UNIT 1 MILLING MACHINES-1

Structure

1.0 OBJECTIVES

After reading this unit you should be able to:

- know the systems and machineries used for loading and unloading of food grains in bulk;
- know about the usage of control apparatus for weighing different kinds of grains by using auto grain weigher; and
- understand the separation of impurities in the grain using cleaning equipments, sieving machineries and separators.

1.1 INTRODUCTION

Rapid advancement in the technology of flour milling results in simplifications of the milling process. It is possible due to improvement in the machine design, capacity, efficiency, power consumption etc., to meet the present needs. Hence in the flour mill, it is a challenging task in selecting the best machine and achieve the optimum performance. It is necessary to maintain the machines to minimize the breakdowns and achieve best performances. Milling process involves various machineries which differ in make, type, design and model. But basic working principles but the functions and operations remains same.

1.2 LOADING AND UNLOADING SYSTEM FOR FOOD GRAINS IN BULK

Lay day of ship in the port is an expensive affair. Hence ship to be loaded / unloaded in a very short period. High capacity loading / unloading systems are installed (approximately 200 MT/hr to 1200 MT/hr) in most of the ports all over the world.

For loading and unloading of food grains in bulk the following systems are used.

(i) Systems without installing on **pier**.

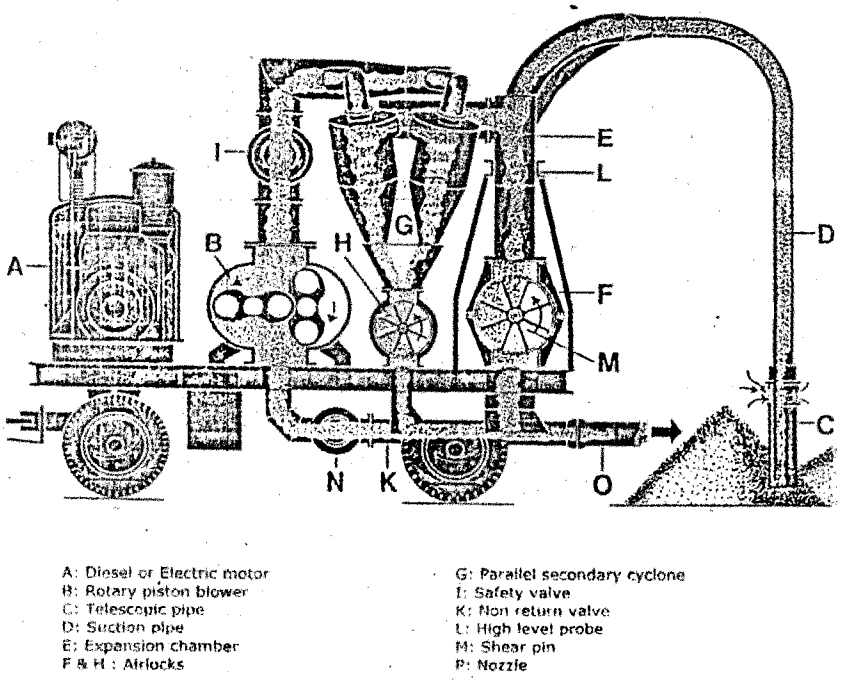
Ex: Mobile pneumatic unloading unit

(ii) Systems with installations on pier (Mobile or stationary)

Ex: Pneumatic unloading, mechanical unloading

1.3 MOBILE PNEUMATIC UNIT

Mobile pneumatic unit unloading system uses air as transporting media to unload the grain in bulk.



A: Diesel or Electric motor
B: Rotary piston blower
C: Telescopic pipe
D: Suction pipe
E: Expansion chamber
F & H : Airlocks
G: Parallel secondary cyclone
I: Safety valve
K: Non return valve
L: High level probe
M: Shear pin
P: Nozzle

Fig. 1: Mobile Pneumatic Unit

Mobile pneumatic unit consists of:

(i) Platform on wheels

(ii) Diesel or electric motor

(iii) Blower or turbo blower

(iv) Cyclone with air locks

(v) Noise absorber

Blower in the mobile pneumatic unit is driven by a diesel / an electric motor. Blower creates suction pressure in the lines and air starts moving from cutting nozzle 'C', through telescopic pipe D. Air locks 'H' & 'M' are also driven by the same motor / diesel engine with appropriate reduction in r.p.m. (speed).

Cutting nozzle 'C' with telescopic pipe is inserted into the wheat. Air, along with product entres expansion chamber 'E'. In the expansion chamber velocity of the product reduces and certain quantity of wheat falls down and goes out to the pipe 'O' through an air lock remaining wheat and air mixture enters the parallel secondary cyclones tangentrally. Tangential entry in the cyclones makes wheat and air to form an outer vortex. Due to centrifugal force and the gravity force wheat falls down and reaches pipe 'O' through an air lock. The dust along with air forms an inner vortex and passes through the filter which is fitted on the thimble of cyclone. Filtered air enters the blower 'B'. The out put of the blower is connected to the

pipe 'O' and pushes the wheat which was delivered from air locks to the desired destination. Non return valve 'K' is provided to avoid back entry of wheat. Level process are installed to sense the 'Choke' of wheat in the system. Shear pins are provided in the air locks for the safety. If the air locks are over loaded shear pins gets sheared and stops the air locks operation.

1.4 PNEUMATIC GRAIN DISCHARGER

Pneumatic unloading is very much liked unloading system on account of its movability, its dust free operation and the good residue clean up. Mixture of grain and air passes through the nozzle and reaches filter system. In filter system separation of grain and dust takes place, and grain goes out through an air lock. Dust laden air gets filtered in the filter unit and clean air is either recycled or led to the atmosphere.

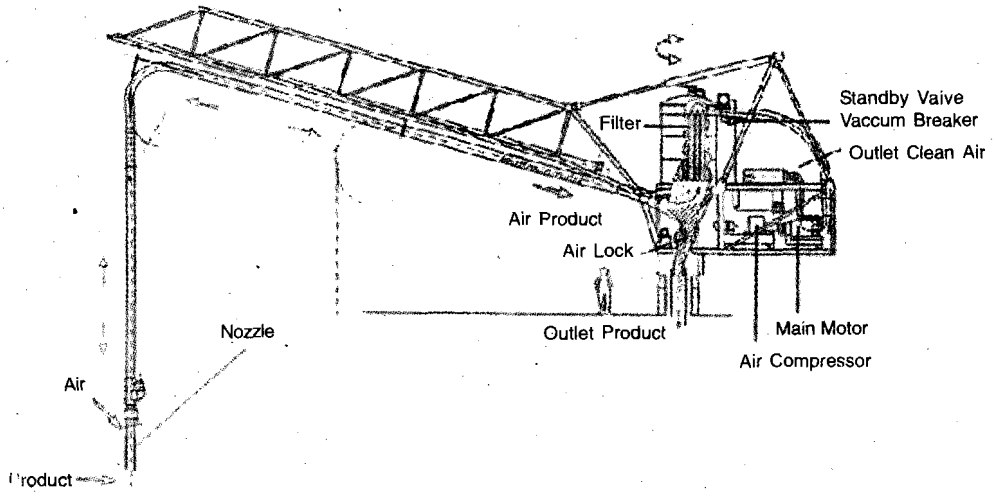


Fig. 2: Pneumatic Grain Discharger

1.5 MECHANICAL UNLOADING

Mechanical unloading of grain in bulk is carried out with the help of chain conveyors. Chain conveyors handling capacities is very high at lower power consumption.

Chain conveyor is put into place where wheat to be unloaded and can be positioned any where on the ship with the help of a crane. Chain conveyor lifts the wheat. Wheat from the outlet of the chain conveyor is fed to the horizontal chain conveyor by gravity. From the horizontal chain conveyor wheat is loaded to the truck or wagon on which are stationed between the rails.

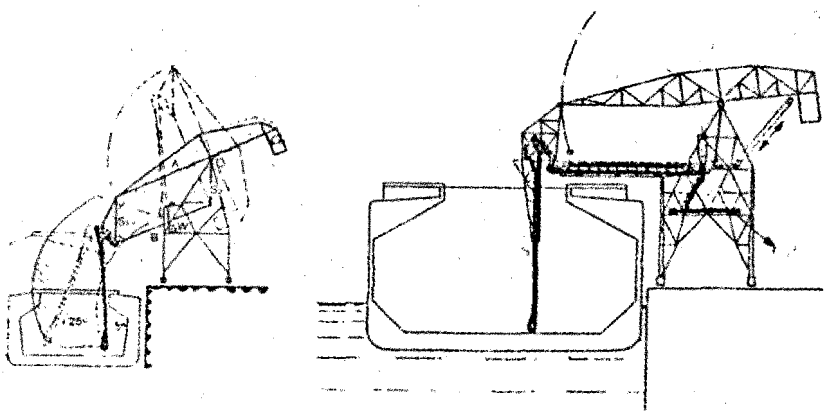


Fig. 3: Mechanical Unloading Unit

1.6 AUTO GRAIN WEIGHER

Auto grain weigher is used in *silos,* grain cleaning sections, and mills for weighing of the grains. The capacity varies from 10 kg to 1000 kg per tipping. Auto grain weigher works on the basic principle of simple balancing. Auto grain weigher consists of a horizontal beam with a pointer at the center. Weight tray is attached to one end of the beam and load hopper on the other end. Grain feeding mechanism is used to feed the hopper.

A known weight is placed on the weight tray. Horizontal beam gets imbalanced. Wheat from the feed hopper flows initially in rapid and fills 90% of the hopper. Remaining 10% is followed by a fine feed and dribbling of the grain. When the weight of wheat equals with the weight in the weight tray, beam remains in equilibrium position i.e. pointer shows 'zero' on the scale. As and when the pointer reaches zero, it hits the toggle joint. Toggle joint actuates the gate arm and releases the load hopper hook. The shape of the hopper and the grain filled in the hopper alters the eccentric of the center of gravity, hopper starts tilling forward. The load hopper flap opens and discharges the wheat. The altered center of gravity of the empty hopper again shifts back and the load hopper swings back for filling position. Flap gate lever opens, feeding of grain takes place and new weighing operation starts.

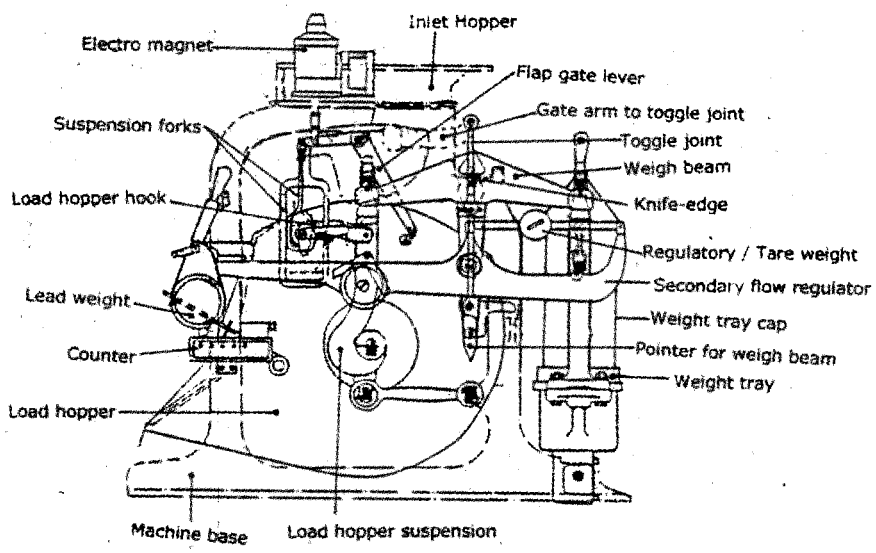


Fig. 4: Auto Grain Weigher

1.7 CLEANING EQUIPMENTS

In flour milling, it is essential to clean the wheat thoroughly prior to milling to get quality products.

Cleaning equipments are used to clean the wheat by

- Removing dust from the surface of the grain. Methods used are washing, brushing and aspiration.
- Removing damaged, shrivelled wheat and all impurities.

Cleaning equipments works on the basic principles of

- **Size:** Impurities separations by size is carried out using sieves covered by wire mesh (or) perforated metal sheets.

- **Specific gravity:** Impurities which are similar in size and shape to wheat but differ in weight.
- **Shape:** Impurities separations by shape is carried out by passing grain over (a) indented metal surface (b) inclined spiral
- **Magnetic property:** Ferrous particles are removed by passing grain over a magnet.
- **Air resistance:** Impurities like chaffs, straw, light grains and dust having less resistance to air current than wheat are separated by selective aspiration.

Above basic principles of separation, effectively separate impurities from the grain. Apart from the basic principles, washing with water and dry scouring with aspirations removes crease dirt and surface dirt respectively.

1.8 SIEVING MACHINES

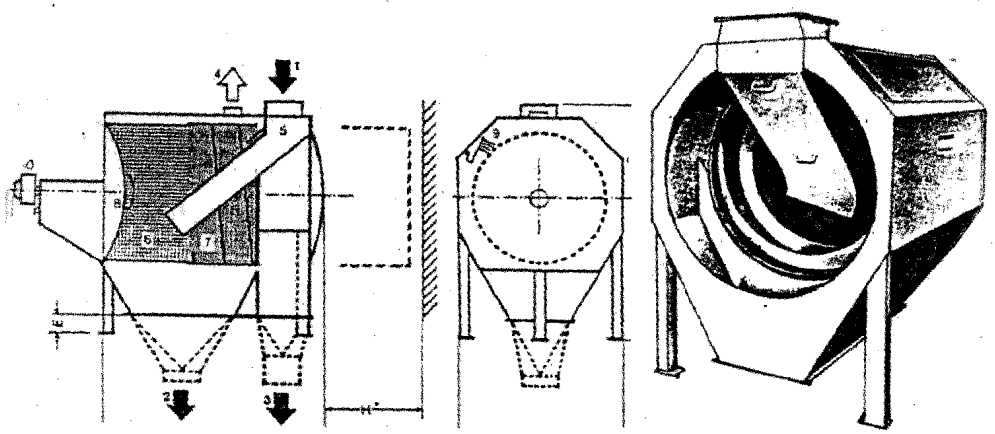
Machines with different mechanical arrangements of sieves are used to separate impurities in the grain according to size. Sieves are made up of perforated sheet metal or wire cloth. Machines are constructed with rotating, oscillatory and combination of both motions.

A Reel machine is a cylindrical or polygonal screening surface rotating about is axis. The rolling, turning motion of the reel and reel inclination in the horizontal axis causes the material to run through the screen.

In earlier days flat riddles were used to remove the impurities from wheat. As the technology advanced, separators were developed and induced in the industry.

In hand riddling grain, either rotary or gyratory action is used. The same principle is used in separators. Separators consisted of a box, either with single layer or double layer perforated sheets. Perforated sheets are selected based on types of impurities to be removed.

1.8.1 Preliminary cleaning machines for the removal of coarse admixtures Drum sieve



(1) Product inlet, (2) throughs, (3) tailings, (4) vent opening, (5) inlet spout, (6) feed cylinder, (7) discharge cylinder with guide spiral, (8) dome shaped cover, (9) brush, (10) geared motor

Fig. 5: Preliminary Cleaning Machine

Drum sieve is used to separate coarse impurities such as straw particles, string, paper, pieces of wood, maize etc.

The machine consisted of a horizontal, over hung sieve drum, which rotates in an enclosed housing. This drum is made up of perforated sheet (or) set of various size meshes to remove different types of impurities. Brush separator is used to clean and keep, the mesh opening. The sieve drum is further subdivided into feed cylinder and discharge cylinder wheat along with impurities enters into the rotating drum through wheat inlet spout. Fines drops through the mesh, where as coarser impurities tails over. The guide spiral located in front of the outlet assists to discharge the coarser impurities and prevents the inclusion of finer impurities.

Features

- High capacity with minimal space and power requirements.
- Rigid and maintenance free construction.

1.8.2 Scalper aspirator

Scalper aspiratiors are used in pre-cleaning where large amount of coarse admixtures are present in the grain.

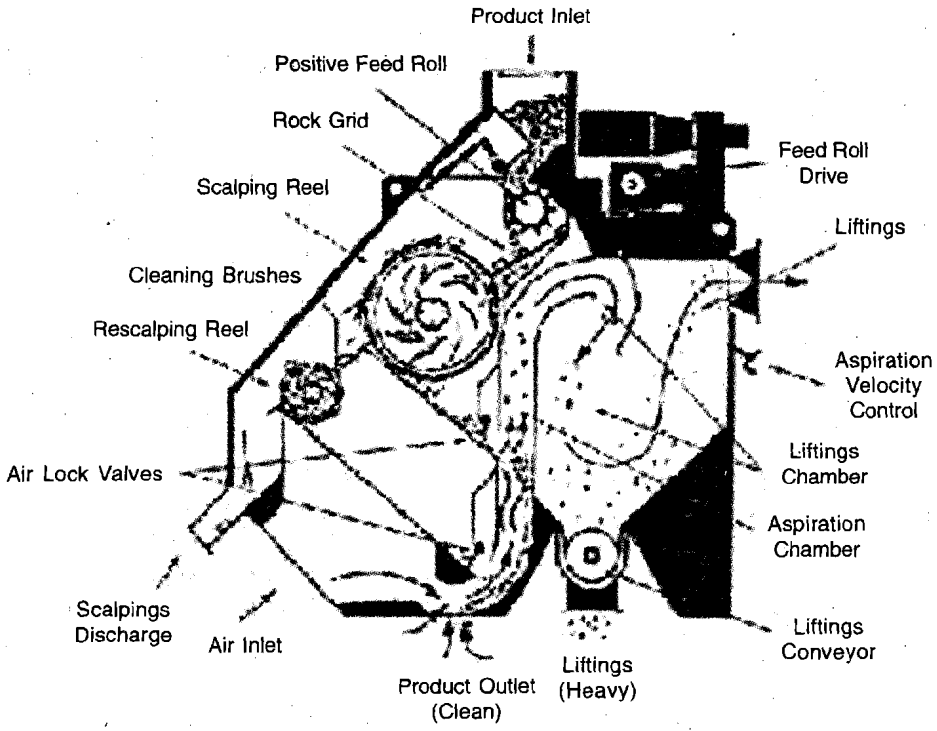


Fig. 6: Scalper Aspirator

Positive feed roll, feeds the product from the inlet to the scalping reel. Scalping reels are covered with wire mesh sieve. Coarser impurities remains on the drum and conveyed to the rescalping reel. In rescalping reel the tailed over grain which comes along with coarse impurities are regained, before sending the coarse admixture to the discharge outlet i.e. scalping discharge. Throughs of the scalping reel are subjected to air resistance (aspirator) before reaching product outlet. Lighter impurities like dust, chaff etc., are carried away by the air, enters the expansion chamber (lifting chamber). In the expansion chamber heavier particles settles down and are conveyed by the lifting conveyor. Air with dust is discharged through the air discharger for further treatment.

1.8.3 Milling Separator

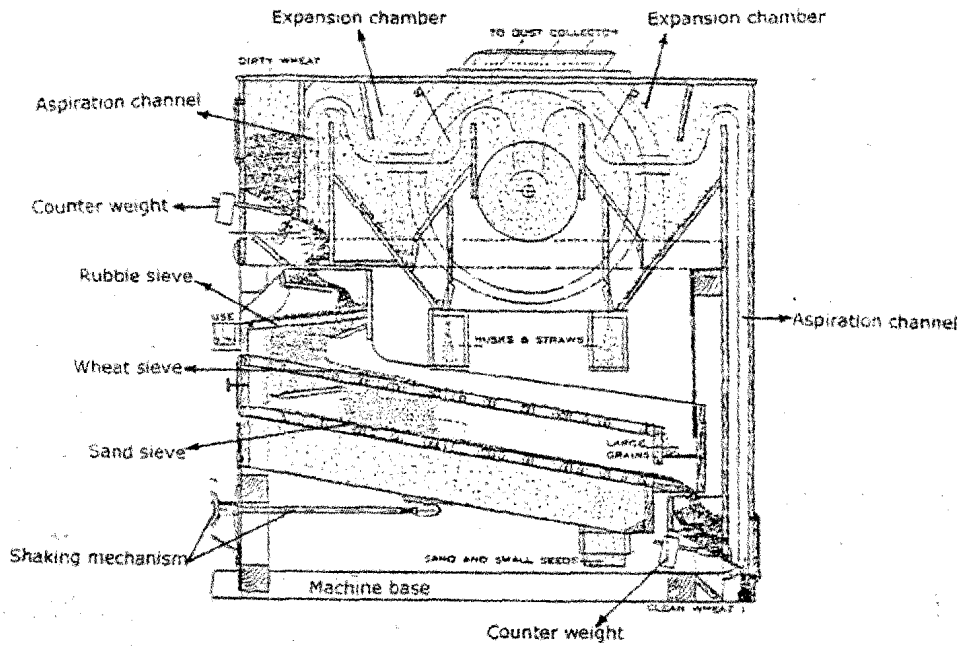


Fig. 7: Milling Separator

The main parts of milling separator are stand, inlet disposition, oscillator, inlet and outlet aspiration with separate expansion chambers.

Grain enters the machine through a cascade and reaches inlet flap. Inlet flap is having a counter weight flap to feed uniform or M layer of grain into the unit. Grain is aspirated before reaching sieve box.

The oscillator sieve box is suspended to the stand with the help of four flat springs and is driven by oscillatory drive mechanism.

Sieve box consists of three sieve layers.

(a) **Rubble sieve:** To remove coarser impurities.

(b) **Wheat sieve** To remove impurities longer than wheat but smaller than rubble sieve size.

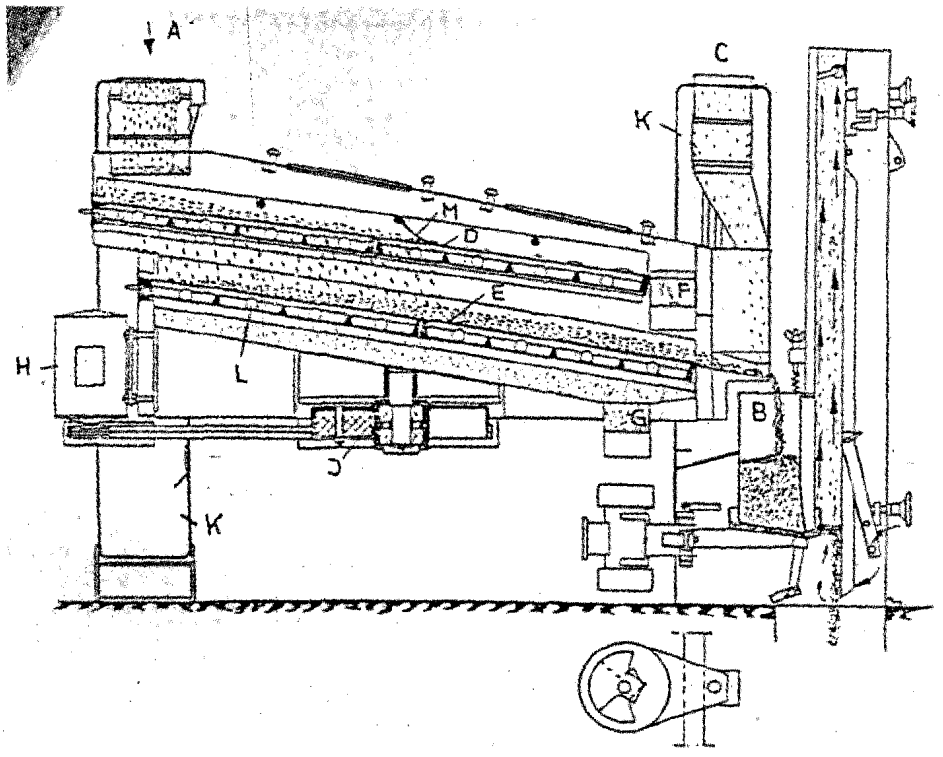
(c) **Sand sieve:** To remove sand.

Sieves are made up of perforated sheet and are kept cleaned during operation with the help of rubber balls (sieve cleaner).

Wheat which is coming out of sand sieve (as over tail) is uniformly distributed to the outlet aspiration system with the help of counter weight flap mechanism. Lighter impurities are carried away by the aspiration channel and to the expansion chamber. The inlet and outlet aspirations are connected to a different expansion chambers where in which heavier impurities settle down. Dusty air passes through dust collector for further separation of dust from air. Finger flaps are provided in the expansion chamber for the discharge of settled coarser impurities.

1.9 SEPARATORS – TYPES, MAGNETIC, DRY DESTONER, TRIEURS, CARTER DISC

1.9.1 Separator with rotating movement



(A) Inlet of grain to be cleaned, (B) Outlet for cleaned product, (C) Connection for the aspiration of the machine, (D) Coarse sieve, (E) Fine (Sand) sieve, (F) Lateral outlet for coarser impurities, (G) Lateral outlet for finer impurities, (H) Electric motor, (J) Fly wheel, (K) Steel frame (machine base), (L) Rubber ball, (M) Curtain screen

Fig. 8: Separator with Rotating Movement

Separator works on the basic principle of impurities separation by size. Separator with rotating sieve movement consists of only two layers. Sieve box with two sieves (rubble and sand sieve) is suspended from a steel base stand with the help of four cane rods or fiber glass rods. Sieve box swings freely, with the help of a flywheel and a built-in motor. Sieves are fastened to the sieve box with the help of eccentric tightening device. Due to the rotating (gyratory) movement, the product spreads uniformly and automatically, on the sieve.

Wheat directly comes on to the distribution plate where the velocity of wheat is reduced and diverted to the top sieve. Top sieve sorts out all the admixtures that are bigger than wheat and goes as overtail through a lateral cross channel at the end of the sieve. Throughs from the top sieve falls on to the bottom sieve (generally known as sand sieve), where fine seeds and sand falls through and are collected and discharged by the lower cross channel. Wheat overtails and subjected to slight aspirations while leaving the separator.

Rubber balls are used as sieve cleaning mechanism. They randomly move on the wire grid supports and hits the mesh. This impact of the rubber balls on the wire mesh creates vibrations in the sieve and keeps the sieve openings clean.

Separators of various sizes are available and is built with a sieve length of 1000 MM to 1500 MM and sieve width from 500 MM upto 2 x 1500 MM.

1.9.2 Aspiration channel attached to the separator

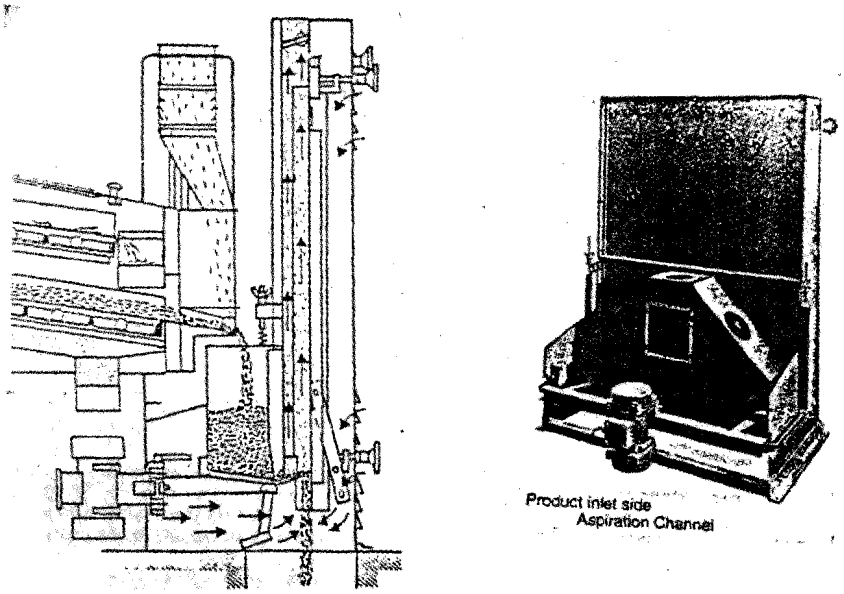


Fig. 9: Aspiration Channel

Aspiration channel works on the basic principle of impurities separation by air resistance. Aspiration channel is used for the separation of lighter impurities from grainy products. Wheat from the separator is passed to the oscillating feeder. Oscillating feeder delivers and spread the products uniformly over the entire width of the aspiration channel. Lighter particles are carried away by the aspirating air flowing through the channel and the aspirated product (wheat) drops to the outlet.

Aspiration channel works on the basic equation of Q=AV
Where Q = Quantity of air in M^3/Min.
A = Area of cross section in M^2 through which air flows
V = Velocity of air in metre / sec.

In the above equation, keeping 'Q' as constant and minimum value, velocity of air can be changed.

i.e. is $V = \frac{Q}{A}$

Velocity of air is inversely proportional to the area of cross section. As the area increases velocity decreases and vice versa.

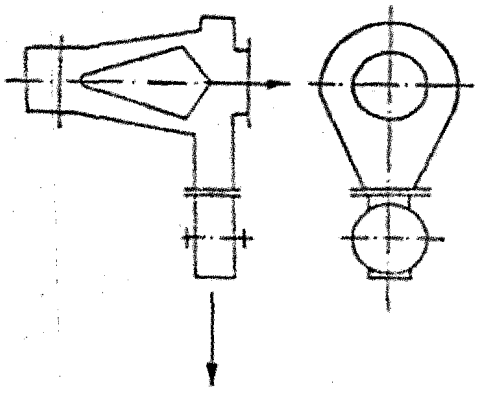
Hence optimum aspiration of the product can be achieved by adjusting rear wall of the aspiration channel (By altering channel cross sectional area) which in turn vary the velocity of flowing air.

1.9.3 Intermediate separator

The exhaust from the aspiration channel contains all separated (air lifted) lighter impurities. These may deposit in the aspiration ducts and if filters are used, they cause wear and tear on the filter sleeves.

Intermediate separators are used very close to the aspiration channel in the air suction ducts and eliminates the heavier impurities either by centrifugal force (or) by expansion chamber and allows only dusting air aspiration to the filter. Advantage

of the intermediate separator is that the separating efficiency of aspiration channel can be checked very close to the machine.



1.9.4 Separator with vibrating motor

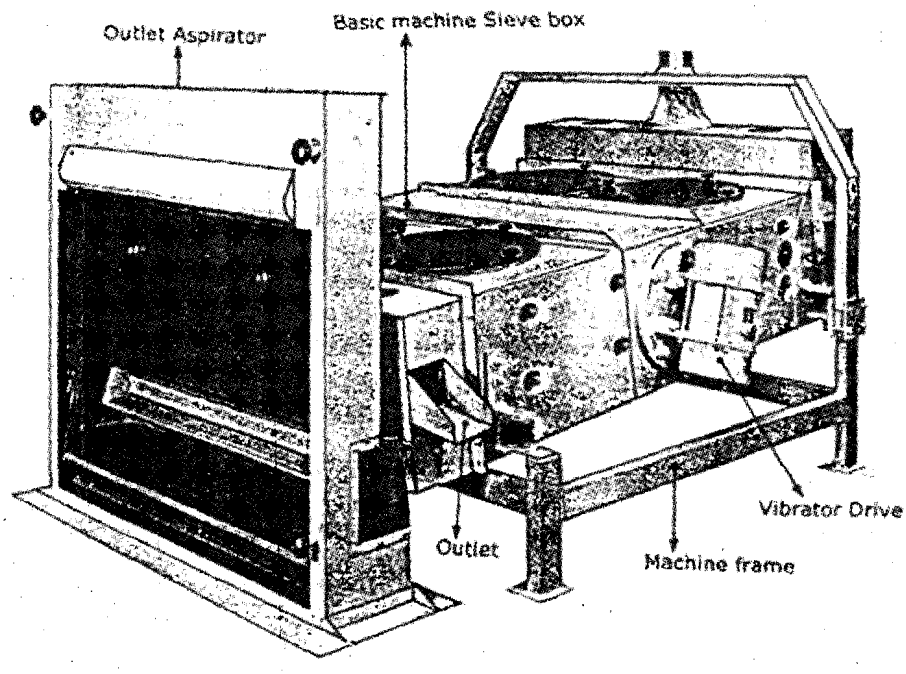


Fig. 11: Separator with Vibrating Motor

Separator with vibrating motor consisting of steel frame, sieve box, inlet, outlet, vibrating drive and the aspirator.

Free swinging sieve box with unidirectional screen motion is supported on hollow rubber cylinders. Perforated sheets (sieves) are exchangeable and are available in round, slotted (or) triangular. Perforated sieves are mounted on a wooden frame base with ball support grid. Rubber balls are used as sieve cleaning mechanism.

Unidirectional sieve box motion is obtained by mounting vibrators in the center of gravity of the machine. Stock is fed by a gravity spout into the center of the inlet box oscillating with the machine. Distribution flap distributes the block across the entire width of the screen and the stock flows over the upper sieve. The throughs from the upper sieve falls on to the lower sieve, while overtails are discharged laterally through the outlet section. The throughs of the lower sieve (sand, round

seeds etc.) drops on the bottom and are removed at the center of the outlet section. Overtailing from the bottom sieve are sent to the outlet section to the aspirator (or) to the aspiration box. Throw angle and stroke length of the sieve box can be adjusted by adjusting the vibromotor position.

1.9.5 Magnet separators

Magnet is a substance, which attracts ferrous particles. The phenomenon by which attraction takes place is known as Magnetism.
Magnetic materials: Iron, Steel, nickel, co-balt etc.,
Non magnetic materials: Aluminium, platinum, Tin, Zinc, gold, etc.,

1.9.6 Type of magnets

- Magnet
  - Natural magnet (found in nature)
  - Artificial magnet (created artificially)
    - Permanent magnet
      - (a) Bar magnet
      - (b) Horse shoe (or) 'U' magnet
      - (c) Needle magnet
    - Electro Magnet (electro magnet loses its magnetic properties when electricity is removed)

1.9.7 Horse shoe magnet

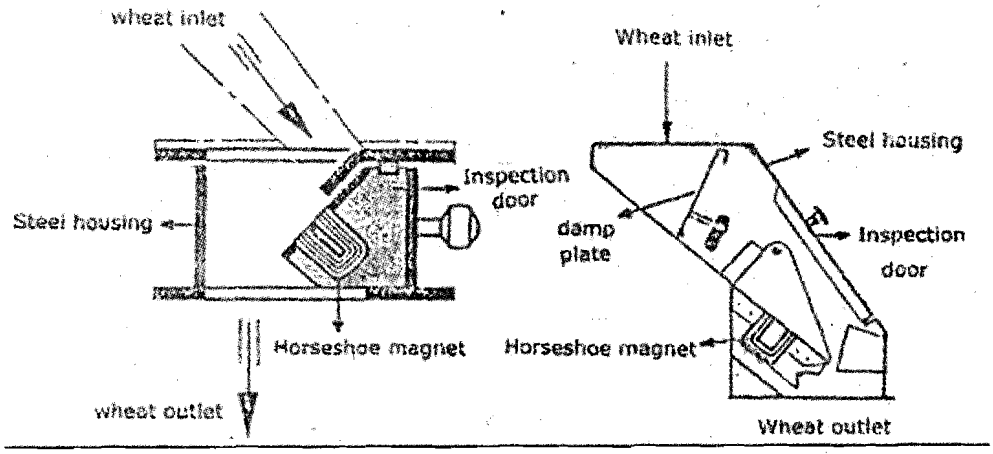


Fig. 12: Horse Shoe Magnet

Horse shoe magnet separator is very simple in construction. Number of horse shoe magnets are arranged in a row, over which slowed down, thin layer of grain stream flows. Ferrous particles get attached to the magnet.

Advantage: No drive is required

Disadvantage:

- Manual cleaning of magnet surface
- If not cleaned regularly, the attached ferrous particles slows down (or) even block the grain stream flow.

1.9.8 Rotary magnet

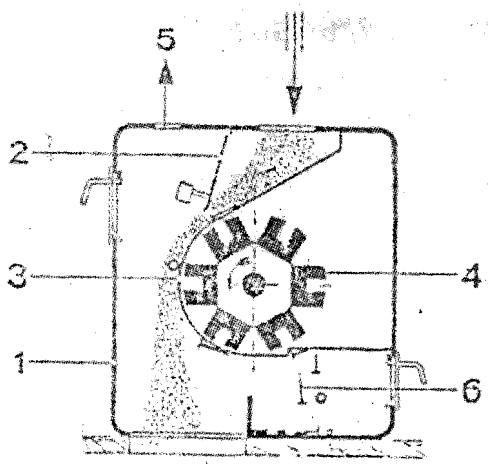


Fig. 13: Rotary Magnet

Wheat flows from the top and slide over the guiding plate, which is made up of non magnetic material. Damp plate with counter weight allows unform feeding of grain. Drum with horse shoe magnets rotates in the counter clock wise direction. Ferrous particles are attracted by the magnetic force of the horse shoe magnets, slide along the guide plate until they get out of the range of the magnetic field and drop down to a collecting tray.

Advantage: Automatic cleaning of magnet surface.

1.9.9 Stationary Magnet

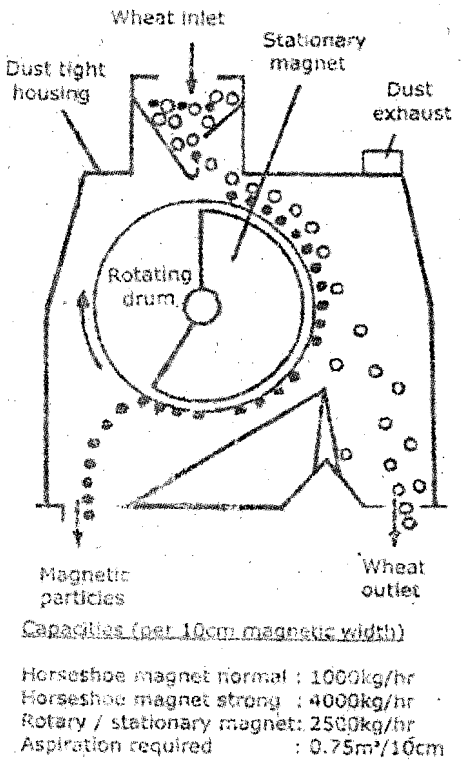


Fig. 14: Stationary Magnet

Wheat is fed through the hopper on to the surface of clockwise rotating drum. "C" shaped stationary magnet which occupies 2/3rd of drum surface is fixed at the center of the rotating drum. Non magnetic material (wheat) travelling down the feed hopper, falls on the drum and are thrown off to the wheat out let.

Magnetic particles sticks on to the rotating drum and remains on to drum until they get out of the magnetic field. Ferrous particles are collected in a tray which is placed under the rotating drum.

Advantage: Automatic cleaning of magnet surface.

1.9.10 Dry de-stoner

In the grain cleaning section, washing machine is eliminated due to raise in water cost, scarcity of fresh water and strict environmental pollution norms. Dry de-stoner are developed to separate stones from the grain and should separate at least 90% of the stones (upper limit of washer). Destoner works based on the principle of "specific gravity and air resistance principle of impurities separation". Grain entry to the de-stoner should be free from coarse and finer impurities. Fine seeds and stones of diameter lesser than 2 mm, clog the wire mesh openings of the table and affect the air distribution. With the elimination of stones the following machineries like trieur (or) carter indents are perfected from wear and tear.

Types of dry de-stoners:

1) Pressure type de-stoner
2) Vacuum dry de-stoner

1.9.11 Pressure type dry de-stoner

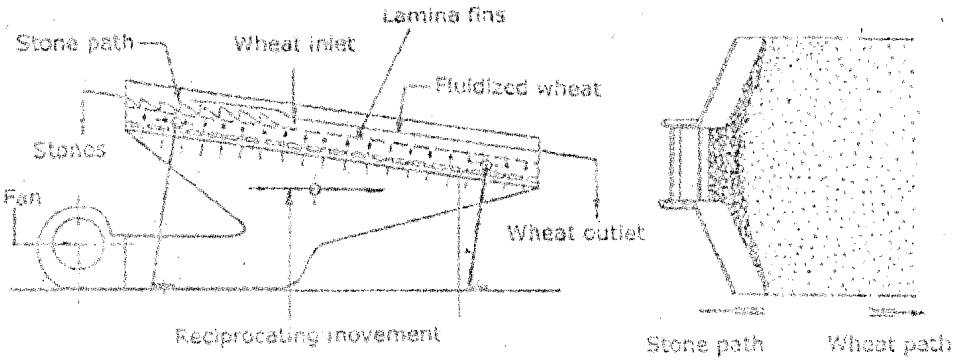


Fig. 15: Pressure Type Dry De-stoner

Machine consists of an inclined table covered with wire mesh, aspiration hood, oscillator drive and fan. The table is made to reciprocate and fan blows air from bottom through laminar fins. Wheat is made to fall on the center of table. Wheat supported by the air cushion flows downwards. Stones and other heavier particles like iron, aluminium and glass remains in touch with the wire mesh. Reciprocating movement of the inclined table causes heavy particles to skip upwards and forward them to the stone outlet.

A clear demarcation between the wheat and stone is possible by adjusting optimum deck angle, stroke and air adjustments. Small stones and earth clods cannot be separated from the wheat, as their weight difference is too small.

1.9.12 Vacuum dry de-stoner

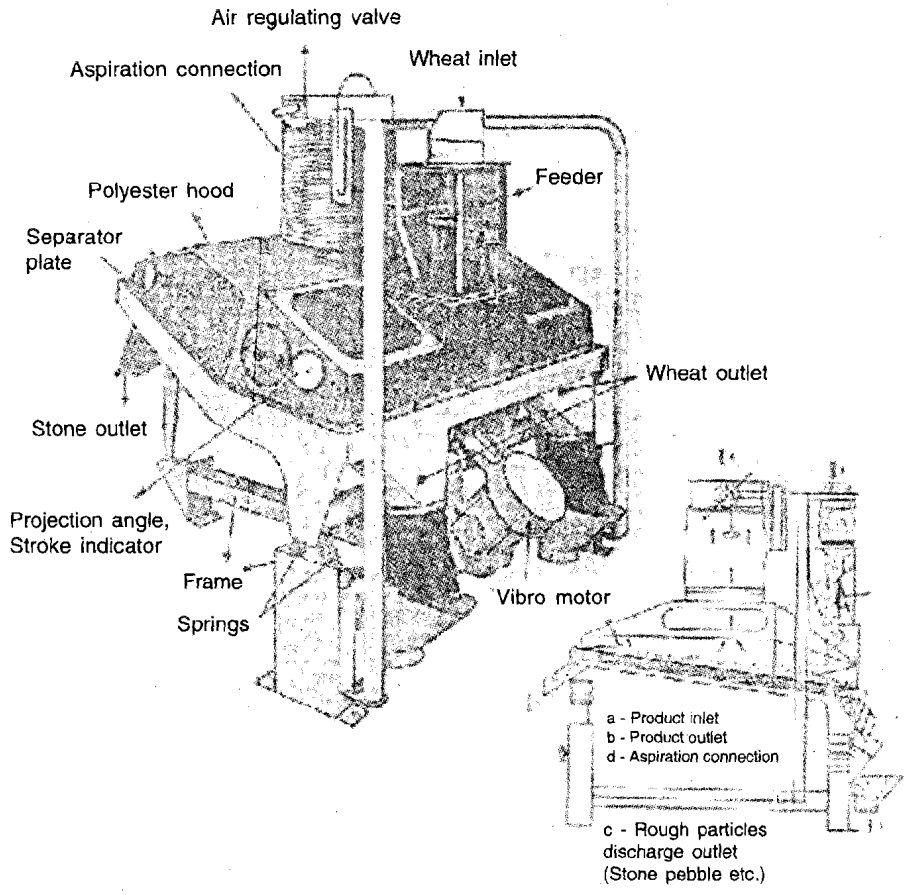


Fig. 16: Vacuum Dry-Destoner

Perfect working performance of the destoner is possible, only when the inlet and outlets of the destoner is constructed for minimum false air entry. Distribution of the air over deck, product layer thickness on the deck are very important, factors which are influenced by the capacity and the table inclination. Change in product thickness during the run, varies air resistance.

Wheat with stones and balls enters the separation plate through the inlet box. Capacity of the destoner can be fixed at the feeder with the help of spring flap mechanism. The separator plate is clothed with the wire mesh screen through which air steadily flows from below upward. Surrounding atmospheric air is made to pass through the sand which frame (deck). Sand which frame consists of an honey comb structure aluminium frame. One side (bottom) of frame is fixed with perforated sheet and the other side (top) with separator plate. Supported on a cushion of air, the product first passes through preliminary separation zone and then flow through the secondary separation zone to the product outlet. Due to oscillating motion of the frame and by air cushion, the product stratifies i.e. lighter material remain on top and heavier particles like stones, mudballs, aluminium pieces, glass etc., sinks down and remains in contact with the wire mesh. Oscillatory motion of the deck makes the heavier particles to jump and makes it to migrate to the final separation zone.

Wheat having similar specific gravity compared to heavier impurities also enters the final separation zone. By using means of counter flow of air, (flexiglass arrangement) the stones are completely separated from the product and discharged through the stone outlet.

Vacuum of the destoner is adjustable with the help of air regulating valve (butterfly valve). Reading of the vacuum (suction pressure) is possible with the help of U-tube manometer. For optimum separation of stones, besides air adjustment, table inclination and flexi glass plate adjustments are also possible.

1.9.13 Trieur cylinder (Indent separator)

Trieurs in mill industry are applied for separating and sorting round seeds like cockle, long grains like oats, barley etc., from the wheat. It is a separation of impurities, which differ in shape and length of wheat.

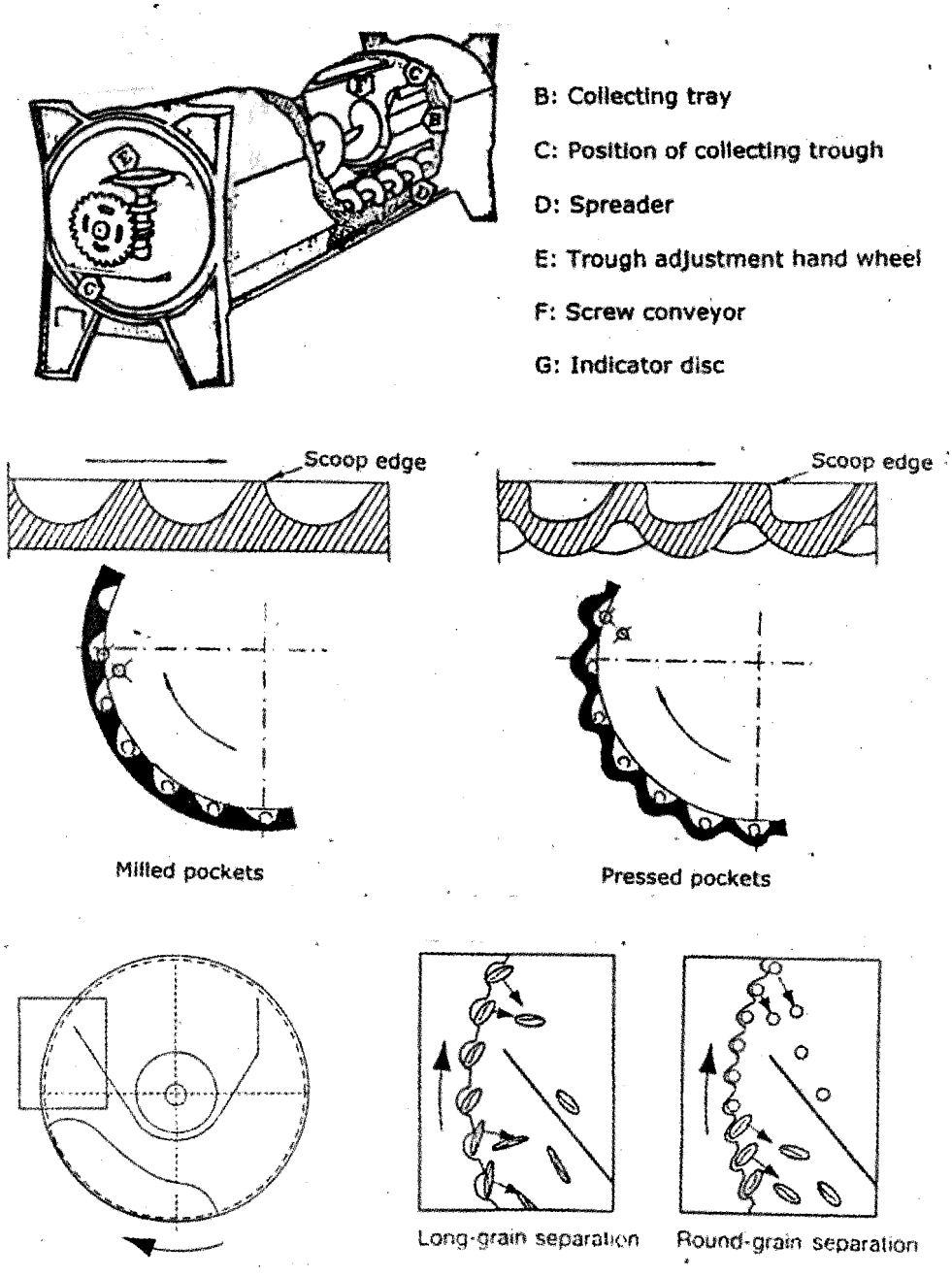


Fig. 17: Treiur Cylinder

Trieur cylinder consists of the rotary cylinder section, the adjustable collection trough and a rugged support frame. The rotating cylinder is made up of steel sheet with pressed pockets and treated with special surface hardening for better resistance against wear and teat. The material is fed at a uniform rate through the inlet directly into the rotating cylinder. As a result of the indented (pressed) pockets in the jacket (cylinder), the material particles that can sit in the pockets are lifted and thrown

into the collection trough. The material collected in the trough is then discharged from the machine by a conveying screen. The material remaining in the jacket (or) dropping back into it flows via the guiding device to the outlet of the cylinder.

The separating efficiency of the machine can be controlled both by selection of pocket size and by adjusting position of the trough Trieur cylinder capacity is very low, because only about one fourth of its total surface is utilized for the purpose of separation. Hence to make better use of cylinder surface, the layer of light and heavy product in the kidney is destroyed by a spreader.

1.9.14 Carter disc separator

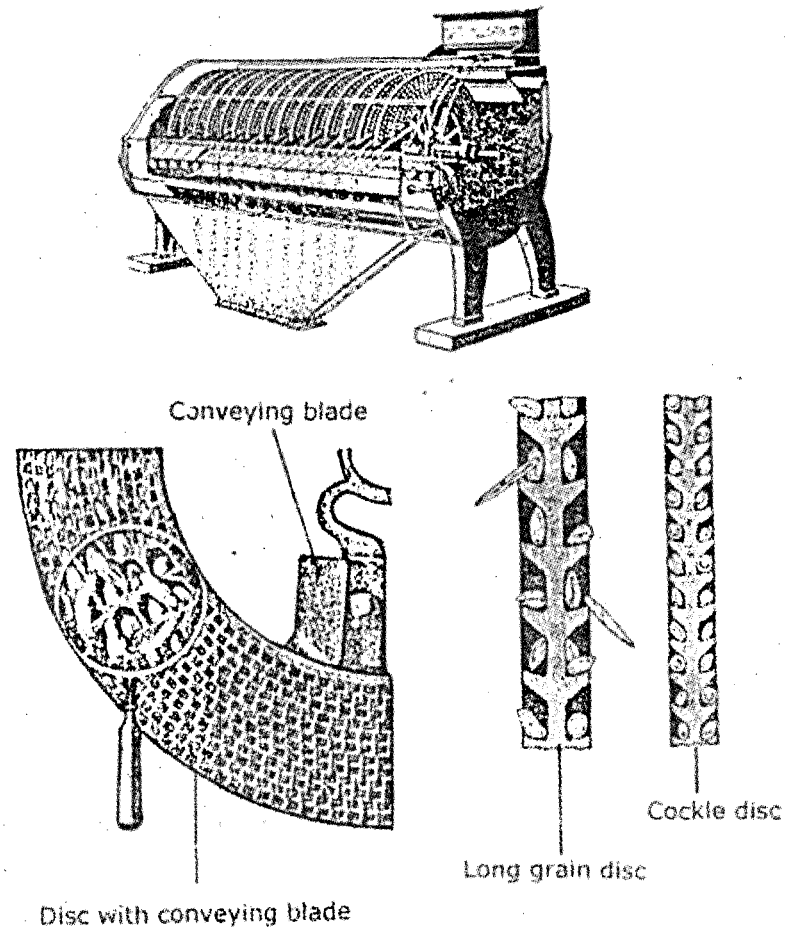


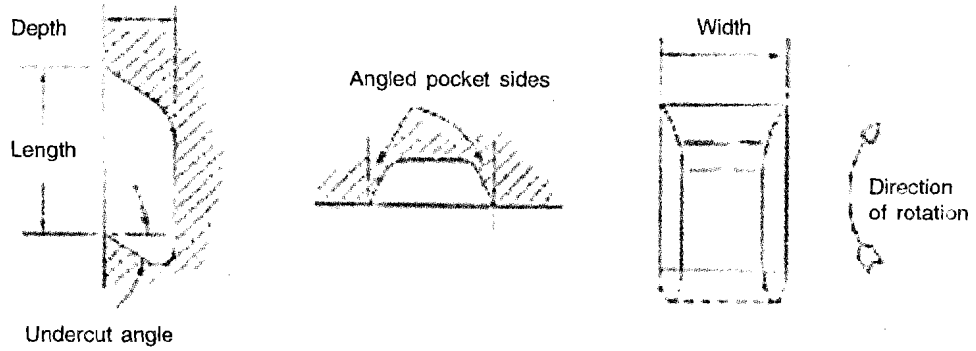
Fig. 18: Carter Disc Seperator

The working principle of carter disc separator is different from the trieur cylinder. Carter disc separator consists of a series of discs mounted on a horizontal shaft. The discs with hundreds of casted under cut pockets on both the sides revolve in a sheet metal moulding. To handle the various shapes of sizes of materials, disc pockets are made in many styles and sizes. The width of the pocket determines the maximum length of grain to be lifted.

Material to be graded enters at one end of the machine and is slowly conveyed towards the outlet with the help of conveying blades which are situated between ring shaped disc and the shaft. The discs revolve through the mass and are either lifting the round leeds (cockle separator) or the wheat (long kernel separator). The round seeds fits into the discs and are lifted out of the longer product. After reaching the top dead center of rotation, the fitted round seeds in the pocket are thrown out centrifugally into the extraction channels which are situated between the discs.

A return conveyor is provided with the change over flaps installed in front of the extraction channel and is driven by the main shaft carries part of the lifting to the inlet for the re-separation. The unlifted product leaves the machine through the machine outlet.

Carter disc is a compact machine. The rpm of the shaft varies between 40 to 60 rpm. The carter disc is available with 15 to 27 discs with diameters of 15", 18" and 25 inches. The discs are made up of cast iron and are available in both solid and split type. Split type reduces the disc replacement down time.



Check Your Progress

Note: a) Use the spaces given below for your answers.
b) Check your answer with those given at the end of the unit.

1. Why ship unloading system is required?

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2. What are the systems used for unloading cereals from ships?

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3. Why mobile pneumatic unit is required?

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4. What are the advantages and disadvantages of pneumatic unloading system?

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5. What is the advantage of mechanical unloading system?

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6. Why autograin weigher is used in a flour mill?

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7. What are the objectives of cleaning wheat in a mill?

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8. What are the principles of impurities separations?

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9. What is the advantage of using preliminary cleaning machines in a flour mill?

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10. Name the preliminary cleaning machines.

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11. What are the sieves used in a milling separator?

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12. What is the basic principle of working of separator? What are the driving arrangements for separator?

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13. Why aspiration channel is used in a flour mill?

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14. On what principle aspiration channel works? How do you adjust the air velocity and why?

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15. Why intermediate separator is required and why it is installed next to aspirator (very close to the aspiration channel)?

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16. What is a magnet and why it is needed in a flour mill?

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17. What are the different types of magnets?

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18. Mention the disadvantages of horseshoe magnet and bar magnet.

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19. Mention the difference between rotating magnet and statutory magnet.

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20. What are the advantages of using either rotary magnet (or) statutory magnet (with drum)?

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21. Describe the working principle of de-stoner.

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22. Products containing fine seeds and stones of diameter less than 2 mm should not be passed to destoner. Why?

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23. Mention the types of destoners. Explain the difference between them.

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24. In destoner final separation zone, how wheat and stones which are having same specific gravity are being separated?

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25. What are the parameters to be checked in destoner to achieve optimum degree of separation of stones?

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26. What are the applications of trieur cylinder in a flour mill?

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27. Describe the principle of trieur cylinder.

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28. Efficiency of trieur depends on what parameters?

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29. What is the basic difference between trieur and carter disc?

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1.10 LET US SUM UP

Grain in bulk transported by ship to be unloaded in a very short period as the lay day of ship is an expensive affair. Various systems are used such as mobile pneumatic unit, & mechanical unloading units.

Various machineries and used to separate the impurities in the grain worked on the basic principle of size, specific gravity, shape, magnetic property, and air resistance. Various machineries which use the basic principles of sieving machines, scalper aspirator, drum sieve, milling separator, aspiration channel, intermediate separator, magnet separators, destoners, disc separators etc.

1.11 KEY WORDS

Pier	:	Ship landing place.
Pneumatic loading / unloading	:	Movement of product-by use of controlled air currents.
Cyclone	:	Device for separating product from moving air.
Air lock	:	A device for introducing stocks into pneumatic line.
Telescopic pipe	:	Adjustable, collapsible pipe.
Thimble	:	Part of cyclone, connected to a fan to suck center vortex formed by dusting air during cyclone operation.
Blower	:	Impeller rotor, in a fixed case, for movement of air.
Non return valve	:	Valve operates in only one direction, i.e. allows the flow in unidirection, reversible flow not possible.
Conveyor	:	Endless bands, chains (or) links or continuous screw used for movement of stocks.
Weigher	:	Automatic machine delivering pre-determined weight of product.
Hopper	:	Feed bin angled towards out let.
Scouring	:	Friction as grain cleaning.
Scalper	:	Sifting machine used to scalp (or) dress the coarser impurities.
Filter	:	A chamber containing sleeve filter elements to treat dust laden air.
Vibrator	:	Machine used to create vibrations (or) oscillations / reciprocating motion.

Overtail : Material passed over the tail end of the dressing machine.

Destoner : Material used to remove stones and mudballs, aluminium pieces, glass pieces etc.,

Trieur cylinder : Indented revolving cylinders used for extraction of seeds and oats, barley from grain.

Disc separator : Machine for removing cockle (or) oats and barley from grain.

1.12 ANSWERS TO CHECK YOUR PROGRESS EXERCISE

1. Your answer should include the following points
   - Cost implification
   - High capacity systems
2. Your answer should include the following points
   - With installations of pier
   - Without installations on pier
3. Your answer should include the following points
   - Possibility of installing systems
   - Quantity material to be handled
4. Your answer should include the following points
   - System movability
   - Dust free operation in power consumption
   - Residue clean up
5. Your answer should include the following points
   - Capacity
   - Power consumption
6. Your answer should include the following points
   - Control apparatus
   - Hourly capacity
7. Your answer should include the following points
   - High standard products
   - Wheat surface dust cleaning
   - Damaged kernels
   - Impurities
8. Your answer should include the following points
   - Size
   - Shape
   - Specific gravity aim
   - Magnetic property
   - Air resistance

9. Your answer should include the following points
   - Coarse admixtures
   - Fine and specific lighter impurities

   If not removed they may:
   - Damage machineries
   - Weer tear,
   - Storage area and grain quality
   - Dust explosion

10. Your answer should include the following points
    - Drum sieve
    - Scalper apparator
    - Reel machine
    - Millerator
    - Aspiration channel
    - Intermediate separator

11. Your answer should include the following points
    - Rubble sieve
    - Wheat sieve and
    - Sand sieve

12. Your answer should include the following points
    - Size
    - Vibro rotors
    - Built in motor and pulley arrangement
    - Oscillatory drive

13. Your answer should include the following points
    - Lighter impurities separation

14. Your answer should include the following points
    - Air resistance
    - Cross sectional area of channel
    - Q=A x V

15. Your answer should include the following points
    - Deposit of lighter impurities in aspiration ducks
    - Wear and tear of filter sieves
    - Check separator efficiency

16. Your answer should include the following points
    - Substance attracts ferrous particles
    - Removal of magnetic materials

17. Your answer should include the following points
    - Permanent magnet
    - Electro magnet

18. Your answer should include the following points
    - Cleaning of magnet surface
    - Blocking of grain stream flow
19. Your answer should include the following points
    - Drum rotation
    - Magnet rotation
20. Your answer should include the following points
    - Surface cleaning of magnet
21. Your answer should include the following points
    - Specific gravity
    - Air resistance
22. Your answer should include the following points
    - Blockage of wire mesh openings of the deck
    - Effect on air distribution
    - Destoner efficiency
23. Your answer should include the following points
    - Pressure type
    - Vacuum type destoner

    Differences:
    - Air movement (either blow type (or) suction type)
24. Your answer should include the following points
    - generation of counter current air and mechanism involved.
25. Your answer should include the following points
    - Deck inclination
    - Air volume
    - Final separation zone adjustments
    - Product layer thickness
    - Deck stroke length
26. Your answer should include the following points
    - Round seeds (cockle)
    - Longer grains (oats, barley)
27. Your answer should include the following points
    - Shape and length of impurities
28. Your answer should include the following points
    - Pocket size
    - Trough position
29. Your answer should include the following points
    - Machine configuration
    - Pocket size and shape
    - Method of producing pockets
    - Capacity
    - Efficiency

1.13 SOME USEFUL REFERENCES

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