MILLING MACHINES

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MILLING

- **Milling:** is the process of removing metal by feeding the work against a rotating multi point cutter.

- In milling operation the rate of metal removal is rapid as the cutter rotates at a high speed and has many cutting edges.
- The machine can also hold one or more cutters at a time.
- It is the most versatile of all machine tools.
- Flat or formed surfaces may be machined with excellent finish and great accuracy.
- It is designed for machining a variety of tool room work

TYPES OF MILLING MACHINES

- Types of milling machines: According to the design and construction they are classified as follows

I. Column and Knee type

1.Hand milling machine
2.Plain milling machine
3.Universal milling machine
4.Omniversal milling machine
5.Vertical milling machine

II. Planer milling machine

III. Fixed bed type

1.Simplex milling machine
2. Duplex milling machine
3.Triplex milling machine

IV. Special types:

1.Rotary table milling machine
2. Drum milling machine
2.Planetary milling machine
3.Duplicating milling machine
5.Profile milling machine

TYPES OF MILLING MACHINES

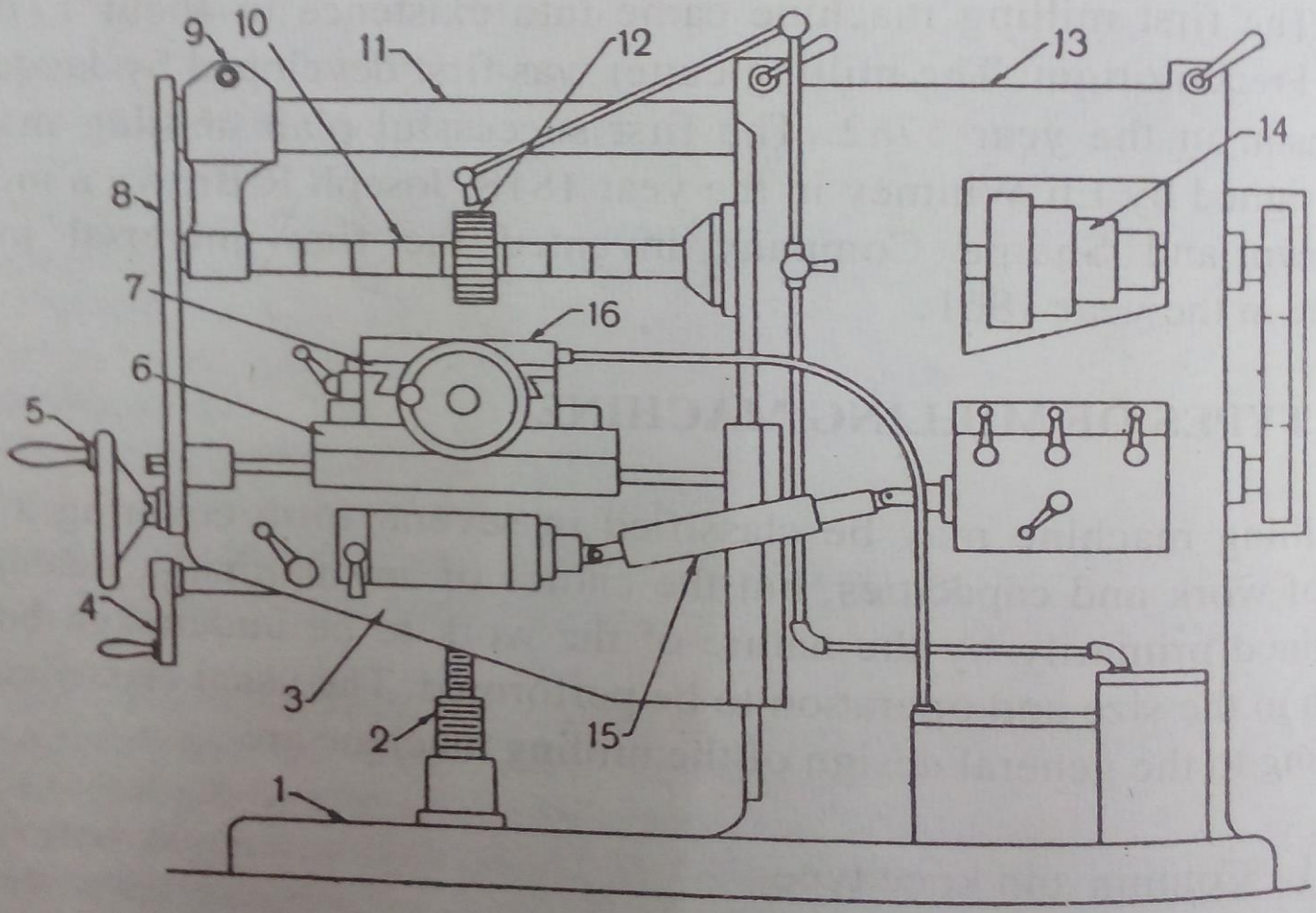


Figure 11.1 Column and knee type milling machine

1. Base, 2. Elevating screw, 3. Knee, 4. Knee elevating handle, 5. Crossfeed handle, 6. Saddle, Table, 8. Front brace, 9. Arbor support, 10. Conepulley, 15. Telescopic feed shaft.

TYPES OF MILLING MACHINES

Simplex Milling machine

Duplex Milling machine

Triplex Milling machine

Drum Milling machine

Planetary Milling machine

TYPES OF MILLING MACHINES

Rotary Milling machine

Rotary Milling attachment

Rotary Milling Operation

Profile Milling Machine

SIZE OF MILLING MACHINE

2.4 SIZE OF MILLING MACHINE :

The size of the column and knee type milling machine is designated by the dimensions of the working surfacc of the table and its maximum length of longitudinal, cross and vertical travel of the table. The following are the typical size of a horizontal knee type milling machine.

Table length × width = 1100 × 310 mm.

Power traverse = longitudinal × cross × vertical

= 650 × 235 × 420 mm.

In addition to the above dimensions, number of spindle speeds, number feeds, spindle nosc taper, power available, net weight and the floor space required, etc. should also be stated in order to specify the machine fully.

MILLING MACHINE OPERATIONS

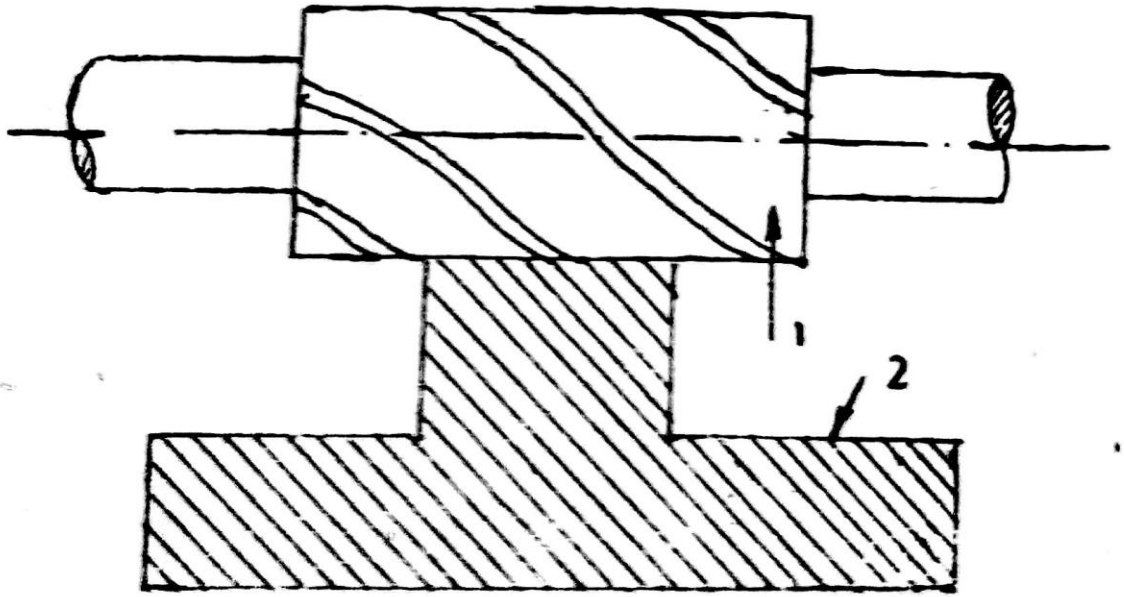
2.5 MILLING OPERATIONS :

The following are the different operations performed in a milling machine

1. Plain milling
2. Face milling
3. Form milling
4. Straddle milling
5. Angular milling
6. Gang milling
7. Profile milling
8. End milling
9. Helical milling
10. Gear cutting

MILLING MACHINE OPERATIONS

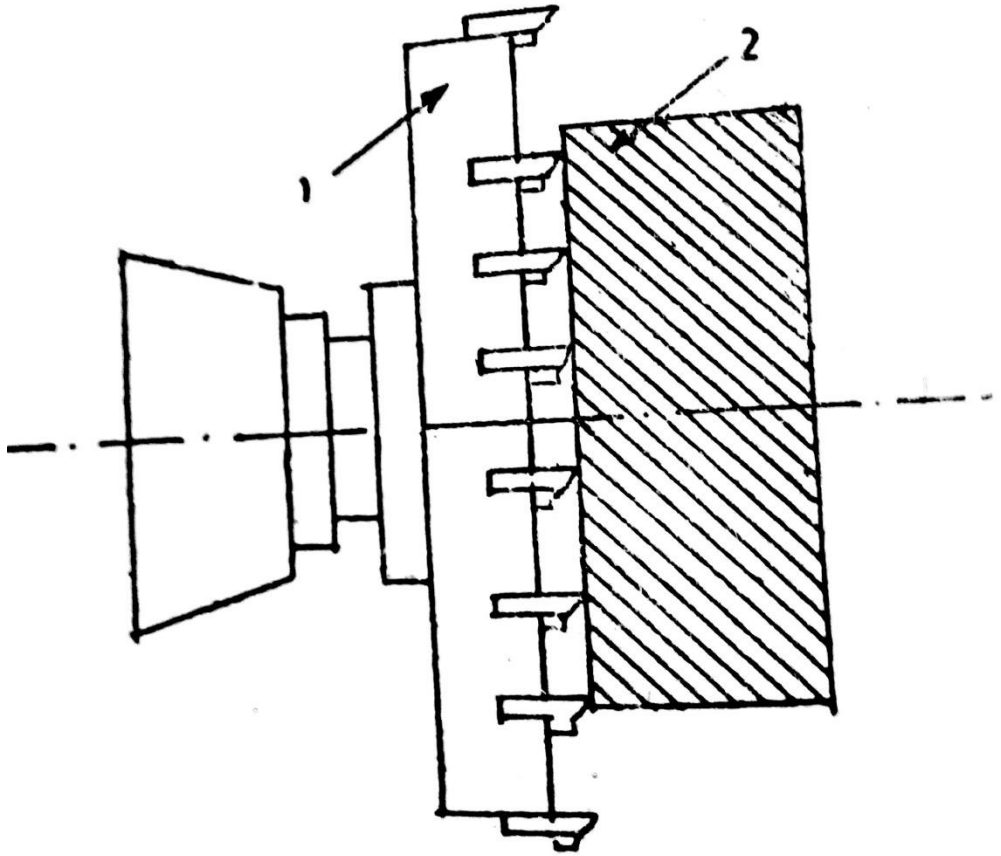
1. **Plain or slab or peripheral milling :** It is the operation of production of a plain, flat, horizontal surface parallel to



1. Slab mill 2. Work

Fig. 2.3. Slab Milling

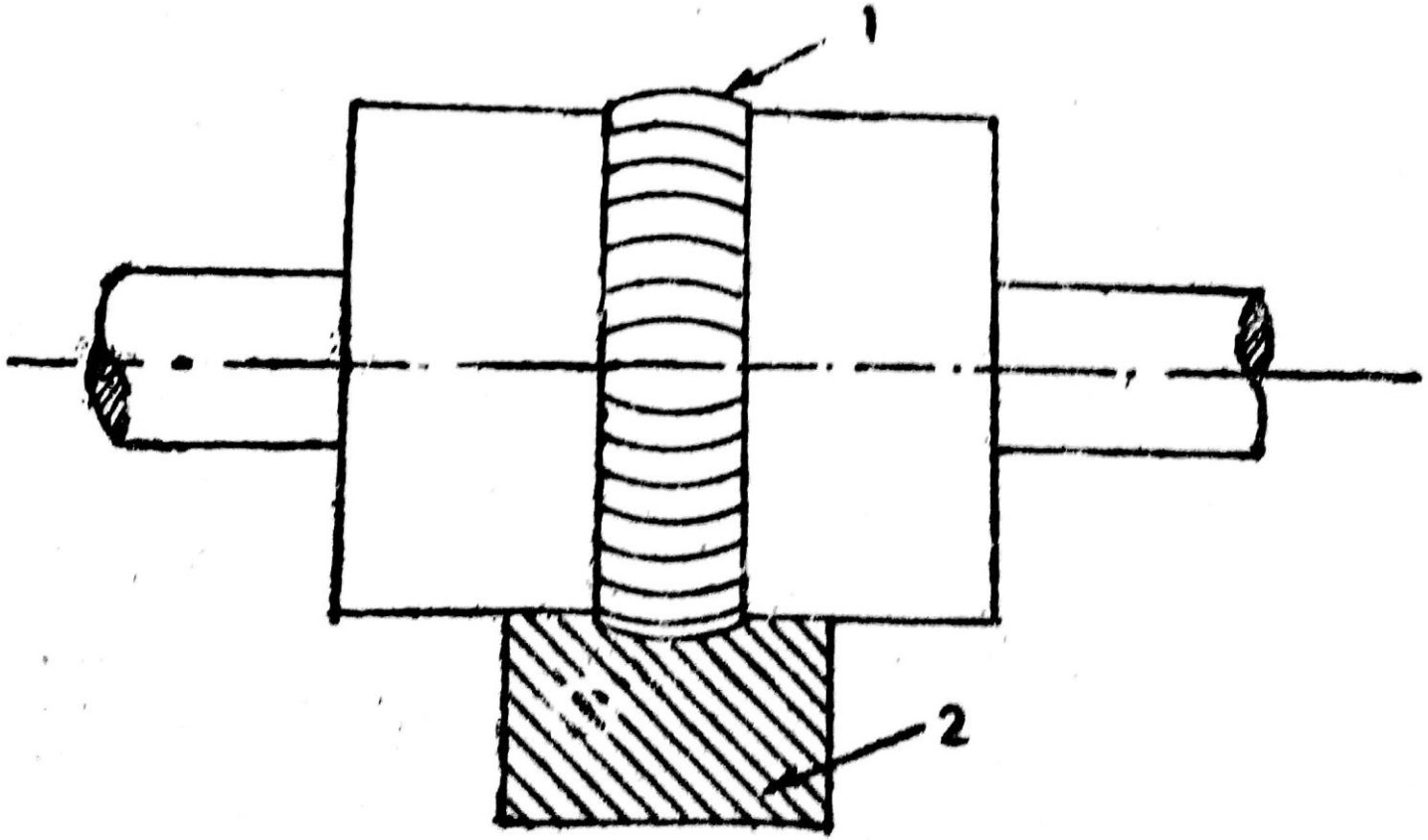
MILLING MACHINE OPERATIONS



1. Face milling cutter 2. Work

Fig. 2.4. Face milling

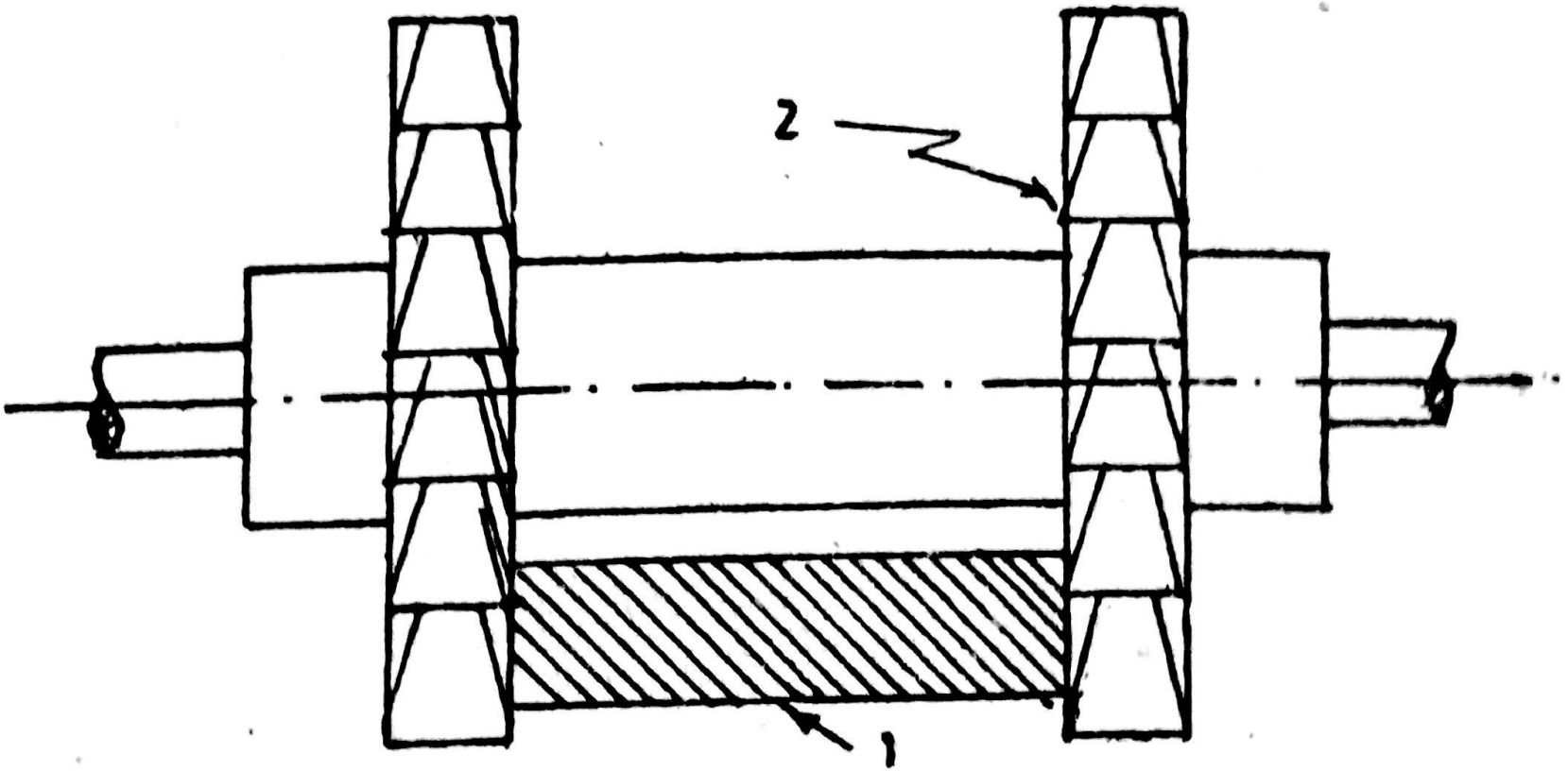
MILLING MACHINE OPERATIONS



1. Formed cutter 2. Work

Fig. 2.5. Form Milling

MILLING MACHINE OPERATIONS



1. Straddle cutter 2. Work

Fig. 2.6. Straddle milling

MILLING MACHINE OPERATIONS

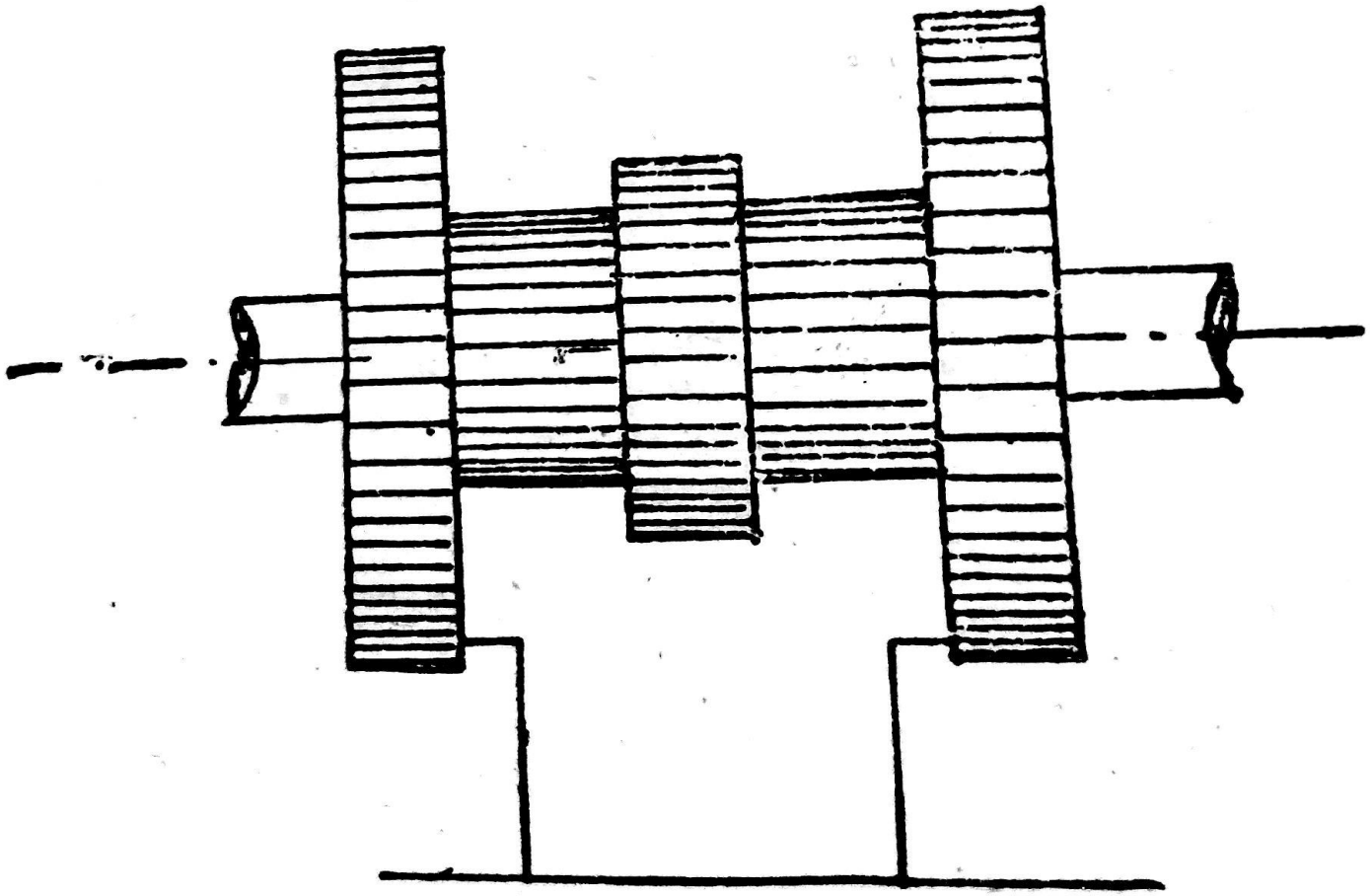
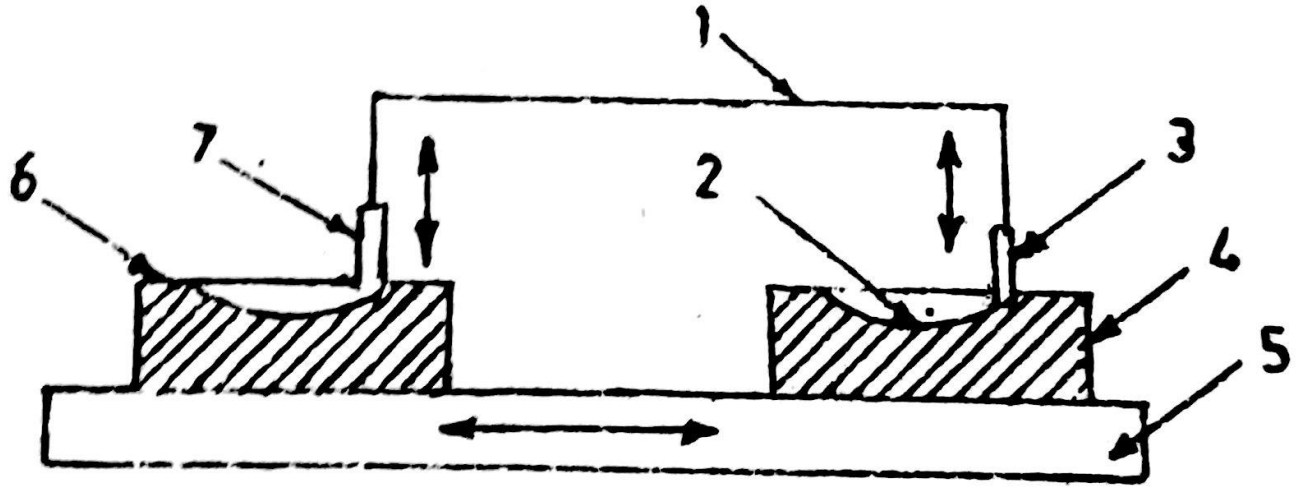


Fig. 2.8. Gang Milling

MILLING MACHINE OPERATIONS



1. Power connection between tool and tracer
2. Contoured profile
3. Tracer
4. Master die
5. Table
6. Work
7. End mill

Fig. 2.9. Profile Milling

Indexing

Indexing: The indexing is the operation of dividing the periphery of a work piece into any number of equal parts

In cutting spur gear, equal spacing of teeth on the gear blank is performed by indexing.

Indexing required for producing

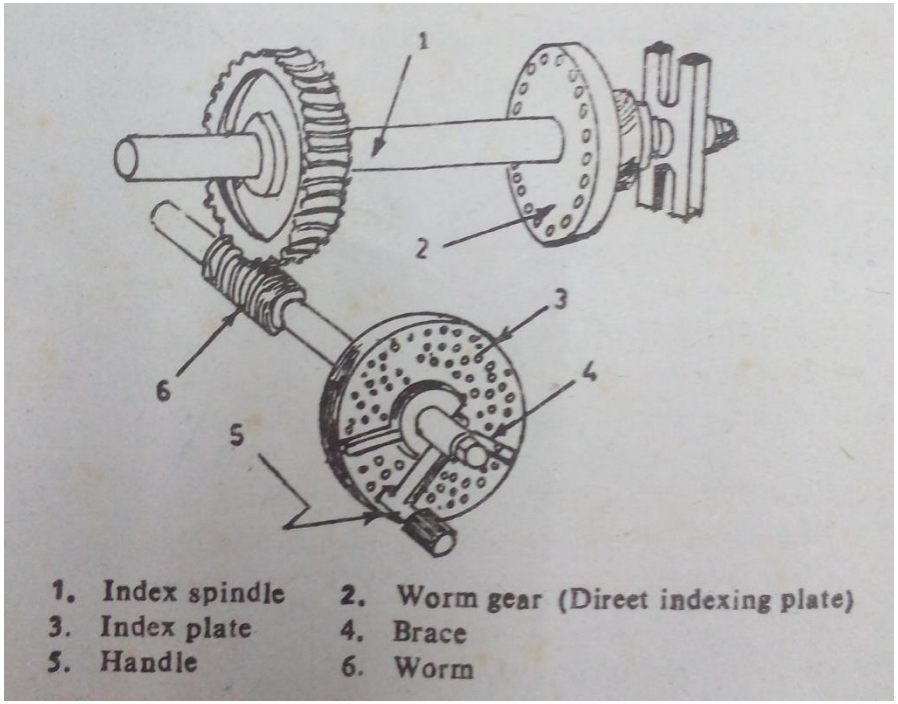
1. Hexagonal and Square head bolts
2. Cutting splines on shafts
3. Fluiting drills, taps and reamers etc.

Indexing is accomplished by using a special attachment known as Dividing Head or Indexing Head

1. Plain or Simple indexing head
2. Universal dividing head
3. Optical dividing head

Indexing Methods

1. Direct or Rapid indexing
2. Plain or simple indexing
3. Compound indexing
4. Differential Indexing
5. Angular Indexing



Indexing Methods

Rule for direct indexing : To find the index movement, divide the total number of holes in the direct index plate by the number of divisions required on the work. In this case, when the direct index plate has 24 holes, the formula for indexing is given below :

$$\text{No. of holes to be moved} = \frac{24}{N} \qquad 12.1$$

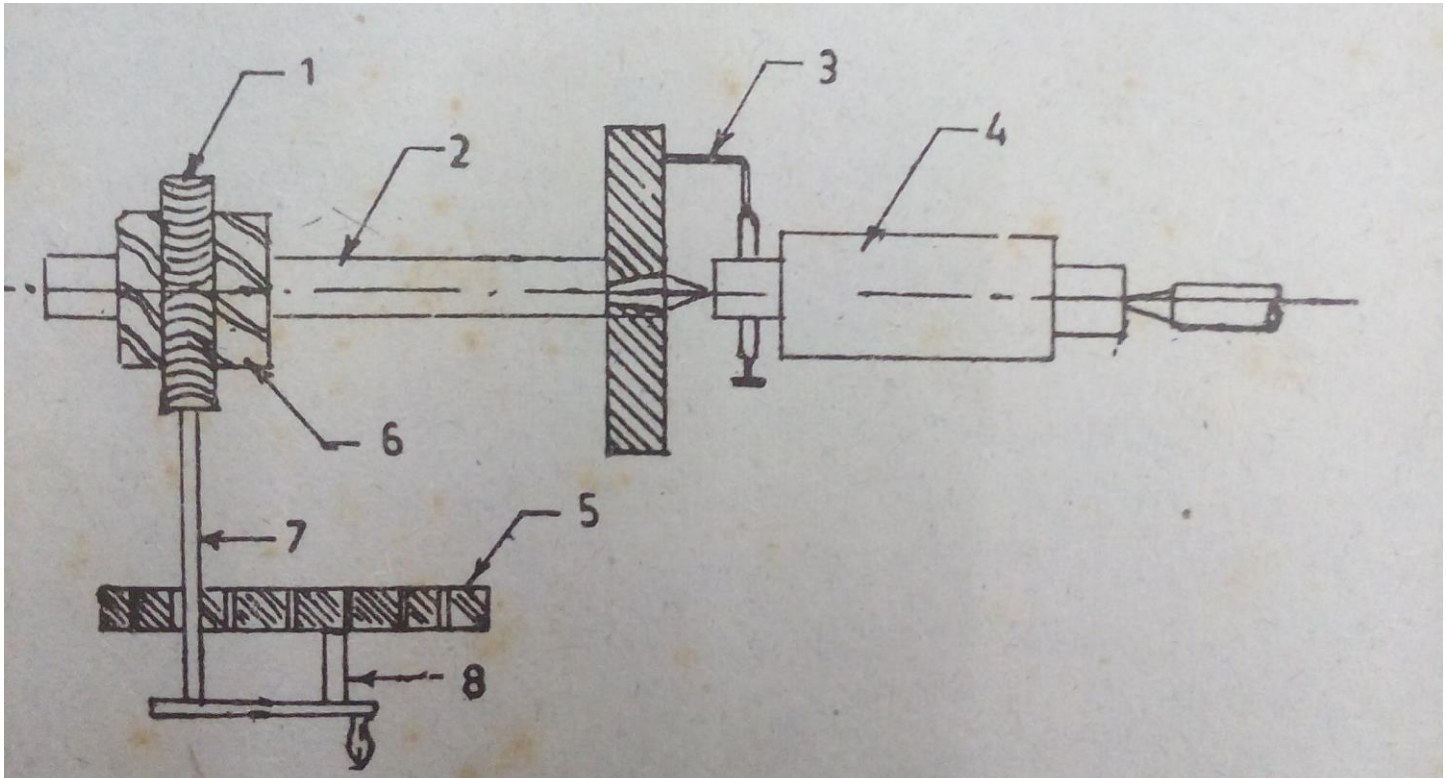
Where, N = number of divisions required

Example 12.1 : Find out the index movement required to mill a hexagonal bolt by direct indexing. The rapid index plate has 24 holes.

$$\text{No. of holes to be moved} = \frac{24}{6} = 4$$

After machining one side of the bolt the index plate will have to be moved by 4 holes for 5 number of times to machine the remaining faces of the bolt.

Indexing Methods



1. Worm wheel
2. Spindle
3. Dog
4. Job
5. Index plate
6. Worm
7. Worm shaft
8. Crank pin

Fig. 2.35 Plain Indexing

Indexing Methods

The index plate has several circles with different number of holes in each circle. The standard Brown and sharp index plates have the following circles.

Plate No. 1———— 15, 16, 17, 18, 19, 20.
Plate No 2———— 21, 23, 27, 29, 31, 33.
Plate No. 3———— 37, 39, 41, 43, 47, 49.

With the above three index plates simple indexing can be used for all divisions up to 50, even numbers upto 100, except 96, and many others.

Rule : The index crank movement $= \frac{40}{N}$ where N is the number of divisions required.

Example (2.2) : Find out the index movement to mill 25 teeth on a spur wheel blank. Index crank movement $= \frac{40}{25} = 1\frac{3}{5} \times \frac{3}{3} = 1\frac{9}{15}$. Thus for indexing, one complete revolution and 9 holes in 15 holes circle of the index plate will

Indexing Methods