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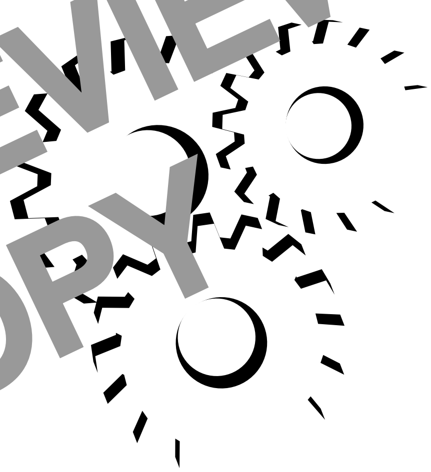
USING INDEXED MILLING PROCEDURES

Lesson One

Using the Dividing Head



TPC Training Systems

32701

Lesson

1 Using the Dividing Head

TOPICS

Indexing
The Dividing Head
Direct Indexing
Simple Indexing
Indexing Fractions of a Turn
Using Sector Arms
Selecting an Index Plate
Angular Indexing
Indexing Parts of a Degree
Compound Indexing
Differential Indexing

OBJECTIVES

After studying this Lesson, you should be able to…

- Describe indexing and its uses.
- Identify the parts of a dividing head.
- List the four types of indexing you can do with a dividing head.
- Explain how to use sector arms to index fractions of a turn.
- Select the right index plate for the job.

KEY TECHNICAL TERMS

Indexing 1.01 rotating a workpiece on its axis for a specific part of a revolution

Dividing head 1.04, Fig. 1-2 a mechanical device used as an aid in indexing

Index pin 1.18, Fig. 1-5 a pin that fits in the holes on an index plate

Index plate 1. 19, Fig. 1-6 a circular plate with circles of holes used in simple and compound indexing

This Lesson presents the basic construction and use of a dividing head. The dividing head is used to divide a circle into evenly spaced increments. By using it, you can make evenly spaced cuts around the circumference of a circular workpiece. In this Lesson, you are shown how the dividing head is made and how it works. The Lesson explains the 40:1 worm and worm gear ratio used in most dividing heads. The uses of the index crank, index plate, and sector arms are also covered.

Descriptions of direct, simple, compound, and differential indexing are given. You will be shown the procedures for indexing a workpiece using these indexing methods. High-number index plates, which are used to index very small fractions of a circle, are also discussed. This Lesson also goes into detail on how to compute angular divisions on a workpiece and how to index these angular divisions.

Indexing

1.01 In a machine shop, *indexing* means rotating a workpiece on its axis for a specific part of a revolution. For example, consider the workpiece shown in Fig. 1-1, which has notches milled in its circumference. The notches are $^1/_4$ in. apart on center.

1.02 After each notch is cut in the machining process, the workpiece is rotated (or indexed) $^1/_4$ in. around its axis. This rotation brings the next notch centerline under the cutter.

1.03 Some maintenance machine shop work will require you to index a workpiece to very close tolerances. If you had to measure each rotation by hand, it would take considerable time and effort. Making these numerous measurements by hand would also increase the chance for error.

The Dividing Head

1.04 Fortunately, you don't have to make such measurements by hand. You can index a workpiece accurately and easily by using a mechanical aid called a dividing head (Fig. 1-2 on the following page). A dividing head, also called an indexing head, helps you to divide a circle into any number of equal segments and to rotate a workpiece accordingly—one segment at a time.

1.05 You will probably use the dividing head most often to machine shapes like gear teeth, which must be cut with great precision so that the parts will mesh and run properly. If you have to drill holes on a common bolt hole circle, however, you might use the dividing head to locate each hole exactly.

1.06 The dividing head can also be used to mill helical grooves, such as the flutes in a twist drill. In applications like this, the workpiece is rotated and, at the same time, synchronized with the machine table travel to produce the helical cut.

1.07 Figure 1-2 shows several important parts of the dividing head:

- **Spindle.** The workpiece is held in the spindle by means of a chuck or any of several other mounting methods.

- **Crank.** The crank turns a worm and worm gear, which rotate the spindle slowly, affording a high degree of control.

Fig. 1-1. A job for indexing

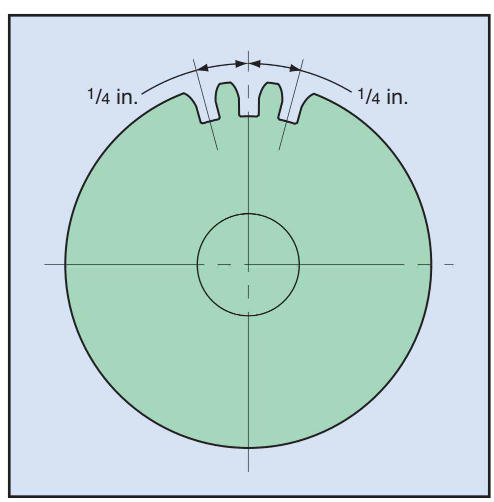
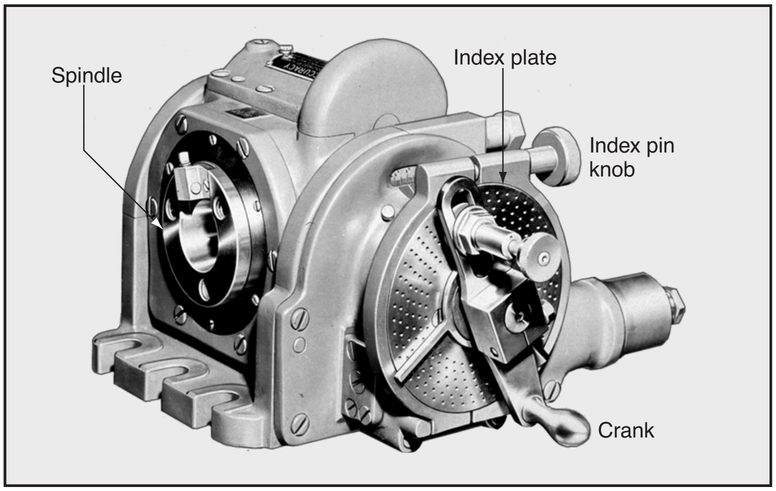


Fig. 1-2. Dividing head



- **Index plate.**
- **Index pin knob.** These last two are used to find the precise index points for a given number of circle segments.

1.08 Figure 1-3 indicates how a dividing head might be set up to index a workpiece on a horizontal milling machine. You can also use a dividing head to index work on a planer, shaper, or several other machine tools.

1.09 You can do four types of indexing with a dividing head: direct indexing, simple indexing, compound indexing, and differential indexing.

Direct Indexing

1.10 Direct indexing is the simplest way to rotate the spindle through given segments of a circle. This method relies on the index holes around the spindle (Fig. 1-4) rather than on the index plate and the crank. In direct indexing, therefore, the worm and worm gear are disengaged so that the spindle may be rotated by hand.

1.11 Suppose that you have to machine six equally spaced notches in the O.D. of a workpiece. Suppose also that the dividing head you are using has 24 index holes around the spindle nose (the number varies with different models). Since 24 divided by six equals four,

Fig. 1-3. Dividing head set up on horizontal milling machine

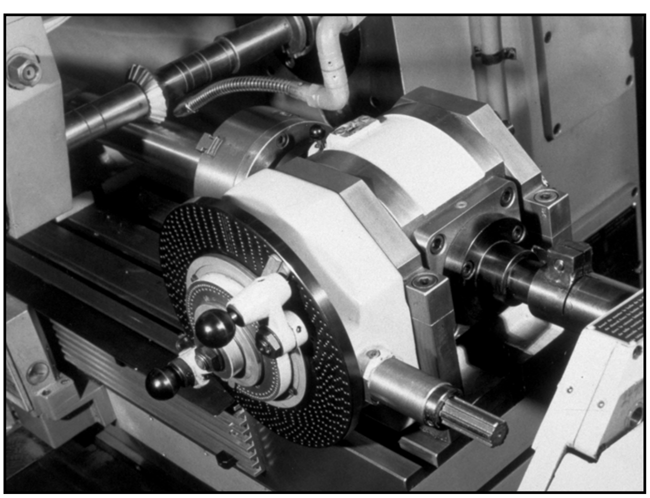
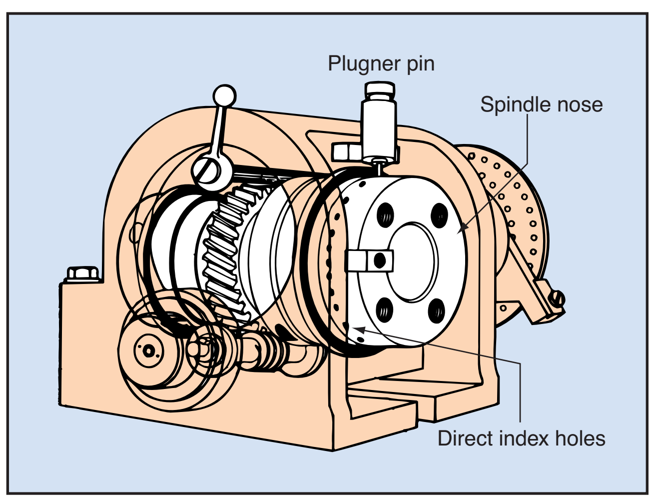


Fig. 1-4. Holes for direct indexing are located in the spindle nose



you know that you must rotate the spindle a distance of four holes to cut each groove.

1.12 With the plunger pin in the top index hole (Fig. 1-4), machine the first notch in the workpiece. Then lift the plunger pin and rotate the spindle. *Do not* count the hole from which you lifted the plunger—it is the "zero hole." When the fourth hole comes under the plunger pin, drop it in, lock the spindle, and machine the second notch. Repeat these procedures until you have cut all six notches.

1.13 The use of this easy method is limited, however. You can use it only if the number of indexed operations to be performed can be divided evenly into the number of holes around.the spindle nose. In the example just cited, for instance, you could not use direct indexing if you had to mill seven evenly spaced notches in the workpiece, because seven cannot be divided into 24 without a remainder. You would have to use simple indexing.

Simple Indexing

1.14 This method is only a little more complex than direct indexing. It does, however, involve the worm and worm gear, the crank and pin, and the index plate.

1.15 **Worm and worm gear.** The worm gearing used in most dividing heads has a ratio of 40:1. The instructions in this Unit, therefore, apply to that ratio. Be sure to check the ratio of the worm and gear set in your dividing head, however. In some models it is 5:1, and different indexing calculations apply.

1.16 With a gear ratio of 40:1, you must turn the worm 40 times to move the worm gear and the spindle through one complete 360 degree revolution. Stated another way, if you turn the worm one revolution, the worm gear and spindle move through $^1/_{40}$th of a complete revolution. The worm is rotated by turning the index crank (usually in a clockwise direction).

1.17 Once you start an indexing operation, turn the crank in one direction only. Turning it back and forth causes backlash, which affects indexing accuracy.

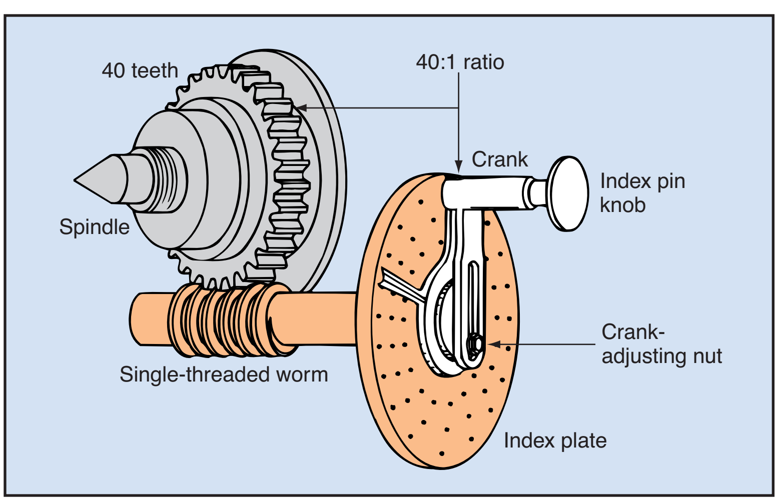
1.18 **Index crank and pin.** Figure 1-5 shows a simplified drawing of the actuating mechanism in a dividing head. Following are the basic procedures for operating the mechanism:

- To move the *index pin* from one circle of holes to another:

  1. Loosen the nut on the end of the worm shaft (the crank-adjusting nut).

  2. Adjust the crank so that the index pin can enter a hole in the correct circle of holes. (Circle selection is covered later in this Lesson.) Then tighten the worm shaft nut.

Fig. 1-5. Actuating mechanism for a dividing head



- To turn the crank:

  1. Pull the index pin knob toward you to remove the pin from the hole.

  2. Turn the crank to rotate the spindle the desired distance.

1.19 **Index plate.** Figure 1-6 is a drawing of an *index plate* that has been highly simplified for the sake of illustration. In practical use, you will never see a plate with a single circle of holes.

1.20 The simplified index plate has 18 precisely spaced holes in the hole circle. This number is indicated by the figure 18 that appears next to one of the holes. Always use the numbered hole in a circle when you start to index. Using the number as a reference point helps you avoid a mistake in counting the number of holes as you turn the crank. The index plate does not rotate as you turn the crank. It serves simply as a guide to help you keep track of the number of crank turns you are making.

1.21 To illustrate simple indexing, suppose a job requires milling 10 splines on a shaft. Position the pin in the hole numbered 18 while you calculate the number of crank turns needed to index the workpiece. In order to make this calculation, use the following formula:

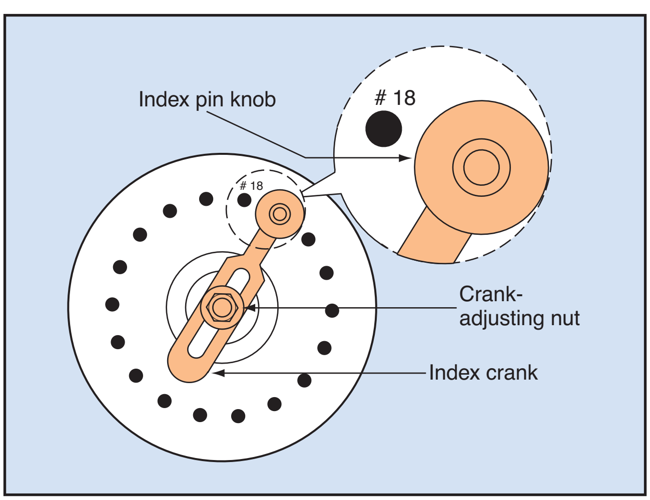
$$T = \frac{40}{N}$$

where: T = the number of crank turns

40 = a constant with a worm and gear ratio of 40:1. (If your dividing head ratio is other than 40:1, use that figure as the numerator.)

N = the desired number of equal divisions on the work.

Fig. 1-6. Simplified index plate



1.22 The number of crank turns needed to index the workpiece each time one of the 10 splines is cut is:

$$T = \frac{40}{N}$$

$$T = \frac{40}{10}$$

$$= 4$$

After you cut the first spline, therefore, raise the index pin from the 18 hole. Turn the crank four complete revolutions, returning the pin to the 18 hole. The centerline of the next spline that you must cut is now positioned under the cutter. Make the cut for the second spline. Repeat the process until all 10 splines are cut.

Indexing Fractions of a Turn

1.23 Suppose, however, the workpiece requires 12 splines instead of 10. The crank turns needed for indexing the work would then be computed as:

$$T = \frac{40}{N}$$

$$T = \frac{40}{12}$$

$$= 3\tfrac{4}{12}$$

$$= 3\tfrac{1}{3} \text{ turns.}$$

1.24 Since you are using an 18-hole circle on the index plate, and since $\frac{1}{3}$ of 18 is six, you would turn the crank three full turns plus six holes to cut each of the 12 splines. In other words, your zero hole keeps changing as you index—it is six holes farther along each time. To keep track of these fractional turns, you can use another indexing device called sector arms.

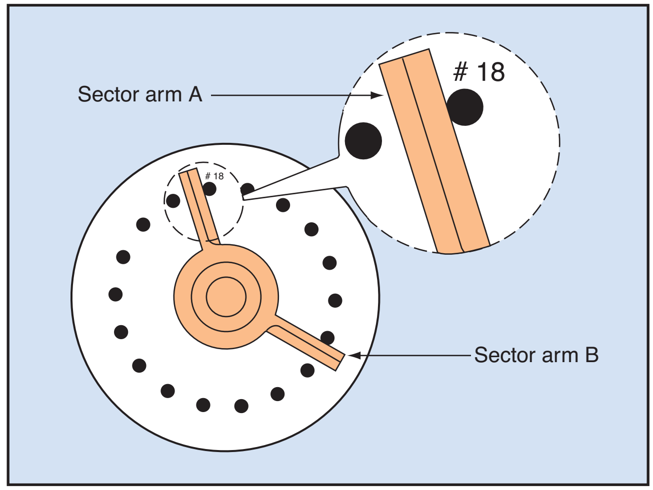
Using Sector Arms

1.25 Figure 1-7 shows the 18 hole index plate with sector arms mounted. Sector arms rotate independently around the worm shaft axis. Like the index plate, they do not turn with the crank. They are shown in Fig. 1-7 as they would be set for the 12 spline indexing. Assume that the index pin is locked in the 18 hole. Position sector arm A against the pin and count six holes beyond. Remember *not* to count the zero hole, where the pin is resting. Position sector arm B just past the sixth hole, as shown.

1.26 Mill the first spline. Remove the pin from the hole in the plate. Rotate the crank three full turns past sector ann A and set the pin in the hole indicated by arm B. You now have turned the crank through three complete revolutions, plus another $^1/_3$ of a revolution. Mill the second spline.

1.27 Now move sector arm A against the side of the pin to mark the new zero hole. Move sector arm B ahead six more holes clockwise. You are again ready to turn the crank $3^1/_3$ times to mill the third spline. Continue this process until all splines are cut.

Fig. 1-7. Using the sector arms on an index plate



The Programmed Exercises on the next page will tell you how well you understand the material you have just read. Before starting the exercises, remove the REVEAL KEY from the back of your Book. Read the instructions printed on the Reveal Key. Follow these instructions as you work through the Programmed Exercises.

1-1. When indexing, a workpiece is __________ after each notch is cut.	1-1. ROTATED Ref: 1.02
1-2. Indexing can be performed easily and accurately with a(n) __________.	1-2. DIVIDING HEAD Ref: 1.04
1-3. Which indexing method relies on the index holes around the spindle of the dividing head?	1-3. DIRECT INDEXING Ref: 1.10
1-4. If a dividing head has 24 holes around its spindle nose, and you must cut eight equally spaced notches in a workpiece, how far must you rotate the spindle between cuts?	1-4. THREE HOLES Ref: 1. 11
1-5. To avoid mistakes in counting index plate holes, always use the __________ hole in a circle when you start to index.	1-5. NUMBERED Ref: 1.20
1-6. What is the function of an index plate in simple indexing?	1-6. IT SERVES AS A GUIDE Ref: 1.20
1-7. To calculate the number of crank turns needed to index a workpiece, you must know the number of divisions required and the __________ of the dividing head.	1-7. GEARING RATIO Ref: 1.21
1-8. To keep track of fractional turns when indexing, use a device called __________.	1-8. SECTOR ARMS Ref: 1.24

Selecting an Index Plate

1.28 Figure 1-8 shows a typical index plate used for simple indexing. This plate has several hole circles, each with a different number of holes. A typical series of hole circles on the surface of such an index plate would be:

15, 16, 17, 18, 19, and 20 holes.

Other such plates would have:

21, 23, 27, 29, 31, and 33 holes.

Still other available index plates have hole circles on both sides of the plate, some of them (called high-number plates) with as many as 199 holes in a circle.

1.29 To select an index plate for a job, first compute the number of crank turns needed, as explained earlier. If the total number of crank turns involves a fraction of a turn, you must be able to divide the denominator of that fraction into the number of holes in a hole circle on an index plate.

1.30 For example, suppose you must mill a 28-tooth gear from a workpiece blank. You would calculate the total number of crank turns needed for indexing each tooth in this way:

$$T = \frac{40}{N}$$

$$T = \frac{40}{28}$$

$$= 1\,^{12}/_{28}$$

$$= 1\,^{3}/_{7} \text{ turns.}$$

1.31 Select an index plate on which one or more of the circles has a total number of holes that is divisible by seven—a 21-hole circle, for instance, or 28 or 49, etc.

1.32 Assume you use a plate with a 21-hole circle. Since $^{3}/_{7}$ of 21 is nine, you will turn the crank one full revolution plus nine holes. Remember not to count the zero hole. Do this after you have cut each tooth. Set the sector arms after each cut.

Angular Indexing

1.33 Some machining jobs require indexing a certain number of degrees instead of inches. This is called angular indexing. It can be done with either the direct or the simple indexing method.

1.34 **Direct angular indexing.** One complete revolution of the dividing head spindle equals 360 degrees. Divide 360 by the number of holes in the spindle to determine the circle segments you can index by the direct method.

1.35 For example, suppose there are 24 index holes in the spindle. Divide 360 by 24. The answer—15—indicates you can use the spindle for direct indexing of angular segments of 15 degrees or any multiple of 15 degrees.

1.36 Consider the drawing in Fig. 1-9 on the following page, for instance. It shows that two notches 105 degrees apart are to be milled into a disk. Since 105 is a multiple of 15 (7), you know you can use direct indexing on the 24 hole spindle for this job.

1.37 Disengage the worm and gear set in the dividing head. Insert the index pin in one of the holes and lock the spindle in position. Mill notch A. Rotate the spindle nose counterclockwise seven holes. Remember not to count the zero hole. Insert the pin in the seventh hole and mill notch B. As you can see, the range of angular divisions you can index

Fig. 1-8. Typical index plate

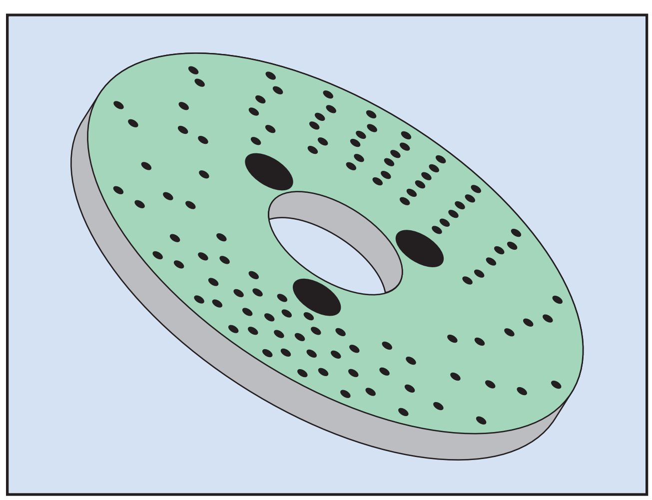
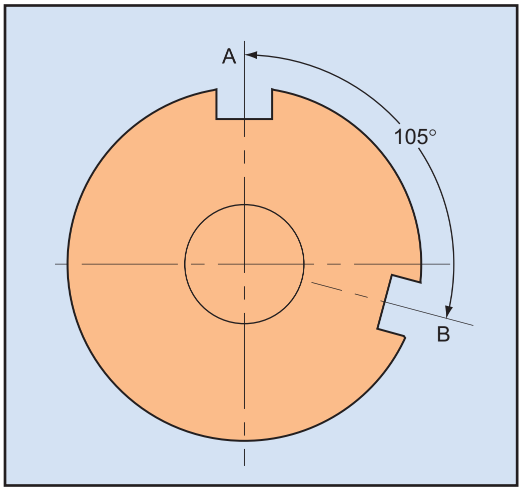


Fig. 1-9. Indexing a disc 105°

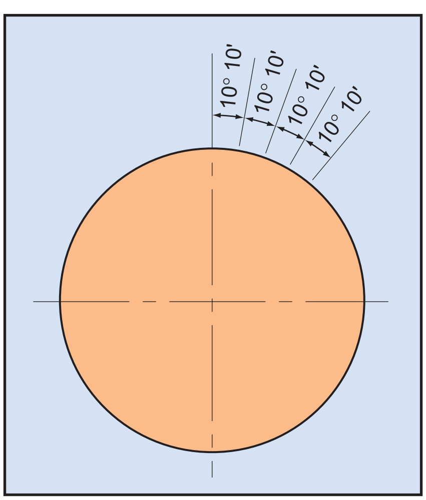


by the direct method is limited by the number of index holes around the spindle.

1.38 **Simple angular indexing.** Remember that in simple indexing, you turn the crank 40 times to get one revolution of 360 degrees on the spindle. One crank turn produces $360/40$, or nine, degrees. For simple angular indexing, therefore, use any circle in the index plate with a total number of holes that can be divided by nine. For example, a 27, 36, 45, or 54 hole circle can be used for simple angular indexing.

1.39 To determine how many holes in a given circle represent one degree, divide the number of holes in the circle by nine. On a 54 hole circle, six holes represent one degree.

Fig. 1-10. Indexing 10° 10'



1.40 To compute how many crank turns are needed to index a certain number of degrees, use the formula:

$$T = \frac{N}{9}$$

where: T = number of crank turns

N = degrees needed per index.

1.41 For example, assume your dividing head spindle does not have 24 holes. To mill the notches in Fig. 1-9, then, you must use simple angular indexing. The number of crank turns needed to index 105 degrees is computed like this:

$$T = \frac{N}{9}$$

$$= \frac{105}{9}$$

$$= 11\tfrac{6}{9}$$

$$= 11\tfrac{2}{3}$$

1.42 Suppose you choose a 36 hole circle. Two thirds of 36 is 24, so you would use the sector arms to mark your zero hole and the 24th hole away from it in a counterclockwise direction.

1.43 Mill the first notch. Then turn the crank counterclockwise 11 full turns past the first sector arm and up to the hole indicated by the second sector arm. Mill the second notch.

1.44 Another way to measure the fractional turn in angular indexing is to calculate it in degrees. Since one turn of the crank moves the spindle nine degrees, you know that after 11 complete turns you have moved the spindle 99 of the required 105 degrees. You need to turn the spindle six degrees farther. In the index circle you are using, 36 holes correspond to one nine-degree turn of the crank, or four holes for each degree. Six more degrees, then, would be 24 more holes.

Indexing Parts of a Degree

1.45 To index work in minutes, first convert all degrees to minutes. The nine-degree spindle movement obtained by turning the crank one full revolution equals 540 minutes (9×60). Compute the number of crank turns needed for a given number of minutes with this formula:

$$T = \frac{\text{minutes}}{540}$$

1.46 Suppose you must index a workpiece 10 degrees 10 minutes after each operation as in the case of the work shown in Fig. 1-10. First, convert degrees and minutes to total minutes:

$$\begin{aligned} 10 \text{ degrees} &= 600 \text{ minutes} \\ &+ \underline{\ 10} \text{ minutes} \\ &\ \ \ 610 \text{ minutes} \end{aligned}$$

Then use this figure in the equation given in the preceding paragraph:

$$T = \frac{610}{540}$$

$$= \frac{61}{54}$$

$$= 1\tfrac{7}{54}$$

Using a 54 hole index plate, you must turn the crank one full revolution plus seven more holes to index 10 degrees 10 minutes.

1.47 In this example, the index plate selection was relatively easy, because the mixed number $1\tfrac{7}{54}$ allowed you to use a standard plate with 54 holes. Not all partial-degree indexing jobs work out this easily.

1.48 When you cannot reduce the total number of minutes to a workable fraction, a different procedure is necessary. Assume, for example, that the workpiece must be indexed 10 degrees 9 minutes, or a total of 609 minutes. First, solve the equation in decimal form:

$$T = \frac{609}{540}$$

$$= 1.278$$

1.49 There are conversion tables published in various handbooks and manuals that provide the equivalent fractions for a broad range of decimals. The precise figure resulting from your formula calculations may not be included. But if your job does not require extreme accuracy, a value close to the one you need can be used. Using these tables will save you many calculations.

1.50 Table 1-1 is an example. Note that it includes a conversion for the decimal 0.1277. This is only 0.0001 turn away from the decimal you need to index 10 degrees 9 minutes.

1.51 The fractional equivalent given for 0.1277 is 6/47. The numerator of this fraction tells you the number of holes you must move the index pin. The denominator tells you to use a 47 hole circle.

1.52 To index 10 degrees 9 minutes, therefore, select an index plate with a 47 hole circle. With this plate mounted on the dividing head, turn the crank one full revolution plus another six holes.

Compound Indexing

1.53 Some difficult indexing jobs cannot be done with either the direct or the simple method. They require use of the compound indexing method.

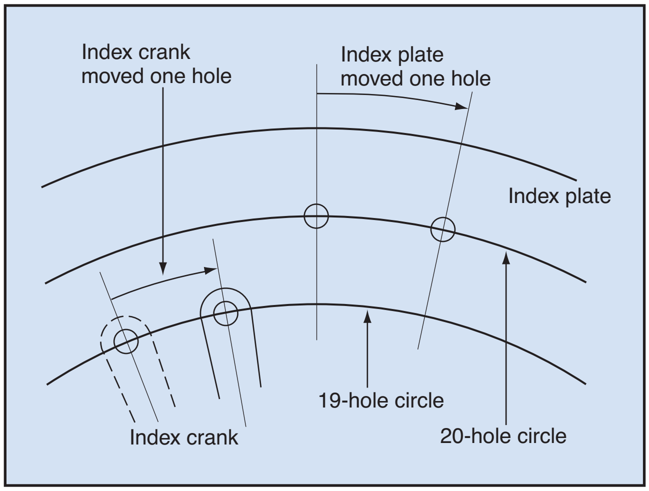
1.54 In compound indexing, you first turn the crank, as in simple indexing. Next, you turn the index plate itself to provide the final index.

1.55 For example, consider the indexing move illustrated in Fig. 1-11 on the following page. The first step in the procedure is to turn the crank one hole on the 19 hole circle. Next, disengage the index plate locking device. This permits you to move the index plate while the crank and pin are held on the 19 hole circle.

Table 1-1. Indexing conversion table

Partial turn needed	Using manufacturer A's plate	Using manufacturer B's plate
0.1200	–	3/25
0.1207	–	7/58
0.1212	4/33	8/66
0.1220	5/41	5/41
0.1224	6/49	6/49
0.1228	–	7/57
0.1250	2/16	3/24
0.1277	6/47	6/47
0.1282	5/39	5/39
0.1290	4/31	8/62
0.1296	–	7/54
0.1304	3/23	6/46

Fig. 1-11. Compound indexing for a one-hole division



1.56 Move the index plate one hole on the 20 hole circle. Lock the plate in this position. In effect you have now done two indexing operations. These have caused the worm to turn $^1/_{19} + ^1/_{20}$ of a revolution.

1.57 The operation described above is called positive compounding, because you moved the crank and the index plate in the same direction (Fig. 1-11). If you move the crank in one direction and the index plate in the opposite direction, as required in some indexing jobs, the result is called negative compounding.

Table 1-2. Compound indexing table

Number of divisions	Indexing	
	Crank	Index plate
111	$3\,^{29}/_{47}$	$+^{17}/_{49}$
112	$4\,^{10}/_{31}$	$-^{13}/_{33}$
113	$3\,^{26}/_{47}$	$-^{18}/_{49}$
114	$1\,^{35}/_{37}$	$+^{25}/_{49}$
117	$7\,^{1}/_{47}$	$-^{9}/_{49}$
118	$1\,^{8}/_{39}$	$+^{24}/_{49}$
119	$3\,^{4}/_{23}$	$-^{16}/_{33}$
121	$1\,^{14}/_{47}$	$-^{15}/_{49}$
122	$3\,^{41}/_{43}$	$-^{17}/_{49}$
123	$1\,^{12}/_{43}$	$+^{17}/_{49}$

1.58 Table 1-2 shows a portion of a typical compound indexing table published in various handbooks. Dividing head manufacturers usually publish such data as it applies to their equipment. In the fractional turns shown in the table, the numerator tells the number of holes to be turned. The denominator tells you the hole circle to use.

1.59 The number of crank turns is shown in the second column. The third column shows the number of index plate turns. When a plus sign appears in front of the plate fraction, move the crank and the plate in the same direction. When a minus sign precedes the plate fraction, you must turn the crank in one direction and the index plate in the opposite direction.

1.60 For example, suppose you have to use compound indexing for 114 divisions on a workpiece. Consulting the table, you find you must first turn the crank one full revolution plus 35 holes on a 37 hole circle. Release the index plate locking device. With the crank and pin held in the 37 hole circle, turn the index plate in the same direction for 25 holes on the 49 hole circle.

1.61 To index 117 divisions, you would turn the crank seven full turns plus one hole on the 47 hole circle. Then turn the index plate nine holes on the 49 hole circle in the opposite direction. This is indicated by the minus sign preceding the fraction in the index plate column.

Differential Indexing

1.62 Differential indexing is similar to, but more accurate than, compound indexing. In differential indexing, a change gear system is attached to the dividing head. This gearing, available from dividing head manufacturers, is used to rotate the worm shaft and index plate accurately. It eliminates the need for the operator to count holes. Differential indexing greatly reduces the chance for error. Manufacturers of differential indexing systems usually furnish charts telling which train of gears to use for indexing with their equipment.

1-9. Index plates that have hole circles with as many as 199 holes are called __________.	1-9. HIGH-NUMBER PLATES Ref: 1.28
1-10. When using direct angular indexing, you must divide the number of spindle holes into ___________.	1-10. 360 DEGREES Ref: 1.34
1-11. To index parts of a degree, you must first convert all measurements into __________.	1-11. MINUTES (or SECONDS) Ref: 1.45
1-12. In compound indexing, you must turn both the crank and the __________.	1-12. INDEX PLATE Ref: 1.54
1-13. In compound indexing, first you turn the plate, then you turn the crank. True or False?	1-13. FALSE Ref: 1.54
1-14. When the crank and index plate are turned in the same direction, the operation is called __________.	1-14. POSITIVE COMPOUNDING Ref: 1.57
1-15. When a minus sign precedes the plate fraction in a compound indexing table, the operation requires __________ compounding.	1-15. NEGATIVE Ref: 1.57, 1.59
1-16. In differential indexing, a(n) ________ system is attached to the dividing head.	1-16. CHANGE GEAR Ref: 1.62

Answer the following questions by marking an "X" in the box next to the best answer.

1-1. Rotating a workpiece on its axis for a specific part of a revolution is called

- ☐ a. tapering
- ☐ b. gearing
- ☐ c. dividing
- ☐ d. indexing

1-2. Which indexing method relies on the index holes around the spindle of the dividing number of spaces on the head?

- ☐ a. Spindle indexing
- ☐ b. Direct indexing
- ☐ c. Angular indexing
- ☐ d. Compound indexing

1-3. If a dividing head has 36 holes around its spindle nose and you must cut nine equally spaced notches in a workpiece, how far must you rotate the spindle between cuts?

- ☐ a. Nine holes
- ☐ b. 36 holes
- ☐ c. Four holes
- ☐ d. Three holes

1-4. With a 40:1 gear ratio, how many revolutions will the workpiece complete if you turn the worm one revolution?

- ☐ a. 40
- ☐ b. 1
- ☐ c. $^1/_2$
- ☐ d. $^1/_{40}$

1-5. Turning the index crank back and forth causes

- ☐ a. backlash
- ☐ b compound indexing
- ☐ c. fractional degrees
- ☐ d. partial indexing

1-6. In simple indexing, the index plate is

- ☐ a. rotated
- ☐ b. used as a guide
- ☐ c. connected to a set of gears
- ☐ d. disengaged

1-7. Sector arms are used to show a specified

- ☐ a. index plate
- ☐ b. index crank
- ☐ c. dividing head spindle
- ☐ d. workpiece axis

1-8. On a dividing head with a 40:1 gear ratio, one crank turn will produce a rotation of ________ degrees.

- ☐ a. 360
- ☐ b. 180
- ☐ c. 90
- ☐ d. 9

1-9. Compound indexing requires you to move the

- ☐ a. crank and sector arms
- ☐ b. index plate and plunger pin
- ☐ c. crank and index plate
- ☐ d. dividing head

1-10. If you move the crank in one direction and the index plate in the opposite direction, the result is called

- ☐ a. backlash
- ☐ b. negative indexing
- ☐ c. positive indexing
- ☐ d. backward indexing

SUMMARY

Indexing is a method used to divide a circle so that you can make evenly spaced cuts around the circumference of a circular workpiece. When using a milling machine, a dividing head is used to index these cuts. Most dividing heads have a worm and worm gear ratio of 40:1. All indexing computations relate to this ratio (or whatever ratio the dividing head has). The workpiece is rotated to exact measurements by turning the spindle or using the index crank, index plate, and sector arms.

Direct indexing is the easiest form of indexing and is performed by rotating the spindle by hand. Simple indexing makes use of the index crank, index plate, and sector arms. Simple indexing allows you to make fractional turns of the workpiece. Compound indexing allows you to divide the circle into very small increments by rotating both the index crank and the index plate. Differential indexing is an even more exact method of indexing in which another system of gearing is attached to the dividing head to rotate the workpiece.

Answers to Self-Check Quiz

1-1. d. Indexing. Ref: 1.01

1-2. b. Direct indexing. Ref: 1.10

1-3. c. Four holes. Ref: 1.11

1-4. d. $^{1}/_{40}$. Ref: 1.16

1-5. a. Backlash. Ref: 1.17

1-6. b. Used as a guide. Ref: 1.20

1-7. a. Index plate. Ref: 1.24-1.27

1-8. d. 9. Ref: 1.38

1-9. c. Crank and index plate. Ref: 1.54

1-10. b. Negative indexing. Ref: 1.57

Contributions from the following sources are appreciated:

Figure 1-2. Kearney and Tracker, Inc.
Figure 1-3. POLAMCO Machine Tools and Equipment