THREADING SUPPLEMENT

To Adapt the

"MANUAL OF LATHE OPERATION"

to the

NEW Atlas F-SERIES 10-INCH LATHES

Atlas Press Company

KALAMAZOO, MICHIGAN

THIS THREADING SUPPLEMENT replaces Part 7 (Pages 95-156) of "Manual of Lathe Operation and Machinists Tables." It contains complete information essential for handling thread cutting and coil winding operations on the new Atlas F-Series 10-inch Lathes.

THREAD CUTTING
ON THE ATLAS F-SERIES 10-INCH LATHE

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

This section deals with the two classes of thread cutting problems: (1) those connected with 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.

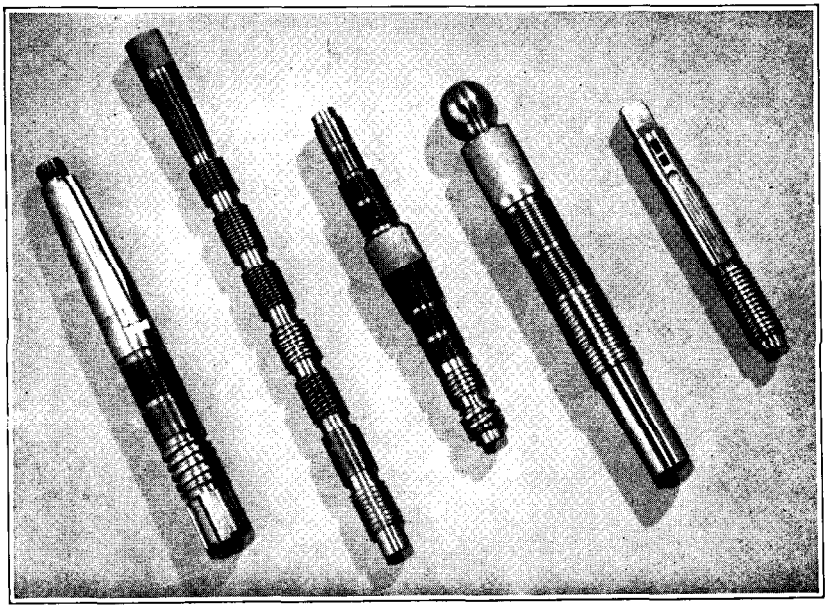


FIG. 1. A few of the threads that can be cut on the lathe.

Every Atlas 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. Metric threads may also be cut with the standard change gears furnished.

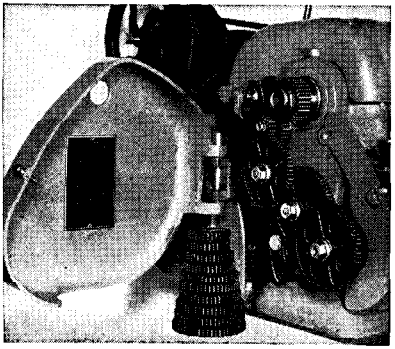


FIG. 2
Left end of lathe with gear guard open, showing change gears, gear train, and location of threading chart.

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.

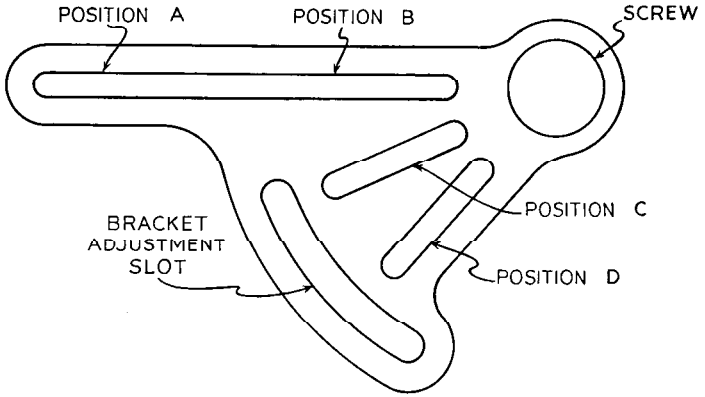


FIG. 3. Gear bracket positions.

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," and the next short slot is Position "D." 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).

SLEEVE AND BUSHING ASSEMBLY

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

THREADING CHART

A-B-C-D ARE GEAR STUD POSITIONS
B = BACK POSITION (TOWARD HEADSTOCK)
F = FRONT POSITION (AWAY FROM HEADSTOCK)
I = IDLER GEAR S = SPACER — = BLANK
X = 24 TOOTH GEAR IN BACK POSITION (SS) = DOUBLE KEYWAY SPACER

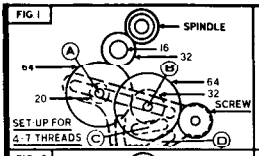
FIG. 1


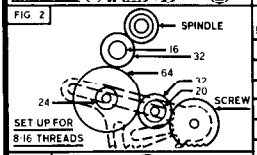
FIG. 2


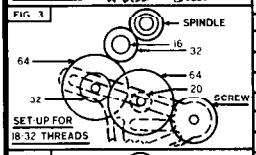
FIG. 3


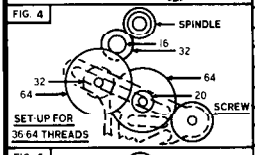
FIG. 4


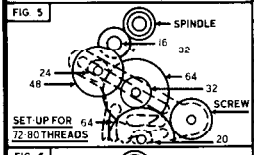
FIG. 5


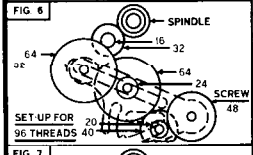
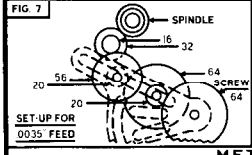
FIG. 6


FIG. 7


THREADS PER INCH	SCREW	POSITION D B	POSITION D F	POSITION C B	POSITION C F	POSITION B B	POSITION B F	POSITION A B	POSITION A F	SPINDLE STUD GEAR	FIG.
4	32F	—	—	—	—	24	48	64I	20S	32	1
4.5	36F	—	—	—	—	32	64	64I	20S	32	1
5	40F	—	—	—	—	32	64	64I	20S	32	1
5.5	44F	—	—	—	—	32	64	64I	20S	32	1
6	48F	—	—	—	—	32	64	64I	20S	32	1
6.5	52F	—	—	—	—	32	64	64I	20S	32	1
7	56F	—	—	—	—	32	64	64I	20S	32	1
8	32B	—	—	—	—	48I	20S	46I	24S	32	2
9	36B	—	—	—	—	32I	20S	64I	24S	32	2
10	40B	—	—	—	—	32I	20S	64I	24S	32	2
11	44B	—	—	—	—	32I	20S	64I	24S	32	2
11.5	46B	—	—	—	—	32I	20S	64I	24S	32	2
12	48B	—	—	—	—	32I	20S	64I	24S	32	2
13	52B	—	—	—	—	32I	20S	64I	24S	32	2
14	56B	—	—	—	—	32I	20S	64I	24S	32	2
16	64B	—	—	—	—	32I	20S	64I	24S	32	2
18	36F	—	—	—	—	20S	64I	64	32	32	3
20	40F	—	—	—	—	20S	64I	64	32	32	3
22	44F	—	—	—	—	20S	64I	64	32	32	3
23	46F	—	—	—	—	20S	64I	64	32	32	3
24	48F	—	—	—	—	20S	64I	64	32	32	3
26	52F	—	—	—	—	20S	64I	64	32	32	3
27	54F	—	—	—	—	20S	64I	64	32	32	3
28	56F	—	—	—	—	20S	64I	64	32	32	3
32	64F	—	—	—	—	20S	56I	48	24	32	3
36	36B	—	—	—	—	64I	20S	24	48	16	4
40	40B	—	—	—	—	64I	20S	32	64	16	4
44	44B	—	—	—	—	64I	20S	32	64	16	4
48	48B	—	—	—	—	64I	20S	32	64	16	4
56	56B	—	—	—	—	64I	20S	32	64	16	4
64	64B	—	—	—	—	64I	20S	24	48	16	4
72	36F	20S	64I	—	—	64	32	24	48	16	5
80	40F	20S	64I	—	—	64	32	24	48	16	5
96	48F	40	20	—	—	64I	24S	32	64	16	6

FEED PER REVOLUTION OF SPINDLE

FEED	SCREW	POSITION D B	POSITION D F	POSITION C B	POSITION C F	POSITION B B	POSITION B F	POSITION A B	POSITION A F	STUD	FIG.
.001877	64B	—	—	20	64	52	20	24	48	16	—
.0035	64F	—	—	—	—	64	20	20	56	16	7
.005	64F X	52	20	—	—	54I	(SS)	20	48	16	—
.006	64F	52	20	—	—	54I	(SS)	24	48	16	—
.007	64B	—	—	—	—	20	64	56	20	32	—
.0087	64F	56	20	—	—	36	46	20S	64I	16	—

METRIC THREADING CHART

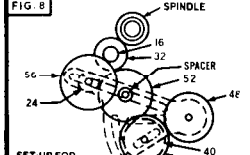
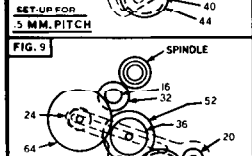
FIG. 8


FIG. 9


PITCH IN MILLIMETERS	GEAR ON SCREW	POSITION D B	POSITION D F	POSITION C B	POSITION C F	POSITION B B	POSITION B F	POSITION A B	POSITION A F	SPINDLE STUD GEAR	FIG.
.5	48F	40	44	—	—	52I	(SS)	24	56	16	8
.75	64F	40	32	—	—	52	44	20S	56I	16	—
1.00	44F	40	32	—	—	52	48	20S	64I	16	—
1.25	44B	—	—	—	—	52	48	20S	64I	16	—
1.50	44B	—	—	—	—	52	40	20S	64I	16	—
1.75	44F	48	52	—	—	56	40	20S	64I	16	—
2.00	40F	44	48	—	—	52	36	20S	64I	16	—
2.5	44B	—	—	—	—	52	24	20S	64I	16	—
3.0	44B	—	—	—	—	52	20	24S	64I	16	—
3.5	44F	48	56	—	—	52	20	24S	64I	16	—
4.0	20F	44	48	—	—	52	36	24S	64I	16	9
4.5	20F	44	54	—	—	52	36	20S	64I	16	—
5.0	24F	44	52	—	—	40	20	20S	64I	16	—
5.5	20F	—	—	—	—	48	52	46I	24S	32	—
6.0	20F	44	52	—	—	48	24	32S	64I	16	—
7.0	48B	52	44	—	—	20	56	64I	24S	32	—

FIG. 4. Threading chart for cutting all standard threads between 4 and 96 per inch and standard metric threads between .5 and 7 mm. Additional gear train information is included in Table I, page 38.

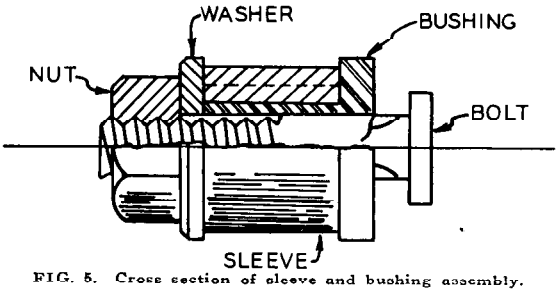


FIG. 5. Cross section of sleeve and bushing assembly.

Notice that in order to make this assembly complete, two gears must be mounted on the sleeve at one time. When both of the gears on a sleeve mesh with other gears in the train, they form a "compound" gear assembly. When only one of two gears on a sleeve meshes with the other gears in the train, it is called an "idler." The smaller gear, which is mounted on the sleeve with an idler, is called a "spacer" gear and does not mesh with any gear in the train (see Fig. 7).

GEAR CLEARANCE

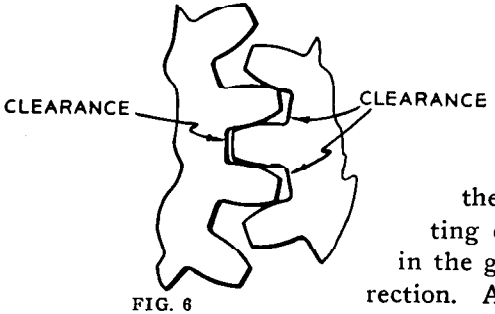


FIG. 6
Proper gear clearance.

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 reverse feed lever to test the direction of the carriage travel. Because some set-ups are simple-geared and some are compounded, the carriage travel will not necessarily be to the right when the reverse lever is shifted to the right. *Always test the direction of carriage travel before starting to cut a thread.*

After the reversing 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 behind large washer on the inside of the "Bracket Adjustment Slot" (Fig. 3).

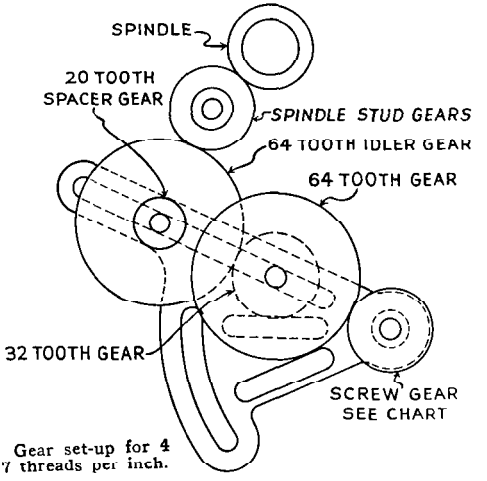


FIG. 7. Gear set-up for 4 through 7 threads per inch.

GEAR TRAIN FOR 4 THROUGH 7 THREADS PER INCH

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

2. Place 32 tooth gear and 64 tooth gear on sleeve and mount in Position B on gear bracket with 32 tooth gear in back position. Tighten so that 64 tooth gear meshes with gear in screw position.

Exception: When cutting 4 threads per inch, the 32 tooth gear and 64 tooth gear are replaced by 24 and 48 tooth gears respectively.

3. Place 64 tooth gear and 20 tooth gear on a sleeve and mount in Position A with 20 tooth gear in front position. Tighten so that 64 tooth gear meshes with the 32 tooth gear in Position B. The 64 tooth gear is an idler; the 20 tooth gear is a spacer.

4. Swing entire gear bracket upward and tighten so that 64 tooth gear in Position A meshes with the 32 tooth spindle stud gear.

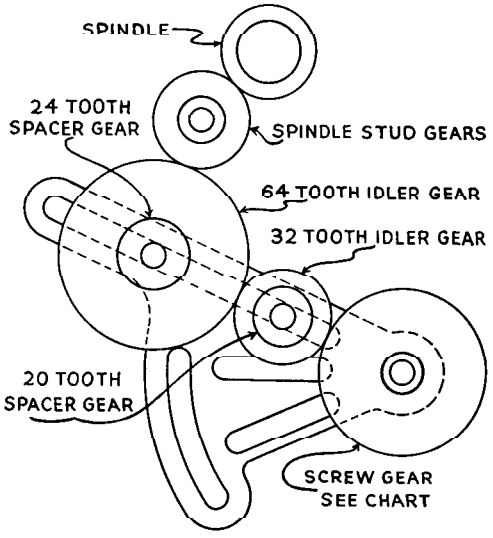


FIG. 8. Gear set-up for 8 through 16 threads per inch.

GEAR TRAIN FOR 8 THROUGH 16 THREADS PER INCH

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

2. Place 32 tooth gear and 20 tooth gear on sleeve in Position B with 32 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.

Exception: When cutting 8 threads per inch, substitute a 48 tooth gear for the 32 tooth gear.

3. Place 64 tooth gear and 24 tooth gear on sleeve and mount in Position A with 64 tooth gear in back position. Tighten so that 64 tooth gear meshes with 32 tooth gear in Position B. The 64 tooth gear is an idler; the 24 tooth gear is a spacer.

Exception: When cutting 8 threads per inch, substitute a 46 tooth gear for the 64 tooth gear.

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

GEAR TRAIN FOR 18 THROUGH 32 THREADS PER INCH

(See Fig. 9, page 9.)

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

2. Place 20 tooth gear and 64 tooth gear on sleeve and mount in Position B with 20 tooth gear in back position. Tighten so that 64 tooth gear meshes with gear in screw position. The 64 tooth gear is an idler; the 20 tooth gear is a spacer.

Exception: When cutting 32 threads per inch, substitute a 56 tooth gear for the 64 tooth gear.

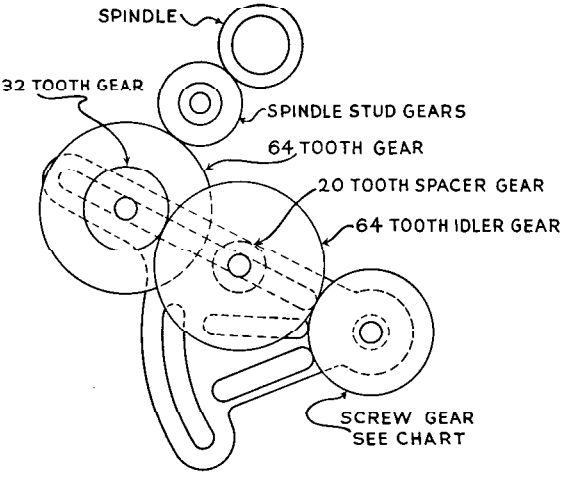


FIG. 9. Gear set-up for 18 through 32 threads per inch.

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

Exception: When cutting 32 threads per inch, substitute 48 tooth gear for 64 tooth gear and 24 tooth gear for 32 tooth gear.

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

GEAR TRAIN FOR 36 THROUGH 64 THREADS PER INCH

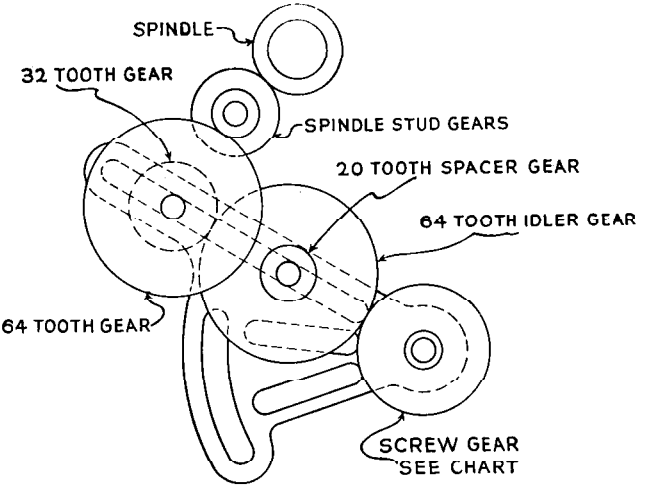


FIG. 10. Gear set-up for 36 through 64 threads per inch (see page 10).

GEAR TRAIN FOR 36 THROUGH 64 THREADS PER INCH

(See Fig. 10, page 9.)

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

2. Place 64 tooth gear and 20 tooth gear 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; the 20 tooth gear is a spacer.

3. Place 32 tooth gear and 64 tooth gear on sleeve and mount in Position A with 20 tooth gear in back position. Tighten so that 32 tooth gear meshes with 64 tooth gear in Position B.

Exception: When cutting 36 and 64 threads per inch substitute 24 tooth gear for 32 tooth gear and 48 tooth gear for 64 tooth gear.

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

GEAR TRAIN FOR 72 AND 80 TIIREADS PER INCH

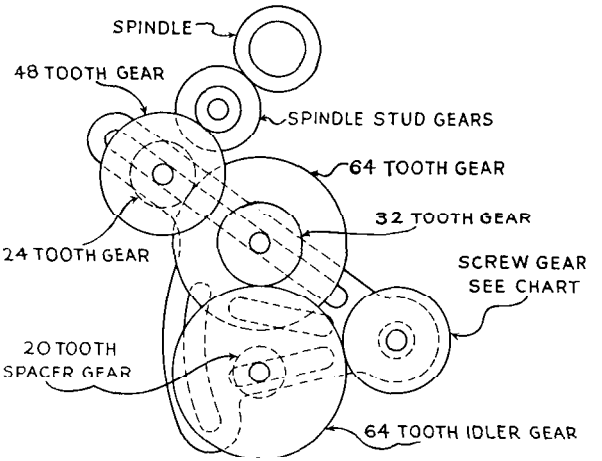


FIG. 11. Gear set-up for 72 and 80 threads per inch.

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

2. Place 20 tooth gear and 64 tooth gear on sleeve and mount in Position D with 20 tooth gear in back position. Tighten so that 64 tooth gear meshes with the gear in screw position. The 64 tooth gear is an idler; the 20 tooth gear is a spacer.

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

4. Place 24 tooth gear and 48 tooth gear on sleeve and mount in Position A with 24 tooth gear in back position. Tighten so that 24 tooth gear meshes with 64 tooth gear in Position B.

5. Swing entire gear bracket upward and tighten so that the 48 tooth gear in Position A meshes with the 16 tooth spindle stud gear.

GEAR TRAIN FOR 96 THREADS PER INCH

1. Place 48 tooth gear on front position of screw stub.

2. Place 40 tooth gear and 20 tooth gear on sleeve in Position D with 40 tooth gear in back position. Tighten so that 20 tooth gear meshes with 48 tooth gear on screw stub.

3. Place 64 tooth gear and 24 tooth gear on sleeve in Position B with 64 tooth gear in back position. Tighten so that 64 tooth gear meshes with 40 tooth gear in Position D. The 64 tooth gear is an idler; the 24 tooth gear is a spacer.

4. Place 32 tooth gear and 64 tooth gear on sleeve in Position A with 32 tooth gear in back position. Tighten so that 32 tooth gear meshes with 64 tooth gear in Position B.

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

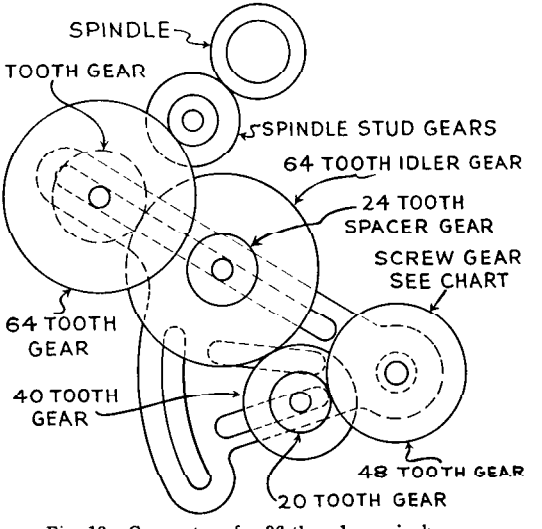


Fig. 12. Gear set-up for 96 threads per inch.

THREAD CUTTING TERMS

(Refer to Figure 13, page 12)

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

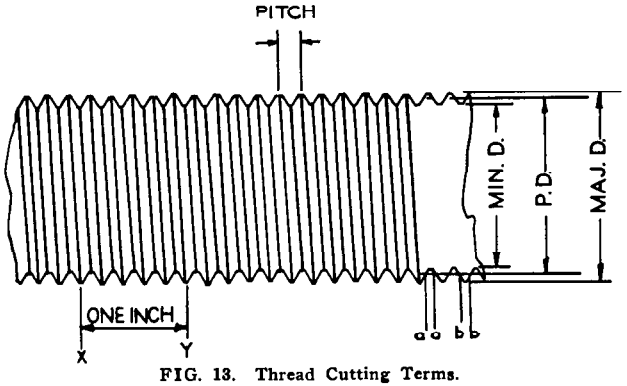


FIG. 13. Thread Cutting Terms.

DOUBLE DEPTH OF THREAD, which is the difference between 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).

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

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.

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

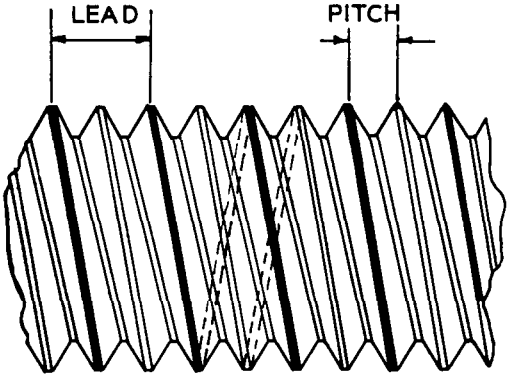


FIG. 14
Double Thread Screw. The lead is double the pitch.

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 1/8 inch, the lead is 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 of the tool. Otherwise the grinding of thread cutting tools follows the same general rules as the grinding of external tools (Manual Parts 3 and 4).

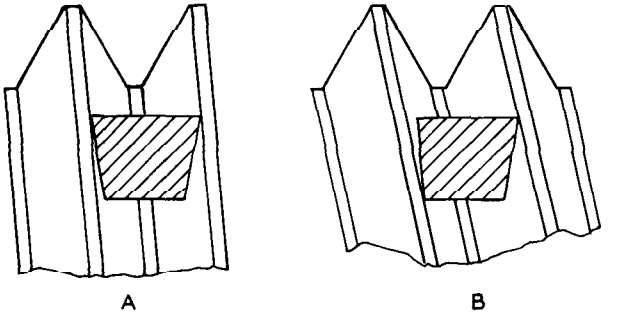
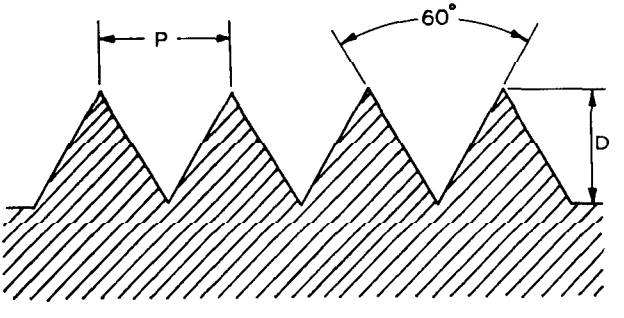


FIG. 15
"A" shows tool with sufficient clearance. When thread pitch is increased, as at "B," same tool has inadequate clearance.

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.

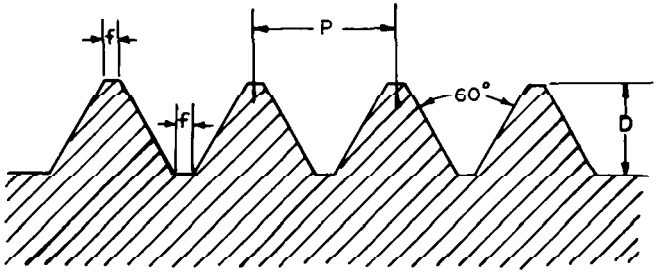
Thread tools are ground nearly flat across the top. When the tool is fed into the work at an angle, as with National Form threads, the tool should have a few degrees of side rake. When the tool is fed into the work at right angles, as with square threads, it should have a small amount of back rake.

CUTTING 60° TYPE THREADS



D= 866 x P

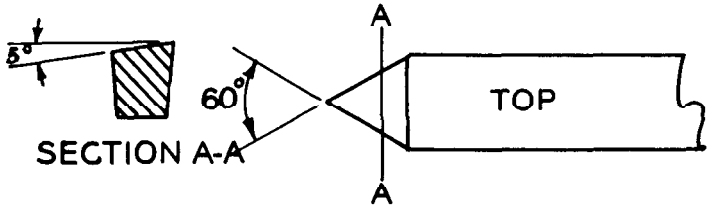
FIG. 16. 60° Vee Thread and Formula (see page 14).



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

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



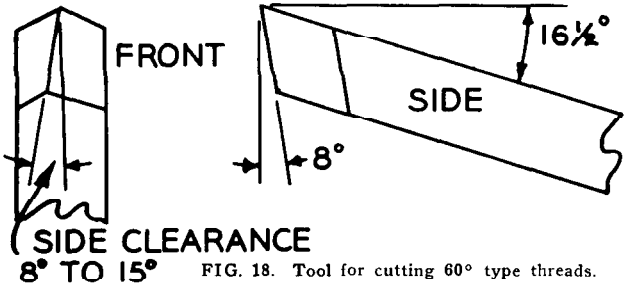


FIG. 18. Tool for cutting 60° type threads.

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.

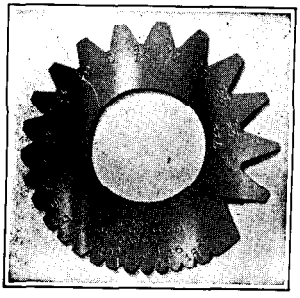


FIG. 19. N. F. Thread Gauge.

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

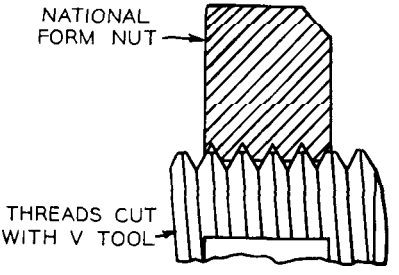


FIG. 20
The National Form nut fits the screw cut with a 60° Vee tool.

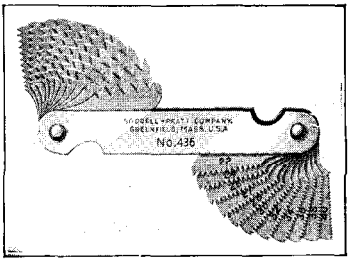


FIG. 21
National Screw Pitch Gauge.

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.

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.

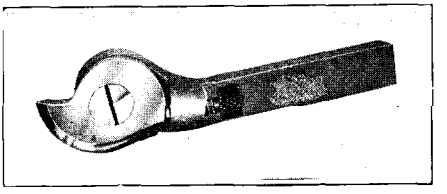


FIG. 22. Threading Tool

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.

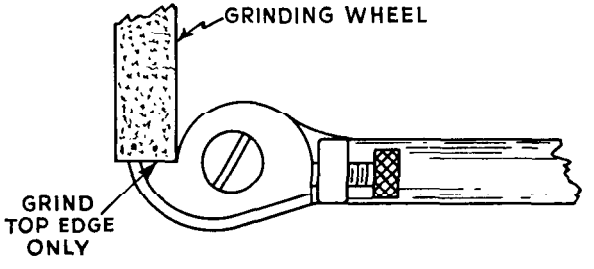


FIG. 23
Proper method of grinding the threading tool shown in Figure 22. The side faces are never ground.

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.

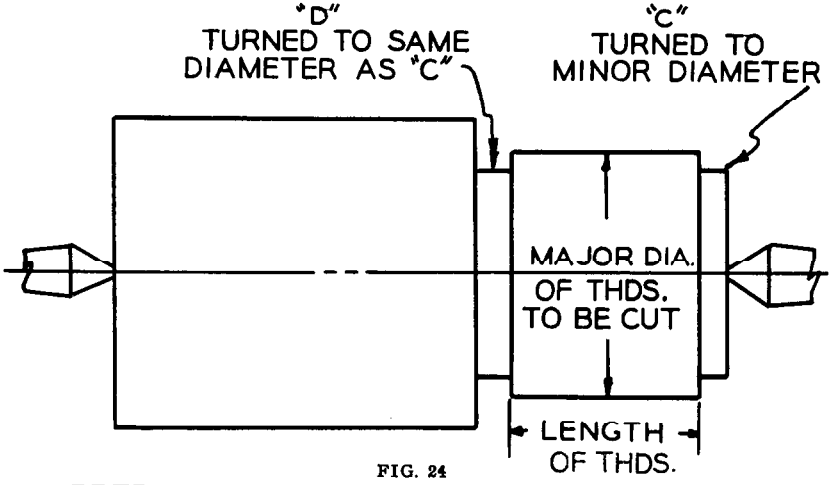


FIG. 24

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. If the thread is to be cut with a sharp pointed 60° tool, the minor diameter is 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. If a tool bit has been formed especially for a National Form thread, the correct minor

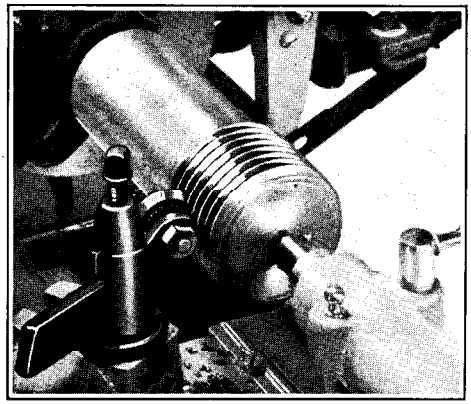


FIG. 25
Correct setting of tool and compound rest when cutting a 60° right hand thread.

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.

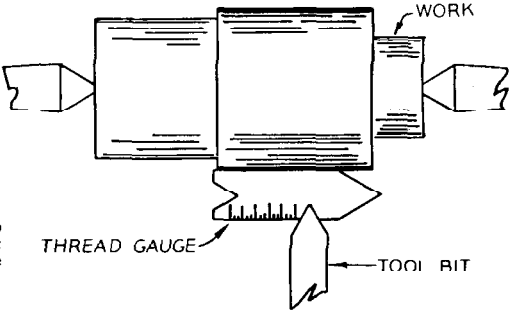


FIG. 27 (Right)
Using the center gauge to set the threading tool at an exact right angle to the work.

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 28 R.P.M. (see Manual, page 47).

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

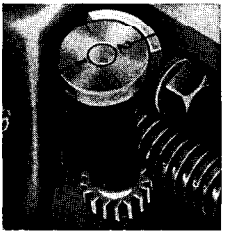


FIG. 28
Threading Dial.

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. Any one of the four dial markings may be used for following cuts.

When cutting *odd-numbered threads* (such as 7, 9, 11, 23, 27, etc. per inch), engage the half-nut lever for the first cut when the stationary mark on the threading dial is in line with *either "1" or "2"* on the rotating portion. Either the "1" or "2" dial marking may be used for following cuts.

When cutting *half-numbered threads* (such as 4½, 5½, 6½, 11½, etc. per inch), engage half-nut lever *at the same mark* on the threading dial for each cut of the thread.

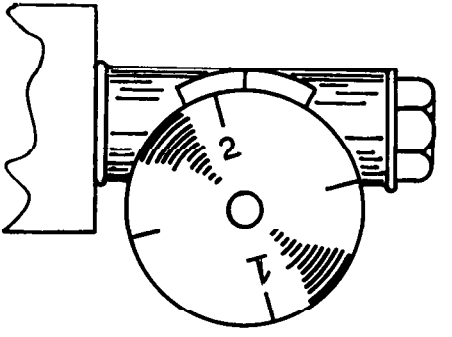


FIG. 29
Threading dial showing mainmarkings. Other markings may be made by the operator as needed.

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. Such a tool is included in the set of boring tools

described on Manual page 91. 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.

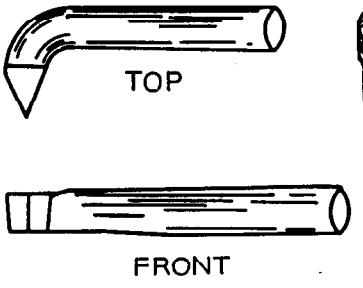


FIG. 30
Tool for cutting internal 60° threads. (When threading brass and plastics, omit side rake.)

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.

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

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.

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.

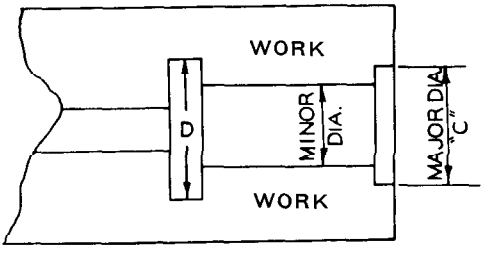


FIG. 31
Grooves C and D help the beginner when threading internally.

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

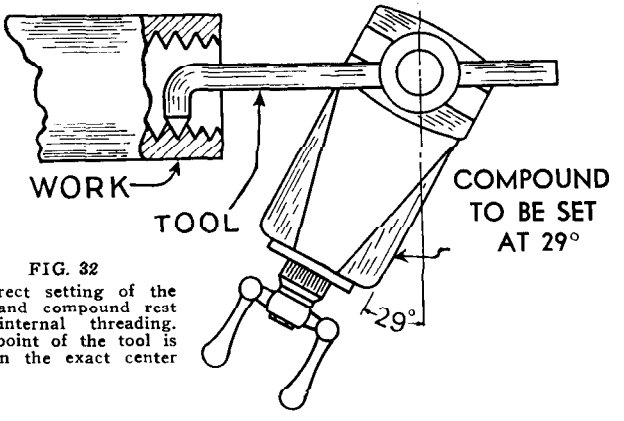


FIG. 32
Correct setting of the tool and compound rest for internal threading. The point of the tool is set on the exact center line.

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.

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.*

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

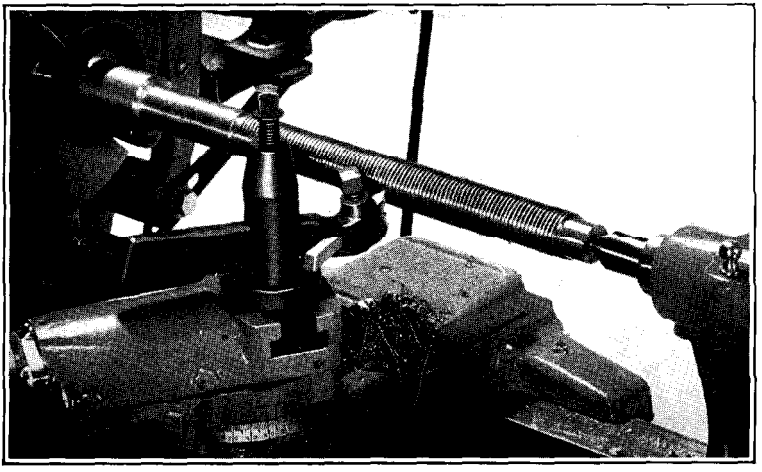


FIG. 33. Cutting a left hand thread.

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

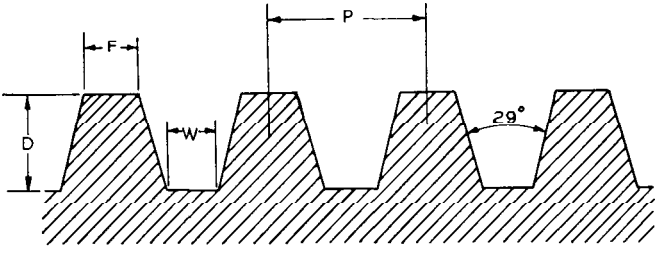


FIG. 34. Acme Screw Thread and Formulas.

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 the Atlas lathe have Acme threads.

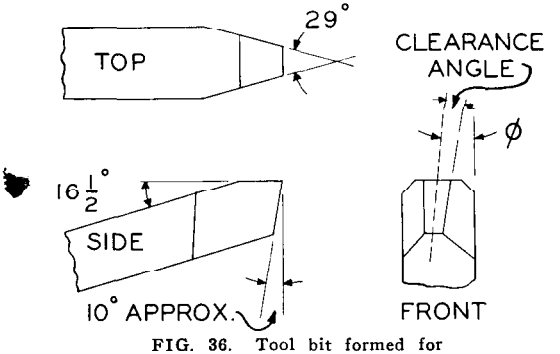


FIG. 36. Tool bit formed for cutting an external Acme thread. To determine angle Φ, refer to Figure 40, page 25.

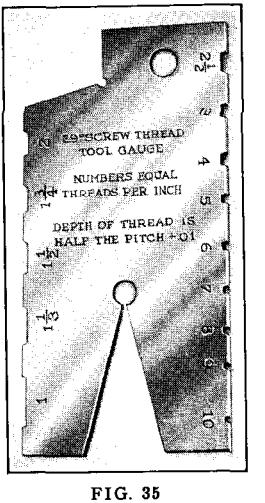


FIG. 35
Acme Thread Gauge.

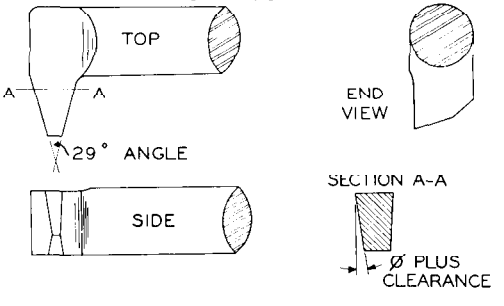


FIG. 37 (Left)
Tool bit formed for cutting an internal Acme thread. To determine angle Φ, refer to Figure 40, page 25.

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 0° 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.

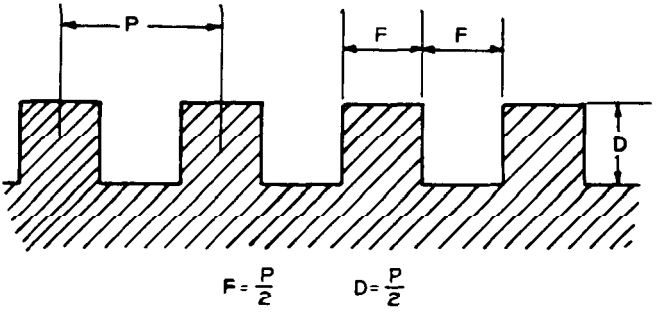


FIG. 38. Square Thread and Formulas.

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.

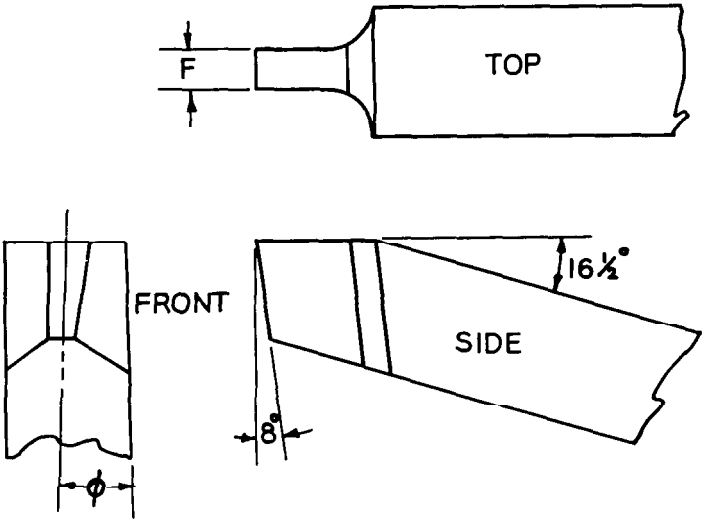


FIG. 39. Tool bit for cutting external square threads.

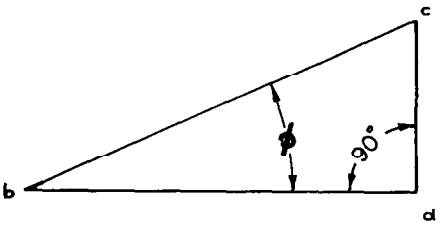


FIG. 40

Determining the angle ϕ for grinding tools for cutting square and Acme threads. 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."

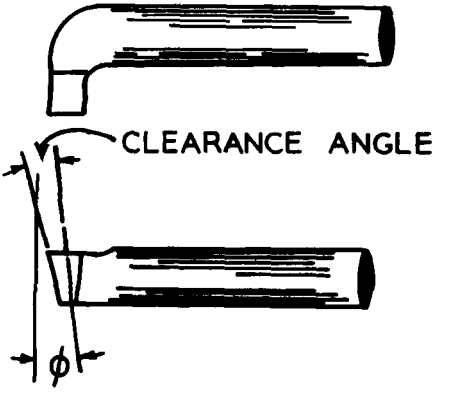


FIG. 41
Tool bit for cutting internal square threads.

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.

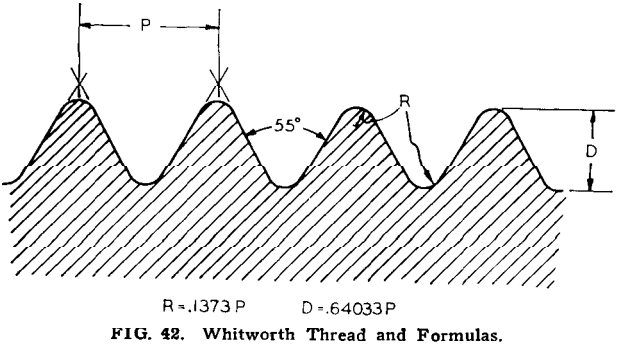


FIG. 42. Whitworth Thread and Formulas.

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.

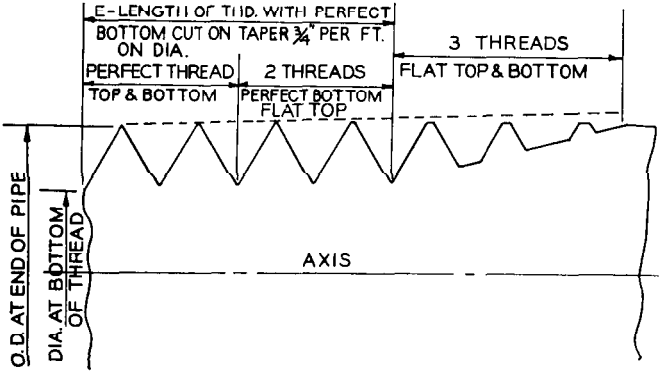


FIG. 43. American Standard Pipe Thread and Formulas.

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 ¾ 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.

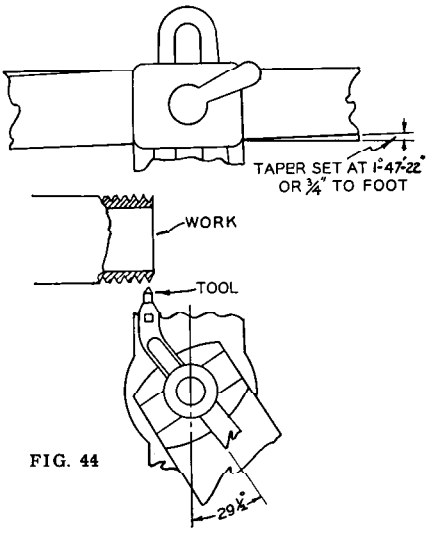


FIG. 44

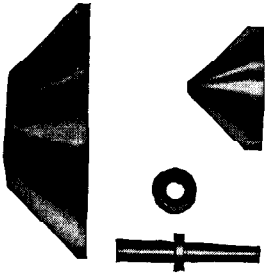


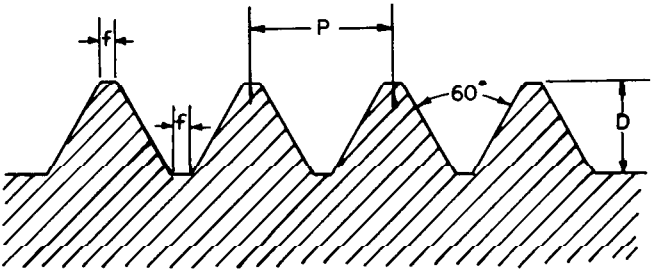
FIG. 45. Pipe Centers.

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 with 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.*

**F-series lathes are available with metric-pitch threads for cross and compound feed screws and feed screw collars graduated in .02 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

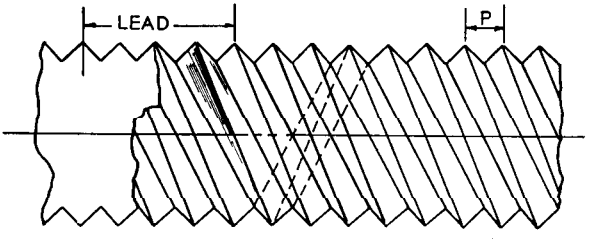


FIG. 47
Quadruple screw thread. The lead is four times the pitch.

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 sixteen 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 (4, 12, 20, 28, etc.)

A single thread of this lead is cut by engaging the half nuts at any of the four mainmarkings on the threading dial or at any of the four "b" positions. To cut the second groove of a double thread, the half nuts are engaged at any of the "a" or "c" positions.

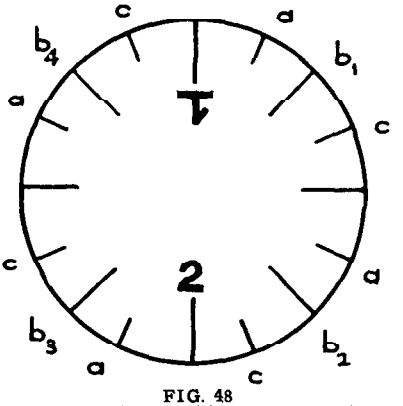


FIG. 48
Intermediate positions on threading dial which can be used for cutting. The numbers "1" and "2" are marked; the lettered positions may be marked as needed.

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 "a" or "c" 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 LEADS IN THREADS PER INCH DIVISIBLE BY TWO, BUT NOT BY FOUR (6, 10, 14, 18, etc.)

A single thread of this lead is cut only by engaging the half nut lever at any one of the four mainmarkings on the threading dial. To cut the second groove of the double thread, the half nuts are engaged at any one of the "b" positions, and the cutting operation is the same as in the preceding paragraph.

For quadruple threads of this lead engage the half nuts at any of the four mainmarkings for the first groove, at any of the "a" positions for the second groove, at any of the "b" positions for the third groove, and at any of the "c" 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 depth of setting.

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 nuts in position "1" or position "2." To cut the second groove of the double thread, the half nuts are engaged at either of the unnumbered marks on the threading dial. The cutting operation is the same as in the preceding paragraph.

For quadruple threads of this lead engage the half nuts at position "1" for the first groove, at position "b_1" for the second groove, at either of the unnumbered lines on the dial for the third groove, and at "b_2" 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 depth of setting.

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 114.9 threads per inch.

The six most common carriage feeds, as shown in the threading chart (page 5), are .0087, .0070, .0060, .0050, .0035, and .001877 inch per spindle revolution. Refer to the threading chart and the six following paragraphs when changing these gear set-ups. Table II on page 40 includes gear set-ups for other carriage feeds obtainable with the standard set of gears.

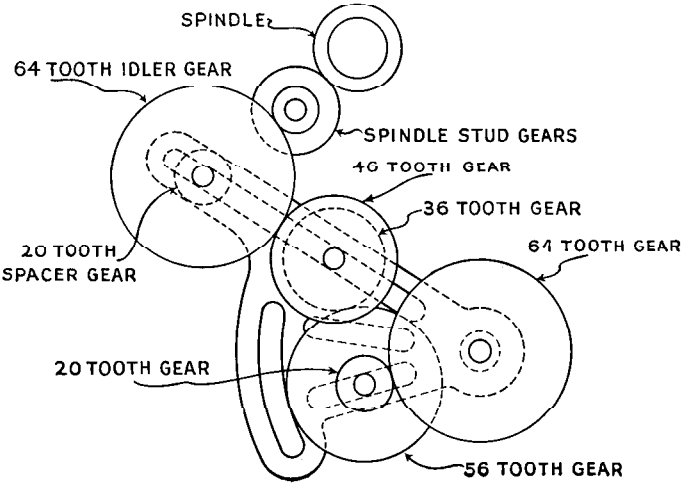


FIG. 49. Gear set-up for .0087 inch carriage feed (see page 32).

GEAR TRAIN FOR .0087 INCH CARRIAGE FEED

(See Fig. 49, page 31)

1. Place 64 tooth gear in front position on screw stub.
2. Place 56 tooth gear and 20 tooth gear on sleeve in Position D, with 56 tooth gear in back position. Tighten so that 20 tooth gear meshes with 64 tooth gear on screw stub.
3. Place 36 tooth gear and 46 tooth gear on sleeve in Position B, with 36 tooth gear in back position. Tighten so that 36 tooth gear meshes with 56 tooth gear in Position D.
4. Place 20 tooth gear and 64 tooth gear on sleeve in Position A with 20 tooth gear in back position. Tighten so that 64 tooth gear meshes with 46 tooth gear in Position B. The 64 tooth gear is an idler; the 20 tooth gear is a spacer.
5. Swing entire gear bracket upward and tighten so that 64 tooth gear in Position A meshes with 16 tooth spindle stud gear.

GEAR TRAIN FOR .0070 INCH CARRIAGE FEED

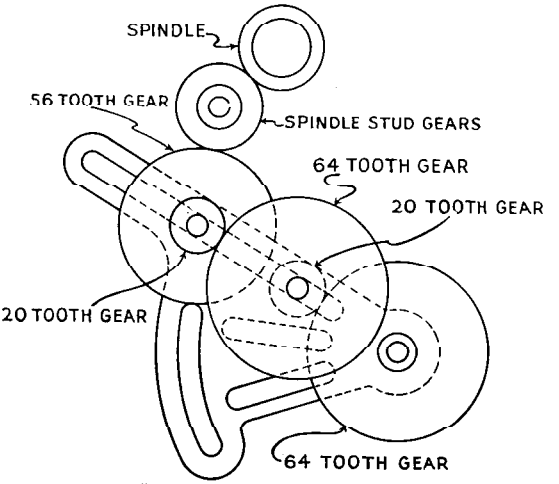


FIG. 50. Gear set-up for .0070 inch carriage feed.

1. Place 64 tooth gear in back position on screw stub.
2. Place 20 tooth gear and 64 tooth gear on sleeve in Position B, with 20 tooth gear in back position. Tighten so that 20 tooth gear meshes with 64 tooth gear on screw stub.
3. Place 56 tooth gear and 20 tooth gear on sleeve in Position A, with 56 tooth gear in back position. Tighten so that 20 tooth gear meshes with 64 tooth gear in Position B.
4. Swing entire gear bracket upward and tighten so that 56 tooth gear in position A meshes with 32 tooth spindle stud gear.

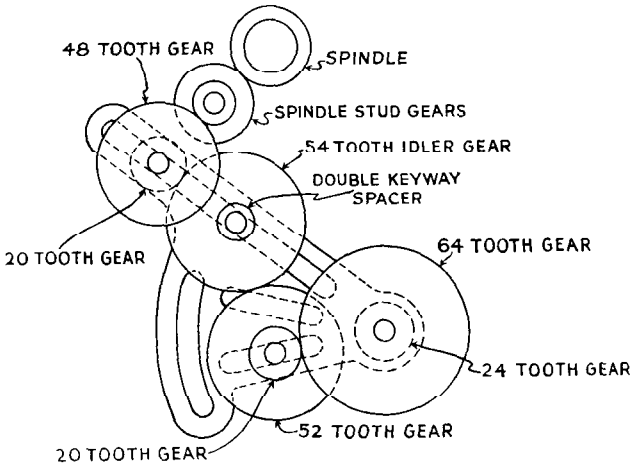


FIG. 51. Gear set-up for .0050 inch carriage feed.

GEAR TRAIN FOR .0050 INCH CARRIAGE FEED

1. Place 64 tooth gear in front position on screw stub and substitute 24 tooth gear for steel spacer in back position on screw stub.

2. Place 52 tooth gear and 20 tooth gear on sleeve in Position D, with 52 tooth gear in back position. Tighten so that 20 tooth gear meshes with 64 tooth gear on screw stub.

3. Place 54 tooth gear and steel spacer from screw stub on sleeve in Position B, with 54 tooth gear in back position. Tighten so that 54 tooth gear meshes with 52 tooth gear in Position D. The 54 tooth gear is an idler.

4. Place 20 tooth gear and 48 tooth gear on sleeve in Position A, with 20 tooth gear in back position. Tighten so that 20 tooth gear meshes with 54 tooth gear in Position B.

5. Swing entire gear bracket upward and tighten so that 48 tooth gear in Position A meshes with 16 tooth spindle stud gear.

GEAR TRAIN FOR .0060 INCH CARRIAGE FEED

The gear set-up for .0060 inch carriage feed is the same as that for the .0050 inch feed except:

(1) Substitute 20 tooth gear for 24 tooth gear in back position on screw stub.

(2) Substitute 24 tooth gear for 20 tooth gear in back position at A.

GEAR TRAIN FOR .0035 INCH CARRIAGE FEED

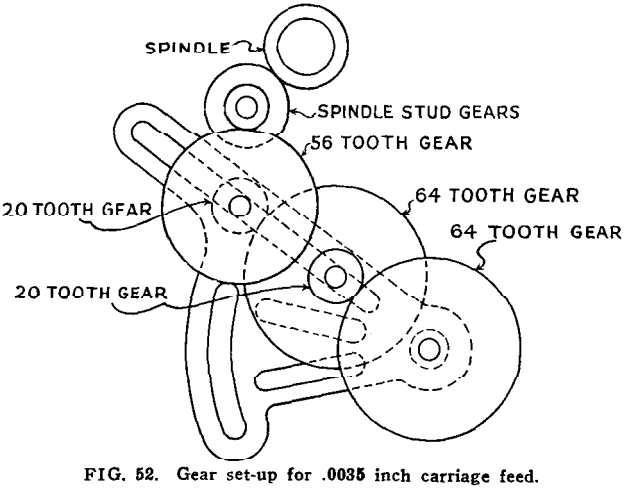


FIG. 52. Gear set-up for .0035 inch carriage feed.

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

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

3. Place 20 tooth gear and 56 tooth gear on sleeve in Position A, with 20 tooth gear in back position. Tighten so that 20 tooth gear meshes with 64 tooth gear in Position B.

4. Swing entire gear bracket upward and tighten so that 56 tooth gear in Position A meshes with 16 tooth spindle stud gear.

GEAR TRAIN FOR .001877 INCH CARRIAGE FEED

(See Fig. 53, page 35)

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 52 tooth gear and 20 tooth gear on sleeve in Position B, with 52 tooth gear in back position. Tighten so that 20 tooth gear meshes with 64 tooth gear in Position C.

4. 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 52 tooth gear in Position B.

5. Swing entire gear bracket upward and tighten so that 48 tooth gear in Position A meshes with 16 tooth spindle stud gear.

GEAR TRAIN FOR .001877 INCH CARRIAGE FEED

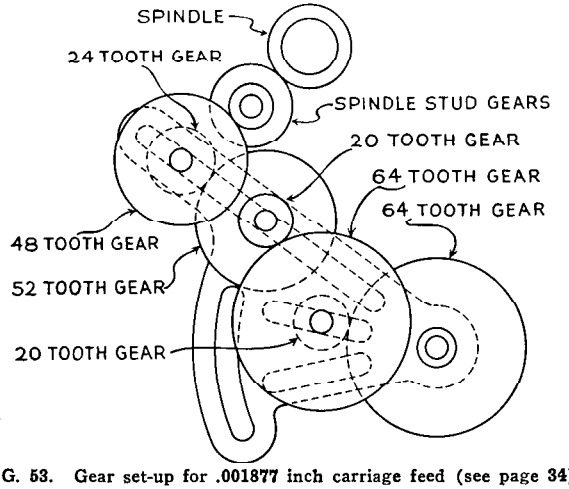


FIG. 53. Gear set-up for .001877 inch carriage feed (see page 34).

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.

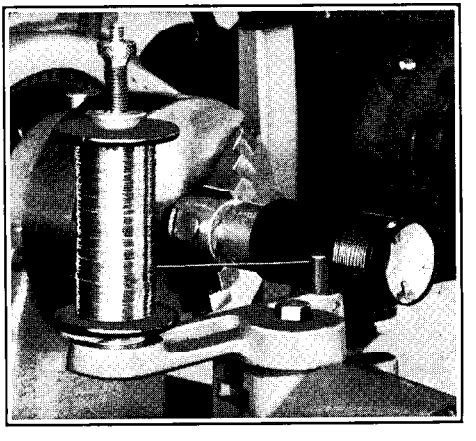


FIG. 54. Winding a coil.

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

I.....ODD-PITCH THREADS

II.....CARRIAGE FEEDS

III.....METRIC THREADS

IV.....DEPTH AND DOUBLE DEPTH OF NATIONAL FORM THREADS

V.....NATIONAL COARSE THREAD DIMENSIONS

VI.....NATIONAL FINE THREAD DIMENSIONS

VII.....FRACTIONAL SIZE THREAD DIMENSIONS

VIII.....MACHINE SCREW THREAD DIMENSIONS

IX.....WHITWORTH THREAD DIMENSIONS

X.....BRITISH ASSOCIATION THREAD DIMENSIONS

XI.....INTERNATIONAL STANDARD THREAD DIMENSIONS—METRIC

XII.....FRENCH STANDARD THREAD DIMENSIONS

XIII.....ACME STANDARD THREAD DIMENSIONS

XIV.....SQUARE THREAD DIMENSIONS

XV.....STRAIGHT PIPE THREAD DIMENSIONS

XVI.....STOVE BOLT THREAD DIMENSIONS

XVII to XXVI....GEAR SET-UPS *FOR COIL WINDING*

TABLE I—GEAR SET-UPS FOR THREADS FROM 1.25 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). Extra gears are available from the factory at nominal cost.

Threads per inch	Accuracy per inch	Gear on Screw	Position D B	Position D F	Position C B	Position C F	Position B B	Position B F	Position A B	Position A F	Spindle Stud Gear	Note
1.25	Exact	20*B*	—	—	40	20	32	64	64*I*	24*S*	32	
1.5	Exact	24*B*	40	20	—	—	32	64	64*I*	20*S*	32	
2.0	Exact	32*B*	40	20	—	—	32	64	64*I*	20*S*	32	
2.25	Exact	36*B*	40	20	—	—	32	64	64*I*	20*S*	32	
2.5	Exact	20*F*	—	—	24*S*	44*I*	20	40	64*I*	32*S*	32	
2.75	Exact	44*B*	48	24	—	—	32	64	64*I*	20*S*	32	
3.0	Exact	24F	—	—	20	40	64*I*	32*S*	—	—	32	
3.25	Exact	52*B*	40	20	—	—	32	64	64*I*	20*S*	32	
3.5	Exact	56*B*	40	20	—	—	32	64	64*I*	20*S*	32	
3.75	Exact	20*F*	48	64	—	—	64*I*	24*S*	—	—	32	
7.5	Exact	40*F*	—	—	—	—	24	32	64*I*	20*S*	32	
8.5	1/3500	44*B*	36	20	—	—	24*S*	64*I*	64	46	32	
9.5	1/2000	52*B*	40	24	—	—	20*S*	64*I*	56	46	32	
10.5	Exact	56*F*	—	—	—	—	48	64	64*I*	20*S*	32	
12.5	Exact	40*F*	—	—	—	—	40	32	64*I*	20*S*	32	*d*
13.5	Exact	54*B*	—	—	—	—	48*I*	20*S*	64*I*	24*S*	32	
15	Exact	54*F*	—	—	—	—	40	36	64*I*	20*S*	32	
17	1/3000	40*B*	36	44	—	—	24*S*	54*I*	64	46	32	
19	1/1500	40*B*	54	44	—	—	*SS*	64*I*	56	24	32	
21	Exact	56*F*	—	—	—	—	54	36	64*I*	20*S*	32	
25	Exact	40*B*	32	40	—	—	20*S*	64*I*	64	32	32	
29	1/1500	46*B*	40	36	—	—	*SS*	64*I*	56	20	32	
30	Exact	54*B*	—	—	—	—	36	40	20*S*	64*I*	16	
31	1/2000	56*B*	20	36	—	—	24*S*	54*I*	64	52	32	
33	Exact	48*B*	—	—	—	—	32	44	24*S*	64*I*	16	
34	1/1100	48*B*	20	46	—	—	*SS*	44*I*	64	52	32	
35	Exact	56*B*	32	40	—	—	*SS*	54*I*	64	32	32	
37	1/1300	54*B*	—	—	—	—	20	48	64	56	32	
38	1/2000	52*B*	—	—	—	—	20	48	56	46	32	
39	Exact	48*B*	—	—	—	—	32	52	20*S*	64*I*	16	
41	1/1000	64*B*	20	32	—	—	24*S*	56*I*	64	40	32	
42	Exact	48*B*	—	—	—	—	32	56	20*S*	64*I*	16	
43	1/2000	46*B*	32	46	—	—	*SS*	56*I*	52	20	32	*g*

Table I—Continued

Threads per inch	Accuracy per inch	Gear on Screw	Position D B	Position D F	Position C B	Position C F	Position B B	Position B F	Position A B	Position A F	Spindle Stud Gear	Note
45	Exact	54*B*	24	40	—	—	20*S*	64*I*	64	32	32	
46	Exact	48*B*	—	—	—	—	24	46	32*S*	64*I*	16	
47	1/1000	48*F*	40	24	—	—	46	54	20*S*	64*I*	16	
49	Exact	56*B*	—	—	—	—	32	64	56	32	32	*hk*
50	Exact	40*F*	40	32	—	—	44*I*	*SS*	24	48	16	*d*
51	1/950	48*F*	36	20	—	—	44	52	24*S*	54*I*	16	
52	Exact	48*B*	—	—	—	—	24	52	32*S*	64*I*	16	
53	1/3000	48*F*	36	20	—	—	44	54	24*S*	48*I*	16	
54	Exact	48*B*	—	—	—	—	64*I*	20*S*	24	54	16	
55	Exact	64*F*	44	24	—	—	36*I*	*SS*				
							24	40	54	48	32	**df*
57	1/3000	56*B*	20	56	—	—	24*S*	52*I*	64	44	32	*h*
58	1/1400	46*B*	20	36	—	—	*SS*	64*I*	56	20	32	*c*
59	1/1800	46*B*	24	44	—	—	20*S*	64*I*	56	20	32	
60	Exact	48*F*	48	24	—	—	32	40	20*S*	54*I*	16	*l*
61	1/1500	48*F*	54	46	—	—	56*I*	20*S*	24	52	16	
62	1/3000	48*F*	44	20	—	—	46	54	20*S*	52*I*	16	
63	Exact	64*B*	—	—	—	—	24	54	56	32	32	
65	Exact	48*F*	40	24	—	—	64*I*	*SS*	32	52	16	
66	Exact	64*B*	24	44	—	—	20*S*	56*I*	54	24	32	
67	1/1400	64*F*	—	—	—	—	40	24				
							32	40	20*S*	52*I*	16	*d*
68	1/1100	48*F*	46	20	—	—	52	64	24*S*	56*I*	16	
69	Exact	64*B*	24	46	—	—	20*S*	56*I*	54	24	32	*f*
70	Exact	48*F*	40	24	—	—	64*I*	*SS*	32	56	16	
71	1/630	48*F*	48	20	—	—	52	64	24*S*	56*I*	16	*l*
73	1/730	48*F*	36	20	—	—	64*I*	24*S*	32	54	16	
74	1/120	64*F*	56	48	—	—	54*I*	*SS*	32	64	16	
75	1/625	52*B*	20	36	—	—	*SS*	64*I*	64	20	32	*e*
76	1/2200	48*F*	56	46	—	—	54*I*	*SS*	20	52	16	
77	Exact	48*F*	44	24	—	—	56*I*	20*S*	32	56	16	*h*
78	Exact	48*F*	40	20	—	—	46*I*	20*S*	32	52	16	
79	1/3100	54*B*	—	—	—	—	20	54	52	24	32	*j*

SYMBOLS:

c—extra 20 tooth gear
d—extra 40 tooth gear
f—extra 24 tooth gear
g—extra 46 tooth gear
h—extra 56 tooth gear
j—extra 54 tooth gear
k—extra 32 tooth gear
l—extra 48 tooth gear
F—position away from headstock
B—position toward headstock
I—idler gear (page 6)
S—spacer gear (page 6)

*—extra sleeve, bushing and bolt assembly—available at the factory.
SS—double keyway spacer

TABLE II—GEAR SET-UPS FOR CARRIAGE FEEDS

Six different carriage feeds between .00157 and .0085 inch per spindle revolution are available on the Atlas lathe in addition to the six most common feeds which are pictured and described in detail between pages 31 and 35. When the material or job requires a certain feed, refer to the table below. Extra gears are available from the factory at nominal cost. Feeds for electrical coil winding begin with Table XVII.

Feed Inches	Threads per inch	Gear on Screw	Position D B	Position D F	Position C B	Position C F	Position B B	Position B F	Position A B	Position A F	Spindle Stud Gear	Note
.0085	118.8	48*F*	44	20	—	—	52*I*	*SS*	24	54	16	
.008	124.8	48*F*	48	20	—	—	54*I*	*SS*	24	52	16	*l*
.004	250.88	64*F*	56	20	—	—	54*I*	*SS*	20	56	16	*ch*
.00288	348.15	56*B*	—	—	20	56	54	24	24	46	16	*hf*
.002045	489.2	56*B*	—	—	20	56	52	20	20	48	16	*cc*
.00157	639.0	64*B*	—	—	20	64	52	20	20	48	16	*cc*

SYMBOLS:

c—extra 20 tooth gear
f—extra 24 tooth gear
h—extra 56 tooth gear
l—extra 48 tooth gear
F—position away from headstock
B—position toward headstock
I—idler gear (page 6)
S—spacer gear (page 6)
SS—double keyway spacer

TABLE III—GEAR SET-UPS FOR METRIC THREADS

Two of the standard change gears furnished with the Atlas Lathe, the 52 tooth gear and the 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 accurate to the extremely close limits of 1 part in 3000.

Refer to page 28 when cutting metric threads.

Pitch in Millimeters	Gear on Screw	Position D B	Position D F	Position B B	Position B F	Position A B	Position A F	Spindle Stud Gear
.5	48*F*	40	44	52*I*	*SS*	24	56	16
.75	64*F*	40	32	52	44	20*S*	56*I*	16
1.00	44*F*	40	32	52	48	20*S*	64*I*	16
1.25	44*B*	—	—	52	48	20*S*	64*I*	16
1.50	44*B*	—	—	52	40	20*S*	64*I*	16
1.75	44*F*	48	52	56	40	20*S*	64*I*	16
2.00	40*F*	44	48	52	36	20*S*	64*I*	16
2.5	44*B*	—	—	52	24	20*S*	64*I*	16
3.0	44*B*	—	—	52	20	24*S*	64*I*	16
3.5	44*F*	48	56	52	20	24*S*	64*I*	16
4.0	20*F*	44	48	52	36	24*S*	64*I*	16
4.5	20*F*	44	54	52	36	20*S*	64*I*	16
5.0	24*F*	44	52	40	20	20*S*	64*I*	16
5.5	20*F*	—	—	48	52	64*I*	24*S*	32
6.0	20*F*	44	52	48	24	32*S*	64*I*	16
7.0	48*B*	52	44	20	56	64*I*	24*S*	32

F—position away from headstock
B—position toward headstock
I—idler gear (page 6)
S—spacer gear (page 6)
SS—double keyway spacer

Note: Position C is not used in any of the above set-ups.

TABLE IV

DEPTH AND DOUBLE DEPTH OF NATIONAL FORM THREADS

This table shows Depth and Double Depth for National Form Threads cut with a formed tool, and also when cut with a Vee type tool. See text, page 14. The two columns at the extreme right give the proper depth of compound feed to obtain the correct thread depth with the compound rest set at an angle of 29° (pg. 17).

Threads per Inch	Pitch Inches	National Form Tool		Vee Form Tool		Depth of 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(1/8)	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"
1 1/8"	7	1.1250	.9394	1.0322	63/64"	1- 9/64"
1 1/4"	7	1.2500	1.0644	1.1572	1- 7/64"	1-17/64"
1 3/8"	6	1.3750	1.1585	1.2667	1- 7/32"	1-25/64"
1 1/2"	6	1.5000	1.2835	1.3917	1-11/32"	1-33/64"
1 3/4"	5	1.7500	1.4902	1.6201	1- 9/16"	1-49/64"
2"	4 1/2	2.0000	1.7113	1.8557	1-25/32"	2- 1/32"
2 1/4"	4 1/2	2.2500	1.9613	2.1057	2- 1/32"	2- 9/32"
2 1/2"	4	2.5000	2.1752	2.3376	2 1/4"	2-17/32"
2 3/4"	4	2.7500	2.4252	2.5876	2 1/2"	2-25/32"
3"	4	3.0000	2.6752	2.8376	2 3/4"	3- 1/32"
3 1/4"	4	3.2500	2.9252	3.0876	3"	3- 9/32"
3 1/2"	4	3.5000	3.1752	3.3376	3 1/4"	3-17/32"
3 3/4"	4	3.7500	3.4252	3.5876	3 1/2"	3-25/32"
4"	4	4.0000	3.6752	3.8376	3 3/4"	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″
1 1/16″	5 1/2	1.6250	1.3888	1.5069	1-29/64″	1-41/64″
1 1/8″	5	1.8750	1.6152	1.7451	1-11/16″	1-57/64″
2 1/8″	4 1/2	2.1250	1.8363	1.9807	1-29/32″	2- 5/32″
2 3/8″	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(⅛)	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	⅛"	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″
1⅛″	7	1.1250	.9420	1.0335	31/32″	1- 9/64″
1¼″	7	1.2500	1.0670	1.1585	1- 3/32″	1-17/64″
1⅜″	6	1.3750	1.1616	1.2683	1- 3/16″	1-25/64″
1½″	6	1.5000	1.2866	1.3933	1- 5/16″	1-33/64″
1⅝″	5	1.6250	1.3689	1.4969	1-13/32″	1-41/64″
1¾″	5	1.7500	1.4939	1.6219	1-17/32″	1-49/64″
2″	4½	2.0000	1.7154	1.8577	1- 3/4 ″	2- 1/32″
2¼″	4	2.2500	1.9298	2.0899	1-31/32″	2- 9/32″
2½″	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
1⅓	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 TIIREAD 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
1/8"	27	.4044	.3451	.3748	11/32"
1/4"	18	.5343	.4455	.4899	7/16"
3/8"	18	.6714	.5826	.6270	37/64"
1/2"	14	.8356	.7213	.7784	23/32"
3/4"	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	1/8"	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. Extra gears available from factory at nominal cost.

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

SYMBOLS:

c—extra 20 tooth gear
d—extra 40 tooth gear
h—extra 56 tooth gear
k—extra 32 tooth gear

F—position away from headstock
B—position toward headstock
I—idler gear (page 6)
S—spacer gear (page 6)
SS—double keyway spacer

Note: position C is not used in any of the above set-ups.

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

Accurate to Commercial Tolerances.
Extra gears available from factory at nominal cost.

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

SYMBOLS:

c—extra 20 tooth gear
f—extra 24 tooth gear
F—position away from headstock
B—position toward headstock
I—idler gear (page 6)
S—spacer gear (page 6)
SS—double keyway spacer

Note: Position C is not used in any of the above set-ups.

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.

Extra gears available from factory at nominal cost.

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

SYMBOLS:

c—extra 20 tooth gear
F—position away from headstock
B—position toward headstock
I—idler gear (page 6)
S—spacer gear (page 6)
SS—double keyway spacer

Note: Position C is not used in any of the above set-ups.

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.

Extra gears available from factory at nominal cost.

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

SYMBOLS:

c—extra 20 tooth gear
k—extra 32 tooth gear
l—extra 48 tooth gear
F—position away from headstock
B—position towards headstock
I—idler gear (page 6)
S—spacer gear (page 6)
SS—double keyway spacer

Note: Position C is not used in the above set-ups.

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 D B	Position D F	Position B B	Position B F	Position A B	Position A F	Spindle Stud Gear
12	.0908	54*F*	—	—	36	44	64*I*	20*S*	32
13	.0810	54*F*	—	—	44	48	64*I*	20*S*	32
14	.0731	64*F*	—	—	48	56	64*I*	20*S*	32
15	.0661	56*F*	—	—	52	48	64*I*	20*S*	32
16	.0598	64*F*	—	—	46	44	64*I*	20*S*	32
17	.0543	64*F*	—	—	46	40	64*I*	20*S*	32
18	.0493	36*F*	—	—	*SS*	52*I*	54	24	32
19	.0444	54*F*	—	—	40	24	64*I*	32*S*	32
20	.0410	44*B*	32	40	20*S*	56*I*	64	36	32
21	.0365	64*B*	—	—	56	48	*SS*	40*I*	16
22	.0334	48*B*	—	—	32	40	20*S*	64*I*	16
23	.0306	48*B*	—	—	32	44	24*S*	64*I*	16
24	.0281	52*B*	32	44	*SS*	56*I*	48	24	32
25	.0259	46*B*	32	40	24*S*	64*I*	54	20	32
26	.0239	48*B*	—	—	64*I*	20*S*	32	56	16
27	.0222	54*B*	24	40	20*S*	64*I*	64	32	32
28	.0206	48*B*	20	36	*SS*	64*I*	54	24	32
29	.0193	48*B*	—	—	56*I*	20*S*	24	52	16
30	.0180	64*F*	64	46	32	40	20*S*	56*I*	16
31	.0169	54*B*	20	44	*SS*	56*I*	64	32	32
32	.0160	48*B*	—	—	64*I*	24*S*	20	52	16
33	.0151	64*B*	—	—	24	64	56	36	32
34	.0143	54*B*	20	52	*SS*	56*I*	64	32	32
35	.0136	64*B*	20	46	*SS*	56*I*	64	32	32
36	.0130	48*B*	—	—	64*I*	*SS*	20	64	16
37	.0125	48*F*	48	20	46	64	32*S*	56*I*	16
38	.0120	48*F*	—	—	48	20	44	64	16
39	.0115	64*F*	48	40	52*I*	*SS*	24	54	16
40	.0112	64*B*	20	48	*SS*	54*I*	56	24	32

SYMBOLS:

F—position away from headstock
B—position toward headstock
I—idler gear (page 6)
S—spacer gear (page 6)
SS—double keyway spacer

Note: Position C is not used in any of the above set-ups.

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

Accurate to Commercial Tolerances.
Extra gears available from factory at nominal cost.

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

SYMBOLS:

c—extra 20 tooth gear
h—extra 56 tooth gear
F—position away from headstock
B—position toward headstock
I—idler gear (page 6)
S—spacer gear (page 6)
SS—double keyway spacer

Note: Position C is not used in any of the above set-ups.

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

Accurate to Commercial Tolerances.

Extra gears available from factory at nominal cost.

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

SYMBOLS:

c—extra 20 tooth gear
F—position away from headstock
B—position toward headstock
I—idler gear (page 6)
S—spacer gear (page 6)
SS—double keyway spacer

Note: Position C is not used in any of the above set-ups.

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

Accurate to Commercial Tolerances.

Extra gears available from factory at nominal cost.

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

SYMBOLS:

c—extra 20 tooth gear
f—extra 24 tooth gear
h—extra 56 tooth gear
l—extra 48 tooth gear
F—position away from headstock
B—position toward headstock
I—idler gear (page 6)
S—spacer gear (page 6)
SS—double keyway spacer

Note: Position C is not used in any of the above set-ups.

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

Accurate to Commercial Tolerances.

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

SYMBOLS:

F—position away from headstock
B—position toward headstock
I—idler gear (page 6)
S—spacer gear (page 6)
SS—double keyway spacer

Note: Position C is not used in any of the above set-ups.

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

Accurate to Commercial Tolerances.

Extra gears available from factory at nominal cost.

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

SYMBOLS:

c—extra 20 tooth gear
f—extra 24 tooth gear
F—position away from headstock
B—position toward headstock
I—idler gear (page 6)
S—spacer gear (page 6)
SS—double keyway spacer

Note: Position C is not used in any of the above set-ups.

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.