

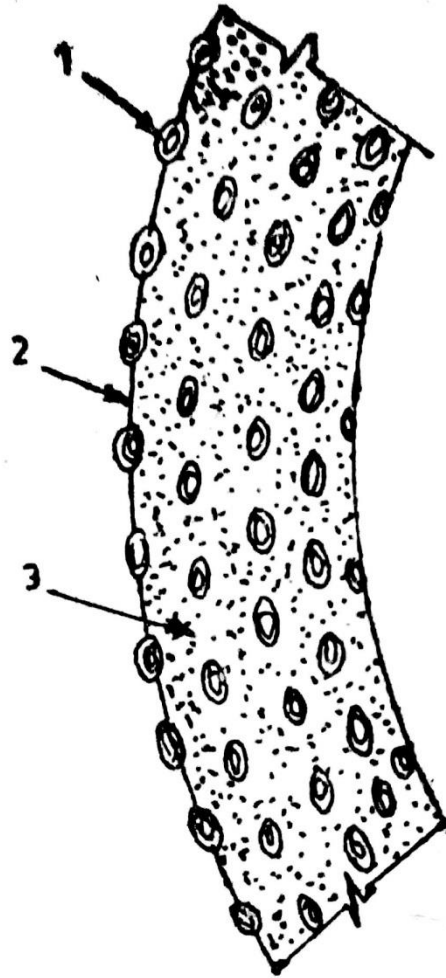
GRINDING MACHINES

BY

S.SRIKRISHNA

Sr.Lecturer, STC/SC

STRUCTURE OF GRINDING WHEEL



1. Abrasive particles

2. Wheel face

3. Bonding Material

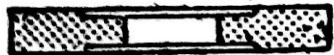
Fig. 3.1 Illustrates the abrasive grains projected from the face of the grinding wheel

GRINDING :

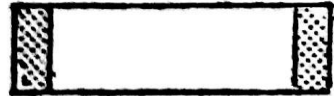
SHAPES OF GRINDING WHEELS



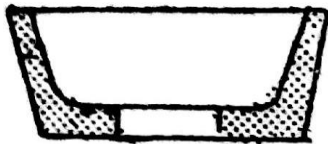
TYPE NO 1-STRAIGHT



TYPE No 7-RECESSED BOTH SIDES(straight)



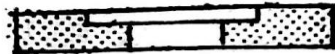
TYPE No 2 CYLINDER



TYPE No 11 FLARING CUP



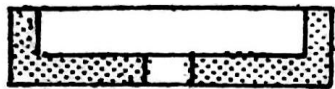
SEGMENTED WHEEL



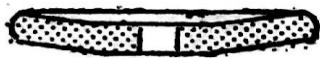
TYPE No 5-RECESSED ONE SIDE(straight)



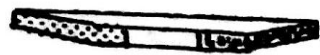
TYPE No 4-TAPERED



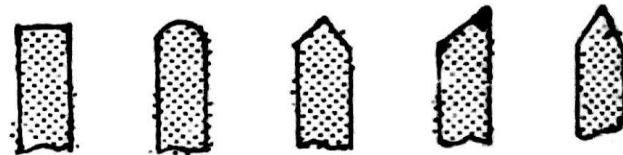
TYPE No 6 STRAIGHT CUP



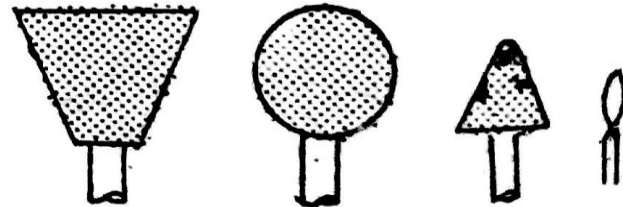
TYPE No 13 SAUCER



TYPE No 12-DISH



STANDARD SHAPES OF GRINDING WHEEL FACES



MOUNTED POINTS

Fig. 3 2 Standard Grinding Wheel Shapes

TYPES OF GRINDING MACHINES

3.18 TYPES OF GRINDING MACHINES :

Grinding machines according to the quality of surface finish, may be classified as :

- (I) Rough grinders.
- (II) Precision grinders.

I. Rough Grinders : Rough grinders are those grinding machines whose chief work is the removal of stock without any reference to the accuracy of results. They are mainly of the following types.

1. Floor stand and bench grinders.
2. Portable and flexible shaft grinders.
3. Swing frame grinders.
4. Abrasive belt grinders.

TYPES OF GRINDING MACHINES

II. Precision Grinders : Precision grinders are those that finish parts to a very accurate dimensions.

According to the type of surface generated or work done they may be classified as follows :

1. Cylindrical grinders

- (a) Centre-type (Plain)
- (b) Centre-type (Universal)
- (c) Centre-less

2. Internal grinders

- (a) Chucking
 - (i) Plain
 - (ii) Universal.
- (b) Planetary
- (c) Centre-less.

3. Surface grinders.

- (a) Reciprocating table
 - (i) Horizontal spindle
 - (ii) Vertical spindle.
- (b) Rotating table
 - (i) Horizontal spindle
 - (ii) Vertical spindle.

4. Tool and cutter grinders.

- (a) Universal
- (b) Special.

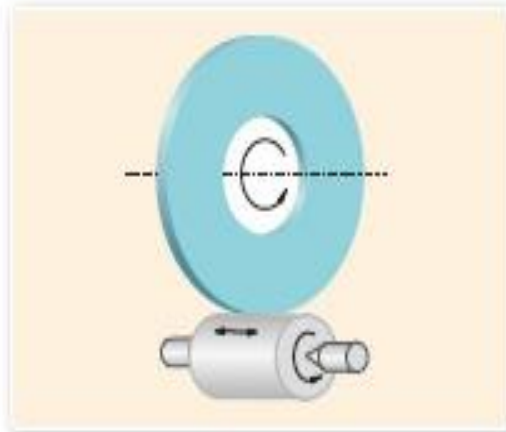
5. Special grinding machines.

METHODS OF GRINDING

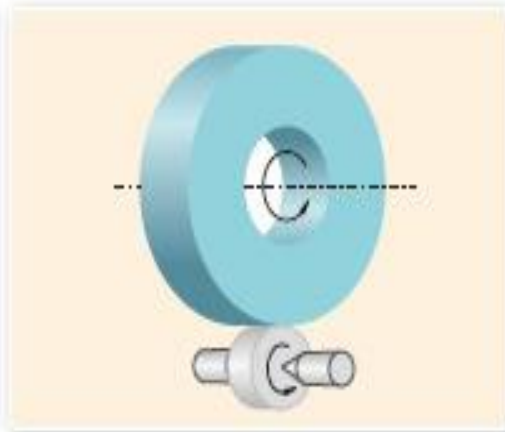
- Cylindrical grinding
- Internal grinding
- Centerless grinding
- Surface grinding
- Tool grinding
- Hand-held grinding and manually guided grinding
- Cutting off
- Machinery parts & other grinding

CYLINDRICAL GRINDING

- Cylindrical Grinding: is the grinding of outside cylindrical and tapered surfaces.



Traverse grinding

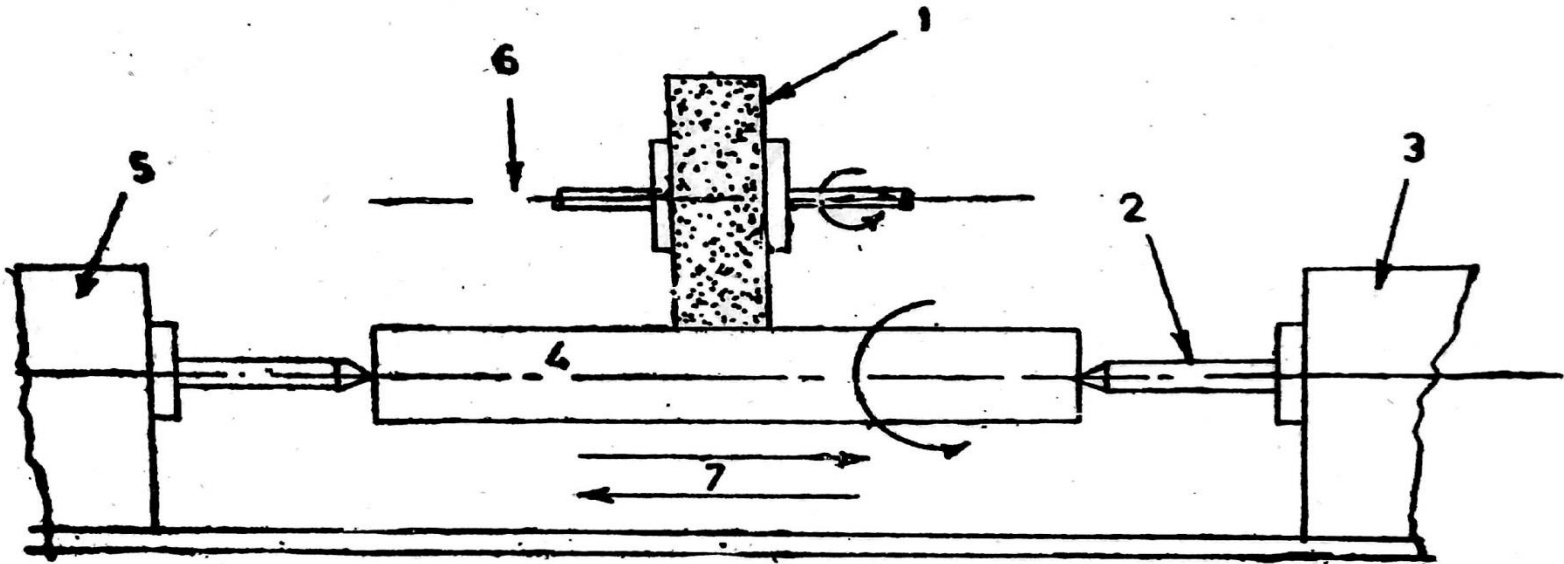


Plunge grinding



Angular slide grinding

CYLINDRICAL GRINDING



- | | | |
|-------------------|------------------|---------------|
| 1. Grinding wheel | 2. Dead centre | 3. Tail stock |
| 4. Work piece | 5. Head stock | 6. Wheel feed |
| | 7. Work Traverse | |

Fig. 3.6 Principle of Cylindrical Grinding

There are four movements in a cylindrical centre type grinding.

- The work must revolve,
- The wheel must revolve,
- The work must pass the wheel, and
- The wheel must pass the work.

INTERNAL GRINDING

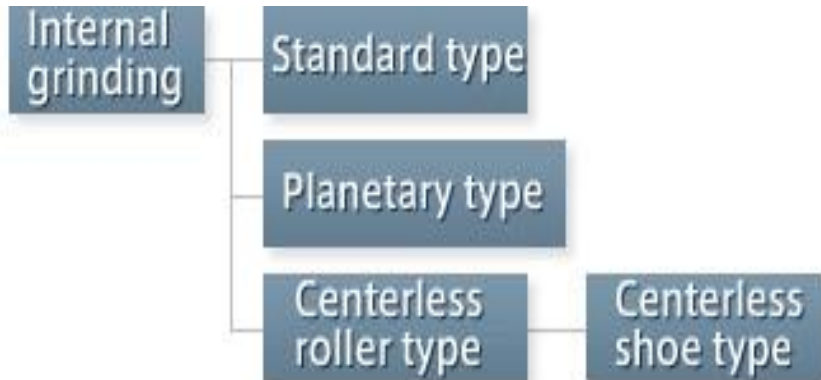
3.23 INTERNAL GRINDERS :

Internal grinders are used to finish straight tapered or formed holes to the correct size, shape and finish.

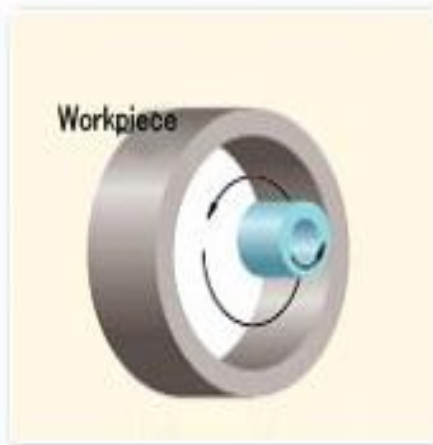
According to the general construction there are three types of Internal Grinders.

- (a) Chucking.
- (b) Planetary.
- (c) Centreless.

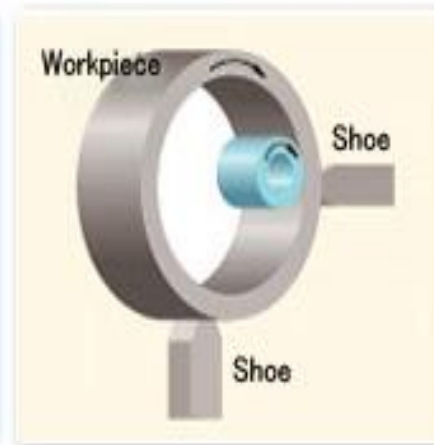
INTERNAL GRINDING



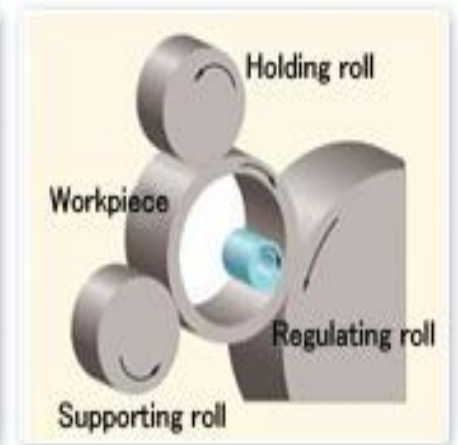
Standard type



Planetary type
(revolving grinding wheel axis)



Centerless shoe type



Centerless roller type

INTERNAL GRINDING

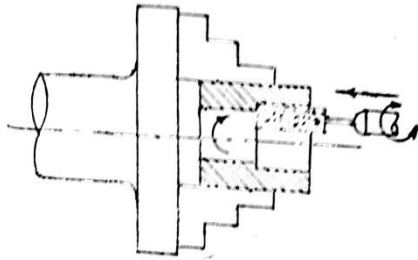
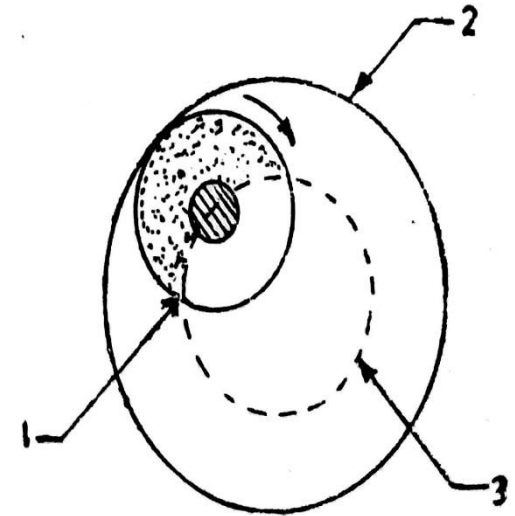


Fig. 3.10 Chucking Type Internal Grinder

(b) **Planetary Type Internal Grinders** : In a planetary grinder the work piece is mounted on the reciprocating table and is not revolved. Instead, the grinding wheel is given rotary and planetary motions to grind cylindrical holes. Planetary grinding is usually limited to large and awkward work-pieces that cannot be conveniently rotated by a chuck. The process is illustrated in the fig. 3.11

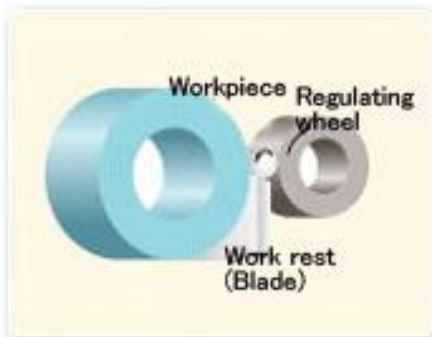


1. Grindlg wheel
2. Cylinder bore
3. Path of grinding wheel

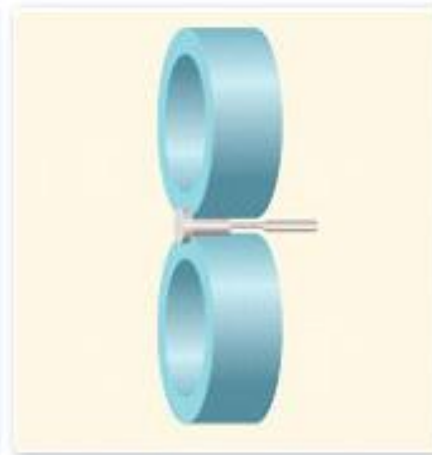
Fig. 3.11 Planetary Type Internal Grinding

CENTERLESS GRINDING

- Centerless Grinding: is a method of grinding exterior, cylindrical, tapered and formed surfaces on work pieces that are not held and rotated on centers

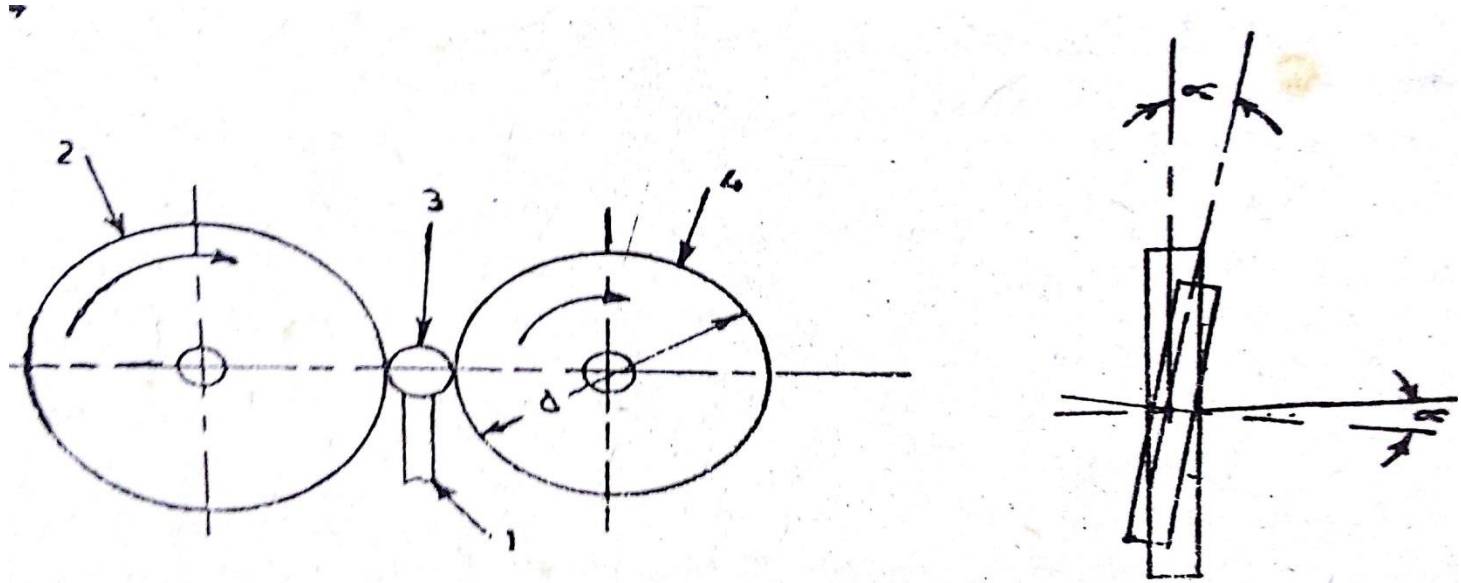


Through feed grinding



Infeed grinding

CENTERLESS GRINDING

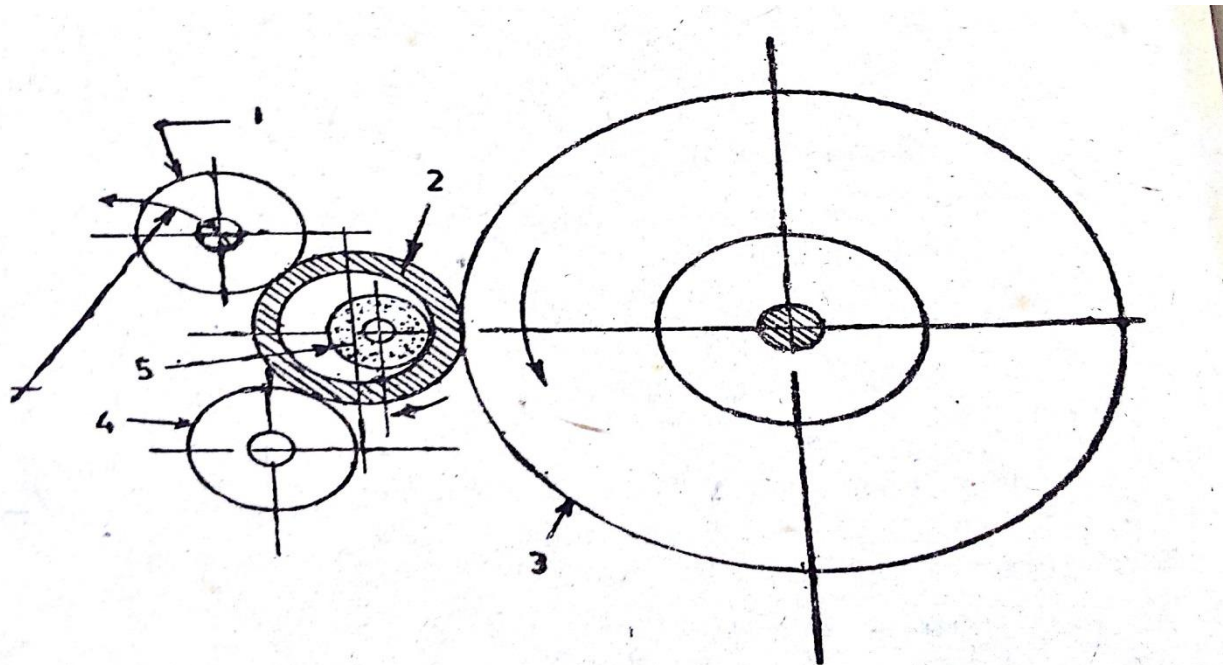


1. Work Rest
2. Grinding wheel
3. Work
4. Regulating wheel

Side view

Fig. 3.8 External Centreless Grinding

CENTERLESS GRINDING

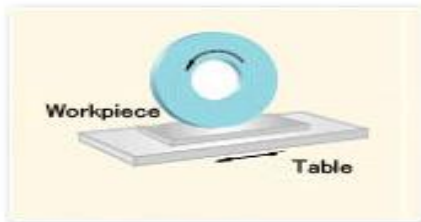


1. Pressure Roll 2. Work 3. Regulating Roll
4. Support Roll 5. Grinding wheel

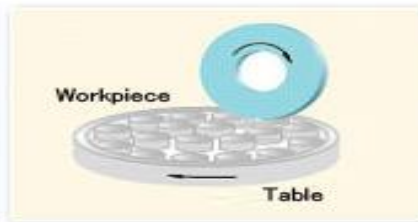
Fig. 3.12 Internal Centreless Grinding

SURFACE GRINDING

It is a method of grinding horizontal flat or plane surfaces



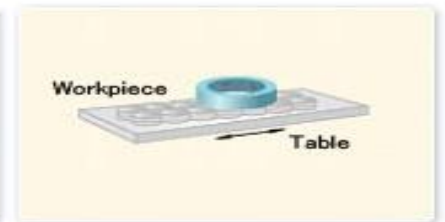
Horizontal spindle reciprocating table



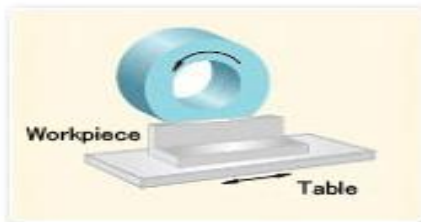
Horizontal spindle rotary table



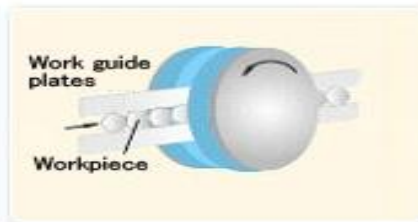
Vertical spindle rotary table



Vertical spindle reciprocating table



Horizontal spindle reciprocating table

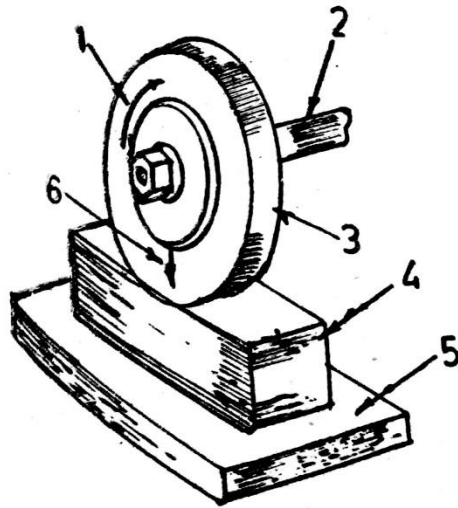


Through feed type



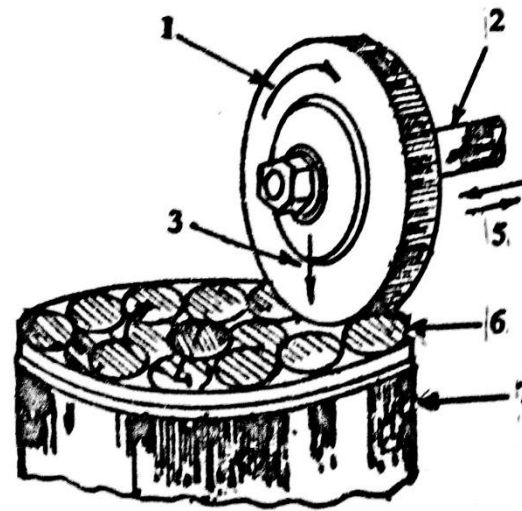
Carrier type

SURFACE GRINDING



1. Direction of wheel rotation
2. Wheel spindle
3. Grinding wheel
4. Work
5. Table
6. Infeed

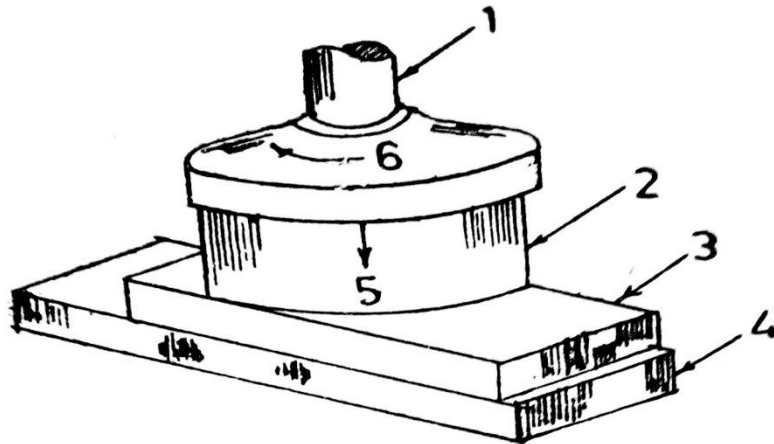
Fig. 3.13 (i) Working Principle of Horizontal Spindle Reciprocating Table Surface Grinder



1. Direction of wheel rotation
2. Wheel spindle
3. Infeed
4. Table
5. Cross feed
6. Work pieces
7. Rotary table.

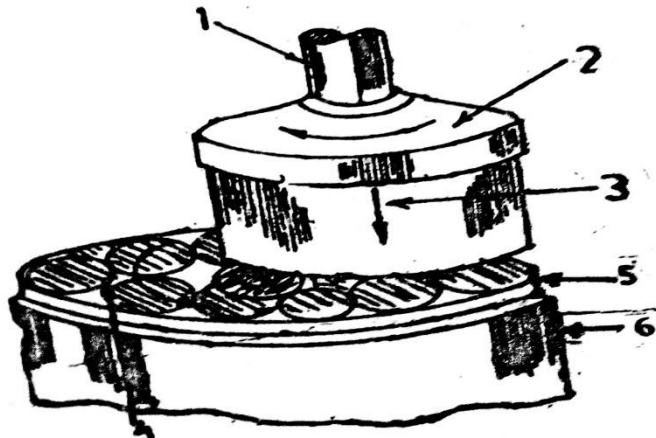
Fig. 3.13 (ii) Working Principle of Horizontal Spindle Rotary Table Surface Grinder

SURFACE GRINDING



1. Spindle
2. Wheel
3. Work
4. Table
5. Infeed
6. Wheel Rotation

Fig. 3.13 (iii) Working Principle of Vertical Spindle Reciprocating Table Surface Grinder

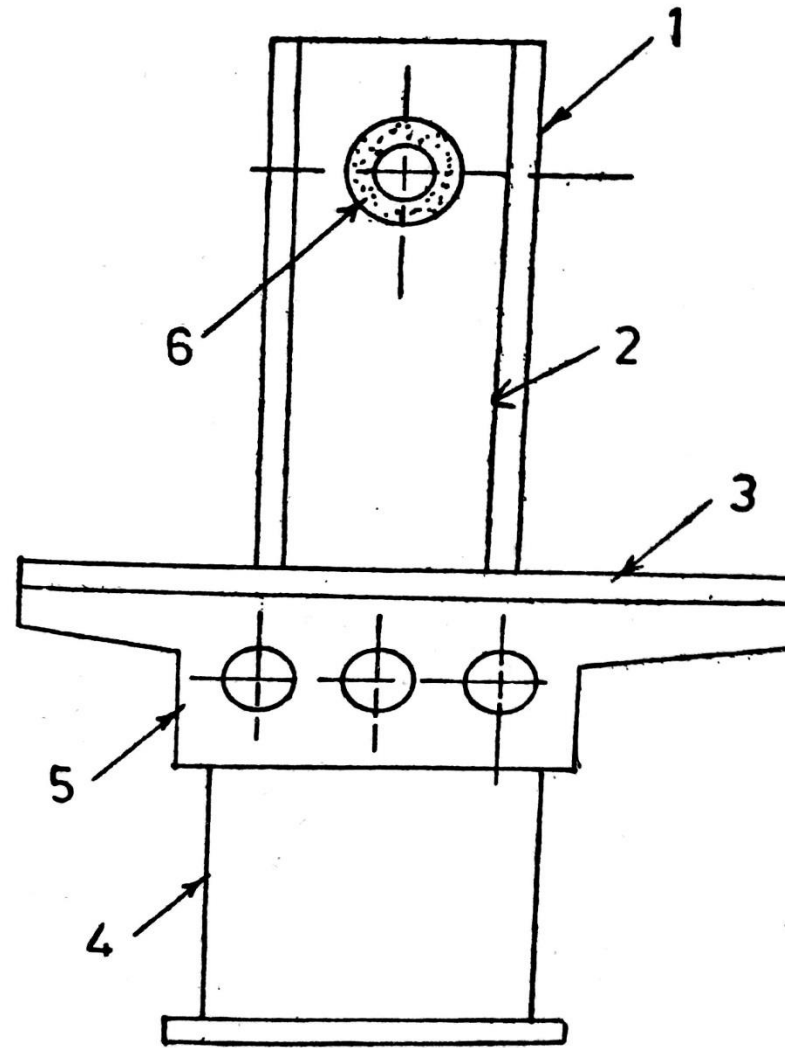


1. Wheel spindle
2. Wheel rotation
3. Infeed
4. Table
5. Work pieces
6. Rotary table

Fig. 3.13 (iv) Working Principle of Vertical Spindle Rotary Table Surface Grinders

Fig. 3.13 Four Types of Surface Grinders
 The four types of surface Grinders are diagrammatical

SURFACE GRINDING



- | | | |
|-----------|---------------|-------------------|
| 1. Column | 2. Wheel head | 3. Table |
| 4. Base | 5. Saddle | 6. Grinding wheel |

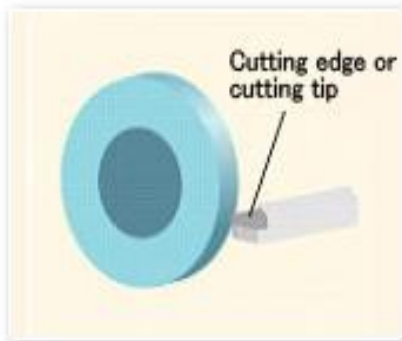
Fig. 3.14 Horizontal Spindle Surface Grinder

TOOL & CUTTER GRINDING

Tool and cutter grinders are used mainly to sharpen and recondition multiple tooth cutters like reamers, milling cutters, drills, taps, hobs and other type of tool used in the shop

Tool grinding

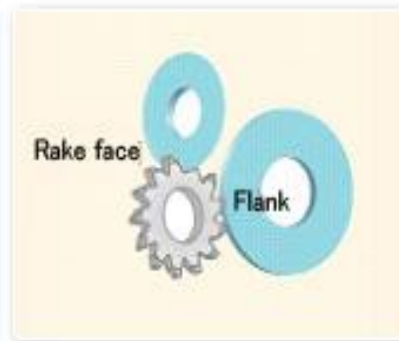
Turning tool, Drill, Milling, Hob, Broach, Pinion cutter, End mill



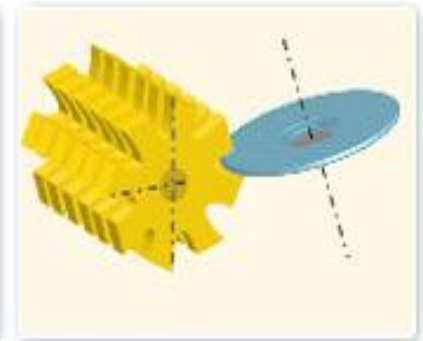
Turning tool grinding



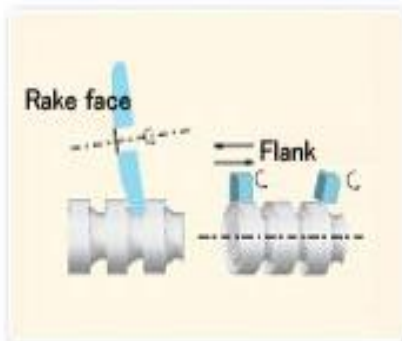
Drill grinding



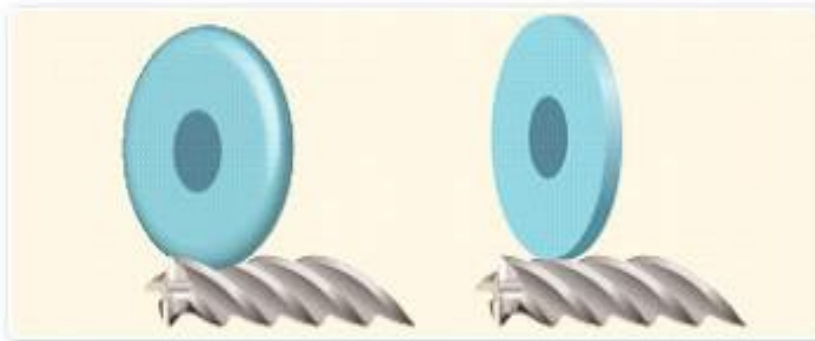
Milling cutter grinding



Hob grinding

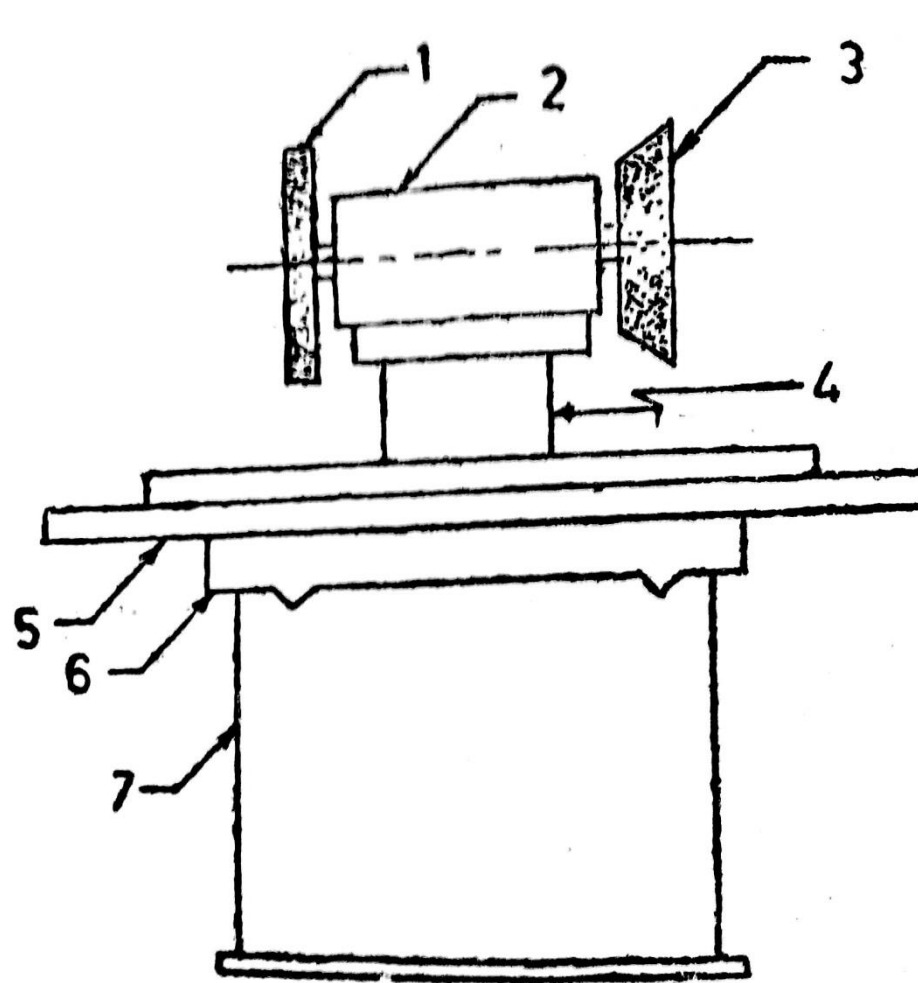


Broach grinding



End mill grinding

TOOL & CUTTER GRINDING



1 & 3. Wheels

2. Wheel head

4. Column

5. Table

6. Saddle

7. Base

Fig. 3.16 Block Diagram of Universal Tool and Cutter Grinder

HAND-HELD GRINDING AND MANUALLY GUIDED GRINDING

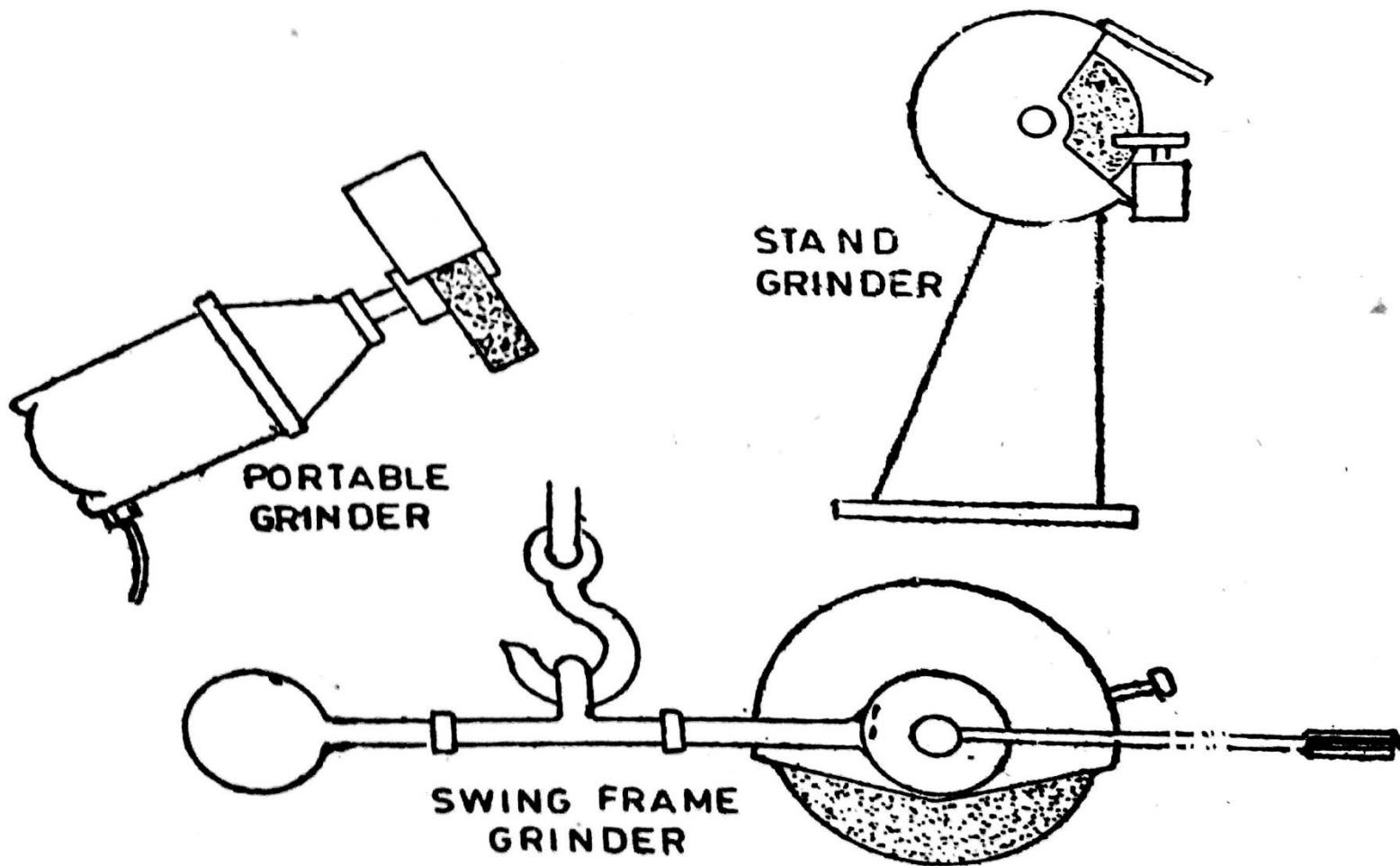
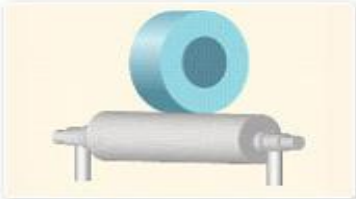
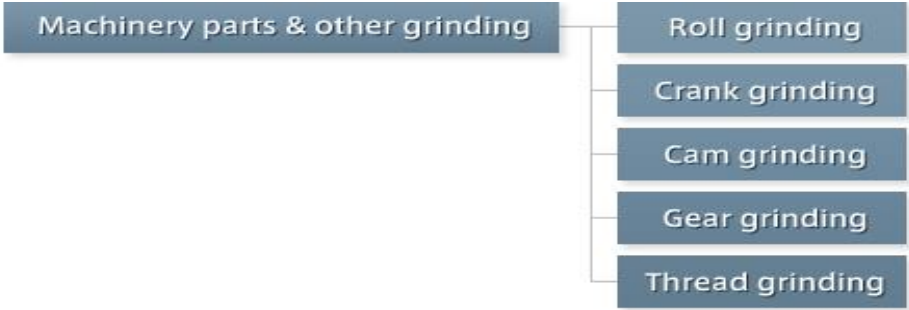


Fig. 3.5 Rough Grinding Machines

ends and is mounted on a base pedestal. There is provision

MACHINERY PARTS & OTHER GRINDING



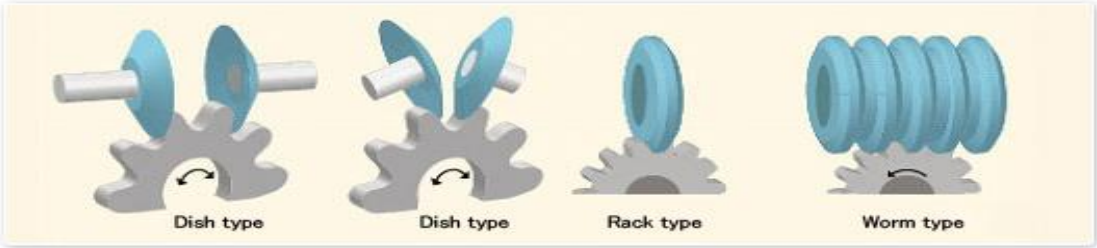
Roll grinding



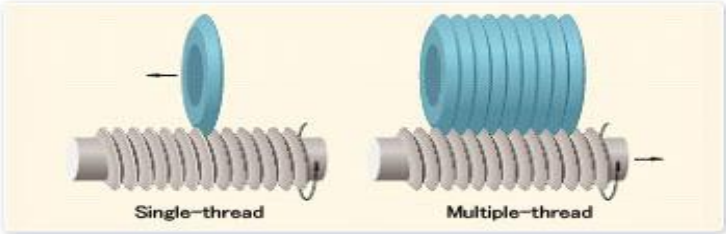
Crankshaft grinding



Camshaft grinding



Gear grinding



Thread grinding

BONDING PROCESS

- **A bond** is a material that holds the abrasive grains together enabling the mixture to be kept in the desired shape in the form of wheel. The most commonly used bonds for manufacture of grinding wheels are
 - i) Vitrified Bond (denoted by 'V')
 - ii) Silicate Bond (denoted by 'S')
 - iii) Shellac Bond (denoted by 'E')
 - iv) Rubber Bond (denoted by 'V')
 - v) Bakelite or resinoid Bond (denoted by 'B')

BONDING PROCESS

- i) Vitriified Bond: It is a clay bond, reddish brown in colour. The base material is 'Feldspar' which is a fusible clay.
- ii) Silicate Bond: Its basic material is silicate of soda or water glass.
- iii) Shellac Bond: **Shellac** is a resin secreted by the female lac bug, on trees in the forests of India and Thailand. Used for thin wheels
- iv) Rubber Bond
- v) Bakelite or resinoid Bond

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GRIT, GRADE AND STRUCTURE OF GRINDING WHEELS

Grit or grain: It indicates the size of the abrasive grains. Grain size is denoted by a number indicating the number of meshes for linear inch of screen

Type of grit	Grain size or grit number
Coarse	8,10,12,14,16,20,24 (8 to 24)
Medium	30,36,46,54,60 (30 to 60)
Fine	80,100,120,150,180 (80 to 180)
Very fine	220,240,280,320,400,500,600 (220 to 600)

GRIT, GRADE AND STRUCTURE OF GRINDING WHEELS

Grade or Strength of the bond: It refers to the hardness or strength of the bond with which it holds the abrasive particles. It does not refer to the hardness of abrasive particles.

Soft	A,B,C,D,E,F,G,H
Medium	J,K,L,M,N,O,P
Hard	Q,R,S,T,U,V,W,X,Y,Z

Hard wheels are recommended for soft materials and soft wheels are recommended for hard materials.

GRIT, GRADE AND STRUCTURE OF GRINDING WHEELS

Structure or Grain spacing: It refers to the no of cutting edges per unit area. The primary purpose of structure is to provide chip clearance.

	Dense								Open						
Structure No	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Grain %	62	60	58	56	54	52	50	48	46	44	42	40	38	36	34

MARKING SYSTEM OF GRINDING WHEEL

SEQUENCE:- PREFIX ABRASIVE GRAIN SIZE GRADE STRUCTURE BOND SUFFIX

W
|
MANUFACTURER'S
ABRASIVE SYMBOL
(USE OPTIONAL)

ALUMINUM OXIDE-A
SILICON CARBIDE-C

COARSE MEDIUM

10 30
12 36
14 46
16 54
20 60
24

SOFT

MEDIUM

HARD

ABCDEFGHIJKLMNOPQRSTUVWXYZ

GRADE }
SCALE }

46

FINE

80

100

120

150

180

VERY
FINE

220

240

280

320

400

500

600

K

DENSE

1

2

3

4

5

6

7

8

(USE OPTIONAL)

5

TO OPEN

9

10

11

12

13

14

15

ETC.

V

17
|
MANUFACTURER'S TYPE
SYMBOL
(USE OPTIONAL)

V - VITRIFIED

B - RESINOID

R - RUBBER

E - SHELLAC

S - SILICATE

O - OXYCHLORIDE.

INDIAN STANDARD MARKING SYSTEM

MARKING SYSTEM OF GRINDING WHEEL