UNIT 3

MILLING MACHINES

INTRODUCTION

A milling machine removes material from a work piece by rotating a cutting tool (cutter) and moving it into the work piece. Milling machines, either vertical or horizontal, are usually used to machine flat and irregularly shaped surfaces and can be used to drill, bore, and cut gears, threads, and slots.

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Plate 2: 21, 23, 27, 29, 31, 33 holes
Plate 3: 37, 39, 41, 43, 47, 49 holes
In the case of Cincinnati type plates, a single plate is used, with holes evenly
distributed on both sides:
First side: 24, 25, 28, 30, 34, 37, 38, 39, 41, 42, 43 holes
Second side: 46, 47, 49, 51, 53, 54, 57, 58, 59, 62, 66 holes
Formula =(linear pitch of the job or workpiece X 40 Indexing movement)/(Lead of
the table lead screw)

2. Simple Indexing: Simple indexing is achieved using a plain indexing head or universal dividing head on a milling machine. It employs a worm, crank, index head, and worm wheel to create precise divisions.

The indexing process utilises several components, including a worm, crank, index head, and worm wheel. Typically, the worm wheel is equipped with 40 teeth, while the worm itself is single-threaded. This configuration ensures that as the crank completes one full revolution, the work wheel rotates by 1/40th of a complete revolution.
Moreover, the worm wheel turns by 2/40th (or 1/20) of a revolution. Consequently, for every single revolution of the workpiece, the crank needs to complete 40 revolutions. Additionally, the holes in the index plate play a crucial role in further subdividing the rotation of the workpiece, enhancing the precision of the indexing process.
Number of Turns = (Number of divisions on index plate) / (Number of divisions

3. Compound Indexing:

Compound indexing is used when complex divisions are required. It combines two simple indexing movements to achieve the desired result. Number of Turns = (N1 * N2) / H

Where:

"N1" represents the number of divisions on the first index plate. "N2" represents the number of divisions on the second index plate. "H" represents the total number of divisions required for the desired compound indexing.

4. Differential Indexing:

In cases where the divisions needed cannot be obtained through simple indexing, a differential indexing approach is employed. It involves a complex arrangement of gears to achieve the required indexing.

The formula for calculating the number of turns required for differential indexing on a milling machine is:

Number of Turns = (N1 *

N2 - 1) / H Where:

"N1" represents the number of divisions on the first index plate. "N2" represents the number of divisions on the second index plate. "H" represents the total number of divisions required for the desired

5. Direct Indexing:

Direct indexing utilises index heads that allow for faster indexing by disconnecting the worm from the worm wheel. A knob controls the index head, facilitating quick and efficient indexing.

The formula for calculating the number of turns required for direct indexing on a milling machine is:

Number of

Turns = (N1 / H)

Where:

"N1" represents the number of divisions on the index plate.

"H" represents the total number of divisions required for the desired direct indexing.

6. Plain Indexing:

plain indexing relies on principles like dividing a full revolution into equal parts. For example, to mill eight equally spaced teeth on a gear, the crank is turned five times after each cut to achieve the desired spacing.

The formula for calculating the number of turns required for plain indexing on a

milling machine is:

Number of Turns = (N / H)

Where:

"N" represents the number of divisions on the index plate.

"H" represents the total number of divisions required

for the desired plain indexing.

7. Indexing Operation:

Indexing operations follow specific rules to determine the number of turns required to obtain the desired divisions. For example, to cut a gear with 42 teeth, you divide 40 by 42, resulting in 20/21 turns, which corresponds to indexing 20 spaces on a 21-hole circle.

These indexing methods are essential in machining operations for achieving precise and consistent results.

- ***Grinding*** is a metal removal process by the action of a rotating ***abrasive wheel.***
- *An* ***abrasive*** is a material whose particles are extremely hard and can be used to machine materials such as hardened steel, glass, carbides, ceramics, etc.
- Grinding operation may be used for removing a thick layer (about 0.5 mm) of material in general class of work.
- Usually grinding is used for finishing & polishing of parts produced by other machining process.

- ***Grinding***
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- *An* ***abra***
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Basic Grinding Theory:

provides an overview of the general process of grinding . Grinding occurs at the point of contact between an abrasive wheel and a workpiece. Like any other cutting process, grinding removes material in the form of chips. In order for a wheel to grind properly, its abrasive grains must wear and self-sharpen at a consistent rate. Otherwise, wheel problems such as loading and glazing may occur. Truing and dressing wheels and applying grinding fluids can fix or prevent these issues.

An understanding of grinding wheels and