

Study of Hammer mill and Ball mill

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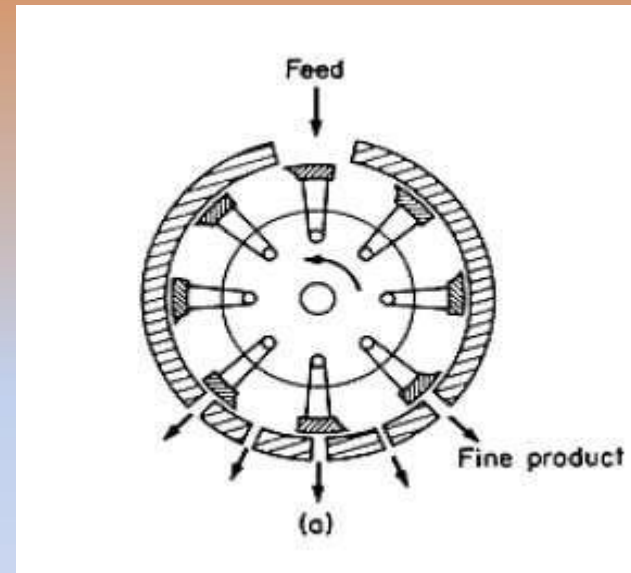
S.No.	Name of the mill	Mechanism of action	Uses
1	Hammer mills	Impact	Used for almost all the drugs
2	Roller mills	Attrition & compression	Soft materials
3	Colloid mills	Impact & attrition	Used for almost all the drugs
4	Ball mill	Impact & attrition	Brittle drugs
5	Fluid energy mill	Impact & attrition	Moderately hard and friable materials

Basic parts of mill

- Feed chute/hopper, which delivers the material.
- Grinding mechanism usually consisting of a rotor and stator.
- The discharging chute /sieves.

Equipments based on the mechanism of Impact :

1. **Hammer mills:** In a hammer mill, swinging hammerheads are attached to a rotor that rotates at high speed inside a hardened casing.



The hammer mill consists of a steel casing in which a central shaft is enclosed to which a number of swinging hammers are attached. When the shaft is rotated the hammers swing out to a radial position.

On the lower part of the casing a screen of desired size is fitted which can be easily replaced according to the particle size required.

The material is crushed and pulverized between the hammers and the casing and remains in the mill until it is fine enough to pass through a screen which forms the bottom of the

- ***Construction & working:***
- A hammer mill is essentially a steel drum containing a vertical or horizontal rotating shaft or drum on which hammers are mounted. The hammers swing on the ends of the cross freely or fixed to the central rotor. The rotor rotates at a high speed (8000-15000rpm) inside the drum while material is fed into a feed hopper. The material is impacted by the hammer bars and expelled through screens in the drum of a selected size.
- Both brittle and fibrous materials can be handled in hammer mills, though with fibrous material, projecting sections on the casing may be used to give a cutting action. The hammer mills are available in various designs and shapes. In pharmaceutical industry they are used for grinding dry materials, wet filter cakes, ointments and slurries.
- **Factors which effect the size reduction**
- Openings in perforated screens or grate bars
- Number, size and type of hammers
- Grinding plate setting
- Rotor speed

Advantages:

1. It is rapid in action, and is capable of grinding many different types of materials.
2. They are easy to install and operate, the operation is continuous.
3. There is little contamination of the product with metal abraded from the mill as no surface move against each other.
4. The particle size of the material to be reduced can be easily controlled by changing the speed of the rotor, hammer type, shape and size of the screen

Disadvantages:

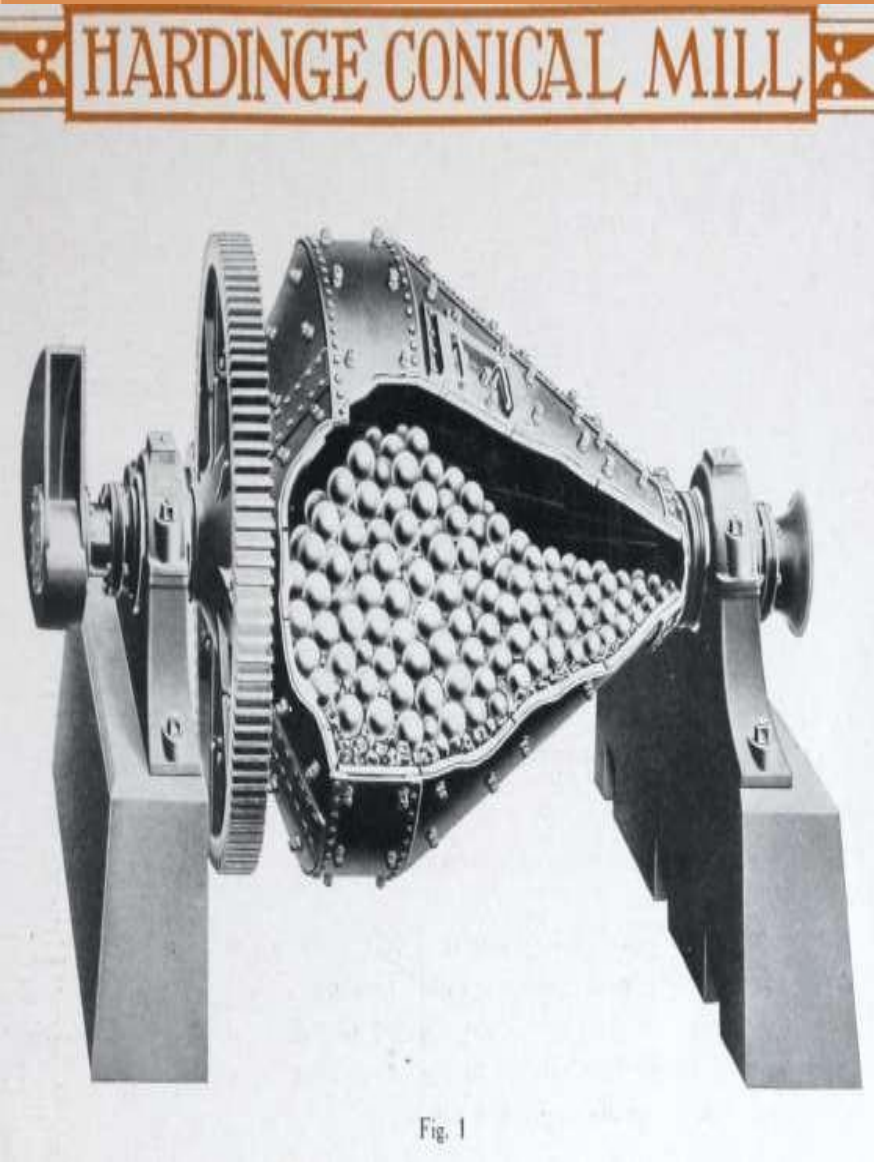
1. The high speed of operation causes generation of heat that may affect thermo labile materials or drugs containing gum, fat or resin. The mill may be water-cooled to reduce this heat damage.
2. The rate of feed must be controlled carefully as the mill may be choked, resulting in decreased efficiency or even damage.
3. Because of the high speed of operation, the hammer mill is susceptible to damage by foreign objects such as stones or metal in the feed. Magnets may be used to remove iron, but the feed must be checked visually for any other contamination.



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BALL MILL/TUMBLING MILL



- Principle: impact b/w rapidly moving balls and powder material. At low speed balls roll over each other attrition takes place.
- Construction :
- A ball mill consists of a hollow cylindrical shell rotating about its axis. The axis of the shell may be either horizontal or at a small angle to the horizontal. It is partially filled with balls. The grinding media is the balls, which may be made of steel (chrome steel), stainless steel, ceramic, or rubber. The inner surface of the cylindrical shell is usually lined with an abrasion-resistant material such as manganese steel or rubber. Less wear takes place in rubber lined mills. The length of the mill is approximately equal to its diameter.

Ball mill:

Ball mill is a type of crusher, is a cylindrical device used to grind or mix materials like ores, chemicals, ceramics and paints. Ball mills rotate around a horizontal axis, partially filled with the material to be ground plus the grinding medium. Different materials are used for media, including ceramic balls, flint pebbles and stainless steel balls. An internal cascading effect reduces the material to a fine powder. Industrial ball mills can operate continuously fed at one end and discharged at the other. Large to medium ball mills are mechanically rotated on their axis, but small ones normally consist of a cylindrical capped container that

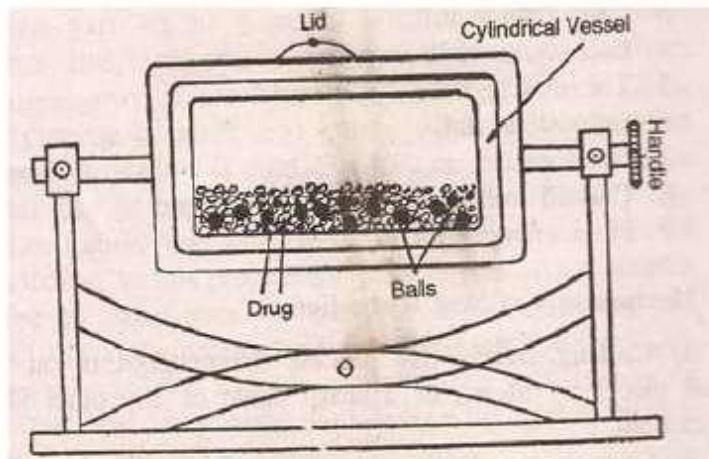


Figure 5-a Ball mill



**Figure 5-b An example of Grinding media for ball mill
(Lead antimony-grinding media with aluminum powder)**

Advantages:

1. Ball mill is capable of grinding a wide variety of materials of differing character and of different degrees of hardness.
2. It can be used in a completely enclosed form, which makes it especially suitable for use with toxic materials.
3. It can produce very fine powders.
4. It can be used for continuous operation, and a classifier can be used in conjunction with the mill, so that particles of suitable size are removed while oversize particles are returned.
5. It is equally suitable for wet or dry grinding processes.

Disadvantages

1. Wear occurs, principally from the balls, but partially from the casing and this may result in the product being contaminated, with abrasive materials this may exceed 0.1 percent, but even ordinary substances may be contaminated with 0.03 percent metal after grinding.
2. In some cases, this may not be significant, but in others it may be of great importance.
3. Soft or sticky materials may cause problems by caking on the sides of the mill or by holding the balls in aggregates.
4. The ball mill is very noisy machine, particularly if the casing is of metal, but much less so if rubber is used.
5. Relatively long time of operation.

