Indexing

Indexing is the process of evenly dividing the circumference of a circular workpiece into equally spaced divisions, such as in cutting gear teeth, cutting splines, milling grooves in reamers and taps, and spacing holes on a circle. The index head of the indexing fixture is used for this purpose.

Index Head

The index head of the indexing fixture (Figure 8-19) contains an indexing mechanism which is used to control the rotation of the index head spindle to space or divide a workpiece accurately. A simple indexing mechanism consists of a 40-tooth worm wheel fastened to the index head spindle, a single-cut worm, a crank for turning the wormshaft, and an index plate and sector. Since there are 40 teeth in the worm wheel, one turn of the index crank causes the worm, and consequently, the index head spindle to make 1/40 of a turn; so 40 turns of the index crank revolve the spindle one full turn.

Index Plate

The indexing plate (Figure 8-25) is a round plate with a series of six or more circles of equally spaced holes; the index pin on the crank can be inserted in any hole in any circle. With the interchangeable plates regularly furnished with most index heads, the spacing necessary for most gears, boltheads, milling cutters, splines, and so forth can be obtained. The following sets of plates are standard equipment:

Brown and Sharpe type consists of 3 plates of 6 circles each drilled as follows:

Plate I - 15, 16, 17, 18, 19, 20 holes

Plate 2 - 21, 23, 27, 29, 31, 33 holes

Plate 3 - 37, 39, 41, 43, 47, 49 holes

Cincinnati type consists of one plate drilled on both sides with circles divided as follows:

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

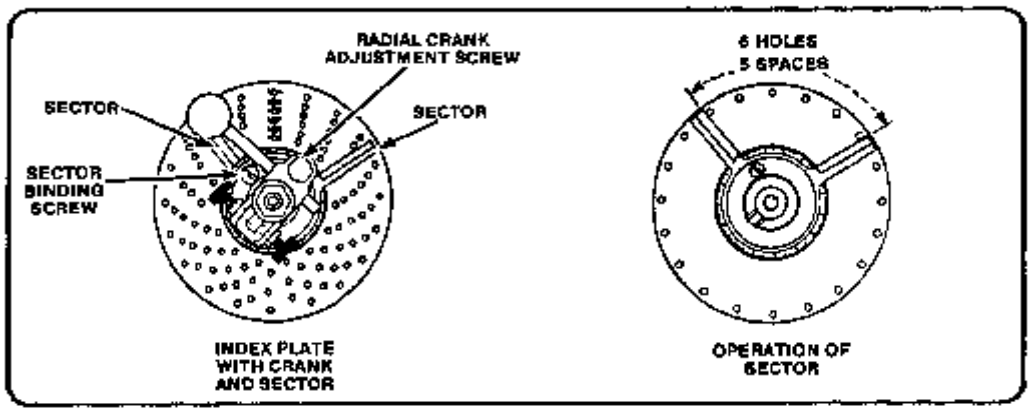

Figure 8-25. Index plate and sector.

Sector

The sector (Figure 8-25) indicates the next hole in which the pin is to be inserted and makes it unnecessary to count holes when moving the index crank after each cut. It consists of two radial, beveled arms which can be set at any angle to each other and then moved together around the center of the index plate. Suppose that, as shown in Figure 8-25, it is desired to make a series of cuts, moving the index crank 1 1/4 turns after each cut. Since the circle illustrated has 20 holes, turn the crank one full turn plus five spaces after each cut, Set the sector arms to include the desired fractional part of a turn or five spaces between the beveled edges of its arms, as shown. If the first cut is taken with the index pin against the left-hand arm, to take the next cut, move the pin once against the right-hand arm of the sector. Before taking the second cut, move the arms so that the left-hand arm is again against the pin; this moves the right-hand arm another five spaces ahead of the pin. Then take the second cut, and repeat the operation until all the cuts have been completed.

NOTE: It is good practice always to index clockwise on the plate to eliminate backlash.

Plain Indexing

The following principles apply to basic indexing of workpieces:

Suppose it is desired to mill a project with eight equally spaced teeth. Since 40 turns of the index crank will turn the spindle one full turn, l/8th of 40 or 5 turns of the crank after each cut will space the gear for 8 teeth. If it is desired to space equally for 10 teeth, 1/10 of 40 or 4 turns would produce the correct spacing.

The same principle applies whether or not the divisions required divide equally into 40. For example, if it is desired to index for 6 divisions, 6 divided into 40 equals 6 2/3 turns; similarly, to index for 14 spaces, 14 divided into 40 equals 2 6/7 turns. These examples may be multiplied indefinitely and from them the following rule is derived: to determine the number of turns of the index crank needed to obtain one division of any number of equal divisions on the workpiece, divide 40 by the number of equal divisions desired (provided the worm wheel has 40 teeth, which is standard practice).

Direct Indexing

The construction of some index heads permits the worm to be disengaged from the worm wheel, making possible a quicker method of indexing called direct indexing. The index head is provided with a knob which, when turned through part of a revolution, operates an eccentric and disengages the worm.

Direct indexing is accomplished by an additional index plate fastened to the index head spindle. A stationary plunger in the index head fits the holes in this index plate. By moving this plate by hand to index directly, the spindle and the workpiece rotate an equal distance. Direct index plates usually have 24 holes and offer a quick means of milling squares, hexagons, taps, and so forth. Any number of divisions which is a factor of 24 can be indexed quickly and conveniently by the direct indexing method.

Differential Indexing

Sometimes, a number of divisions is required which cannot be obtained by simple indexing with the index plates regularly supplied. To obtain these divisions, a differential index head is used. The index crank is connected to the wormshaft by a train of gears instead of a direct coupling as with simple indexing. The selection of these gears involves calculations similar to those used in calculating change gear ratio for lathe thread cutting.

Indexing in Degrees

Workpieces can be indexed in degrees as well as fractions of a turn with the usual index head. There are 360 degrees in a complete circle and one turn of the index crank revolves the spindle 1/40 or 9 degrees. Therefore, 1/9 turn of the crank rotates the spindle 1 degree. Workpieces can therefore be indexed in degrees by using a circle of holes divisible by 9. For example, moving the crank 2 spaces on an 18-hole circle, 3 spaces on a 27-hole circle, or 4 spaces on a 36-hole circle will rotate the spindle 1 degree. Smaller crank movements further subdivide the circle: moving 1 space on an 18-hole circle turns the spindle 1/2 degree (30 minutes), 1 space on a 27-hole circle turns the spindle 1/3 degree (20 minutes), and so forth.

Indexing Operations

The following examples show how the index plate is used to obtain any desired part of a whole spindle turn by plain indexing.

- Milling a hexagon. Using the rule previously given, divide 40 by 6 which equals 6 2/3 turns, or six full turns plus 2/3 of a turn or any circle whose number is divisible by 3. Take the denominator which is 3 into which of the available hole circles it can be evenly divided. In this case, 3 can be divided into the available 18-hole circle exactly 6 times. Use this result 6 as a multiplier to generate the proportional fraction required.

$$\textbf{Example: } \frac{2 \times 6}{3 \times 6} = \frac{12}{18}$$

Therefore, 6 full turns of the crank plus 12 spaces on an 18-hole circle is the correct indexing for 6 divisions.

- Cutting a gear. To cut a gear of 52 teeth, using the rule again, divide 40 by 52. This means that less than one full turn is required for each division, 40/52 of a turn to be exact. Since a 52-hole circle is not available, 40/52 must be reduced to its lowest term which is 10/13. Take the denominator of the lowest term 13, and determine into which of the available hole circles it can be evenly divided. In this case, 13 can be divided into a 39-hole circle exactly 3 times. Use this result 3 as a multiplier to generate the proportional fraction required.

$$\textbf{Example: } \frac{10 \times 3}{13 \times 3} = \frac{30}{39}$$

Therefore, 30 holes on a 39-hole circle is the correct indexing for 52 divisions. When counting holes, start with the first hole ahead of the index pin.