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THREADING INFORMATION

Atlas SIX-INCH LATHES

Atlas Press Company
KALAMAZOO 13D, MICHIGAN, U. S. A.

THIS BOOK contains complete information essential for handling thread cutting and coil winding operations on the Atlas Six-Inch Lathes (Catalog Nos. 612 and 618).

THREAD CUTTING
ON THE ATLAS SIX-INCH LATHE

No phase of lathe operation is more interesting or profitable than the cutting of screws and threads; and no operation requires more care and study. The thread cutting range of the modern lathe is practically unlimited—a few sample threads are shown in Fig. 1.

This section deals with the two classes of thread cutting problems: those connected with (1) the change gear train and its proper set-up for cutting the various sizes of threads, and (2) the actual cutting of the many thread forms.

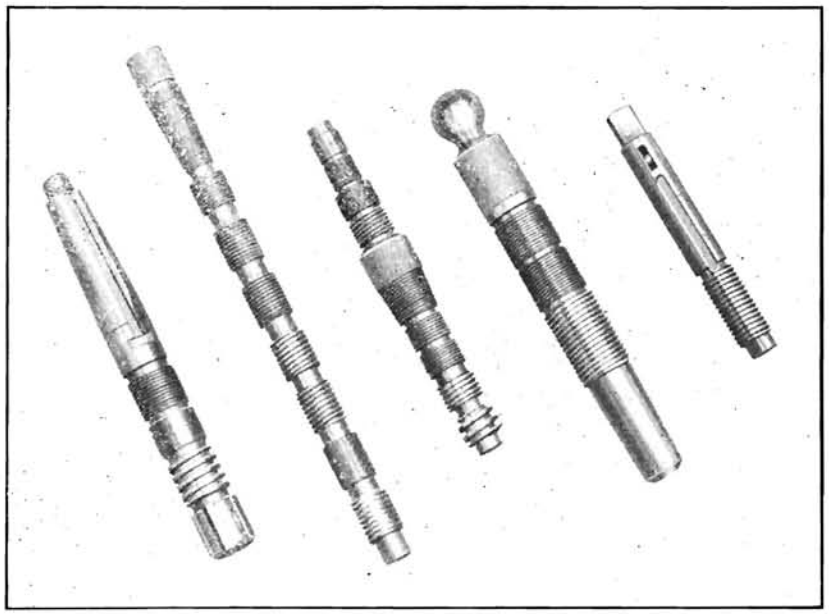


FIG. 1. A few of the threads that can be cut on the lathe.

Every Craftsman lathe comes equipped with change gears and threading dial for cutting threads in the following standards: National Coarse (U.S.S.), National Fine (S.A.E.), Acme, Square, and Whitworth. Gear set-ups for standard threads are shown on the pictorial threading chart on the inside of the change-gear guard. (Fig. 2). Figure 4 is an actual-size reproduction of this threading chart. Gear data for odd-size threads are given in Table I, page 38.

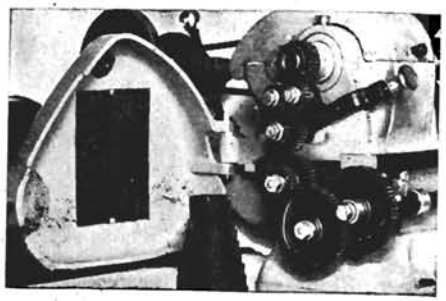


FIG. 2
Left end of lathe with gear guard open, showing change gears, gear train, and location of threading chart.

READING THE GEAR CHARTS

To simplify gear set-ups, the three different gear bracket positions have been assigned letters as shown in Figure 3. These designations will be found on the lathe threading chart as well as in all of the following gear data.

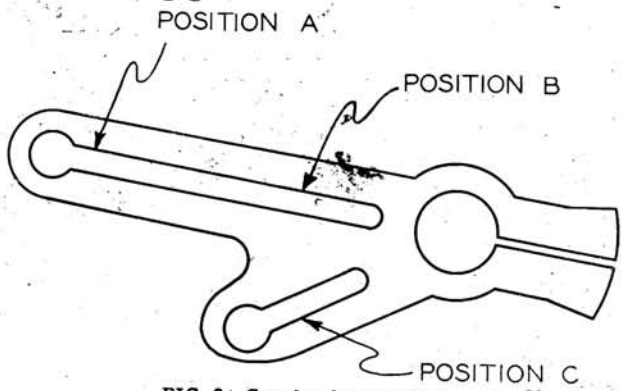


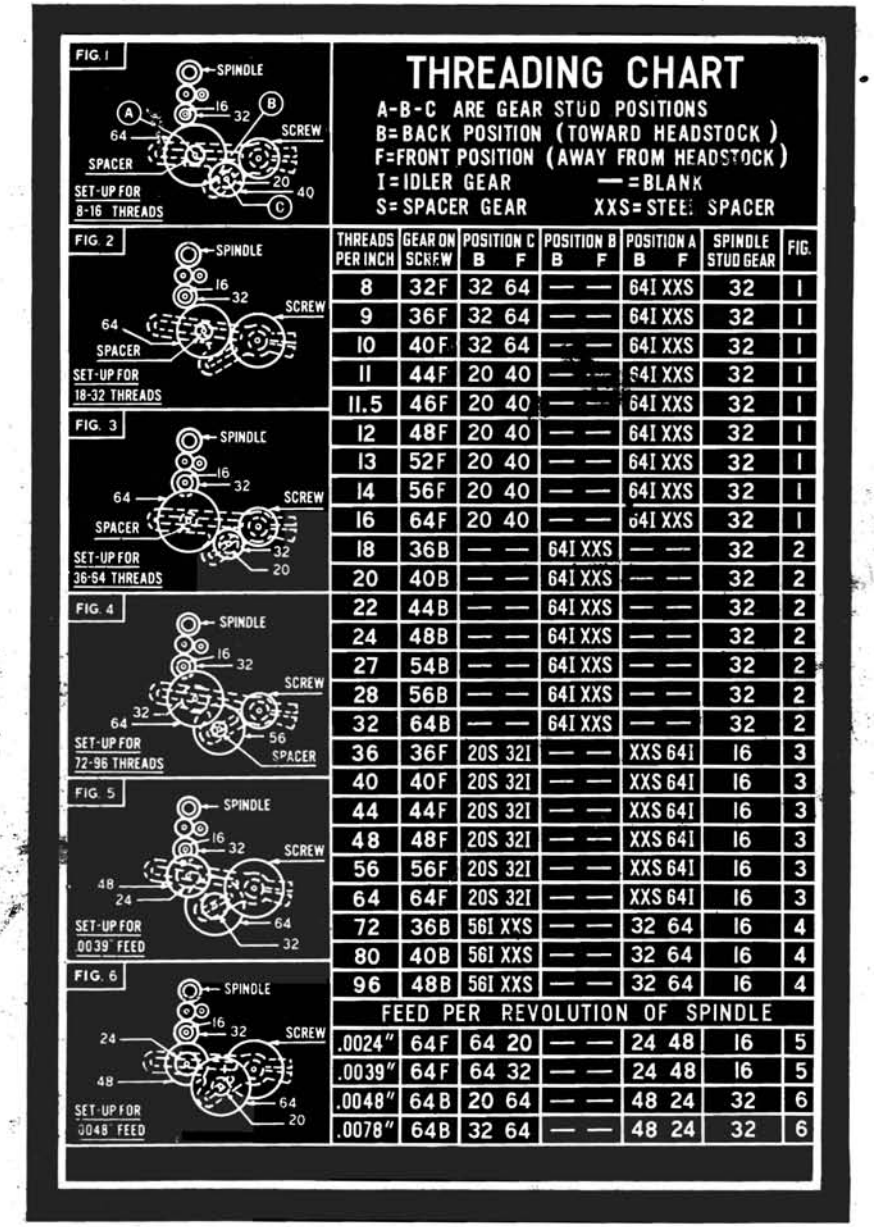
FIG. 3. Gear bracket positions.

The outer end of the longest bracket slot is called "Position A," the inner portion of the same slot is "Position B." The short slot adjacent to the long slot is Position "C." These gear positions are approximate—they will vary with the size and number of the gears composing the train (see diagrams in Fig. 4 and on the following pages).

CHANGE GEAR STUD ASSEMBLY

Before setting up a train of change gears, examine one of the change gear stud assemblies which hold the change gears to the gear bracket (Fig. 5). Each stud assembly has an outer gear bushing long enough to accommodate two gears. The gear bushing has a double key which fits into the keyways in the gears. The gear bushing and two gears fit over a stud bushing, and the assembly is bolted to the gear bracket. The washer is a bearing for the outer end of the gear bushing.

THREADING CHART FOR CRAFTSMAN 6-INCH LATHES



THREADING CHART

A-B-C ARE GEAR STUD POSITIONS
B=BACK POSITION (TOWARD HEADSTOCK)
F=FRONT POSITION (AWAY FROM HEADSTOCK)
I=IDLER GEAR —=BLANK
S=SPACER GEAR XXS=STEEL SPACER

THREADS PER INCH	GEAR ON SCREW	POSITION C B	POSITION C F	POSITION B B	POSITION B F	POSITION A B	POSITION A F	SPINDLE STUD GEAR	FIG.
8	32F	32	64	—	—	64I	XXS	32	1
9	36F	32	64	—	—	64I	XXS	32	1
10	40F	32	64	—	—	64I	XXS	32	1
11	44F	20	40	—	—	64I	XXS	32	1
11.5	46F	20	40	—	—	64I	XXS	32	1
12	48F	20	40	—	—	64I	XXS	32	1
13	52F	20	40	—	—	64I	XXS	32	1
14	56F	20	40	—	—	64I	XXS	32	1
16	64F	20	40	—	—	64I	XXS	32	1
18	36B	—	—	64I	XXS	—	—	32	2
20	40B	—	—	64I	XXS	—	—	32	2
22	44B	—	—	64I	XXS	—	—	32	2
24	48B	—	—	64I	XXS	—	—	32	2
27	54B	—	—	64I	XXS	—	—	32	2
28	56B	—	—	64I	XXS	—	—	32	2
32	64B	—	—	64I	XXS	—	—	32	2
36	36F	20S	32I	—	—	XXS	64I	16	3
40	40F	20S	32I	—	—	XXS	64I	16	3
44	44F	20S	32I	—	—	XXS	64I	16	3
48	48F	20S	32I	—	—	XXS	64I	16	3
56	56F	20S	32I	—	—	XXS	64I	16	3
64	64F	20S	32I	—	—	XXS	64I	16	3
72	36B	56I	XXS	—	—	32	64	16	4
80	40B	56I	XXS	—	—	32	64	16	4
96	48B	56I	XXS	—	—	32	64	16	4
FEED PER REVOLUTION OF SPINDLE									
.0024"	64F	64	20	—	—	24	48	16	5
.0039"	64F	64	32	—	—	24	48	16	5
.0048"	64B	20	64	—	—	48	24	32	6
.0078"	64B	32	64	—	—	48	24	32	6

FIG. 4. Threading chart for cutting standard threads between 8 and 96 per inch. For additional gear train data, refer to Table I, page 38.

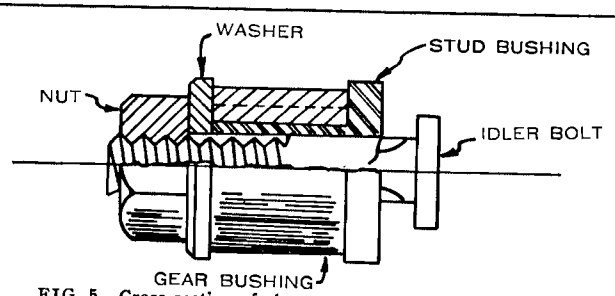


FIG. 5. Cross section of change gear stud assembly.

Notice that in order to make this assembly complete, two gears must be mounted on the gear bushing at one time. When both of the gears on a gear bushing mesh with other gears in the train, they form a "compound" gear assembly. When only one of two gears on a gear bushing meshes with the other gears in the train, it is called an "idler." The smaller gear, which is mounted on the gear bushing with an idler, is called a "spacer" gear and does not mesh with any gear in the train (see Fig. 10).

GEAR CLEARANCE

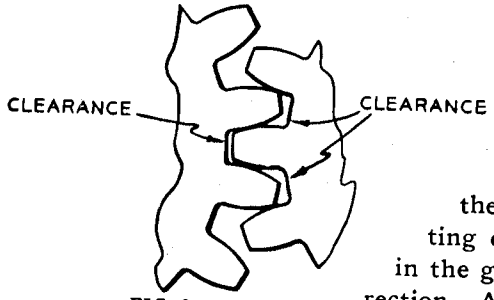


FIG. 6
Proper gear clearance.

When setting up the gear train, be sure to allow sufficient clearance between two meshing gears (Fig. 6). Gear clearance does not reduce the accuracy of a thread cutting operation, because all play in the gears is taken up in one direction. A method often used to obtain proper gear clearance is: (1) Place a sheet of thick writing paper between the teeth of the two meshing gears, (2) tighten gears in position, and (3) remove paper. A small amount of grease, preferably graphite grease, applied to gear teeth will often aid in obtaining smoother, more quiet operation.

THE REVERSING MECHANISM

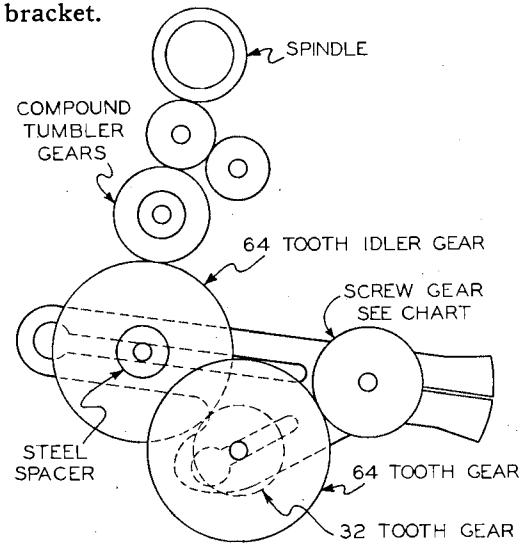
Right hand threads are cut with the carriage traveling toward the headstock. Left hand threads are cut with the carriage traveling toward the tailstock.

Whenever a new gear train has been set up, shift the tumbler gear lever to test the direction of the carriage travel. Because some set-ups are simple-geared and some are compounded, the carriage travel may be to the right for one set-up and to the left for another set-up, even though the lever is shifted to the same position in each case. *Always test the direction of carriage travel before starting to cut a thread.*

After the tumbler gear lever has been shifted to the proper position, it should not be moved until the thread has been completed. ***This is especially important because a shift in the lever position destroys the relation between the threading dial and the lathe spindle and causes splitting of the thread.***

GEAR TRAINS FOR STANDARD THREADS

The following pages give detailed instructions for mounting gears for the more common thread sizes. Refer to these pages and the lathe threading chart when making set-ups. "Back Position" of a sleeve or the screw stub means the position *toward* the headstock. "Front Position" is the position *away from* the headstock. The gear bracket is tightened in position by locking the nut on the front of the gear bracket.



GEAR TRAIN FOR 8 THROUGH 10 THREADS PER INCH

1. Place on front position of screw stub the gear listed in "Gear on Screw" column of threading chart.
2. Place 32 tooth gear and 64 tooth gear on sleeve and mount in Position C on gear bracket with 32 tooth gear in back position. Tighten so that 64 tooth gear meshes with gear in screw position.
3. Place 64 tooth gear and spacer on sleeve and mount in Position A with 64 tooth gear in back position. Tighten so that 64 tooth gear meshes with the 32 tooth gear in Position C. The 64 tooth gear is an idler.
4. Swing entire gear bracket upward and tighten so that 64 tooth gear in Position A meshes with the 32 tooth compound tumbler gear.

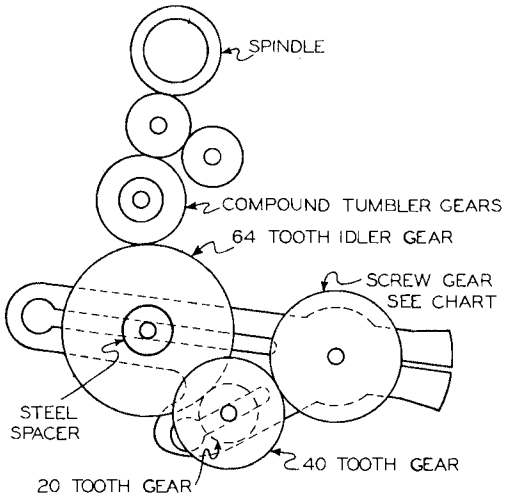


FIG. 8. Gear set-up for 11 through 16 threads per inch.

GEAR TRAIN FOR 11 THROUGH 16 THREADS PER INCH

1. Place on back position of screw stub the gear listed in "Gear on Screw" column of threading chart.

2. Place 20 tooth gear and 40 tooth gear on sleeve in Position C with 20 tooth gear in back position. Tighten so that 40 tooth gear meshes with gear in screw position.

3. Place 64 tooth gear and spacer on sleeve and mount in Position A with 64 tooth gear in back position. Tighten so that 64 tooth gear meshes with 20 tooth gear in Position C. The 64 tooth gear is an idler.

4. Swing entire gear bracket upward and tighten so that 64 tooth gear in Position A meshes with 32 tooth compound tumbler gear.

GEAR TRAIN FOR 18 THROUGH 32 THREADS PER INCH

(See Fig. 9, page 9.)

1. Place on back position of screw stub the gear listed in "Gear on Screw" column of threading chart.

2. Place 64 tooth gear and spacer on sleeve and mount in Position B with 64 tooth gear in back position. Tighten so that 64 tooth gear meshes with gear in screw position. The 64 tooth gear is an idler.

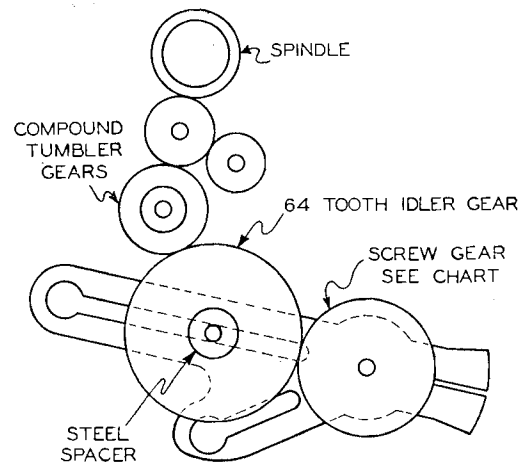


FIG. 9. Gear set-up for 18 through 32 threads per inch.

3. Swing entire gear bracket upward and tighten so that 64 tooth gear in Position B meshes with 32 tooth compound tumbler gear.

GEAR TRAIN FOR 36 THROUGH 64 THREADS PER INCH

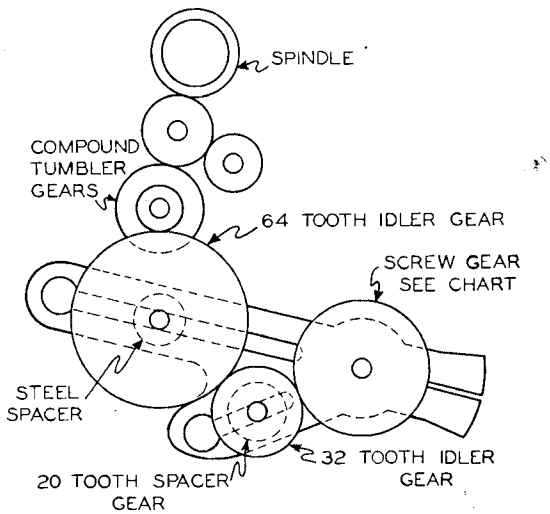


FIG. 10. Gear set-up for 36 through 64 threads per inch (see page 10).

GEAR TRAIN FOR 36 THROUGH 64 THREADS PER INCH

(See Fig. 10, page 9.)

1. Place in front position of screw stub the gear listed in "Gear on Screw" column of threading chart.

2. Place 20 tooth gear and 32 tooth gear on sleeve and mount in Position C with 20 tooth gear in back position. Tighten so that 32 tooth gear meshes with gear in screw position. The 32 tooth gear is an idler; the 20 tooth gear is a spacer.

3. Place spacer and 64 tooth gear on sleeve and mount in Position A with spacer in back position. Tighten so that 64 tooth gear meshes with 32 tooth gear in Position C. The 64 tooth gear is an idler.

4. Swing entire gear bracket upward so that the 64 tooth gear in Position A meshes with the 16 tooth compound tumbler gear.

GEAR TRAIN FOR 72 THROUGH 96 THREADS PER INCH

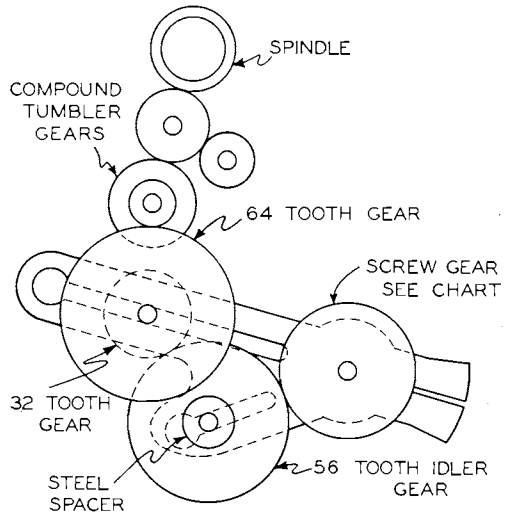


FIG. 11. Gear set-up for 72 and 80 threads per inch.

1. Place in back position of screw stub the gear listed in "Gear on Screw" column of threading chart.

2. Place 56 tooth gear and spacer on sleeve and mount in Position C with 56 tooth gear in back position. Tighten so that 56 tooth gear meshes with the gear in screw position. The 56 tooth gear is an idler.

3. Place 64 tooth gear and 32 tooth gear on sleeve and mount in Position A with 32 tooth gear in back position. Tighten so that 32 tooth gear meshes with 56 tooth gear in Position C.

4. Swing entire gear bracket upward and tighten so that the 64 tooth gear in Position A meshes with the 16 tooth compound tumbler stud gear.

THREAD CUTTING TERMS

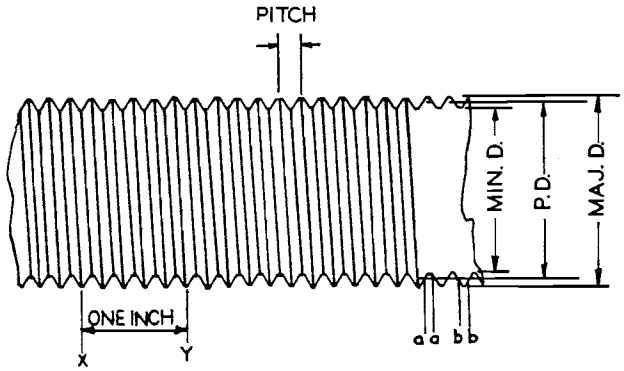


FIG. 13. Thread Cutting Terms.

MAJOR DIAMETER—The largest diameter of the thread of either the screw or the nut.

MINOR DIAMETER—The smallest diameter of the thread of either the screw or the nut.

PITCH DIAMETER—On a straight screw thread, the diameter of an imaginary cylinder, the surface of which would pass through the threads at such points as to make equal the width of the threads and the width of the spaces cut by the surface of the cylinder. In Figure 13 the lines representing the diameter "PD," are located so as to make spaces "aa" and "bb" equal. On a 60° Vee-type thread and on National Form threads, the pitch diameter is simply the major diameter less the depth of the thread.

DEPTH OF THREAD—One-half the difference between the major diameter and the minor diameter. In lathe work, the DOUBLE DEPTH OF THREAD, which is the difference be-

tween the major and minor diameters, is a quite common term. Thus, knowing the major diameter required, subtracting from it the double depth of thread for the required pitch, gives the minor diameter. A table giving double depths of National Form threads for different pitches will be found on page 42.

PITCH—The distance from a point on a screw thread to a corresponding point on the next thread, measured parallel to the axis (see Fig. 13).

$$\text{p} = \text{Pitch of thread in inches} = \frac{1}{\text{Number of threads per inch}}$$

THREADS PER INCH—The number of complete threads in the space of one inch. In Figure 13, the distance between points X and Y represents one inch, and there are five threads per inch.

$$\text{n} = \text{Number of threads per inch} = \frac{1}{\text{pitch}}$$

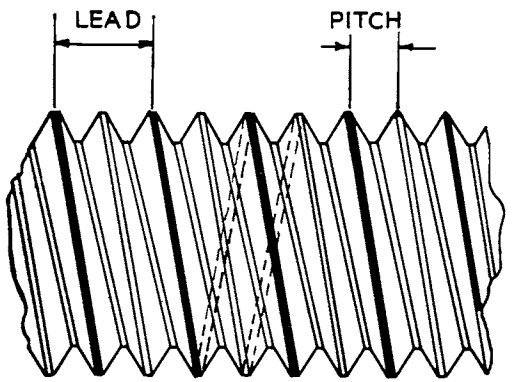


FIG. 14
Double Thread Screw. The lead is double the pitch.

LEAD — The distance a screw thread advances axially in one turn. On a single thread screw, the lead and the pitch are identical; on a double thread screw, the lead is twice the pitch; on a triple thread screw the lead is three times the pitch, etc.

Figure 14 shows a double thread screw. There are two separate grooves or helices around the screw, each of which advances twice the pitch in a single turn. If the pitch of this screw is $\frac{1}{8}$ inch, the lead is $\frac{1}{4}$ inch.

THREAD CUTTING TOOLS

Thread cutting tools must be ground to the form of thread desired. Clearance must be increased because of the rapid advance

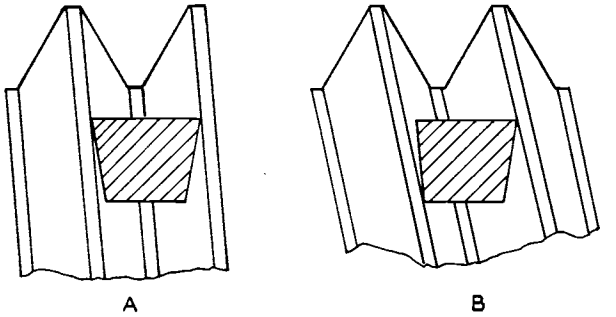


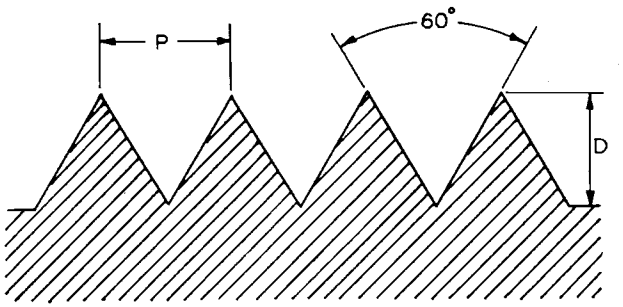
FIG. 15
"A" shows tool with sufficient clearance. When thread pitch is increased, as at "B," same tool has inadequate clearance.

of the tool. (See Φ, Fig. 40). Otherwise the grinding of thread cutting tools follows the same general rules as the grinding of external tools.

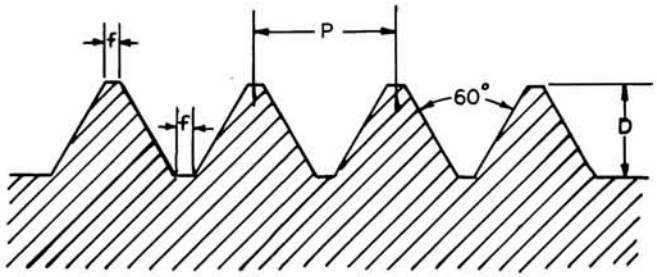
Clean, accurate threads are impossible unless one side and the front of the tool are given enough clearance to permit the tool to advance as the work revolves. Figure 15 shows how a tool which is satisfactory for cutting a fine thread may not have enough clearance to cut a coarse thread. "Hogging" and rough threads are usually the result of insufficient clearance.

Thread tools are ground nearly flat across the top. When the tool is fed into the work at an angle, as with National Form threads, the tool should have a few degrees of side rake. When the tool is fed into the work at right angles, as with square threads, it should have a small amount of back rake.

CUTTING 60° TYPE THREADS



D = .866 × P
FIG. 16. 60° Vee Thread and Formula (see page 14).



$D = .64952 \times P \qquad f = \frac{P}{8}$

FIG. 17. American National or National Form Thread and Formulas.

60 degree type threads include the 60° Vee thread (Fig. 16) and the American National Screw Thread (Fig. 17). The 60° Vee thread is cut very seldom, usually for small screws on which the flat

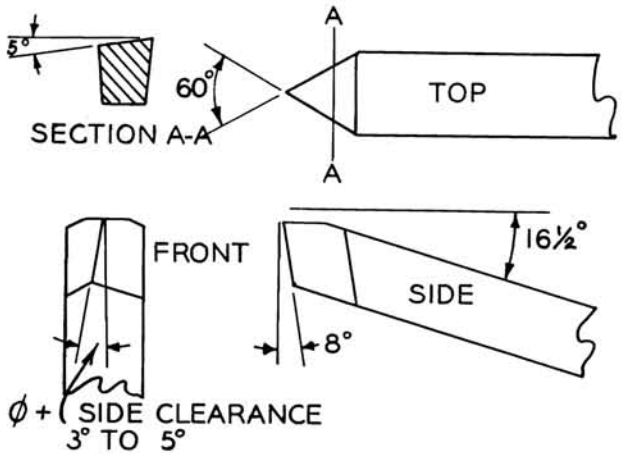


FIG. 18. Tool for cutting 60° type threads. Fig. 40 explains how angle ϕ must be determined.

at the top and bottom of the National Form thread would be so small that it approaches the Vee form. Small taps usually produce Vee-type threads, and the resulting holes accommodate the standard National Form Screws.

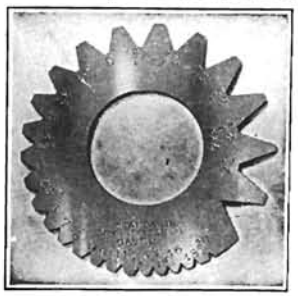


FIG. 19. N. F. Thread Gauge.

The American National Screw threads, (National Fine and National Coarse) are practically standard for automotive and machine shop work in the United States. These threads are 60° Vee threads with the points cut off so

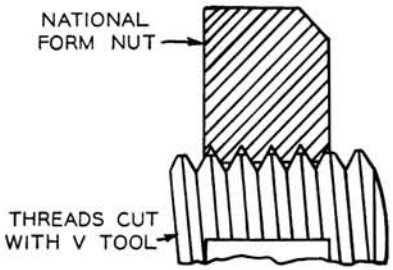


FIG. 20
The National Form nut fits the screw cut with a 60° Vee tool.

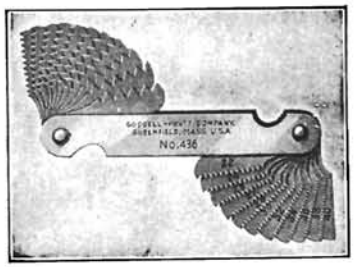


FIG. 21
National Screw Pitch Gauge.

that the depth is 75% of the depth of a Vee thread of the same pitch.

Figure 18 shows a tool bit ground for cutting sharp pointed Vee threads. This tool will also cut an exact National Form Screw thread when the point is ground flat to fit the proper slot in the National Form thread gauge (Fig. 19). Generally, however, the tool is left sharp pointed and the thread is cut with the regulation Vee bottom, but the top is left with the proper amount of flat. Figure 20 shows how a screw cut in this manner fits a National Form nut. **Only when desiring absolute maximum strength is the tool ground to the exact National Form.**

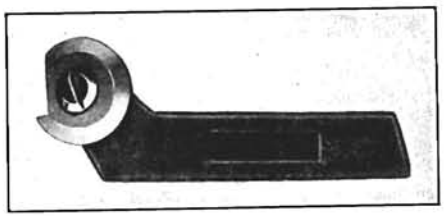


FIG. 22. Threading Tool.

The screw pitch gauge shown in Figure 21 is used to determine the exact pitch of a V-thread screw or nut. This gauge has thirty separate leaves with pitches between 4 and 42 per inch.

THREADING TOOL

The threading tool shown in Figure 22 has become extremely popular because it can be used to cut all pitches of National Form threads with the slight difference in form mentioned above.

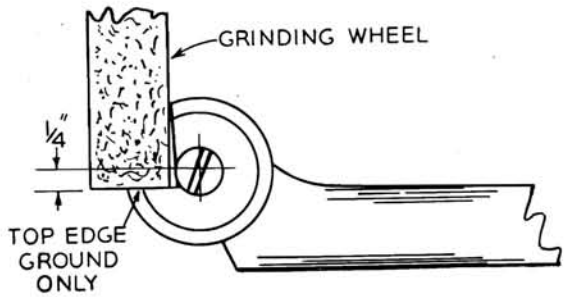


FIG. 23
Proper method of grinding the threading tool shown in Figure 22. The side faces are never ground.

The sides of this tool are ready ground to an included angle of approximately 65 degrees. The extra 5° compensates for rake angle and the grinding of the tool—a perfect 60° thread is produced when the tool is set into the work properly (see page 17). The form of this tool also provides ample clearance for even the coarsest threads. The tool is resharpened by simply grinding the top edge, adjusting the tool as it wears.

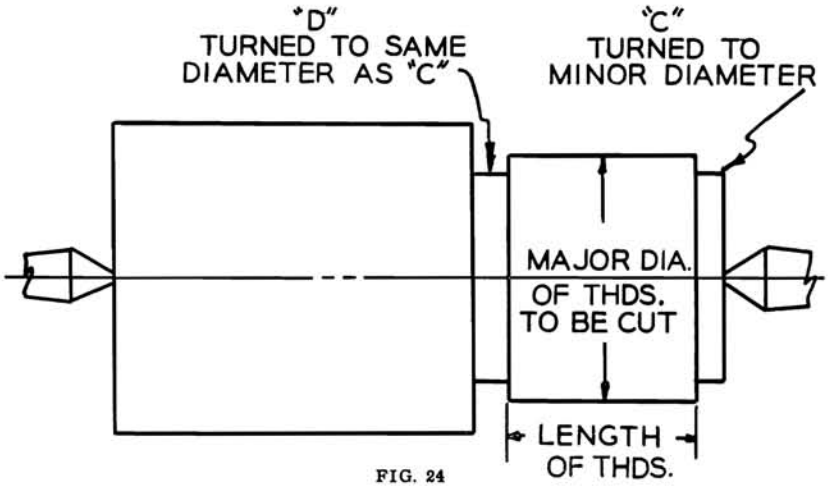


FIG. 24

PREPARING THE WORK FOR AN EXTERNAL 60° NATIONAL FORM THREAD

The work to be threaded is first turned to the exact major diameter of the desired thread. The beginner often finds it helpful to turn the grooves C and D (Fig. 24) to the exact minor diameter. The size of the minor diameter depends upon the form of the threading tool. Theoretically, if the thread were to be cut with a sharp pointed 60° tool, the minor diameter would be equal to the major diameter less the Vee-Form Double Depth of Thread (Table IV, page 42) or the major diameter less 1.732 × pitch. In common practice, however, a tool bit is formed especially for a National Form thread, and the correct minor

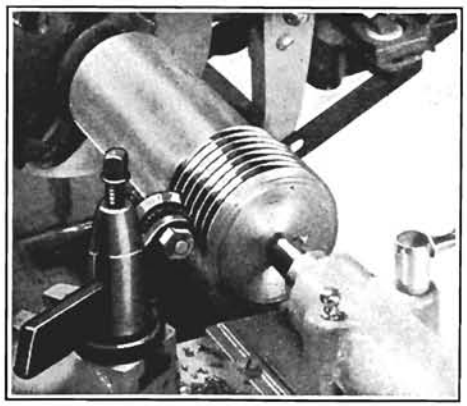


FIG. 25

Correct setting of tool and compound rest when cutting a 60° right hand thread.

diameter is listed in Table V or Table VI, pages 43 and 44 (major diameter less 1.299 × pitch).

Groove C permits accurate measurement with a micrometer of the bottom of the thread. When the tool point has cut to the depth of the groove C, the thread has been finished. Groove D permits the work to revolve freely at the end of each cut. *As soon as the beginner has become a little more familiar with threading practice, these grooves can be omitted.*

FIG. 26. Center Gauge.

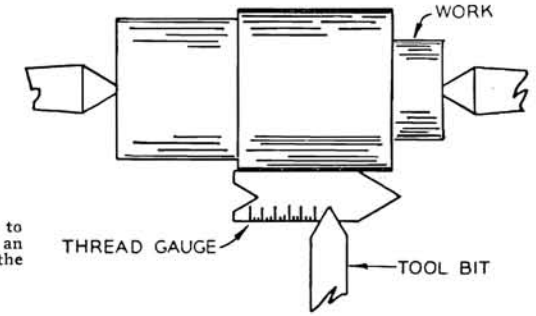


FIG. 27 (Right)
Using the center gauge to set the threading tool at an exact right angle to the work.

SETTING THE 60° THREADING TOOL

After the work has been properly prepared for threading, set the compound rest at the 29° angle shown in Figure 25. Mount the tool holder in the tool post so that the point of the tool is exactly on the lathe center line—tighten tool post screw just enough to hold the tool holder. Then use a center or thread gauge (Fig. 26) to set the tool point at an exact right angle to the work as shown in Figure 27. Tap lightly on the back of the tool holder when bringing it into position. A piece of white paper placed under the center gauge will aid in checking the fit of the tool in the Vee of the gauge. With the tool point at an exact right angle to the work, recheck the center line position and tighten tool post screw.

THE CUTTING OPERATION

Before starting the actual cutting of a right hand thread, be sure that the change gear train is assembled properly and that the reverse lever is in the correct position to feed the carriage toward the headstock. Adjust belts for a speed of 54 R.P.M. (see Instructions and Parts List, page 1).

Set the compound rest approximately in the center of its ways

and advance the cross feed so that it is set at 0 with the tool close to the work. With the point of the tool about an inch to the right of the start of the thread, advance the tool with the compound rest so that the first cut will be about .003 inch.

Start the lathe and engage the half-nut lever on the carriage as described on page 19. The 29° angle of the compound rest should allow the back of the tool to take a fine chasing cut on the finished side of the thread while the cutting edge does the work of forming the thread. Apply plenty of lubricant to the work. When the point of the tool reaches the groove at the end of the thread (groove D in Figure 24), raise the half-nut lever on the carriage, back out the cross feed a turn or two, and return the carriage by hand to the starting point. Advance the cross feed to its original position at 0, advance the compound rest for the desired depth of cut, and engage the half-nut lever for the second cut. All feeding is done with the compound rest. Follow the same routine on all succeeding cuts.

DEPTH OF CUT: The first two or three cuts should be approximately .005 inch advance of the compound feed and the following cuts gradually reduced until the last few cuts taken are only .001 inch or even .0005 inch. A final pass through the thread with no advance whatever will often clean up any remaining high spots. Take the last cuts with extreme care. Heavier cuts can be taken on soft metals such as brass or aluminum, but if a fine finish is desired, the last cuts should be very light.

LUBRICANTS: When cutting steel use liberal quantities of a commercial cutting compound, lard oil or equivalent. With other metals use the type of lubricant recommended for general turning operations.

THREAD CUTTING SPEEDS: The beginner in thread cutting should adjust belts to obtain a speed of 28 R.P.M. (Manual, page 47). This slow speed allows plenty of time to engage and disengage the half-nut lever. After more experience in cutting threads, higher speeds can be used up to approximately 1/3 or 1/2 the speeds recommended for turning the various materials (Manual, Part 4).

THE THREADING DIAL

FIG. 28
Threading Dial.

The threading dial (Figs. 28 and 29) performs an important function by indicating the proper time to engage the half-nut lever so that the tool will enter the same groove of the thread for each cut. Without the threading dial it would be necessary to reverse the motor at the end of each cut and "wind" the tool out of the thread — a cumbersome method little used except when cutting metric and special fractional threads (page 28).

RULES FOR USING THE THREADING DIAL

When cutting an *even-numbered thread* (such as 12, 14, 16, 32, etc. per inch), engage the half-nut lever for the first cut when the stationary mark on the outside of the threading dial is in line with any one of the four marks on the rotating portion of the dial. The same dial marking, *or the one opposite,* must be used for following cuts.

When cutting *odd-numbered threads* (such as 9, 11, 13, 27, etc. per inch) *and half-numbered threads* (such as 8½, 9½, 10½, etc. per inch), engage the half-nut lever *at the same mark on the threading dial for each cut.*

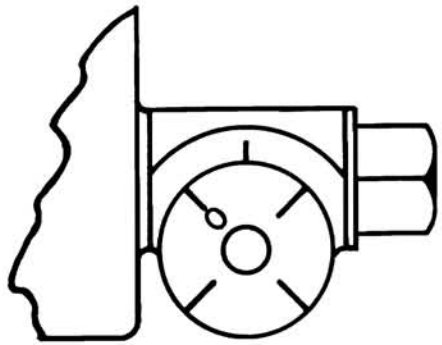


FIG. 29
Threading dial showing mainmarkings. Other lines may be marked in by the operator as needed.

CUTTING INTERNAL 60° NATIONAL SCREW THREADS

The tool shown in Figure 30 is designed for cutting internal 60° form threads and is mounted directly in the tool post exactly

like a boring tool. The angles shown are typical and satisfactory for threads as coarse as 12 per inch and holes as small as 5/8 inch. The point is ground to 60° and has a slight side rake as shown in the front view. It is very important to have plenty of front and side clearance —much more important than with the plain boring tool. The point of the tool is set exactly on the center line of the work.

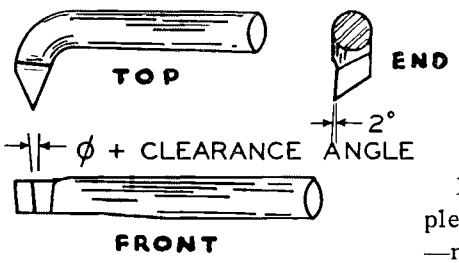


FIG. 30

Tool for cutting internal 60° threads. (When threading brass and plastics, omit side rake.) Fig. 40 explains how the angle Φ must be determined.

PREPARING THE WORK FOR INTERNAL NATIONAL FORM THREADS

Work to be threaded internally is prepared much in the same manner as for cutting an external thread (see page 16). The work is first bored to the exact minor diameter. Beginners often turn grooves C and D to the exact major diameter as shown in Figure 31. If the thread is to be cut with a sharp pointed 60° tool, the major diameter is equal to the minor diameter plus the Vee-form Double Depth of Thread (Table IV, page 42). If the tool bit is formed especially for a certain National Form thread, the correct major diameter is listed in Table V or Table VI, pages 43 and 44.

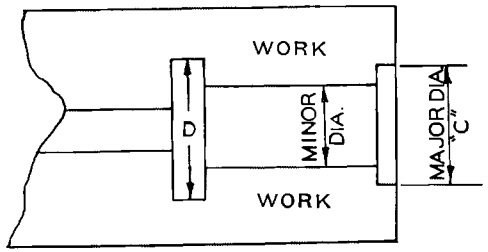


FIG. 31

Grooves C and D help the beginner when threading internally.

Groove C permits the beginner to measure accurately the bottom of the thread with a micrometer or caliper and serves as a guide for depth. When the tool point has cut to the depth of groove C, the thread has been finished. This outer groove is not necessary if the thread is being cut to fit a certain screw—the proper depth is then reached when the screw fits the thread correctly.

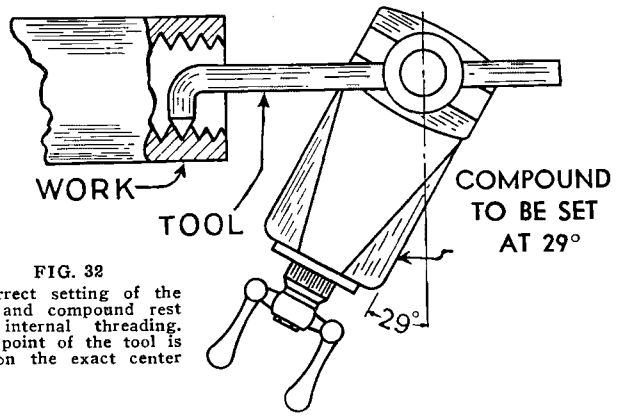


FIG. 32

Correct setting of the tool and compound rest for internal threading. The point of the tool is set on the exact center line.

Groove D should be about twice as wide as the thread pitch and a few thousandths larger than the major diameter. This groove provides a brief interval at the end of each cut during which the work can revolve freely while the half-nut lever is disengaged. *The grooves C and D can be omitted after the operator has learned internal thread cutting operations.*

PRECAUTIONS IN CUTTING THREADS

Never disengage the half-nut lever in the middle of the thread without first backing out the tool with the cross feed.

Do not shift the reverse feed lever until the thread is completed.

If the work must be removed for checking the fit of a cut or for any other reason, be sure to replace the work with the tail of the lathe dog in the same slot of the face plate as before. Never remove work held in a chuck until the thread is completed.

When a long, heavy thread is being turned, considerable heat may be generated, causing the work to expand. If the work is mounted between centers, stop the lathe at regular intervals and check the tightness of the work against the centers. Take a light cut after checking in this way, because the work may have shifted a trifle in relation to the position of the tool bit. If the tool has a tendency to "hog in," check tool clearance.

CUTTING INTERNAL THREADS

The internal cutting operation is the same as the cutting of an external thread (page 17), with the following exceptions: First, the 29° angle of the compound rest is measured from the opposite side of the graduated base (Fig. 32).

Second, the compound rest feed is *toward* the operator for cutting and the cross feed is *advanced* to clear the work.

Due to the spring of an internal tool, cuts should be much lighter than when cutting external threads. The last finish cuts should be taken without changing the setting of the compound rest.

CUTTING LEFT HAND THREADS

Figure 33 shows the cutting of a left hand thread. The direction of carriage feed is toward the tailstock. Gear set-ups and general cutting procedure are exactly the same as for right hand threads with the changes in tool angles made necessary by the different direction of carriage travel. Clearance angles and side

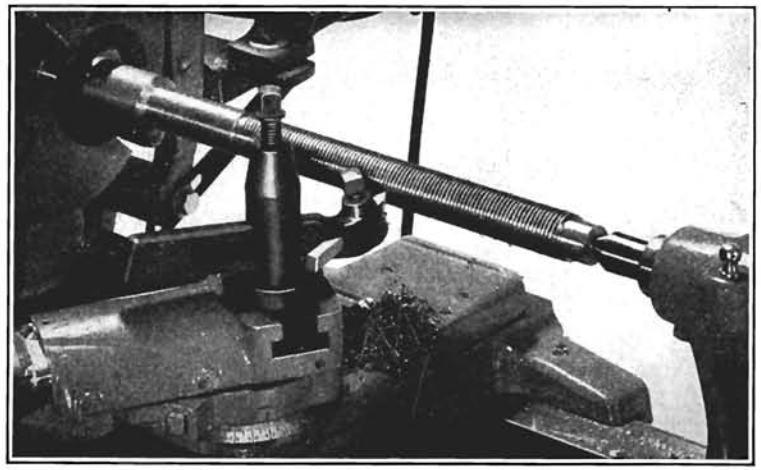
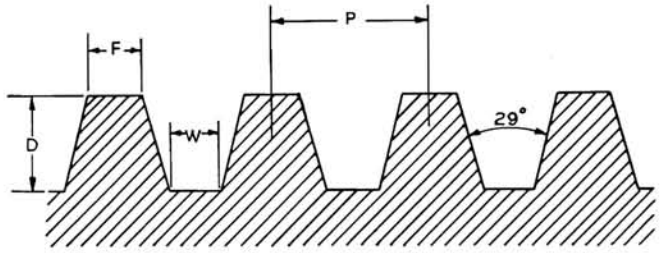


FIG. 33. Cutting a left hand thread.

rake should be the opposite of those shown in Figure 18. In cutting left hand 60° type threads, the compound rest should be set at 29° in the direction shown in Figure 33 which is opposite that for right hand threads.

CUTTING ACME THREADS

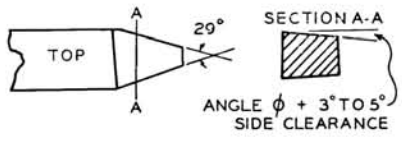


$D = \frac{P}{2} + .010''$ $F = .3707 \times P$

$W = .3707 \times P - .0052''$ MINOR DIA. = MAJOR DIA. $- (P + .020)$

FIG. 34. Acme Screw Thread and Formulas.

The Acme screw thread (Fig. 34) is often found in power transmissions, where heavy loads necessitate close-fitting threads. Another common application is in the lead screws and feed screws of precision machine tools. The lead screw, cross feed and compound rest feed screw of most lathes have Acme threads.



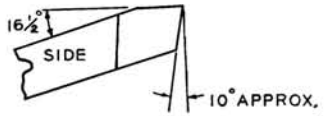
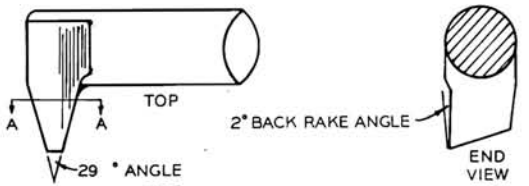


FIG. 36. Tool bit formed for cutting an external Acme thread. To determine angle ϕ, refer to Figure 40, page 25.



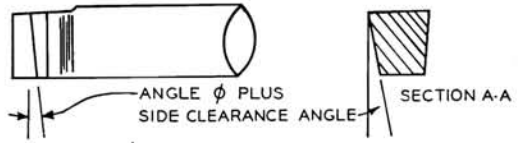


FIG. 35
Acme Thread Gauge.

FIG. 37 (Left)
Tool bit formed for cutting an internal Acme thread. To determine angle ϕ, refer to Figure 40, page 25.

Figures 36 and 37 show the proper tool forms for cutting external and internal Acme threads. The forms must be checked with the Acme thread gauge (Fig. 35) during the cutting process.

The various steps in the cutting of an Acme thread are similar to those for 60° type threads (pages 13 to 19). Set the compound rest at 14½° and advance compound feed after cut, returning cross feed each time to the same setting. Take lighter cuts than with 60° type threads because the total cutting face of the tool is longer.

CUTTING SQUARE THREADS

The square thread (Fig. 38) is rarely cut because it is a difficult job and results in a thread which is not so strong as the Acme. It is cut, however, for many vise and clamp screws and other worm-screw forms. The Acme thread is recommended for all such applications—it is stronger, easier to cut, and capable of closer fits.

In cutting a square thread with a large lead, the tool angles must be absolutely correct. Clearance should be allowed on two sides, tapering from both the top and front of the tool (see Figs. 39 and 41). Figure 40 explains how the important angle Φ must be determined.

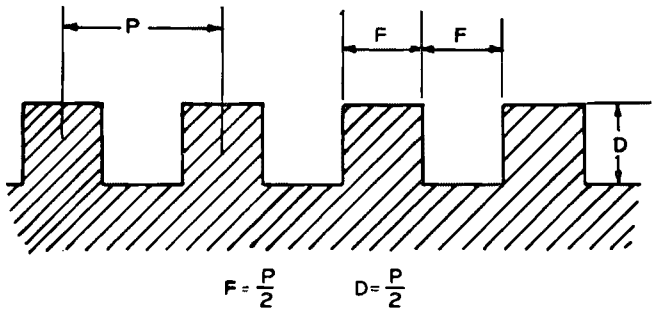


FIG. 38. Square Thread and Formulas.

External square threads should be cut to the minor diameter plus about .005 inch, internal square threads to the major diameter plus about .005 inch. The additional .005 inch allows a small clearance at the bottom of the thread, which helps to compensate for any small inaccuracies in the tool or cutting.

The tool must be fed directly into the work with the cross feed

(or compound rest feed), and care must be taken to avoid chatter and "hogging-in." The simplest method is to set the compound rest at 0°, feed in with the compound, and back out and return the tool with the cross feed. Take very light cuts when turning or boring a square thread.

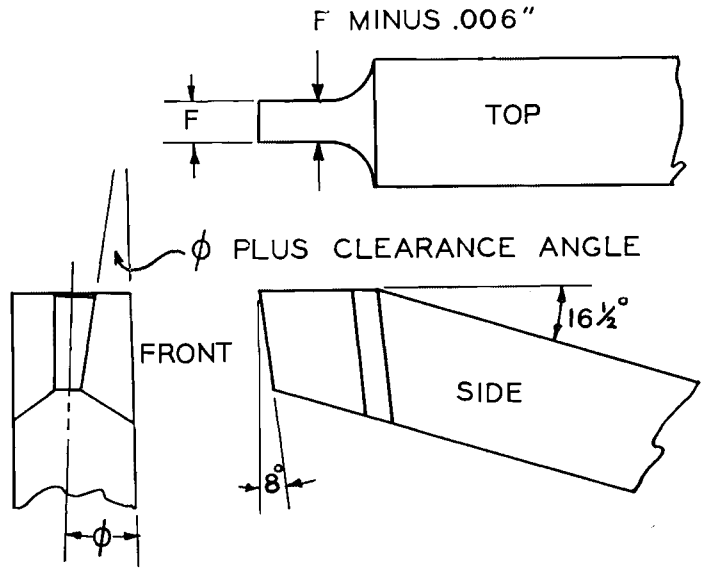


FIG. 39. Tool bit for cutting external square threads.

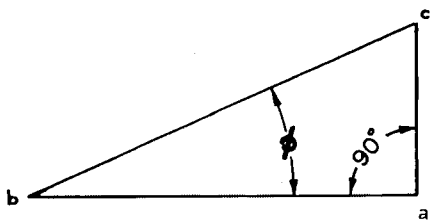


FIG. 40
Determining the angle Φ. Draw line "ab" equal to the circumference of the thread (3.1416 × major diameter). Then draw line "ac" at right angles to "ab" and equal in length to the thread pitch (or lead, if a multiple thread). Draw line "bc." The angle Φ is equal to the angle made by lines "ba" and "bc."

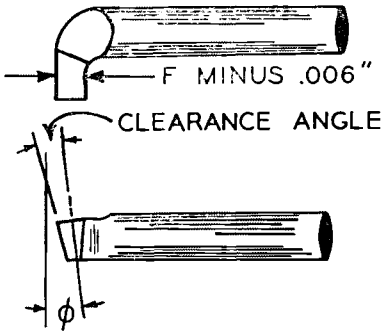


FIG. 41
Tool bit for cutting internal square threads.

WHITWORTH FORM THREAD

Figure 42 shows the Whitworth thread, a form which is standard in the British Isles for nearly all types of threads. The smaller sizes of the Whitworth form are called British Standard Fine.

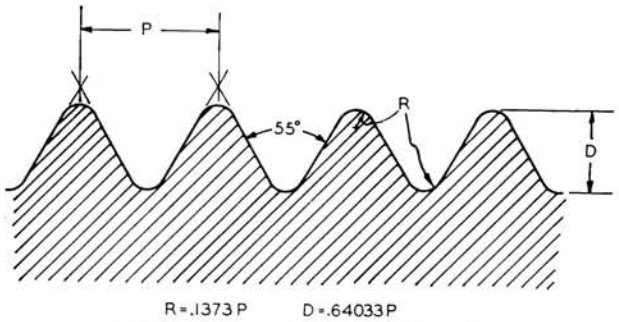


FIG. 42. Whitworth Thread and Formulas.

A Whitworth thread is cut in much the same manner as an Acme thread. There are two major differences: The thread angle is smaller, and the radius at the top and bottom of the thread must be shaped properly with a formed tool.

CUTTING PIPE-THREADS

Figure 43 shows the exact form of the American Standard Pipe thread when cut correctly in a pre-formed die. When turned into the receiving nut, the tapered lines cause the tight "jamming" for which the pipe thread is so well known. In a straight form this thread is used in oil cups and several types of electrical fittings.

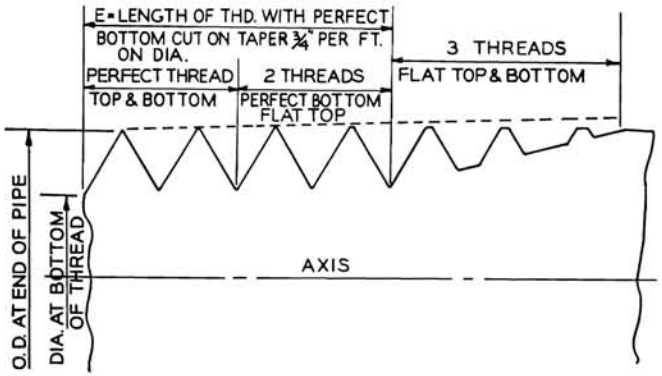


FIG. 43. American Standard Pipe Thread and Formulas.

In order to cut the American Standard Pipe thread on the lathe without special dies or equipment, some variation in form is necessary. Excellent pipe-type threads, satisfactory for commercial use and having the same jamming effect when forced into the nut or coupling, can be cut with a 60° Vee type tool and a set-over of the tailstock to obtain a taper of approximately 3/4 inch per foot. If the stock cannot be mounted between lathe centers, the taper attachment (Part 8) is required for the cutting operation. The threading operation is similar to that for a standard Vee thread and produces a thread resembling the threaded portion shown in Figure 44. Figure 45 shows a type of pipe center recommended for supporting the stock while cutting pipe type threads.

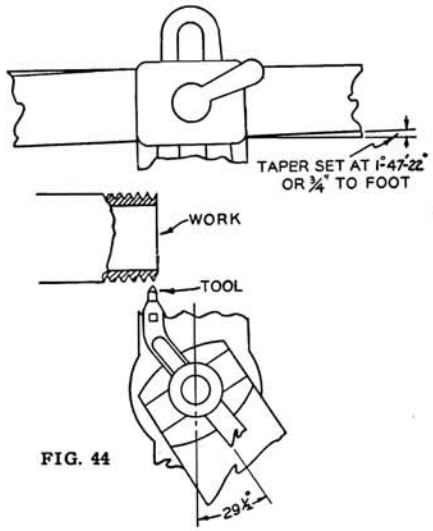


FIG. 44

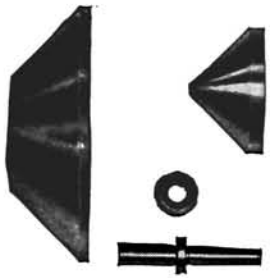


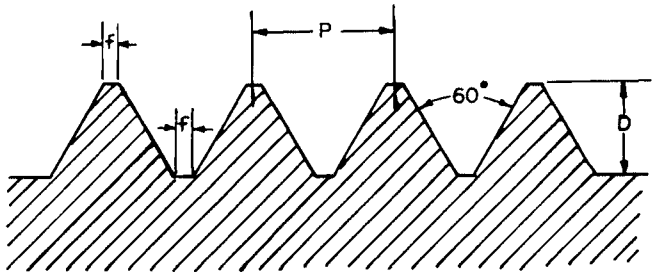
FIG. 45. Pipe Centers.

CUTTING METRIC THREADS

(Also Special Fractional Threads)

The Metric Standard screw thread form shown in Figure 46 (page 28) is accepted almost universally wherever the metric system is the standard of measurement. The metric thread angle and form is identical to that of the National Form thread, and the cutting operation is exactly the same, with one important exception: the motor must be reversed after each cut. This procedure is necessary because metric threads have no definite relation to the threading dial.*

**The six inch lathes are available with metric-pitch threads for cross and compound feed screws and feed screw collars graduated in .04 mm.*



$D = .64952 \times P \qquad f = \frac{P}{8}$

FIG. 46. Metric Standard Screw Thread Form and Formulas.

The following cutting method applies to metric threads and also to special fractional threads, wire feeds, and the threads in Table I, page 38, not marked "Exact": After the half-nut lever on the carriage is engaged for the first cut, it should not be moved until the thread has been completed. As the tool reaches the end of each cut, back out the cross feed, stop the lathe, and reverse the motor until the tool has been returned to the starting position. Then advance the cross feed to its original 0 position, turn in the compound rest feed for the next cut, start the motor and repeat the cutting operation.

MULTIPLE THREADS

Multiple threads of almost any pitch and number of starts can be cut by two methods. The threading dial is quick, simple and accurate for some double threads and some quadruple or "multiple-four" threads. Multiple threads can also be cut by "slipping teeth" on either the spindle gear or the screw gear (see page 30).

Multiple threading requires larger tool clearance angles. Figure 14 shows a double screw thread and Figure 47 shows a

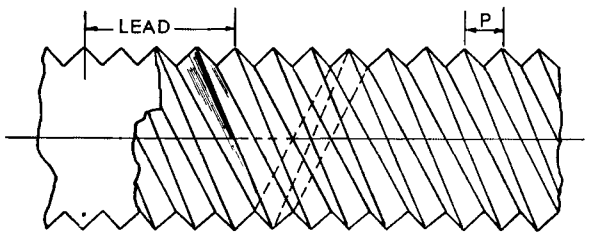


FIG. 47
Quadruple screw thread. The lead is four times the pitch.

quadruple or multiple four thread. These drawings illustrate how the angle of advance has been increased—*the tool clearance must be sufficient for the lead, not merely the pitch.*

USING THE THREADING DIAL FOR MULTIPLE THREADS

Although only four marks are cut into the top of the threading dial, there are actually eight different positions at which the half-nut lever can be engaged. Figure 48 shows the intermediate points between the four mainmarkings. These points can be marked with pencil, or the positions easily estimated. In the following paragraphs, "Lead in Threads Per Inch" is equal to 1 divided by Lead in Inches.

CUTTING DOUBLE THREADS WITH LEAD IN THREADS PER INCH DIVISIBLE BY FOUR BUT NOT BY EIGHT (12, 20, 28, 36, etc.)

A single thread of this lead is cut by engaging the half nuts at any of the four main markings on the threading dial (O, A, B or C in Figure 48). To cut the second groove of a double thread, the half nuts are engaged at any of the "b" positions.

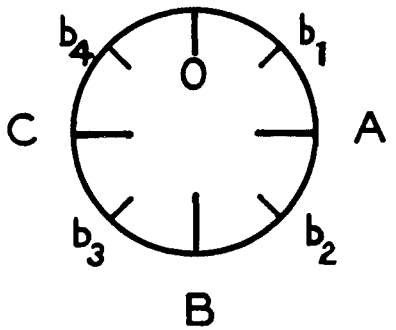


FIG. 48
Threading Dial Positions. The line and letter for the "O" position is marked in the face of the dial. Lines for "A," "B," and "C" positions are marked, but not the letters themselves. The four "b" positions may be marked by the operator as needed.

Example: To Cut a Double Thread with a Pitch of 1/24 inch and a Lead of 1/12 inch. Set up the change gears for the lead in threads per inch (12, not 24). Engage the half nut lever for the first cut when the stationary mark on the outside of the threading dial is in line with any one of the four main marks on the rotating portion of the dial. Then return to the starting point and engage half nuts at any one of the "b" positions, taking the first cut on the second groove of the thread. The compound rest feed remains *at one setting* until both grooves have been cut to the same depth.

CUTTING DOUBLE AND QUADRUPLE THREADS WITH LEAD IN THREADS PER INCH DIVISIBLE BY TWO, BUT NOT BY FOUR (10, 14, 18, 22, etc.)

A single thread of this lead can be cut only by engaging the half nut lever at the "O" or "B" markings, on the threading dial. To cut the second groove of the double thread, the half nuts are engaged at the "A" or "C" markings, and the cutting operation is the same as in the preceding paragraph.

For quadruple threads of this lead, engage the half nut lever at the "O" or "B" markings for the first groove, at the b_1 or b_3 positions for the second groove, at the "A" or "C" markings for the third groove, and at the b_2 or b_4 positions for the fourth groove. The setting of the compound rest feed is changed only after each of the four grooves has been cut to the same depth.

CUTTING DOUBLE AND QUADRUPLE THREADS WITH LEAD IN THREADS PER INCH DIVISIBLE BY ONE, BUT NOT BY TWO (ODD NUMBERS)

A single thread of this lead is cut by engaging the half nut lever at the "O" marking. To cut the second groove of the double thread, the half nuts are engaged at the "B" marking on the threading dial. The cutting operation is the same as in the preceding paragraph.

For quadruple threads of this lead, engage the half nut lever at the "O" marking for the first groove, at "A" for the second groove, at "B" for the third groove, and at "C" for the fourth groove. The setting of the compound rest feed is changed only after each of the four grooves has been cut to the same depth.

CUTTING MULTIPLE THREADS BY SLIPPING TEETH ON THE SPINDLE GEAR

Double and quadruple threads can also be cut by "slipping teeth" on the compound gear. This practice is not so common as the use of the threading dial, but is not complicated.

To cut multiple threads by slipping teeth on the compound gear: cut the complete first groove to a minor diameter dependent upon pitch of the desired thread. The change gear train should be arranged for the desired lead. It is important to use the same 0 point of reference to cut each thread—be sure to remember this point during the cutting operations.

Refer to the table on page 31, then slip the required number of teeth by marking adjacent teeth on the compound gear and the gear meshing with the compound gear. Drop the entire gear bracket low enough to disengage the gears and turn the compound gear forward the proper number of teeth by rotating spindle by hand. Raise the gear bracket so that the previously marked gear tooth meshes with the newly selected compound gear tooth.

To Cut Double Threads:—Slip 16 teeth to cut the second groove.

To Cut Quadruple Threads:—Slip 8 teeth to cut the second groove, 8 teeth more to cut the third groove, and 8 teeth more to cut the fourth groove.

Each thread groove is cut to its complete depth and finished before starting the next groove.

GEAR TRAINS FOR CARRIAGE FEEDS

The automatic longitudinal carriage feed per spindle revolution is obtained by setting up the gear train in the same manner as for thread cutting (pages 3 to 11). The feed in inches is equal to

$$\frac{1}{\text{threads per inch}}$$

For example, a feed of .0078 inch requires the gear set-up as 128 threads per inch.

The four most common carriage feeds, as shown in the threading chart (page 5), are .0078, .0048, .0039, and .0024 inch per spindle revolution. Refer to the threading chart and the four following paragraphs when changing these gear set-ups. Table II on page 40 includes gear set-ups for other carriage feeds.

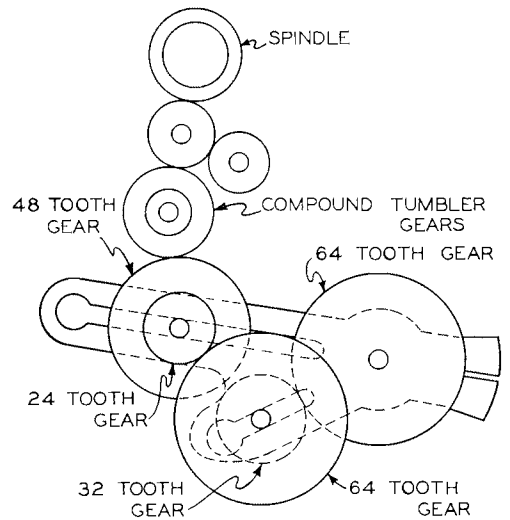


FIG. 49. Gear set-up for .0078 inch carriage feed (see page 32).

GEAR TRAIN FOR .0078 INCH CARRIAGE FEED

(See Fig. 49, page 31)

1. Place 64 tooth gear in back position on screw stub.
2. Place 32 tooth gear and 64 tooth gear on sleeve in Position C, with 32 tooth gear in back position. Tighten so that 32 tooth gear meshes with 64 tooth gear on screw stub.
3. Place 48 tooth gear and 24 tooth gear on sleeve in Position A, with 48 tooth gear in back position. Tighten so that 24 tooth gear meshes with 64 tooth gear in Position C.
4. Swing entire gear bracket upward and tighten so that 48 tooth gear in Position A meshes with 32 tooth compound tumbler gear.

GEAR TRAIN FOR .0048 INCH CARRIAGE FEED

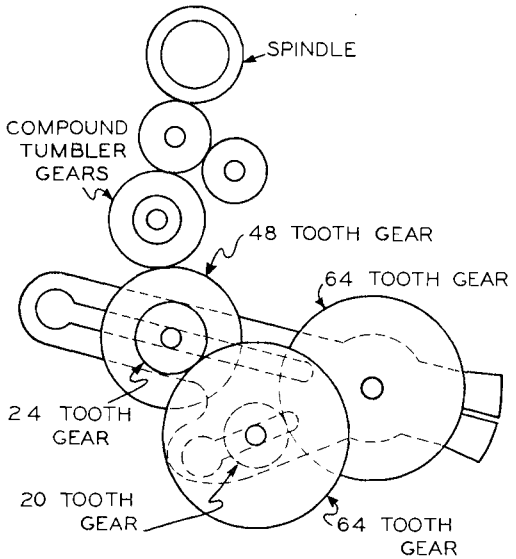


FIG. 50. Gear set-up for .0048 inch carriage feed.

1. Place 64 tooth gear in back position on screw stub.
2. Place 20 tooth gear and 64 tooth gear on sleeve in Position C, with 20 tooth gear in back position. Tighten so that 20 tooth gear meshes with 64 tooth gear on screw stub.
3. Place 48 tooth gear and 24 tooth gear on sleeve in Position A, with 48 tooth gear in back position. Tighten so that 24 tooth gear meshes with 64 tooth gear in Position C.
4. Swing entire gear bracket upward and tighten so that 48 tooth gear in position A meshes with 32 tooth compound tumbler gear.

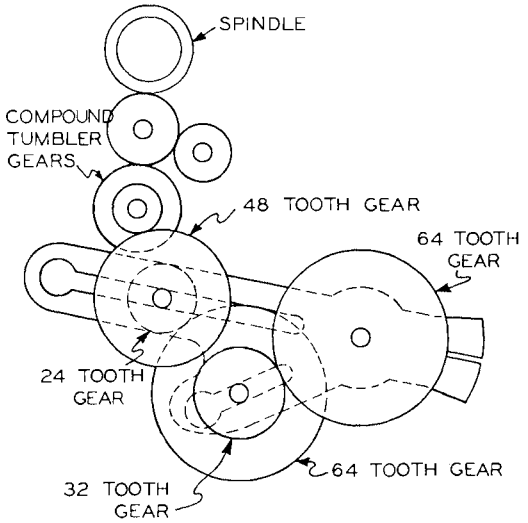


FIG. 51. Gear set-up for .0039 inch carriage feed.

GEAR TRAIN FOR .0039 INCH CARRIAGE FEED

1. Place 64 tooth gear in front position on screw stub.
2. Place 64 tooth gear and 32 tooth gear on sleeve in Position C, with 64 tooth gear in back position. Tighten so that 32 tooth gear meshes with 64 tooth gear on screw stub.
3. Place 24 tooth gear and 48 tooth gear from screw stub on sleeve in Position A, with 24 tooth gear in back position. Tighten so that 24 tooth gear meshes with 64 tooth gear in Position C.
4. Swing entire gear bracket upward and tighten so that 48 tooth gear in Position A meshes with 16 tooth compound tumbler gear.

GEAR TRAIN FOR .0024 INCH CARRIAGE FEED

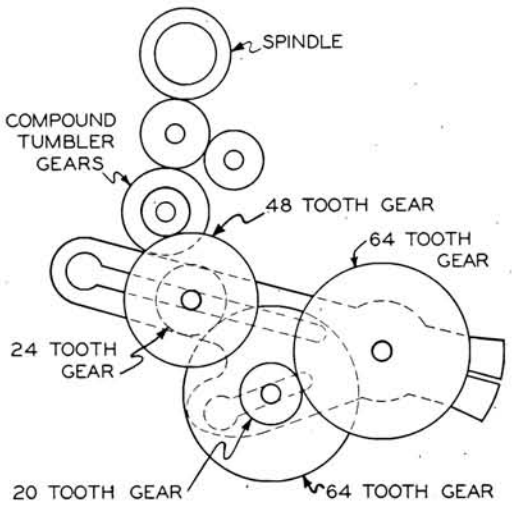


FIG. 52. Gear set-up for .0024 inch carriage feed.

1. Place 64 tooth gear in front position on screw stub.

2. Place 64 tooth gear and 20 tooth gear on sleeve in Position C, with 64 tooth gear in back position. Tighten so that 20 tooth gear meshes with 64 tooth gear on screw stub.

3. Place 24 tooth gear and 48 tooth gear on sleeve in Position A, with 24 tooth gear in back position. Tighten so that 24 tooth gear meshes with 64 tooth gear in Position C.

4. Swing entire gear bracket upward and tighten so that 48 tooth gear in Position A meshes with 16 tooth compound tumbler gear.

SPECIAL THREADS AND FEEDS

Engineers have charted over a thousand threads and feeds between the coarsest thread and the finest feed. Tables I and II in the following section give proper gear set-ups for a wide variety of special threads and feeds. Most of these set-ups are exact—some are accurate to the limits mentioned. Table III gives set-ups for metric threads with pitch between 0.5 and 7.0 millimeters.

ELECTRICAL COIL WINDING

Figure 54 shows a coil winding operation with a simple guide mounted in place of the tool post on the compound rest. This set-up is very popular with electrical shops and has done much to make coil winding on the lathe a simple job. This guide is available at the Atlas factory.

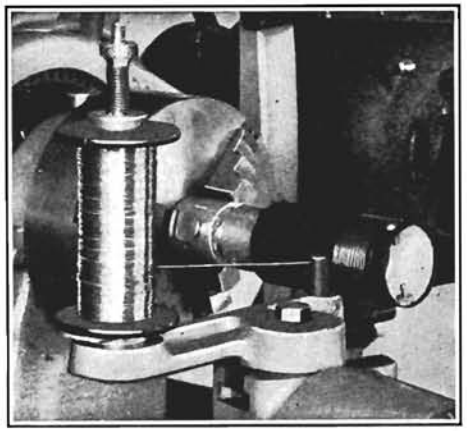


FIG. 54. Winding a coil.

Feeds are available to match the diameter of B & S magnet wire in sizes between 12 and 40, using bare wire or any of the following insulations: single cotton, double cotton, single silk, double silk, enamel, silk enamel, and cotton enamel. Gear set-ups are given in the following tables.

Feeds are also available for spring making, wire wrapping and coil winding with steel and iron wire in the following gauges: American Steel and Wire Company, music wire, American or B & S, and Washburn and Moen. Gear data for winding iron and steel wire and wires with other than enamel insulation are given in the following section.

TABLES FOR THREAD CUTTING

TABLE I—GEAR SET-UPS FOR THREADS FROM 7½ THROUGH 79 PER INCH NOT SHOWN ON THE THREADING CHART

The threading dial can be used when cutting threads below marked "exact" in the column under "Accuracy." All other threads must be cut in the same manner as metric threads (See Page 28). Set-ups which call for "Position D" require a special extension bracket assembly available from the factory. Extra gears are also available from the factory at nominal cost.

Threads per inch	Accuracy per inch	Gear on Screw	Position C B	Position C F	Position B B	Position B F	Position A B	Position A F	Position D B	Position D F	Compound Tumbler Gear	Note
7.5	Exact	40*F*	24	64	—	—	64*I*	*xxS*	—	—	32	
8.5	1/470	20*F*	46	54	—	—	64*I*	*xxS*	—	—	32	
9.5	1/950	52*B*	56	24	—	—	*xxS*	52*I*	46	54	32	*p*(*)
10.5	Exact	56*B*	48	36	20	40	44*I*	*xxS*	—	—	32	*
12.5	Exact	40*F*	—	—	20	32	64*I*	*xxS*	—	—	32	
13.5	Exact	54*F*	—	—	20	40	46*I*	*xxS*	—	—	32	
15	Exact	54*B*	36	40	20	40	46*I*	*xxS*	—	—	32	*d**
17	1/560	40*F*	—	—	46	54	52*I*	*xxS*	—	—	32	
19	1/630	48*F*	40	46	—	—	44	20	*xxS*	56*I*	16	(*)
21	Exact	56*F*	36	48	—	—	64*I*	*xxS*	—	—	32	
25	Exact	40*F*	—	—	40	32	64*I*	*xxS*	—	—	32	*d*
29	1/780	40*B*	40	56	—	—	56	54	—	—	32	*dh*
30	Exact	48*F*	—	—	40	32	64*I*	*xxS*	—	—	32	
31	1/6200	48*F*	52	56	—	—	46	32	*xxS*	54*I*	16	(*)
33	Exact	40*B*	32	48	—	—	44	40	—	—	32	*d*
34	1/340	40*B*	32	46	—	—	52	44	—	—	32	
35	Exact	40*F*	*xxS*	54*I*	—	—	56	32	—	—	32	
37	1/360	54*B*	24	46	—	—	40	56	52*I*	*xxS*	32	(*)
38	1/1580	52*B*	40	52	—	—	36	32	—	—	32	*p*
39	Exact	54*F*	52	36	—	—	56*I*	*xxS*	—	—	32	
41	1/410	46*B*	40	56	—	—	56	44	—	—	32	*h*
42	Exact	48*F*	56	32	—	—	54*I*	*xxS*	—	—	32	
43	1/2100	44*B*	36	44	*xxS*	40*I*	32	20	—	—	32	*t**
45	Exact	40*F*	*xxS*	52*I*	—	—	54	24	—	—	32	
46	Exact	46*F*	—	—	—	—	*xxS*	64*I*	—	—	16	
47	1/470	54*B*	46	40	—	—	*xxS*	52*I*	—	—	16	
49	Exact	56*F*	56	32	—	—	54*I*	*xxS*	—	—	32	*h*
50	Exact	40*B*	—	—	32	40	*xxS*	64*I*	—	—	16	*d*

Table I—Continued

Threads per inch	Accuracy per inch	Gear on Screw	Position C B	Position C F	Position B B	Position B F	Position A B	Position A F	Position D B	Position D F	Compound Tumbler Gear	Note
51	1/400	54*B*	36	56	—	—	56	46	—	—	32	*h*
52	Exact	52*F*	—	—	—	—	*xxS*	64*I*	—	—	16	
53	1/3000	54*B*	40	64	—	—	54	44	—	—	32	*j*
54	Exact	54*F*	—	—	—	—	*xxS*	64*I*	—	—	16	
55	1/7000	64*B*	44	64	—	—	52	44	—	—	32	*t*
57	1/320	56*B*	—	—	24	44	40	36	—	—	32	
58	1/580	54*B*	32	54	—	—	56	44	—	—	32	*j*
59	1/770	40*B*	—	—	64*I*	*xxS*	20	48	64	52	32	(*)
60	Exact	48*B*	—	—	32	40	*xxS*	64*I*	—	—	16	
61	1/1500	54*B*	46	52	—	—	*xxS*	56*I*	—	—	16	
62	1/620	48*B*	20	44	—	—	54	46	—	—	32	
63	1/2100	64*B*	—	—	24	40	52	44	—	—	32	
65	Exact	48*B*	32	52	—	—	40	24	—	—	32	
66	1/75	44*B*	36	54	—	—	*xxS*	64*I*	—	—	16	
67	1/670	40*F*	44	46	—	—	52*I*	*xxS*	32	56	16	(*)
68	1/680	40*F*	46	32	—	—	44	52	*xxS*	48I	16	(*)
69	Exact	54*B*	36	46	—	—	*xxS*	64*I*	—	—	16	
70	Exact	40*B*	—	—	48*I*	*xxS*	32	56	—	—	16	
71	1/710	64*B*	36	40	—	—	*xxS*	64*I*	—	—	16	
73	1/730	48*B*	20	36	*xxS*	44*I*	54	32	—	—	32	*
74	1/740	54*F*	46	24	—	—	56	40	*xxS*	64*I*	16	(*)
75	Exact	40*F*	36	24	32	40	*xxS*	44*I*	—	—	16	*d*
76	1/1900	52*F*	52	40	—	—	32	36	*xxS*	48*I*	16	(*)*p*
77	Exact	44*B*	32	56	—	—	*xxS*	54*I*	—	—	16	
78	Exact	54*B*	36	52	—	—	*xxS*	64*I*	—	—	16	
79	1/790	54*F*	52	40	—	—	32	36	*xxS*	44*I*	16	(*)

SYMBOLS:

d—extra 40 tooth gear
h—extra 56 tooth gear
j—extra 54 tooth gear
p—extra 52 tooth gear
t—extra 44 tooth gear
F—position away from headstock
B—position toward headstock
I—idler gear
xxS—steel spacer
*—extra sleeve, bushing and bolt assembly
(*)—special extension bracket assembly

TABLE II—GEAR SET-UPS FOR CARRIAGE FEEDS

Seven different carriage feeds between .001046 and .0080 inch per spindle revolution are available on the six-inch lathes in addition to the four most common feeds pictured and described in detail between pages 31 and 34. Two of these set-ups call for an extra position (Position D) which requires a special extension bracket assembly available from the factory. When the material or job requires a certain carriage feed, refer to the table below. Feeds for electrical coil winding begin with Table XVII.

Feed Inches	Threads per inch	Gear on Screw	Position C B	Position C F	Position B B	Position B F	Position A B	Position A F	Position D B	Position D F	Compound Tumbler Gear	Note
.008	124.8	64*B*	20	52	—	—	54	36	—	—	32	
.007	143.94	64*B*	20	54	—	—	40	24	—	—	32	
.006	166.4	64*B*	20	52	—	—	*xxS*	56*I*	—	—	16	
.005	199.1	64*F*	64	32	—	—	36	56	—	—	16	
.004	249.6	64*F*	52	20	—	—	24	36	*xxS*	48*I*	16	(*)
.0021	478	64*F*	64	20	—	—	24	56	—	—	16	
.001046	956	64*B*	20	64	—	—	56	24	24	48	16	*f*(*)

SYMBOLS:

f—extra 24 tooth gear

(*)—special extension bracket assembly

xxS—steel spacer

F—position away from headstock

B—position toward headstock

I—idler gear

S—Spacer gear

TABLE III—GEAR SET-UPS FOR METRIC THREADS

Two of the standard change gears furnished with the six-inch lathe, the 52 tooth gear and 44 tooth gear, combine to give a ratio of 44/52 or .846154, which is an almost exact function of 2.54, the English to Metric ratio. Thus, it is possible to cut metric threads very close to the standard metric pitches.

Refer to page 28 when cutting metric threads. The three set-ups below which call for "Position D" require a special extension bracket assembly available from the factory.

Pitch MM.	Gear on Screw	Position C B	Position C F	Position B B	Position B F	Position A B	Position A F	Position D B	Position D F	Compound Tumbler Gear	Note
.5	48*B*	54*I*	*xxS*	—	—	24	56	40	44	32	(*)
.6	56*B*	36	64	—	—	44	52	—	—	32	
.7	64*B*	24	32	—	—	44	52	—	—	32	
.75	64*B*	32	40	—	—	44	52	—	—	32	
.8	54*B*	46	64	—	—	44	52	—	—	32	
.9	46*B*	36	52	—	—	44	52	—	—	32	
1.0	40*B*	32	48	—	—	44	52	—	—	32	
1.25	44*F*	48	52	—	—	40*I*	20*S*	—	—	32	
1.50	44*F*	40*S*	52*I*	—	—	46*I*	20*S*	—	—	32	
1.75	44*B*	56	40	—	—	20*S*	46*I*	48	52	32	(*)
2.0	40*B*	48	44	—	—	36	52	64*I*	20*S*	32	(*)
2.5	44*F*	24	52	—	—	64*I*	20*S*	—	—	32	
3.0	44*F*	20	52	—	—	64*I*	20*S*	—	—	32	

TABLE IV

DEPTH AND DOUBLE DEPTH OF NATIONAL FORM THREADS

This table shows (I) Depth and Double Depth for National Form Threads cut with a NF formed tool, and (II) Depth and Double Depth of NF threads cut with a 60° V-type tool, making a V bottom but leaving top of thread with proper amount of flat (see text, page 15). Two columns at extreme right give proper depth of compound feed to obtain correct depth of thread with compound rest set at 29° (page 17).

Threads per Inch	Pitch Inches	(I) When Cut with NATIONAL FORM TOOL		(II) When Cut with VEE FORM TOOL		Depth of Compound Feed Single Depth	
		Single Depth of Thread	Double Depth of Thread	Single Depth of Thread	Double Depth of Thread	N. F. Tool	Vee Form Tool
4	.2500	.1624	.3248	.1894	.3789	.186	.216
4½	.2222	.1443	.2887	.1684	.3368	.165	.193
5	.2000	.1299	.2598	.1516	.3031	.148	.173
5½	.1818	.1181	.2362	.1378	.2755	.135	.157
6	.1667	.1083	.2165	.1263	.2525	.124	.144
7	.1429	.0928	.1856	.1082	.2165	.106	.123
8	.1250	.0812	.1624	.0947	.1894	.093	.108
9	.1111	.0722	.1443	.0842	.1684	.083	.095
10	.1000	.0650	.1299	.0758	.1515	.074	.087
11	.0909	.0590	.1181	.0689	.1377	.067	.078
12	.0833	.0541	.1083	.0631	.1263	.062	.072
13	.0769	.0500	.0999	.0583	.1166	.057	.067
14	.0714	.0464	.0928	.0541	.1082	.053	.062
16	.0625	.0406	.0812	.0473	.0947	.046	.054
18	.0556	.0361	.0722	.0421	.0842	.041	.047
20	.0500	.0325	.0650	.0379	.0758	.037	.043
22	.0454	.0295	.0590	.0345	.0690	.034	.038
24	.0417	.0271	.0541	.0316	.0632	.031	.036
27	.0370	.0241	.0481	.0281	.0562	.028	.032
28	.0357	.0232	.0464	.0270	.0541	.027	.031
30	.0333	.0217	.0433	.0253	.0506	.025	.029
32	.0313	.0203	.0406	.0237	.0474	.023	.027
36	.0278	.0180	.0361	.0211	.0421	.021	.024
40	.0250	.0162	.0325	.0189	.0379	.019	.021
44	.0227	.0148	.0295	.0172	.0345	.017	.020
48	.0208	.0135	.0271	.0157	.0315	.015	.018
50	.0200	.0130	.0260	.0151	.0303	.015	.017
56	.0179	.0116	.0232	.0135	.0271	.013	.016
64	.0156	.0101	.0203	.0118	.0237	.012	.014
72	.0139	.0090	.0180	.0105	.0210	.010	.012
80	.0125	.0081	.0162	.00945	.0189	.009	.011
96	.0104	.0068	.0136	.00901	.01802	.008	.010

***Note:** Using Formed Tool—Minor Diameter = Major Diameter minus Double Depth of Thread in National Form Tool column.*

Using Vee Tool—Minor Diameter = Major Diameter minus Double Depth of Thread in Vee Form Tool column.

TABLE V

NATIONAL COARSE THREAD SERIES

(Formerly U. S. Standard)

THREAD DIMENSIONS AND TAP DRILL SIZES

Nominal Size	Threads per Inch	Major Diameter Inches	Minor Diameter Inches	Pitch Diameter Inches	Tap Drill for 75% Thread	Clearance Drill Size*
1	64	.0730	.0527	.0629	53	47
2	56	.0860	.0628	.0744	50	42
3	48	.0990	.0719	.0855	47	36
4	40	.1120	.0795	.0958	43	31
5(⅛)	40	.1250	.0925	.1088	38	29
6	32	.1380	.0974	.1177	36	25
8	32	.1640	.1234	.1437	29	16
10	24	.1900	.1359	.1629	25	13/64″
12	24	.2160	.1619	.1889	16	7/32″
1/4″	20	.2500	.1850	.2175	7	17/64″
5/16″	18	.3125	.2403	.2764	F	21/64″
3/8″	16	.3750	.2938	.3344	5/16″	25/64″
7/16″	14	.4375	.3447	.3911	U	29/64″
1/2″	13	.5000	.4001	.4500	27/64″	33/64″
9/16″	12	.5625	.4542	.5084	31/64″	37/64″
5/8″	11	.6250	.5069	.5660	17/32″	41/64″
3/4″	10	.7500	.6201	.6850	21/32″	49/64″
7/8″	9	.8750	.7301	.8028	49/64″	57/64″
1″	8	1.0000	.8376	.9188	7/8″	1- 1/64″
1⅛″	7	1.1250	.9394	1.0322	63/64″	1- 9/64″
1¼″	7	1.2500	1.0644	1.1572	1- 7/64″	1-17/64″
1⅜″	6	1.3750	1.1585	1.2667	1- 7/32″	1-25/64″
1½″	6	1.5000	1.2835	1.3917	1-11/32″	1-33/64″
1¾″	5	1.7500	1.4902	1.6201	1- 9/16″	1-49/64″
2″	4½	2.0000	1.7113	1.8557	1-25/32″	2- 1/32″
2¼″	4½	2.2500	1.9613	2.1057	2- 1/32″	2- 9/32″
2½″	4	2.5000	2.1752	2.3376	2¼″	2-17/32″
2¾″	4	2.7500	2.4252	2.5876	2½″	2-25/32″
3″	4	3.0000	2.6752	2.8376	2¾″	3- 1/32″
3¼″	4	3.2500	2.9252	3.0876	3″	3- 9/32″
3½″	4	3.5000	3.1752	3.3376	3¼″	3-17/32″
3¾″	4	3.7500	3.4252	3.5876	3½″	3-25/32″
4″	4	4.0000	3.6752	3.8376	3¾″	4- 1/32″

*Clearance drill makes hole with standard clearance for diameter of nominal size.

TABLE VI

NATIONAL FINE THREAD SERIES

(Formerly S. A. E.)

THREAD DIMENSIONS AND TAP DRILL SIZES

Nominal Size	Threads per Inch	Major Diameter Inches	Minor Diameter Inches	Pitch Diameter Inches	Tap Drill for 75% Thread	Clearance Drill Size*
0	80	.0600	.0438	.0519	3/64″	51
1	72	.0730	.0550	.0640	53	47
2	64	.0860	.0657	.0759	50	42
3	56	.0990	.0758	.0874	45	36
4	48	.1120	.0849	.0985	42	31
5(⅛)	44	.1250	.0955	.1102	37	29
6	40	.1380	.1055	.1218	33	25
8	36	.1640	.1279	.1460	29	16
10	32	.1900	.1494	.1697	21	13/64″
12	28	.2160	.1696	.1928	14	7/32″
1/4″	28	.2500	.2036	.2268	3	17/64″
5/16″	24	.3125	.2584	.2854	I	21/64″
3/8″	24	.3750	.3209	.3479	Q	25/64″
7/16″	20	.4375	.3726	.4050	25/64″	29/64″
1/2″	20	.5000	.4351	.4675	29/64″	33/64″
9/16″	18	.5625	.4903	.5264	33/64″	37/64″
5/8″	18	.6250	.5528	.5889	37/64″	41/64″
3/4″	16	.7500	.6688	.7094	11/16″	49/64″
7/8″	14	.8750	.7822	.8286	13/16″	57/64″
1″	14	1.0000	.9072	.9536	15/16″	1- 1/64″
1⅛″	12	1.1250	1.0168	1.0709	1- 3/64″	1- 9/64″
1¼″	12	1.2500	1.1418	1.1959	1-11/64″	1-17/64″
1⅜″	12	1.3750	1.2668	1.3209	1-19/64″	1-25/64″
1½″	12	1.5000	1.3918	1.4459	1-27/64″	1-33/64″

*Clearance drill makes hole with standard clearance for diameter of nominal size.

TABLE VII

FRACTIONAL SIZES

NATIONAL SPECIAL THREAD SERIES
THREAD DIMENSIONS AND TAP DRILL SIZES

Nominal Size	Threads per Inch	Major Diameter Inches	Minor Diameter Inches	Pitch Diameter Inches	Tap Drill for 75% Thread	Clearance Drill Size*
1/16″	64	.0625	.0422	.0524	3/64″	51
5/64″	60	.0781	.0563	.0673	1/16″	45
3/32″	48	.0938	.0667	.0803	49	40
7/64″	48	.1094	.0823	.0959	43	32
1/8″	32	.1250	.0844	.1047	3/32″	29
9/64″	40	.1406	.1081	.1244	32	24
5/32″	32	.1563	.1157	.1360	1/8″	19
5/32″	36	.1563	.1202	.1382	30	19
11/64″	32	.1719	.1313	.1516	9/64″	14
3/16″	24	.1875	.1334	.1604	26	8
3/16″	32	.1875	.1469	.1672	22	8
13/64″	24	.2031	.1490	.1760	20	3
7/32″	24	.2188	.1646	.1917	16	1
7/32″	32	.2188	.1782	.1985	12	1
15/64″	24	.2344	.1806	.2073	10	1/4″
1/4″	24	.2500	.1959	.2229	4	17/64″
1/4″	27	.2500	.2019	.2260	3	17/64″
1/4″	32	.2500	.2094	.2297	7/32″	17/64″
5/16″	20	.3125	.2476	.2800	17/64″	21/64″
5/16″	27	.3125	.2644	.2884	J	21/64″
5/16″	32	.3125	.2719	.2922	9/32″	21/64″
3/8″	20	.3750	.3100	.3425	21/64″	25/64″
3/8″	27	.3750	.3269	.3509	R	25/64″
7/16″	24	.4375	.3834	.4104	X	29/64″
7/16″	27	.4375	.3894	.4134	Y	29/64″
1/2″	12	.5000	.3918	.4459	27/64″	33/64″
1/2″	24	.5000	.4459	.4729	29/64″	33/64″
1/2″	27	.5000	.4519	.4759	15/32″	33/64″
9/16″	27	.5625	.5144	.5384	17/32″	37/64″
5/8″	12	.6250	.5168	.5709	35/64″	41/64″
5/8″	27	.6250	.5769	.6009	19/32″	41/64″
11/16″	11	.6875	.5694	.6285	19/32″	45/64″
11/16″	16	.6875	.6063	.6469	5/8″	45/64″
3/4″	12	.7500	.6418	.6959	43/64″	49/64″
3/4″	27	.7500	.7019	.7259	23/32″	49/64″
13/16″	10	.8125	.6826	.7476	23/32″	53/64″
7/8″	12	.8750	.7668	.8209	51/64″	57/64″
7/8″	18**	.8750	.8028	.8389	53/64″	57/64″
7/8″	27	.8750	.8269	.8509	27/32″	57/64″
15/16″	9	.9375	.7932	.8654	53/64″	61/64″
1″	12	1.0000	.8918	.9459	59/64″	1- 1/64″
1″	27	1.0000	.9519	.9759	31/32″	1- 1/64″
1⅛″	5½	1.6250	1.3888	1.5069	1-29/64″	1-41/64″
1⅞″	5	1.8750	1.6152	1.7451	1-11/16″	1-57/64″
2⅛″	4½	2.1250	1.8363	1.9807	1-29/32″	2- 5/32″
2⅜″	4	2.3750	2.0502	2.2126	2- 1/8 ″	2-13/32″

** *Standard Spark Plug Size*

*Clearance drill makes hole with standard clearance for diameter of nominal size.

TABLE VIII

MACHINE SCREW SIZES

THREAD DIMENSIONS AND TAP DRILL SIZES
NATIONAL SPECIAL THREAD SERIES

Nominal Size	Threads per Inch	Major Diameter Inches	Minor Diameter Inches	Pitch Diameter Inches	Tap Drill for 75% Thread	Clearance Drill Size*
1	56	.0730	.0498	.0614	54	47
4	32	.1120	.0714	.0917	45	31
4	36	.1120	.0759	.0940	44	31
5(1/8)	36	.1250	.0889	.1070	40	29
6	36	.1380	.1019	.1200	34	25
7	30	.1510	.1077	.1294	31	21
7	36	.1510	.1149	.1330	1/8"	21
8	30	.1640	.1207	.1423	30	16
8	40	.1640	.1315	.1478	28	16
9	24	.1770	.1229	.1499	29	13
9	30	.1770	.1337	.1553	27	13
9	32	.1770	.1364	.1567	26	13
10	28	.1900	.1436	.1668	23	13/64"
10	30	.1900	.1467	.1684	22	13/64"
12	32	.2160	.1754	.1957	13	7/32"
14	20	.2420	.1770	.2095	10	17/64"
14	24	.2420	.1879	.2149	7	17/64"

*Clearance drill makes hole with standard clearance for diameter of nominal size.

TABLE IX

BRITISH STANDARD — WHITWORTH FORM
THREAD DIMENSIONS AND TAP DRILL SIZES

Nominal Size	Threads per Inch	Major Diameter Inches	Minor Diameter Inches	Pitch Diameter Inches	Tap Drill for Full Thread	Clearance Drill Size*
1/16"	60	.0625	.0412	.0518	57	51
3/32"	48	.0938	.0671	.0804	50	40
1/8"	40	.1250	.0930	.1090	40	29
5/32"	32	.1563	.1162	.1362	31	19
3/16"	24	.1875	.1341	.1608	28	8
7/32"	24	.2188	.1654	.1921	17	1
1/4"	20	.2500	.1860	.2180	9	17/64"
9/32"	26	.2813	.2321	.2566	C	19/64"
5/16"	18	.3125	.2414	.2769	1/4"	21/64"
3/8"	16	.3750	.2950	.3350	5/16"	25/64"
7/16"	14	.4375	.3460	.3918	T	29/64"
1/2"	12	.5000	.3933	.4466	Z	33/64"
9/16"	12	.5625	.4558	.5091	15/32"	37/64"
5/8"	11	.6250	.5086	.5668	17/32"	41/64"
11/16"	11	.6875	.5711	.6293	19/32"	45/64"
3/4"	10	.7500	.6219	.6860	41/64"	49/64"
13/16"	10	.8125	.6844	.7485	45/64"	53/64"
7/8"	9	.8750	.7327	.8039	3/4"	57/64"
1"	8	1.0000	.8399	.9200	55/64"	1- 1/64"
1 1/8"	7	1.1250	.9420	1.0335	31/32"	1- 9/64"
1 1/4"	7	1.2500	1.0670	1.1585	1- 3/32"	1-17/64"
1 3/8"	6	1.3750	1.1616	1.2683	1- 3/16"	1-25/64"
1 1/2"	6	1.5000	1.2866	1.3933	1- 5/16"	1-33/64"
1 5/8"	5	1.6250	1.3689	1.4969	1-13/32"	1-41/64"
1 3/4"	5	1.7500	1.4939	1.6219	1-17/32"	1-49/64"
2"	4 1/2	2.0000	1.7154	1.8577	1- 3/4 "	2- 1/32"
2 1/4"	4	2.2500	1.9298	2.0899	1-31/32"	2- 9/32"
2 1/2"	4	2.5000	2.1798	2.3399	2- 7/32"	2-17/32"

TABLE X

BRITISH ASSOCIATION STANDARD
THREAD DIMENSIONS AND TAP DRILL SIZES

Number Size	Pitch m/m	Major Diameter m/m	Minor Diameter m/m	Pitch Diameter m/m	Tap Drill for Full Thread	Clearance Drill Size*
0	1.00	6.0	4.80	5.400	10	F
1	.90	5.3	4.22	4.760	17	1
2	.81	4.7	3.73	4.215	24	7
3	.73	4.1	3.22	3.660	29	15
4	.66	3.6	2.81	3.205	32	21
5	.59	3.2	2.49	2.845	37	27
6	.53	2.8	2.16	2.480	43	30
7	.48	2.5	1.92	2.210	46	32
8	.43	2.2	1.68	1.940	50	37
9	.39	1.9	1.43	1.665	53	42
10	.35	1.7	1.28	1.490	55	44
11	.31	1.5	1.13	1.315	56	48
12	.28	1.3	.96	1.130	60	50

*Clearance drill makes hole with standard clearance for diameter of nominal size.

TABLE XI

INTERNATIONAL STANDARD—METRIC

THREAD DIMENSIONS AND TAP DRILL SIZES

Major Diameter m/m	Pitch m/m	Minor Diameter m/m	Pitch Diameter m/m	Tap Drill for 75% Thread m/m	Tap Drill for 75% Thread No. or Inches	Clearance Drill Size†
2.0	.40	1.48	1.740	1.6	1/16	41
2.3	.40	1.78	2.040	1.9	48	36
2.6	.45	2.02	2.308	2.1	45	31
3.0	.50	2.35	2.675	2.5	40	29
3.5	.60	2.72	3.110	2.9	33	23
4.0	.70	3.09	3.545	3.3	30	16
4.5	.75	3.53	4.013	3.75	26	10
5.0	.80	3.96	4.480	4.2	19	3
5.5	.90	4.33	4.915	4.6	14	15/64″
6.0	1.00	4.70	5.350	5.0	9	1/4″
7.0	1.00	5.70	6.350	6.0	15/64″	19/64″
8.0	1.25	6.38	7.188	6.8	H	11/32″
9.0	1.25	7.38	8.188	7.8	5/16″	3/8″
10.0	1.50	8.05	9.026	8.6	R	27/64″
11.0	1.50	9.05	10.026	9.6	V	29/64″
12.0	1.75	9.73	10.863	10.5	Z	1/2″
14.0*	1.25	12.38	13.188	13.0	33/64″	9/16″
14.0	2.00	11.40	12.701	12.0	15/32″	9/16″
16.0	2.00	13.40	14.701	14.0	35/64″	21/32″
18.0*	1.50	16.05	17.026	16.5	41/64″	47/64″
18.0	2.50	14.75	16.376	15.5	39/64″	47/64″
20.0	2.50	16.75	18.376	17.5	11/16″	13/16″
22.0	2.50	18.75	20.376	19.5	49/64″	57/64″
24.0	3.00	20.10	22.051	21.0	53/64″	31/32″
27.0	3.00	23.10	25.051	24.0	15/16″	1- 3/32″
30.0	3.50	25.45	27.727	26.5	1- 3/64″	1-13/64″
33.0	3.50	28.45	30.727	29.5	1-11/64″	1-21/64″
36.0	4.00	30.80	33.402	32.0	1-17/64″	1- 7/16″
39.0	4.0	33.80	36.402	35.0	1- 3/8 ″	1- 9/16″
42.0	4.50	36.15	39.077	37.0	1-29/64″	1-43/64″
45.0	4.50	39.15	42.077	40.0	1-37/64″	1-13/16″
48.0	5.00	41.50	44.752	43.0	1-11/16″	1-29/32″

* *Special Spark Plug Sizes*

†Clearance drill makes hole with standard clearance for diameter of nominal size.

TABLE XII

FRENCH STANDARD THREADS — METRIC

THREAD DIMENSIONS AND TAP DRILL SIZES

Major Diameter m/m	Pitch m/m	Minor Diameter m/m	Pitch Diameter m/m	Tap Drill for 75% Thread m/m	Tap Drill for 75% Thread No. or Inches	Clearance Drill Size*
1.5	.35	1.05	1.273	1.1	57	48
2.0	.45	1.42	1.708	1.5	53	41
2.5	.45	1.92	2.208	2.0	47	32
3.0	.60	2.22	2.610	2.4	3/32″	29
3.5	.60	2.72	3.110	2.9	33	23
4.0	.75	3.03	3.513	3.25	30	16
4.5	.75	3.53	4.013	3.75	26	10
5.0	.90	3.83	4.415	4.1	20	3
5.5	.90	4.33	4.915	4.6	14	15/64″
6.0	1.00	4.70	5.350	5.0	9	1/4″
7.0	1.00	5.70	6.350	6.0	15/64″	19/64″
8.0	1.00	6.70	7.350	7.0	I	11/32″
9.0	1.00	7.70	8.350	8.0	5/16″	3/8″
10.0	1.50	8.05	9.026	8.6	R	27/64″
12.0	1.50	10.05	11.026	10.5	Z	1/2″
14.0	2.00	11.40	12.701	12.0	15/32″	9/16″
16.0	2.00	13.40	14.701	14.0	35/64″	21/32″
18.0	2.50	14.75	16.376	15.5	39/64″	47/64″
20.0	2.50	16.75	18.376	17.5	11/16″	13/16″
22.0	2.50	18.75	20.376	19.5	49/64″	57/64″
24.0	3.00	20.10	22.051	21.0	53/64″	31/32″
26.0	3.00	22.10	24.051	23.0	57/64″	1- 3/64″
28.0	3.00	24.10	26.051	25.0	63/64″	1- 3/64″
30.0	3.50	25.45	27.727	26.5	1- 3/64″	1-13/64″
32.0	3.50	27.45	29.727	28.5	1- 1/8 ″	1- 9/32″
34.0	3.50	29.45	31.727	30.5	1-13/64″	1-23/64″
36.0	4.00	30.80	33.402	32.0	1-17/64″	1- 7/16″
38.0	4.00	32.80	35.402	34.0	1-21/64″	1-33/64″
40.0	4.00	34.80	37.402	36.0	1-27/64″	1-19/32″
42.0	4.50	36.15	39.077	37.0	1-29/64″	1-43/64″
44.0	4.50	38.15	41.077	39.0	1-17/32″	1-3/4″
46.0	4.50	40.15	43.077	41.0	1-39/64″	1-53/64″
48.0	5.00	41.50	44.752	43.0	1-11/16″	1-13/16″
50.0	5.00	43.50	46.752	45.0	1-49/64″	2″

*Clearance drill makes hole with standard clearance for diameter of nominal size.

TABLE XIII
ACME STANDARD THREAD DIMENSIONS

Threads per Inch	Pitch Inches P	Depth of Thread	Double Depth of Thread	Width of Top of Thread	Width of Space at Bottom of Thread
1	1	.5100	1.0200	.3707	.3655
1½	3/4	.3850	.7700	.2780	.2728
2	1/2	.2600	.5200	.1853	.1801
3	1/3	.1767	.3534	.1235	.1183
4	1/4	.1350	.2700	.0927	.0875
5	1/5	.1100	.2200	.0741	.0689
6	1/6	.0933	.1867	.0618	.0566
7	1/7	.0814	.1628	.0530	.0478
8	1/8	.0725	.1450	.0463	.0411
9	1/9	.0655	.1311	.0413	.0361
10	1/10	.0600	.1200	.0371	.0319

Note: Minor Diameter equals Major Diameter minus Double Depth of Thread.

TABLE XIV
SQUARE THREAD DIMENSIONS

Threads per Inch	Pitch Inches P	Depth of Thread	Double Depth of Thread	Width of Top of Thread	Width of Space at Bottom of Thread
1	1.0000	.5000	1.0000	.5000	.5000
1⅓	.7500	.3750	.7500	.3750	.3750
1½	.6667	.3333	.6667	.3333	.3333
1¾	.5714	.2857	.5714	.2857	.2857
2	.5000	.2500	.5000	.2500	.2500
2½	.4000	.2000	.4000	.2000	.2000
3	.3333	.1667	.3333	.1667	.1667
3½	.2857	.1429	.2857	.1429	.1429
4	.2500	.1250	.2500	.1250	.1250
4½	.2222	.1111	.2222	.1111	.1111
5	.2000	.1000	.2000	.1000	.1000
5½	.1818	.0909	.1818	.0909	.0909
6	.1667	.0833	.1667	.0833	.0833
7	.1429	.0714	.1429	.0714	.0714
8	.1250	.0625	.1250	.0625	.0625
9	.1111	.0556	.1111	.0556	.0556
10	.1000	.0500	.1000	.0500	.0500
11	.0909	.0455	.0909	.0455	.0455
12	.0833	.0417	.0833	.0417	.0417
13	.0769	.0385	.0769	.0385	.0385
14	.0714	.0357	.0714	.0357	.0357
15	.0667	.0333	.0667	.0333	.0333
16	.0625	.0312	.0625	.0312	.0312
18	.0556	.0278	.0556	.0278	.0278
20	.0500	.0250	.0500	.0250	.0250
22	.0455	.0227	.0455	.0227	.0227
24	.0417	.0208	.0417	.0208	.0208

TABLE XV
STRAIGHT PIPE THREADS
AMERICAN STANDARD FORM
THREAD DIMENSIONS AND TAP DRILL SIZES

Nominal Pipe Size	Threads per Inch	Major Diameter Inches	Minor Diameter Inches	Pitch Diameter Inches	Tap Drill for Full Thread
⅛"	27	.4044	.3451	.3748	11/32"
¼"	18	.5343	.4455	.4899	7/16"
⅜"	18	.6714	.5826	.6270	37/64"
½"	14	.8356	.7213	.7784	23/32"
¾"	14	1.0460	.9318	.9889	59/64"
1"	11½	1.3082	1.1690	1.2386	1- 5/32"
1¼"	11½	1.6530	1.5138	1.5834	1- 1/2 "
1½"	11½	1.8919	1.7527	1.8223	1-47/64"
2"	11½	2.3658	2.2267	2.2963	2- 7/32"
2½"	8	2.8622	2.6622	2.7622	2- 5/8 "
3"	8	3.4885	3.2885	3.3885	3- 1/4 "
3½"	8	3.9888	3.7888	3.8888	3- 3/4 "
4"	8	4.4871	4.2871	4.3871	4- 1/4 "

TABLE XVI
STOVE BOLTS
MANUFACTURERS STANDARD FORM—60° THREAD
THREAD DIMENSIONS AND TAP DRILL SIZES

Nominal Size	Threads per Inch	Major Diameter Inches	Minor Diameter Inches	Pitch Diameter Inches	Tap Drill	Clearance Drill Size*
1/8"	32	.1250	.0910	.1080	42	29
5/32"	28	.1630	.1250	.1440	⅛"	19
3/16"	24	.1950	.1510	.1730	24	8
7/32"	22	.2220	.1740	.1980	16	1
1/4"	18	.2500	.1980	.2240	8	17/64"
5/16"	18	.3125	.2403	.2764	C	21/64"
3/8"	16	.3750	.2938	.3344	M	25/64"
7/16"	14	.4375	.3447	.3911	S	29/64"
1/2"	13	.5000	.4000	.4500	Y	33/64"

*Clearance drill makes hole with standard clearance for diameter of nominal size.

TABLE XVII—GEAR SET-UPS TO OBTAIN PROPER CARRIAGE FEEDS FOR WINDING WITH AMERICAN STEEL AND WIRE MUSIC WIRE GAUGE

The American S & W gauge is universal for denoting sizes of music wire used in making small springs. Set-ups which call for "Position D" require a special extension bracket assembly available from the factory. Extra gears are also available from factory at nominal cost.

A. S. & W. Gauge No.	Wire Diameter	Gear on Screw	Position C B	Position C F	Position B B	Position B F	Position A B	Position A F	Position D B	Position D F	Compound Tumbler Gear	Note
6/0	.004	64*F*	52	20	—	—	24	36	*xxS*	48*I*	16	(*)
5/0	.005	64*F*	64	32	—	—	36	56	—	—	16	
4/0	.006	64*B*	20	52	—	—	48	24	—	—	32	
3/0	.007	64*F*	46	36	—	—	48*I*	*xxS*	32	56	16	(*)
2/0	.008	64*B*	20	52	—	—	54	36	—	—	32	
0	.009	64*B*	20	46	—	—	48	32	—	—	32	
1	.010	64*B*	20	52	—	—	48	40	—	—	32	
2	.011	56*B*	32	52	—	—	*xxS*	64*I*	—	—	16	
3	.012	64*B*	40	52	—	—	*xxS*	64*I*	—	—	16	
4	.013	44*B*	32	56	—	—	*xxS*	64*I*	—	—	16	
5	.014	44*F*	36	24	—	—	48	52	*xxS*	46*I*	16	(*)
6	.016	52*F*	48	20	—	—	56*I*	*xxS*	—	—	32	
7	.018	64*B*	—	—	46	40	*xxS*	48*I*	—	—	16	
8	.020	40*B*	—	—	32	40	*xxS*	64*I*	—	—	16	*d*
9	.022	56*F*	52	32	—	—	54*I*	*xxS*	—	—	32	
10	.024	64*F*	52	40	—	—	56*I*	*xxS*	—	—	32	
11	.026	48*F*	32	20	—	—	56*I*	*xxS*	—	—	32	
12	.029	48*F*	46	32	—	—	56*I*	*xxS*	—	—	32	
13	.031	56*F*	46	40	—	—	54*I*	*xxS*	—	—	32	
14	.033	56*F*	52	48	—	—	54*I*	*xxS*	—	—	32	
15	.035	52*F*	44	40	—	—	56*I*	*xxS*	—	—	32	
16	.037	54*B*	—	—	64*I*	*xxS*	—	—	—	—	32	
17	.039	40*F*	46	36	—	—	56*I*	*xxS*	—	—	32	
18	.041	40*F*	44	36	—	—	56*I*	*xxS*	—	—	32	
19	.043	56*B*	48	20	—	—	*xxS*	64*I*	—	—	16	
20	.045	40*F*	40	36	—	—	56*I*	*xxS*	—	—	32	
21	.047	36*F*	52	44	—	—	56*I*	*xxS*	—	—	32	
22	.049	36*F*	52	46	—	—	56*I*	*xxS*	—	—	32	
23	.051	64*B*	36	24	*xxS*	40*I*	44	48	—	—	32	*
24	.055	20*B*	44*I*	*xxS*	20	32	64	56	—	—	32	*c
25	.059	40*F*	—	—	46	54	52*I*	*xxS*	—	—	32	
26	.063	24*B*	40	44	*xxS*	32*I*	56	52	—	—	32	*
27	.067	20*F*	*xxS*	56*I*	—	—	54	36	—	—	32	
28	.071	24*F*	*xxS*	52*I*	—	—	54	46	—	—	32	
29	.075	20*F*	*xxS*	56*I*	—	—	64	48	—	—	32	
30	.080	20*F*	*xxS*	56*I*	—	—	40	32	—	—	32	
31	.085	20*F*	*xxS*	56*I*	—	—	52	44	—	—	32	
32	.090	40*F*	—	—	20	36	64*I*	*xxS*	—	—	32	
33	.095	24*F*	*xxS*	56*I*	—	—	56	64	—	—	32	
34	.100	20*B*	56*I*	20*S*	—	—	64*I*	*xxS*	—	—	32	

SYMBOLS:

c—extra 20 tooth gear
d—extra 40 tooth gear
*—extra sleeve, bushing and bolt assembly
F—position away from headstock
B—position toward headstock
I—idler gear
xxS—steel spacer
(*)—special extension bracket assembly

TABLE XVIII—GEAR SET-UPS TO OBTAIN PROPER CARRIAGE FEED FOR WINDING WITH ENAMEL COVERED MAGNET WIRE

Accurate to Commercial Tolerances. Set-up for B & S Gauge No. 28 requires a special extension bracket assembly available from the factory. Extra gears are also available from factory at nominal cost.

B & S Gauge No.	Wire Dia.	Gear on Screw	Position C B	Position C F	Position B B	Position B F	Position A B	Position A F	Position D B	Position D F	Compound Tumbler Gear	Note
12	.0828	48*F*	20	40	—	—	64*I*	*xxS*	—	—	32	
13	.0740	32*F*	*xxS*	56*I*	—	—	44	52	—	—	32	
14	.0660	36*F*	*xxS*	56*I*	—	—	54	64	—	—	32	
15	.0588	40*F*	—	—	46	54	52*I*	*xxS*	—	—	32	
16	.0534	56*F*	—	—	36	54	48*I*	*xxS*	—	—	32	
17	.0468	36*F*	*xxS*	52*I*	—	—	64	54	—	—	32	
18	.0417	48*B*	—	—	64*I*	*xxS*	—	—	—	—	32	
19	.0368	46*F*	*xxS*	56*I*	—	—	52	44	—	—	32	
20	.0333	48*F*	—	—	40	32	64*I*	*xxS*	—	—	32	
21	.0298	56*F*	*xxS*	52*I*	—	—	48	40	—	—	32	
22	.0266	64*F*	—	—	—	—	54	46	—	—	32	
23	.0237	44*F*	—	—	*xxS*	54*I*	46	24	—	—	32	
24	.0212	52*B*	44	40	—	—	*xxS*	56*I*	—	—	16	
25	.0189	48*B*	40	44	—	—	*xxS*	56*I*	—	—	16	
26	.0169	64*B*	—	—	52	48	*xxS*	56*I*	—	—	16	
27	.0152	56*B*	46	54	—	—	*xxS*	64*I*	—	—	16	
28	.0135	54*F*	46	24	—	—	56	40	*xxS*	64*I*	16	(*)
29	.0122	56*B*	20	56	—	—	46	44	—	—	32	*h*
30	.0108	52*B*	36	64	—	—	*xxS*	56*I*	—	—	16	
31	.0097	46*B*	56*I*	*xxS*	—	—	24	54	—	—	16	
32	.0087	46*F*	48	24	32	40	*xxS*	40*I*	—	—	16	*d**
33	.0077	48*B*	56*I*	*xxS*	—	—	20	54	—	—	16	
34	.0069	64*B*	20	56	—	—	52	32	—	—	32	
35	.0061	64*B*	24	56	—	—	44	20	—	—	32	
36	.0055	56*F*	64	32	—	—	32	52	—	—	16	
37	.0049	56*B*	20	56	—	—	52	20	—	—	32	*ch*
38	.0043	64*B*	20	56	—	—	52	20	—	—	32	*c*
39	.0038	64*F*	—	—	54	24	24	44	—	—	16	*f*
40	.0034	64*F*	64	32	—	—	20	46	—	—	16	

SYMBOLS:

c—extra 20 tooth gear
d—extra 40 tooth gear
f—extra 24 tooth gear
h—extra 56 tooth gear
*—extra sleeve, bushing and bolt assembly
F—position away from headstock
B—position toward headstock
I—idler gear
xxS—steel spacer
(*)—special extension bracket assembly

TABLE XIX—GEAR SET-UPS TO OBTAIN PROPER CARRIAGE FEEDS FOR WINDING WITH AMERICAN OR BROWNE AND SHARPE WIRE GAUGE

This gauge is universal for denoting size of copper, brass, bronze, aluminum wire, small brass tubing, sheet and strip brass and copper, nickel silver wire and strip, heating alloy wire, and armature binding wire. The table below includes bare wire only.

Set-up for B & S Gauge No. 35 requires a special extension bracket assembly available from the factory. Extra gears are also available from factory at nominal cost.

B & S Gauge No.	Wire Diameter	Gear on Screw	Position C B	Position C F	Position B B	Position B F	Position A B	Position A F	Position D B	Position D F	Compound Tumbler Gear	Note
12	.080808	64*F*	—	—	20	52	54*I*	*xx*S	—	—	32	
13	.071961	32*F*	—	—	40	46	54*I*	*xx*S	—	—	32	
14	.064084	24*F*	*xx*S	56*I*	—	—	52	40	—	—	32	
15	.057068	20*F*	*xx*S	64*I*	—	—	56	32	—	—	32	
16	.050820	32*F*	*xx*S	56*I*	—	—	64	52	—	—	32	
17	.045257	32*B*	44	56	—	—	52	48	—	—	32	
18	.040303	46*F*	56	52	—	—	64*I*	*xx*S	—	—	32	
19	.035890	46*F*	56	46	—	—	64*I*	*xx*S	—	—	32	*g*
20	.031961	48*F*	52	40	—	—	64*I*	*xx*S	—	—	32	
21	.028462	64*F*	—	—	44	40	48*I*	*xx*S	—	—	32	
22	.025347	46*B*	56	48	—	—	*xx*S	64*I*	—	—	16	
23	.022571	36*B*	52	64	—	—	*xx*S	64*I*	—	—	16	
24	.020100	64*F*	56	36	—	—	64*I*	*xx*S	—	—	32	
25	.017900	48*F*	*xx*S	64*I*	—	—	56	24	—	—	32	
26	.015940	64*B*	20	32	*xx*S	36*I*	54	44	—	—	32	
27	.014195	64*F*	44	20	—	—	64*I*	*xx*S	—	—	32	
28	.012641	44*B*	—	—	20	36	*xx*S	56*I*	—	—	16	
29	.011257	44*B*	20	40	—	—	*xx*S	64*I*	—	—	16	
30	.010025	52*B*	24	46	—	—	*xx*S	64*I*	—	—	16	
31	.008928	64*B*	32	56	—	—	*xx*S	64*I*	—	—	16	
32	.007950	56*B*	24	54	—	—	*xx*S	64*I*	—	—	16	
33	.007080	64*B*	20	44	—	—	*xx*S	64*I*	—	—	16	
34	.006304	64*B*	20	56	—	—	64	36	—	—	32	
35	.005614	52*F*	56	36	—	—	46*I*	*xx*S	20	44	16	(*)
36	.005000	64*F*	64	32	—	—	36	56	—	—	16	
37	.004453	64*F*	64	32	—	—	32	56	—	—	16	
38	.003965	56*F*	54	24	—	—	24	48	—	—	16	*f*

SYMBOLS:

f—extra 24 tooth gear

g—extra 46 tooth gear

*—extra sleeve, bushing and bolt assembly

F—front position, away from headstock

B—back position, toward headstock

I—idler gear

*xx*S—steel spacer

(*)—special extension bracket assembly

TABLE XX—GEAR SET-UP TO OBTAIN PROPER CARRIAGE FEEDS FOR WINDING WITH WASHBURN AND MOEN OR STEEL WIRE GAUGE

This gauge applies to practically all types of iron and steel wire except steel music wire. Galvanized iron wire, stove pipe and soft iron wire, binding wire, and steel wire for springs (except music wire) are specified in this gauge.

Set-ups for W & M Gauge Nos. 36 and 37 require a special extension bracket assembly available from the factory. Extra gears are also available from factory at nominal cost.

W & M Gauge No.	Wire Diameter	Gear on Screw	Position C B	Position C F	Position B B	Position B F	Position A B	Position A F	Position D B	Position D F	Compound Tumbler Gear	Note
12	.1055	32*F*	32	54	—	—	64*I*	*xx*S	—	—	32	
13	.0915	24*F*	40	44	—	—	64*I*	*xx*S	—	—	32	
14	.0800	20*F*	—	—	*xx*S	52*I*	40	32	—	—	32	
15	.0720	20*F*	*xx*S	64*I*	—	—	64	46	—	—	32	
16	.0625	32*B*	64*I*	*xx*S	—	—	56*I*	20*S*	—	—	32	
17	.0540	48*F*	—	—	40	52	46*I*	*xx*S	—	—	32	
18	.0475	56*F*	36	48	—	—	64*I*	*xx*S	—	—	32	
19	.0410	40*F*	44	36	—	—	64*I*	*xx*S	—	—	32	
20	.0348	40*F*	46	32	—	—	64*I*	*xx*S	—	—	32	
21	.0317	36*F*	*xx*S	64*I*	—	—	56	32	—	—	32	
22	.0286	64*F*	—	—	48	44	—	—	—	—	32	
23	.0258	36*B*	52	56	—	—	*xx*S	64*I*	—	—	16	
24	.0230	46*B*	40	64	—	—	52	44	—	—	32	
25	.0204	56*F*	56	32	—	—	54*I*	*xx*S	—	—	32	*h*
26	.0181	48*F*	46	20	—	—	64*I*	*xx*S	—	—	32	
27	.0173	52*B*	36	40	—	—	*xx*S	64*I*	—	—	16	
28	.0162	56*F*	44	20	—	—	64*I*	*xx*S	—	—	32	
29	.0150	64*B*	46	48	—	—	*xx*S	64*I*	—	—	16	
30	.0140	56*B*	44	56	—	—	*xx*S	64*I*	—	—	16	*h*
31	.0132	64*B*	44	52	—	—	*xx*S	64*I*	—	—	16	
32	.0128	64*B*	36	44	—	—	*xx*S	64*I*	—	—	16	
33	.0118	44*B*	24	46	—	—	*xx*S	64*I*	—	—	16	
34	.0104	64*B*	24	36	—	—	*xx*S	64*I*	—	—	16	
35	.0095	40*F*	36	24	44*I*	*xx*S	32	56	—	—	16	*
36	.0090	52*F*	64	48	—	—	20	32	*xx*S	46*I*	16	(*)
37	.0085	48*F*	56	32	—	—	40	56	*xx*S	52*I*	16	(*)*h*
38	.0080	64*B*	20	52	—	—	54	36	—	—	32	
39	.0075	64*B*	20	52	—	—	64	40	—	—	32	
40	.0070	64*B*	24	56	—	—	46	24	—	—	32	*f*

SYMBOLS:

f—extra 24 tooth gear

h—extra 56 tooth gear

*—extra sleeve, bushing and bolt assembly

F—position away from headstock

B—position toward headstock

I—idler gear

*xx*S—steel spacer

(*)—special extension bracket assembly

TABLE XXI—GEAR SET-UPS TO OBTAIN PROPER CARRIAGE FEEDS FOR WINDING WITH DOUBLE COTTON COVERED MAGNET WIRE

Accurate to Commercial Tolerances.

B & S Gauge No.	Wire Diameter	Gear on Screw	Position C B	Position C F	Position B B	Position B F	Position A B	Position A F	Compound Tumbler Gear	Note
12	.0908	44*F*	20	40	—	—	64*I*	*xxS*	32	
13	.0810	44*F*	36	64	—	—	64*I*	*xxS*	32	
14	.0731	32*F*	48	56	—	—	64*I*	*xxS*	32	
15	.0661	36*F*	54	64	—	—	64*I*	*xxS*	32	
16	.0598	32*F*	*xxS*	64*I*	—	—	46	44	32	
17	.0543	32*F*	*xxS*	64*I*	—	—	46	40	32	
18	.0493	36*F*	*xxS*	64*I*	—	—	54	48	32	
19	.0444	40*F*	*xxS*	64*I*	—	—	54	48	32	
20	.0410	36*F*	*xxS*	64*I*	—	—	54	40	32	
21	.0365	64*F*	—	—	—	—	48	56	32	
22	.0334	48*F*	—	—	40	32	64*I*	*xxS*	32	
23	.0306	56*F*	—	—	—	—	56	48	32	*h*
24	.0281	64*F*	40	36	—	—	64*I*	*xxS*	32	
25	.0259	56*F*	44	32	—	—	64*I*	*xxS*	32	
26	.0239	40*B*	44	46	—	—	*xxS*	64*I*	16	
27	.0222	54*F*	40	24	—	—	64*I*	*xxS*	32	
28	.0206	56*B*	46	40	—	—	*xxS*	64*I*	16	
29	.0193	46*B*	32	36	—	—	*xxS*	64*I*	16	
30	.0180	64*B*	—	—	46	40	*xxS*	48*I*	16	
31	.0169	64*B*	—	—	52	48	*xxS*	56*I*	16	
32	.0160	52*F*	48	20	—	—	56*I*	*xxS*	32	
33	.0151	56*B*	44	52	—	—	*xxS*	64*I*	16	
34	.0143	40*B*	—	—	48*I*	*xxS*	32	56	16	
35	.0136	64*F*	46	20	—	—	64*I*	*xxS*	32	
36	.0130	44*B*	32	56	—	—	*xxS*	64*I*	16	
37	.0125	40*B*	56*I*	*xxS*	—	—	32	64	16	
38	.0120	64*B*	40	52	—	—	*xxS*	64*I*	16	
39	.0115	40*B*	64*I*	*xxS*	—	—	24	52	16	
40	.0112	64*B*	40	56	—	—	*xxS*	64*I*	16	

SYMBOLS:

h—extra 56 tooth gear available from factory
xxS—steel spacer
F—position away from headstock
B—position toward headstock
I—idler gear

TABLE XXII—GEAR SET-UPS TO OBTAIN PROPER CARRIAGE FEEDS FOR WINDING WITH SINGLE COTTON COVERED MAGNET WIRE

Accurate to Commercial Tolerances.

Set-ups for B & S Gauge Nos. 36 and 37 require a special extension bracket assembly available from the factory. Extra gears are also available from factory at nominal cost.

B & S Gauge No.	Wire Diameter	Gear on Screw	Position C B	Position C F	Position B B	Position B F	Position A B	Position A F	Position D B	Position D F	Compound Tumbler Gear	Note
12	.0858	56*F*	20	48	—	—	64*I*	*xxS*	—	—	32	
13	.0765	24*F*	*xxS*	64*I*	—	—	48	44	—	—	32	
14	.0686	32*F*	*xxS*	64*I*	—	—	40	44	—	—	32	
15	.0616	20*F*	*xxS*	64*I*	—	—	52	32	—	—	32	
16	.0553	32*F*	*xxS*	64*I*	—	—	52	46	—	—	32	
17	.0498	46*F*	*xxS*	54*I*	—	—	56	64	—	—	32	
18	.0448	32*F*	*xxS*	64*I*	—	—	56	40	—	—	32	
19	.0399	40*F*	—	—	40	32	64*I*	*xxS*	—	—	32	*d*
20	.0365	48*F*	*xxS*	52*I*	—	—	64	56	—	—	32	
21	.0325	56*F*	44	40	—	—	64*I*	*xxS*	—	—	32	
22	.0294	40*B*	32	46	—	—	52	44	—	—	32	
23	.0266	52*F*	*xxS*	48*I*	—	—	52	36	—	—	32	*p*
24	.0241	40*B*	54	56	—	—	*xxS*	64*I*	—	—	16	
25	.0219	44*B*	54	56	—	—	*xxS*	64*I*	—	—	16	
26	.0199	48*B*	44	46	—	—	*xxS*	64*I*	—	—	16	
27	.0182	64*B*	44	64	—	—	52	44	—	—	32	*t*
28	.0166	56*B*	*xxS*	48*I*	—	—	52	56	—	—	16	
29	.0153	56*B*	48	56	—	—	*xxS*	46*I*	—	—	16	
30	.0140	56*B*	*xxS*	64*I*	—	—	44	56	—	—	16	*h*
31	.0129	54*B*	32	46	—	—	*xxS*	64*I*	—	—	16	
32	.0120	64*B*	40	52	—	—	*xxS*	64*I*	—	—	16	
33	.0111	40*B*	64*I*	*xxS*	—	—	24	54	—	—	16	
34	.0103	54*B*	20	36	—	—	*xxS*	64*I*	—	—	16	
35	.0096	64*B*	32	52	—	—	*xxS*	64*I*	—	—	16	
36	.0090	52*F*	64	48	—	—	20	32	*xxS*	46*I*	16	(*)
37	.0085	48*F*	56	32	—	—	40	56	*xxS*	52*I*	16	*h*(*)
38	.0080	64*B*	20	52	—	—	54	36	—	—	32	
39	.0075	64*B*	20	52	—	—	64	40	—	—	32	
40	.0071	64*B*	20	44	—	—	*xxS*	64*I*	—	—	16	

SYMBOLS:

d—extra 40 tooth gear
h—extra 56 tooth gear
p—extra 52 tooth gear
t—extra 44 tooth gear
F—position away from headstock
B—position toward headstock
I—idler gear
xxS—steel spacer
(*)—special extension bracket assembly

TABLE XXIII—GEAR SET-UPS TO OBTAIN PROPER CARRIAGE FEEDS FOR WINDING WITH DOUBLE SILK COVERED MAGNET WIRE

Accurate to Commercial Tolerances.

Set-ups for B & S Gauge Nos. 36 and 37 require a special extension bracket assembly available from the factory. Extra gears are also available from factory at nominal cost.

B & S Gauge No.	Wire Diameter	Gear on Screw	Position C B	Position C F	Position B B	Position B F	Position A B	Position A F	Position D B	Position D F	Compound Tumbler Gear	Note
12	.0848	20*F*	*xxS*	64*I*	—	—	52	44	—	—	32	
13	.0760	24*F*	*xxS*	64*I*	—	—	48	44	—	—	32	
14	.0681	24*F*	*xxS*	64*I*	—	—	44	36	—	—	32	
15	.0611	20*F*	*xxS*	64*I*	—	—	52	32	—	—	32	
16	.0548	32	*xxS*	64*I*	—	—	64	56	—	—	32	
17	.0493	36*F*	*xxS*	64*I*	—	—	54	48	—	—	32	
18	.0443	36*F*	*xxS*	64*I*	—	—	40	32	—	—	32	
19	.0394	46*F*	44	40	—	—	64*I*	*xxS*	—	—	32	
20	.0360	48*F*	*xxS*	54*I*	—	—	64	56	—	—	32	
21	.0325	44*F*	56	40	—	—	64*I*	*xxS*	—	—	32	
22	.0284	64*F*	44	40	—	—	64*I*	*xxS*	—	—	32	
23	.0266	64*F*	—	—	—	—	54	46	—	—	32	
24	.0241	40*B*	54	56	—	—	*xxS*	64*I*	—	—	16	
25	.0219	44*B*	54	56	—	—	*xxS*	64*I*	—	—	16	
26	.0199	48*B*	44	46	—	—	*xxS*	64*I*	—	—	16	
27	.0182	64*B*	44	64	—	—	52	44	—	—	32	*t*
28	.0166	56*B*	*xxS*	48*I*	—	—	52	56	—	—	16	
29	.0153	56*B*	*xxS*	46*I*	—	—	48	56	—	—	16	
30	.0140	56*B*	44	56	—	—	*xxS*	64*I*	—	—	16	*h*
31	.0129	54*B*	32	46	—	—	*xxS*	64*I*	—	—	16	
32	.0120	64*B*	40	52	—	—	*xxS*	64*I*	—	—	16	
33	.0111	40*B*	64*I*	*xxS*	—	—	24	54	—	—	16	
34	.0103	54*B*	20	36	—	—	*xxS*	64*I*	—	—	16	
35	.0096	64*B*	32	52	—	—	*xxS*	64*I*	—	—	16	
36	.0090	52*F*	64	48	—	—	20	32	*xxS*	46*I*	16	(*)
37	.0085	48*F*	56	32	—	—	40	56	*xxS*	52*I*	16	(*)
38	.0080	64*B*	20	52	—	—	54	36	—	—	32	
39	.0075	64*B*	20	52	—	—	64	40	—	—	32	
40	.0071	64*B*	20	44	—	—	*xxS*	64*I*	—	—	16	

SYMBOLS:

h—extra 56 tooth gear
t—extra 44 tooth gear
(*)—special extension bracket assembly
F—position away from headstock
B—position toward headstock
I—idler gear
xxS—steel spacer

TABLE XXIV—GEAR SET-UPS TO OBTAIN PROPER CARRIAGE FEEDS FOR WINDING WITH SINGLE SILK COVERED MAGNET WIRE

Accurate to Commercial Tolerances.

Set-ups for B & S Gauge Nos. 34, 35 and 36 require a special extension bracket assembly available from the factory. Extra gears are also available from factory at nominal cost.

B & S Gauge No.	Wire Diameter	Gear on Screw	Position C B	Position C F	Position B B	Position B F	Position A B	Position A F	Position D B	Position D F	Compound Tumbler Gear	Note
12	.0828	20*F*	*xxS*	64*I*	—	—	48	40	—	—	32	
13	.0740	20*F*	*xxS*	64*I*	—	—	54	40	—	—	32	
14	.0661	36*F*	54	64	—	—	64*I*	*xxS*	—	—	32	
15	.0591	40*F*	—	—	46	54	52*I*	*xxS*	—	—	32	
16	.0528	32*F*	*xxS*	64*I*	—	—	52	44	—	—	32	
17	.0473	36*F*	54	46	—	—	64*I*	*xxS*	—	—	32	
18	.0423	40*F*	52	44	—	—	64*I*	*xxS*	—	—	32	
19	.0374	44*F*	56	46	—	—	64*I*	*xxS*	—	—	32	
20	.0340	54*F*	48	44	—	—	64*I*	*xxS*	—	—	32	
21	.0305	54*F*	56	46	—	—	64*I*	*xxS*	—	—	32	
22	.0274	56*F*	52	40	—	—	64*I*	*xxS*	—	—	32	
23	.0246	56*F*	64	44	—	—	64*I*	*xxS*	—	—	32	
24	.0221	40*B*	46	52	—	—	*xxS*	64*I*	—	—	16	
25	.0199	48*B*	44	46	—	—	*xxS*	64*I*	—	—	16	
26	.0179	56*F*	20*S*	32*I*	—	—	*xxS*	64*I*	—	—	16	
27	.0162	56*B*	40	44	—	—	*xxS*	64*I*	—	—	16	
28	.0146	44*B*	36	56	—	—	*xxS*	64*I*	—	—	16	
29	.0133	64*B*	24	48	—	—	54	46	—	—	32	
30	.0120	64*B*	40	52	—	—	*xxS*	64*I*	—	—	16	
31	.0109	46*B*	20	40	—	—	*xxS*	64*I*	—	—	16	
32	.0100	64*B*	20	52	—	—	48	40	—	—	32	
33	.0091	48*B*	20	46	—	—	*xxS*	64*I*	—	—	16	
34	.0083	64*F*	40	24	—	—	46	52	*xxS*	48*I*	16	(*)
35	.0076	56*F*	40	20	—	—	46	54	*xxS*	48*I*	16	(*)
36	.0070	64*F*	46	36	—	—	48*I*	*xxS*	32	56	16	(*)
37	.0065	64*B*	20	48	—	—	*xxS*	64*I*	—	—	16	
38	.0060	64*B*	20	52	—	—	48	24	—	—	32	
39	.0055	56*F*	64	32	—	—	32	52	—	—	16	
40	.0051	56*F*	64	32	—	—	32	56	—	—	16	*h*

SYMBOLS:

h—extra 56 tooth gear
(*)—extension bracket assembly
xxS—steel spacer
F—position away from headstock
B—position toward headstock
I—idler gear

TABLE XXV—GEAR SET-UPS TO OBTAIN PROPER CARRIAGE FEEDS FOR WINDING WITH ENAMEL AND SINGLE COTTON COVERED MAGNET WIRE

Accurate to Commercial Tolerances

Set-ups for B & S Gauge Nos. 26 and 32 require a special extension bracket assembly available from the factory. Extra gears are also available from factory at nominal cost.

B & S Gauge No.	Wire Diameter	Gear on Screw	Position C B	Position C F	Position B B	Position B F	Position A B	Position A F	Position D B	Position D F	Compound Tumbler Gear	Note
12	.0878	20*F*	*xxS*	64*I*	—	—	64	56	—	—	32	
13	.0785	20*F*	*xxS*	64*I*	—	—	56	44	—	—	32	
14	.0705	24*F*	*xxS*	64*I*	—	—	52	44	—	—	32	
15	.0633	44*F*	—	—	40	56	48*I*	*xxS*	—	—	32	
16	.0569	44*F*	32	40	—	—	64*I*	*xxS*	—	—	32	
17	.0513	36*F*	52	48	—	—	64*I*	*xxS*	—	—	32	
18	.0462	40*F*	52	48	—	—	64*I*	*xxS*	—	—	32	
19	.0413	44*F*	44	40	—	—	64*I*	*xxS*	—	—	32	*t*
20	.0378	48*F*	44	40	—	—	64*I*	*xxS*	—	—	32	
21	.0338	36*B*	56	46	—	—	*xxS*	64*I*	—	—	16	
22	.0306	56*F*	—	—	—	—	56	48	—	—	32	*h*
23	.0277	36*F*	20*S*	32*I*	—	—	*xxS*	64*I*	—	—	16	
24	.0252	44*F*	36	20	—	—	64*I*	*xxS*	—	—	32	
25	.0229	48*B*	44	40	—	—	*xxS*	64*I*	—	—	16	
26	.0209	54*B*	—	—	52	46	—	—	*xxS*	44*I*	16	(*)
27	.0192	52*F*	—	—	—	—	*xxS*	64*I*	—	—	16	
28	.0175	52*B*	40	44	—	—	*xxS*	64*I*	—	—	16	
29	.0162	56*B*	40	44	—	—	*xxS*	64*I*	—	—	16	
30	.0148	54*B*	32	40	—	—	*xxS*	64*I*	—	—	16	
31	.0137	48*B*	20	36	*xxS*	44*I*	54	32	—	—	32	*
32	.0127	64*B*	—	—	—	—	52	64	*xxS*	40*I*	16	(*)
33	.0117	48*B*	36	64	—	—	*xxS*	64*I*	—	—	16	
34	.0109	46*B*	20	40	—	—	*xxS*	64*I*	—	—	16	
35	.0101	54*B*	24	44	—	—	*xxS*	64*I*	—	—	16	
36	.0095	40*F*	36	24	44*I*	*xxS*	32	56	—	—	16	*
37	.0089	64*B*	32	56	—	—	*xxS*	64*I*	—	—	16	
38	.0084	54*B*	20	44	—	—	*xxS*	64*I*	—	—	16	
39	.0078	64*B*	20	40	—	—	*xxS*	64*I*	—	—	16	
40	.0074	54*F*	40	20	32	40	*xxS*	44*I*	—	—	16	*d**

SYMBOLS:

d—extra 40 tooth gear
h—extra 56 tooth gear
t—extra 44 tooth gear
*—extra sleeve, bushing and bolt assembly
F—position away from headstock
B—position toward headstock
I—idler gear
(*)—special extension bracket assembly

TABLE XXVI—GEAR SET-UPS TO OBTAIN PROPER CARRIAGE FEEDS FOR WINDING WITH ENAMEL AND SINGLE SILK COVERED MAGNET WIRE

Accurate to Commercial Tolerances. Set-up for B & S Gauge No. 25 requires a special extension bracket assembly available from the factory.

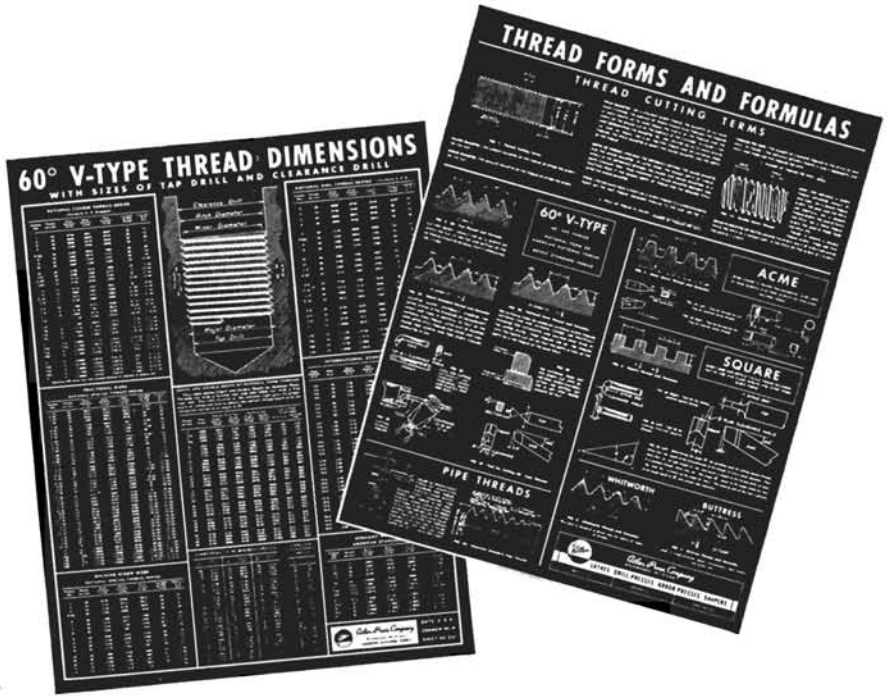
B & S Gauge No.	Wire Diameter	Gear on Screw	Position C B	Position C F	Position B B	Position B F	Position A B	Position A F	Position D B	Position D F	Compound Tumbler Gear	Note
12	.0848	20*F*	*xxS*	64*I*	—	—	52	44	—	—	32	
13	.0760	24*F*	*xxS*	64*I*	—	—	48	44	—	—	32	
14	.0680	24*F*	*xxS*	64*I*	—	—	54	44	—	—	32	
15	.0608	24*F*	*xxS*	64*I*	—	—	44	32	—	—	32	
16	.0544	20*F*	—	—	*xxS*	64*I*	36	20	—	—	32	*c*
17	.0488	36*F*	*xxS*	64*I*	—	—	64	56	—	—	32	
18	.0437	40*F*	64	56	—	—	64*I*	*xxS*	—	—	32	
19	.0388	40*B*	56	36	—	—	*xxS*	64*I*	—	—	16	
20	.0353	46*F*	64	52	—	—	64*I*	*xxS*	—	—	32	
21	.0318	36*F*	56	32	—	—	64*I*	*xxS*	—	—	32	
22	.0286	64*F*	—	—	48	44	—	—	—	—	32	
23	.0257	44*B*	52	46	—	—	*xxS*	64*I*	—	—	16	
24	.0232	54*B*	40	32	—	—	*xxS*	64*I*	—	—	16	
25	.0209	54*B*	—	—	52	46	—	—	*xxS*	44*I*	16	(*)
26	.0189	48*B*	40	44	—	—	*xxS*	64*I*	—	—	16	
27	.0172	48*B*	46	56	—	—	*xxS*	64*I*	—	—	16	
28	.0155	56*B*	40	46	—	—	*xxS*	64*I*	—	—	16	
29	.0142	64*F*	44	20	—	—	64*I*	*xxS*	—	—	32	
30	.0128	64*B*	36	44	—	—	*xxS*	64*I*	—	—	16	
31	.0117	48*B*	36	64	—	—	*xxS*	64*I*	—	—	16	
32	.0107	56*B*	24	40	—	—	*xxS*	64*I*	—	—	16	
33	.0097	46*B*	56*I*	*xxS*	—	—	24	54	—	—	16	
34	.0089	64*B*	32	56	—	—	*xxS*	64*I*	—	—	16	
35	.0081	56*B*	20	44	—	—	*xxS*	64*I*	—	—	16	
36	.0075	64*B*	20	52	—	—	64	40	—	—	32	
37	.0069	64*B*	20	56	—	—	52	32	—	—	32	
38	.0064	64*F*	52	32	24	36	*xxS*	40*I*	—	—	16	
39	.0058	64*B*	20	54	—	—	*xxS*	64*I*	—	—	16	
40	.0054	52*F*	64	36	—	—	24	48	—	—	16	

SYMBOLS:

c—extra 20 tooth gear available from factory
(*)—special extension bracket assembly
F—position away from headstock
B—position toward headstock
I—idler gear
xxS—steel spacer

We will assist with your special work by calculating gear train set-ups for odd threads and feeds not listed in Figure 4 (page 5), Table I (pages 38-39), Table II (page 40), or in any of the tables for coil winding between pages 52 and 61.

Address your inquiry to the Technical Service Department — it will receive prompt attention.



WALL CHARTS ON THREAD CUTTING

These large blueprint charts (each 16¼" wide, 21" high) display valuable reference data on thread cutting and make useful wall pieces for machinist, apprentice and student. Technical material in these charts has been adapted from "Manual of Lathe Operation."

The wall charts shown above are two in a series published by Atlas Press Company, Kalamazoo 13D, Michigan. The complete series, covering important phases of lathe operation and machine shop practice, will be mailed upon request to any point in the United States. When ordering, enclose twenty-five cents for each set in coin or stamps to cover costs of printing and postage.

THREADING INFORMATION

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