augur and go for re-threshing. The clean grains pass through grain elevator and finally go to packing unit. Grains are collected in a hopper provided at suitable place. The fan is adjusted such that the chaff etc is blown off to the rear side of the machine. The size of the combine is indicated by the width of cut, it covers in the field.

A combine may be (i) Self propelled type and (ii) P T O driven type.



Combine