UNIT 2 MILLING MACHINES-2

Structure

2.0 Objectives

2.1 Introduction

2.2 Functions, Construction, Merits And Demerits of Disc Cylinder Separator & Trieur Battery

2.3 Introduction, Construction, Working Principles, Functions, Merits and Demerits of Weinhold System.

2.4 Washing, Rinsing And Whizzer Systems

2.5 Combined Washing Machine and Whizzer

2.6 Functions, Merits And Demerits of Water Addition System

- Bucket Wheel Dampener
- Flow Meters

2.7 Water Mixing Systems

- Dampening Screw
- Intensive Dampener
- Grain Mixers

2.8 Construction, Working and Functions of Horizontal Scourer and Vertical Scourers

2.9 Let Us Sum Up

2.10 Key Words

2.11 Answers to Check Your Progress Exercise

2.12 Some Useful References

2.0 OBJECTIVES

After reading this unit you should be able to:

- understand the functions, construction, advantages and disadvantages of machineries used for impurities separation using the principle of shape and length;
- describe the purpose of wheat washing and machineries involved in it;
- explain the importance of water addition, and mixing of wheat;
- understand methods for water addition and mixing;
- describe scouring and its importance;
- discuss scouring and its importance; and
- discuss merits and demerits of various machineries used for impurities separation water addition, scouring etc.

2.1 INTRODUCTION

In Milling Machine-2, various machineries that are used in the milling industry, right from carter discs to vertical scourer will be dealt. In this unit emphasis will be laid more on the function and operational aspects of the machineries rather than design constructional aspects.

Merits and demerits of the machineries are dealt in detail, which would help in selection of machineries to suit the requirements.

Basic concepts of water addition and machineries associated with the process are dealt to know the importance of process and methodology to achieve the set objectives of the process.

2.2 FUNCTIONS, CONSTRUCTION, MERITS AND DEMERITS OF DISC CYLINDER, SEPARATOR AND TRIEUR BATTERY

Disc cylinder separator

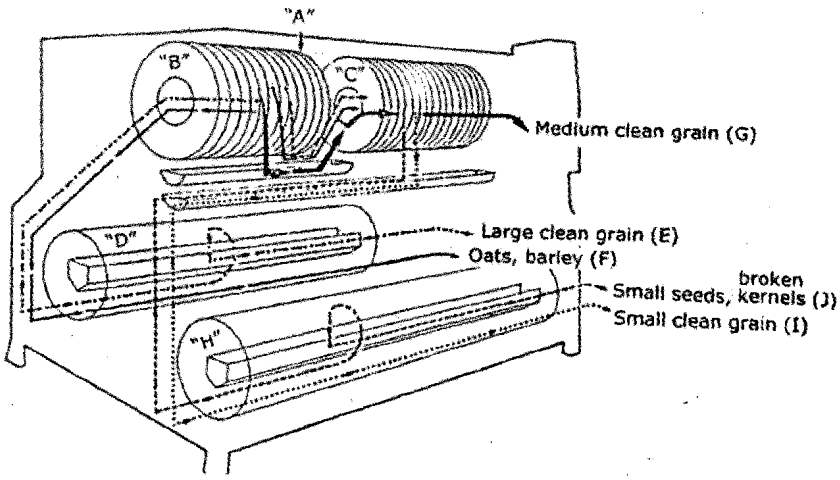


Fig. 1: Disc Cylinder Separator

To handle higher capacities a large trieur cylinder surface is required and it results in large space requirements. To overcome this, disc cylinder separator is used.

The merit of disc cylinder separator merit is that it combines the high performance capability of disc separator with the precision separating capabilities of trieur cylinder.

Disc cylinder separator consists of discs (splitter and grader sections) and Trieurs. Discs are mounted on a common shaft. Shaft and Trierus cylinders are driven by a motor. Product enters at inlet 'A'. The disc portion of the machine is subdivided into splitter section 'B' and grader section 'C'. Lifting of the spliter sectors are diverted to the grader section. Tailing of the splitter section goes to the oat cylinder 'D' (Trieur1) where in which the grain is divided into large clean grain, 'E' and oats, barley 'F'. The tailing of the grader section are medium clean grain (G) and it is the heavy steam from the machine. The lifted portion removed from the grader section is conveyed to the seed cylinder '(H)' (Trieur 2) where the product stream is divided into small clean grain (I), small seeds and broken kernels (J).

Merits

- Better utilization of disc surface and higher speed.
- Separated product from each disc can be controlled individually.
- Discs with different pockets size and shape can be combined in one machine.

Demerit

- All the discs are rotating in to pool of wheat results in wear and tear of pockets.
- Limitation in the capacity as the number of discs available only 15 to 27.

- For high capacities, separate machines are to be used for round, long grains and their re-treatment.
- For smaller capacities, combined in one machine to be used (round, long grain and weight their retreatment)

Trieur Battery

Trieur battery consists of main trieurs (Round seed cylinder and long seed cylinder) and re-treatment cylinders (long seed re-treatment and round seed re-treatment cylinder). Capacity of the main trieur is very high and only pregrading can be made. To catch all the round seeds, the size of the pockets in the main trieur is selected slightly bigger, so that small wheat can also be lifted (along with the round seeds) out of the wheat stream. Lifted mixture is sent to the round seed treatment separator, whose pocket size is ¾ mm smaller than the main trieur (main round seed cylinder), but bigger enough to take out smallest round seed and broken kernels. Remaining wheat (Tail overs) is flowing out of the cylinder and is made to pass through a slotted sieve cylinder. Throughs of the sieve cylinder is good small wheat, which can be sent to main wheat stream. The overs consists of large cockles (round seeds) and brokens which can be sent for further separation.

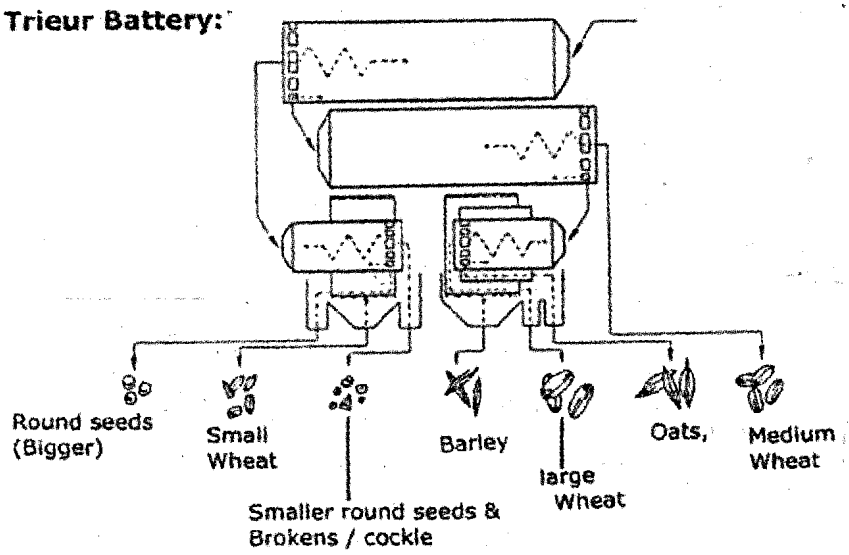


Fig. 2: Trieur Battery

Long seed cylinder of main trieur works on the same principle of round seed cylinder. Wheat is lifted into the trough, the long seeds like oats, barley, large wheat kernels remains in the cylinder flows to the outlet and further to the long retreat cylinder.

Main long seed trieur pocket size is so selected to avoid small oats and barley to go along with the wheat. Some large wheat with oats and barley flows to the re-treator. Pockets in the retreator are chosen ½ to ¾ mm bigger than those of the main long seed trieur. Large wheat and small oats are lifted into the trough and pases through a slotted sieve cylinder, where by barley is falling through and the bolder wheat is tailing over. Tail over of the retreator are passed through the sieve cylinder in which tail over of sieve cylinder consists of only oats.

Merits: Clear segregation of products (impurities) namely round seeds (bigger), smaller round seeds and brokens / cockle, barley, oats, small wheat, large and medium wheat.

Demerits: Pockets are to be checked periodically for frequent cleaning of indent surface is needed. That wear and tear, which influences the efficiency of trieur.

2.3 INTRODUCTION, CONSTRUCTION, WORKING PRINCIPLES, FUNCTIONS, MERITS AND DEMERITS OF WEINHOLD SYSTEM

2.3.1 Wheat washing

General rule states that, in wheat cleaning systems, the cleaning has to be followed by a wet cleaning if the natural moisture of the wheat permits.

2.3.2 Main purpose of wheat washing

- Cleaning of wheat surface from adhering dirt and dust, especially cleaning of the crease and beard portion of the wheat kernel.
- Separation of stones, mud balls, nonmagnetic metal particles and coal.
- Floating off of various weed seeds as well as rat and mouse excreta.
- Additions of water to the wheat in order to bring it to the optimal grinding condition.

2.3.3 "WEIN HOLD" system

Wein hold system consists of a separate stone extracting apparatus.

Incoming wheat is distributed evenly over a cone which is surrounded by a collecting hopper. Water with a pressure of about 0.3 atmosphere flows through the ring shaped gap between the cone and the hopper against the flow of wheat. Heavier stones (larger than 3 mm) are able to drop down against the water stream and collected in the stone collecting hopper. Wheat sinking to the ground of the floating off tanks together with the water leaves the wet destoner through the outlet spout.

Lighter impurities like straw, chaff etc., are floating off. Wheat is again rinsed in an inclined screw provided with a slotted jacket, which is placed in a water collecting trough. The final stage of the washing process is the centrifugation of the wheat in a whizzer.

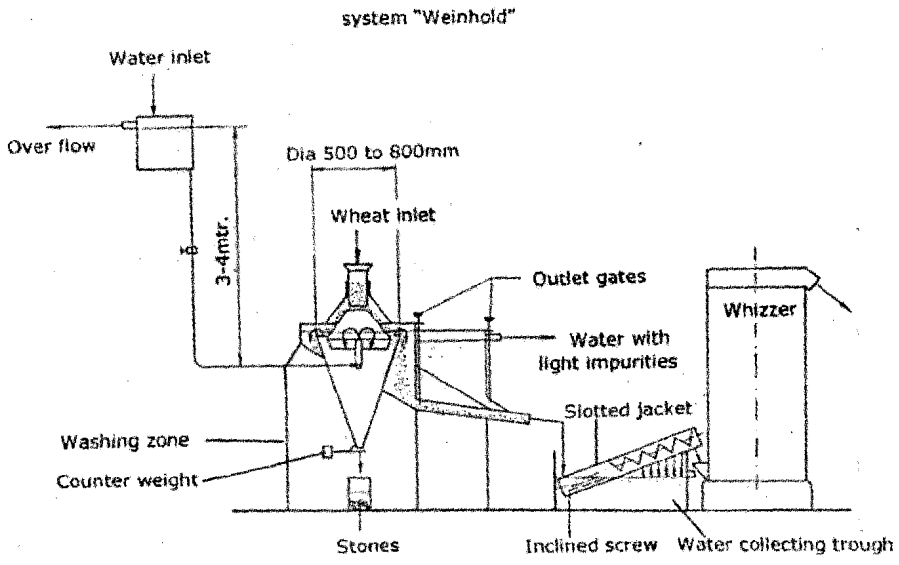


Fig. 3: Wein Hold System

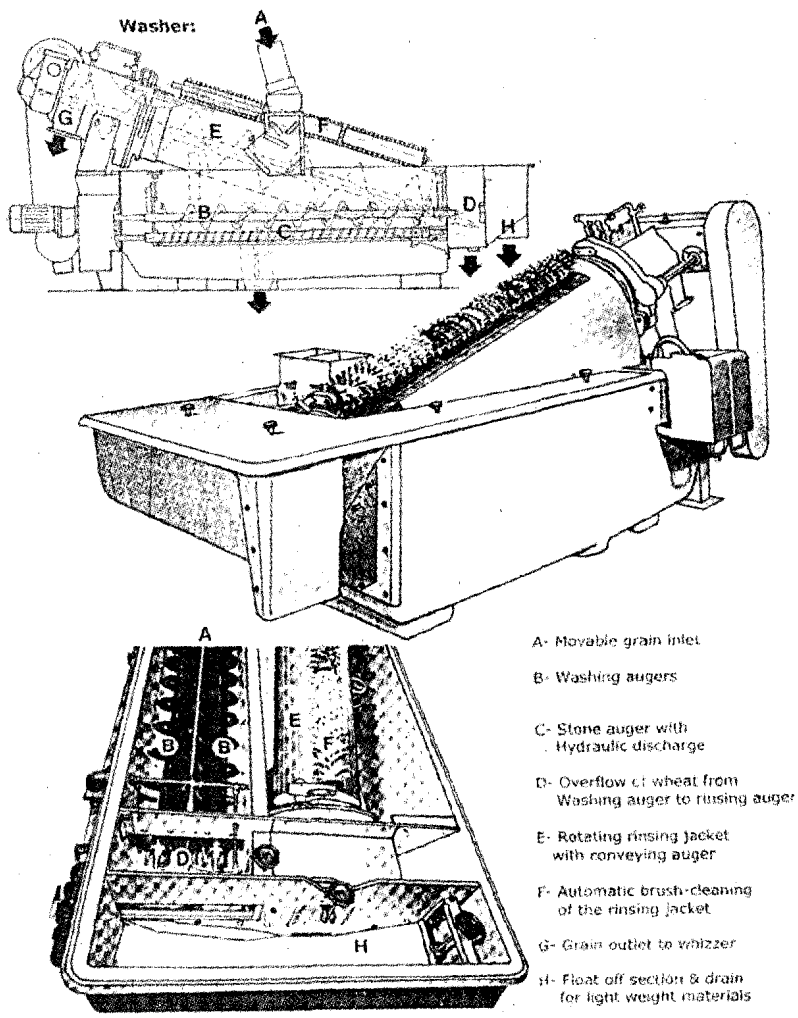
Merits: Cheaper solution

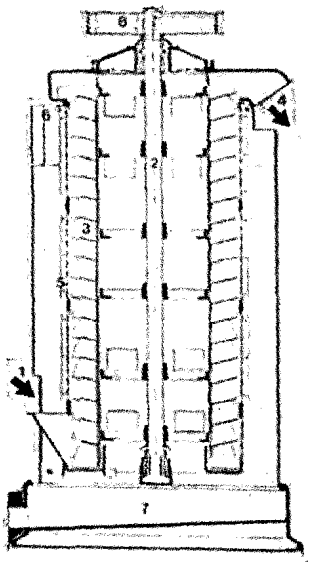
Demerits: Sensitiveness of system for fluctuations in capacity and water pressure.

- Stones less than 3 mm size are partially removed.
- Water consumption is very high.
- More space requirement.
- Wheat washing time cannot be regulated.

2.4 WASHING RINSING AND WHIZZER SYSTEMS

Washing whizzer systems consists washing trough, augers (screws), rotating rinsing jacket with conveying screw, automatic brush cleaning mechanism for rinsing jacket, float off section for light weight impurities. Wheat enters the machine through a movable inlet, whose position can be changed, so that wheat washing time can be regulated according to the impurities conditions (amount of stones and degree of dirtiness) of each sort of grain. The depth of water is regulated by means of an outlet valve and over flow. The auger (screw) moves the grain through the water from inlet to the float off section. Heavier impurities such as stones sink into the stone auger from their it will be discharged. Lighter impurities such as smuts, hollow kernels, weed seeds, float to the top and are passed to the over flow of the float off section. Wheat entering to the rotating jacket where it itself gets rinsed as much as possible with fresh water. It is then conveyed to the whizzer by the auger (screw).





1. Grain inlet
2. Rotor
3. Impeller blades
4. Grain outlet
5. Special steel jacket
6. Spraying device
7. Collecting reservoir for waste water & outlet
8. Drive

Fig. 4: Washing Rinsing and Whizzer System

In the whizzer water sticking on the grain is removed by centrifugal action of the rotor and a special steel jacket. When whizzer rotates it creates current of air which further increases the drying effect on wheat. Blades on the whizzer rotor are set at an oblique angle to throw the grain on to the perforated steel jacket. At the same time the scouring of the grain takes place when the wheat moves from bottom to the top of the whizzer. The stainless steel of the jacket is kept cleaned by fresh water spraying mechanism.

The water absorption of the wheat depends on the surface properties of wheat, the initial moisture content, the retaining time of the wheat in the water and the load on the whizzer.

Merits:

- Less water consumption (approximately 2 ltr / kg of wheat)
- Better washing effect

Demerits:

- Expensive machine
- Higher power consumption

2.5 COMBINED WASHING MACHINE

Combined washing machine consists of the following main parts

- Movable grain inlet
- Washing augers (screws)
- Stone auger
- Whizzer system with rotor and grain outlet

In combined washing machine float-off device and rinsing jacket mechanisms are removed when compared with "washing, rinsing and whizzer system". The combined washing machine trough is firmly fixed to the centrifugal drying column (whizzer). Working of the combined washing machine is same as that of "Washing, rinsing, and whizzer system".

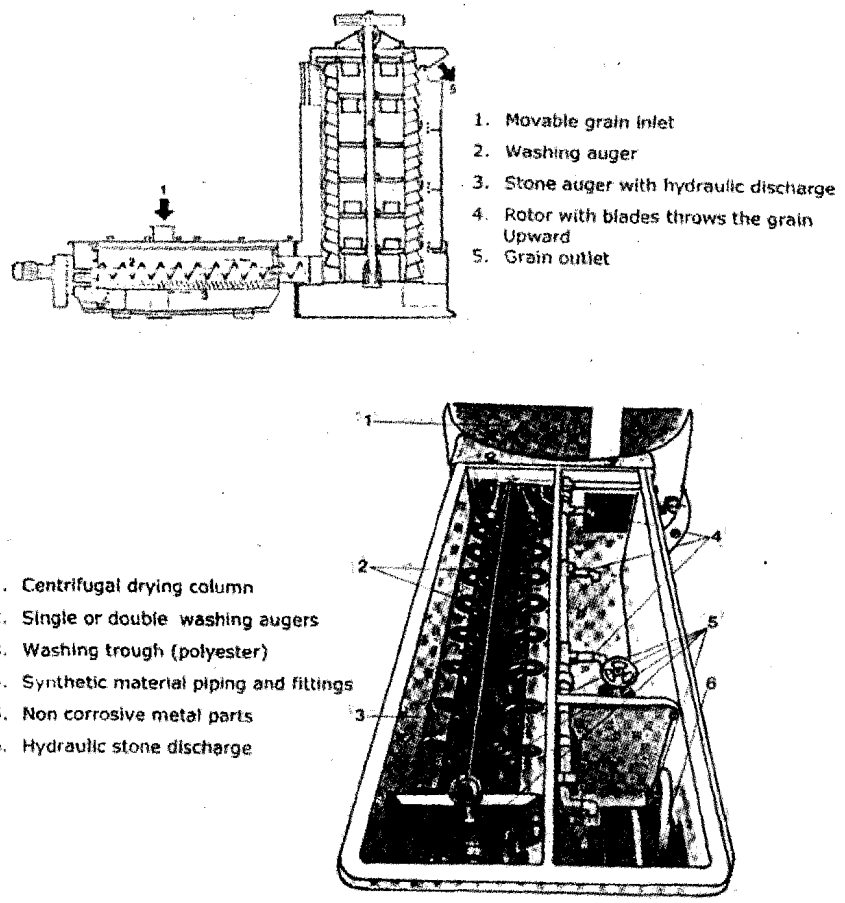


Fig. 5: Combined Washing Machine

The movable inlet determines the washing time. Adjustable over flow controls the water level. Washing auger washes and conveys the grain from inlet to the whizzer. Heavier impurities like stones sink into the stone auger and are discharged. At the end of the washing auger, mixture of grain and water enters directly into the foot of the whizzer, where it is thoroughly washed by the bottom rotor portion of the whizzer column. When wheat climbs the whizzer column by the action of the rotor it gets dried and discharged through the whizzer wheat outlet.

Merits:

- Less space requirement and lower cost
- Better washing effect as the lower part of the whizzer is used for intense washing of wheat

Demerits:

- High foam production
- No float off device

2.6 FUNCTIONS,MERITS AND DEMERITS OF WATER ADDITION SYSTEMS

Why water addition is necessary?

After thorough cleaning of wheat, water is to be added depending on its initial moisture to prepare the wheat to produce:

- The maximum percentage of flour with desired quality and more important the correct and constant final product moisture.

- A minimum percentage of bran and shorts with the lowest possible starch content and an acceptable moisture level.

Water addition is done with the help of following machineries.

1) Water wheel dampner
2) Flow meter
3) Intensive dampner

2.6.1 Bucket wheel dampner

Bucket wheel dampner is used to add required quantity of water to wheat before the tempering. It is always used in combination with a dampening screw (or) Intensive dampner.

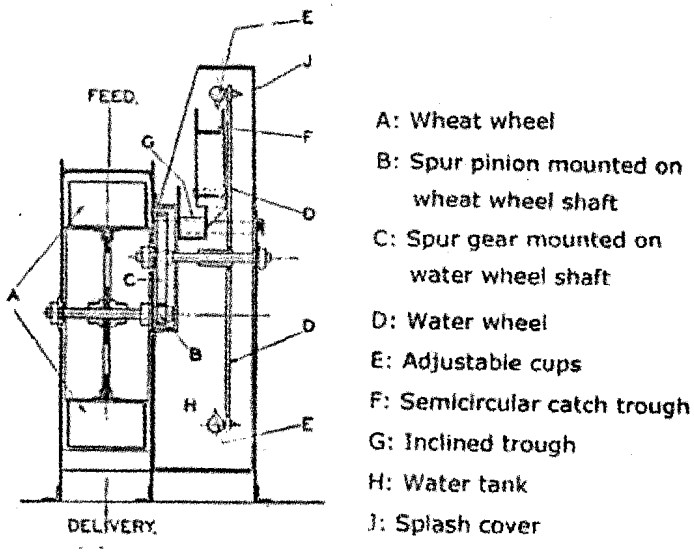


Fig. 6: Bucket Wheel Dampner

Bucket wheel consists of wheat wheel, spur gear mechanism, water wheel, adjustable cups, water catch trough and inclined trough, water tank and splash cover.

Wheat from the spout falls on the paddle wheel and makes it to rotate which in turn rotates the bucket wheel via spur gear mechanism. Water level in the tank is regulated by an overflow tube (or) by a floating value arrangement.

By changing the number of buckets (or) by adjusting position of buckets (or) by maintaining the water level, the quantity of water to be added can be regulated. Amount of water flowing to the dampner is regulated by the quantity of wheat flow to the dampner as the paddle wheel is governed by the wheat stream.

Merits

- Cheaper solution.
- Automatic water addition in relation to change in wheat flow rate.
- Water addition stops when wheat flow is interrupted.
- No electric power utilization as it works mechanically. Hence less maintenance and breakdown.

Demerits

- Water quantity to be set manually by trial and error method.
- Water flow rate cannot be recorded.

2.6.2 Flow meters

Flow meters are used when an instant control of water quantity is desired. Flow meter allows better supervision than the wheel dampner.

Flow meter consists of rotameter, dozevalve, water filter and a main valve.

The required quantity of water is regulated by a dosage valve and the reading is read off with the help of a glass tube and floating simmer (Rotameter). The water filter eliminates all fine particles like dust, small stones and iron particles to protect the doze valve nozzle from clogging (or) choke.

If the wheat flow is interrupted, the flow control at the inlet of dampening screw gives signal to the solenoid valve, which then stops the water flow.

Merits

- Better supervision.
- Amount of water added can be read off instantly.
- Provides continuous feed of water to the mixing screw even for small quantity of water.

Demerits

- Regular water pressure to be maintained.
- Ensure regular water addition.
- Overhead tank with over flow provision to be installed before flow meters.

2.7 WATER MIXING SYSTEMS

2.7.1 Dampening screw

Dampening screw consists of a shaft on which helical blades are mounted. Wheat and water enters at the inlet of dampening screw and gets mixed and transported

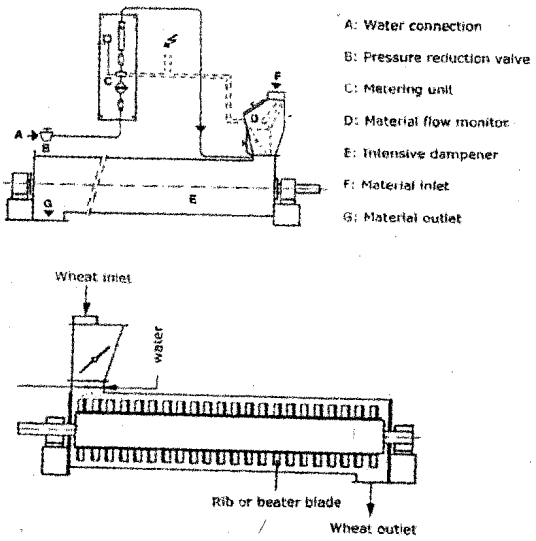


Fig. 7: Intensive Dampner

to the wheat outlet when the screw is rotated. In this method, close observation reveals that only approximately 2/3rd of kernel surface are dampened. Especially the crease, bread and the germ sections of wheat are neglected. In addition to the above, dampening screw has been increasingly attached for hygiene reasons.

2.7.2 Intensive dampner

Intensive dampner consists of a circular housing in which a drum with screwed ribs on it is centrally located. The ribs have certain twist angles in order to convey the grain from inlet to the outlet. Due to the high speed of rotor, the wheat and the water are intensively mixed with each other. In one passage upto 5% water can be added. Water penetration is faster and the tempering time can be reduced drastically by about 30%. The water metering is done by means of a flow meter (or) a bucket wheel dampner. At the inlet a wheat flow control is installed to stop the water in case of interruption of the wheat flow (only required when flow meter is used).

The housing with inlet and outlet as well as the beater ribs are made up of stainless steel.

Merits

- Less space requirement and less maintenance
- Less water consumption and good water distribution
- Assisting scourer by breaking mud balls and loosening the outer most wheat layer.

Demerits

- Higher power consumption
- No extraction of stones and lighter impurities

2.7.3 Grain mixers

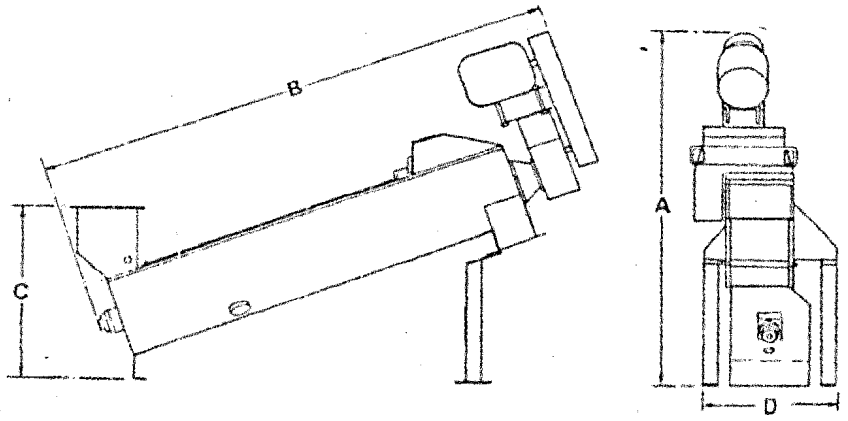


Fig. 8: Grain Mixers

The grain tempering mixers are continuous mixers, designed to properly apply and distribute measured amount of water uniformly to each and every kernel.

The grain mixture is installed in a 20° upward inclination with the wheat and water inlet at the bottom. Fan shaped blades on a rotating shaft move the grain upward. The conveying rate and grain depth can be set by changing the angle of the blades. Any accidental overfeed of water would run back to a drain at the feed end, this will ensure that any excess water does not enter the wheat bin.

The trough shape combined with slow paddle rotation allows the grain to be gently lifted and mixed, causing maximum surface contact. Kernels are not subjected to any impact (or) damaging forces.

Merits

- High capacity with low power consumption.
- Uniform mixing with in hygiene stainless steel assembly.
- Less maintenance.

Demerits

- Blade angles to be set for change in conveying rate and grain depth.

2.8 CONSTRUCTION WORKING AND FUNCTIONS OF HORIZONTAL SCOURERS AND VERTICAL SCOURERS

Why scourer machine is needed in wheat flour mill?

Scouring was always felt to be necessary in wheat cleaning section when wheat was externally dirty.

Millers today prefer to scour (or) polish the wheat, whereby only the loose parts of the cellulose layer (bee-swings) are rubbled off, to prevent the particles are getting into the flour at the break sections (roller mills).

Scouring is done gently (less beating but more rubbing action) with an even effect to all the kernels in order to prevent the damage (or) breakage of sound grains.

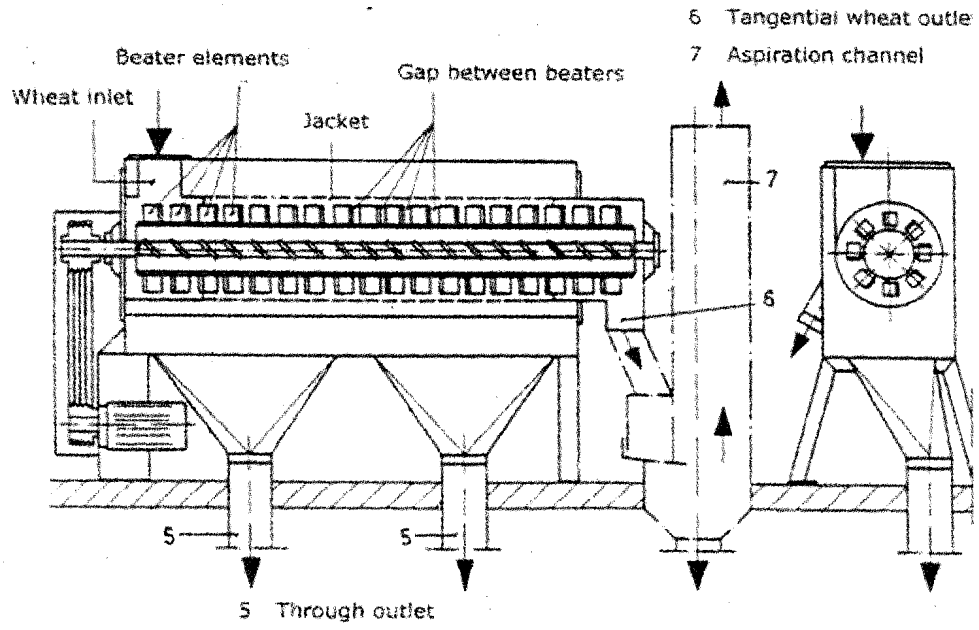


Fig. 9: Horizontal Scourer

2.8.1 Horizental Scourer

Horizontal scouring machine consists of a horizontally supported rotor with exchangeable beater rails on which a great number of small beater elements are welded.

A two part sieve jacket surrounds the rotor. The drum (rotor) causes the product to stay at the periphery, because of the relative narrow space between drum and jacket.

The grain flowing through the inlet is seized by the beater elements and scoured against the jacket. Due to the interspaces between the beater elements, the flow of the kernels is retarded and again seized by the next following beater.

In the scourer a triple friction effect (scouring) takes place namely

- Friction between kernel and beater
- Friction between kernel and jacket
- Friction between kernel and kernel

Smaller diameter of the jacket gives good distribution of the product to the complete circumference of the jacket. A long wire mesh jacket with an opening of 1 MM is used. The difference between ribs and jackets 16 is to be 22 mm.

The through of the jacket are collected in the hoppers arranged beneath. The aspiration channel with vibro feed used for aspiration of the over tails from the scourer.

2.8.2 Vertical scourer

Vertical scourer differs from the horizontal scourer only in its construction but its purpose is same. Vertical machine has the advantage, that the product is distributed over the complete jacket surface. In case of any choke it gets emptied automatically. It requires less space and consumes less power because the wheat does not have to be lifted with in the machine.

Vertical sourer are supplied with wire jackets hence strong scouring action is ensured. The distance between ribs and jacket is 15 to 20 mm.

The aspiration after scouring can be solved by adding round aspirator to the scourer outlet.

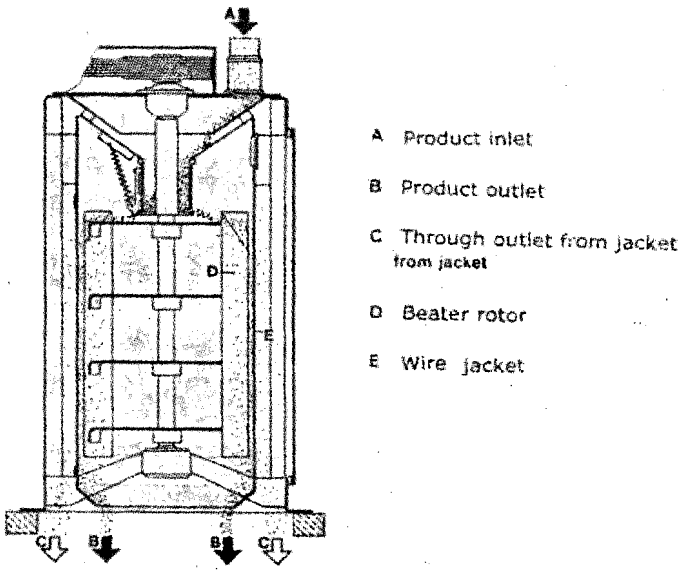


Fig. 10: Vertical Scourer

Wheat enters through the wheat inlet and falls on to the feeder cone, which distributes the wheat over the total circumference of the wire jacket. As the wheat falls, it is carried by the beaters against the steel wire mesh jacket and thoroughly scoured. The dirt and scoured bran skins passes through the wire mesh and collected at the respective outlet. Wheat leaves the machine through the wheat outlet and is aspirated in a round aspirator.

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. What ate the merits of using disc cylinder separator instead of trieur and carter disc?

.....

.....

.....

.....

2. Explain the working of disc cylinder separator.

.....

.....

.....

.....

3. Mention the different parts of Trieur battery.

.....

.....

.....

.....

4. What are the merits of using Trieur battery?

.....

.....

.....

.....

5. Why "weinhold" system is required?

.....

.....

.....

.....

6. Mention the merits and demerits of "weinhold" system.

.....

.....

.....

.....

7. Mention the important parts of washing, rinsing and whizzer system.

.....

.....

.....

.....

8. What are the merits and demerits of washing, rinsing and whizzer system.

.....

.....

.....

.....

9. Explain the working of combined washing machine.

.....

.....

.....

.....

10. Mention the difference between combined washing machine and washing, rinsing and whizzer system.

.....

.....

.....

.....

11. Why water addition to wheat is necessary?

.....

.....

.....

.....

12. What are the machineries used for water addition?

.....

.....

.....

.....

13. Mention the merits and demerits of bucker wheat dampener.

.....

.....

.....

.....

14. Why flow meters are preferred than bucket wheel dampener?

.....

.....

.....

.....

15. Describe the functions of different parts of flow meters.

.....

.....

.....

.....

16. What are the demerits of dampening screw?

.....

.....

.....

.....

17. Describe the working of intensive dampner.

.....

.....

.....

.....

18. What are the merits and demerits of intensive dampner?

.....

.....

.....

.....

19. Explain the working of grain mixer.

.....

.....

.....

.....

20. What is the necessity of scourer in a flour mill?

.....

.....

.....

.....

21. Mention types of friction that takes place in a scourer?

.....

.....

.....

.....

22. What are the advantages of using vertical scourer?

.....

.....

.....

.....

23. Explain working of vertical scourer.

.....

.....

.....

- Water flow rate recording

14. Your answer should include following points
    - Control capability
    - Supervision
15. Your answer should include following points
    - Purpose of
    - Main valve
    - Water filter
    - Solenoid valve
    - Dosing valve
    - Rotameter
16. Your answer should include following points
    - Amount of surface area dampened
    - Portions of wheat which are neglected
    - Hygiene
17. Your answer should include following points
    - Construction of intensive dampner
    - Product flow parh
    - Importance of different parts of the machine
18. Your answer should include following points
    - Space requirement
    - Maintenance
    - Water consumption
    - Helpfulness to the sourer
19. Your answer should include the following points
    - Mixer angle inclination
    - Type of blade
    - Adjustments for varying grain depth and conveying rate
    - Over feed of water
    - Impact and damaging forces
20. Your answer should include the following points
    - Condition of wheat
    - Rubbing action and production of Bee swings
21. Your answer should include the following points
    - Beater
    - Jacket
    - Kernel
22. Your answer should include the following points
    - Product distribution
    - Cleaning of choked of products
    - Space requirement

- Power consumption

23. Your answer should include the following points
    - Purpose of feeder cone
    - Function of beaters
    - Purpose of wire jacket
    - Application of round aspirator

2.12 SOME USEFUL REFERENCES

1. Arthur W. Rohner, Machine manual for millers, Buhler Brs., Oberuzwil, Switzerland.
2. The Practice of Flour Milling. Vol. I, 1979, Nabim, 21 Arlington St. London,
3. Lockwood, J.F., Flour Milling, The Northern Publishing Co. Ltd., London.
4. Flour Milling Training Manual 1968, Nabim, London.