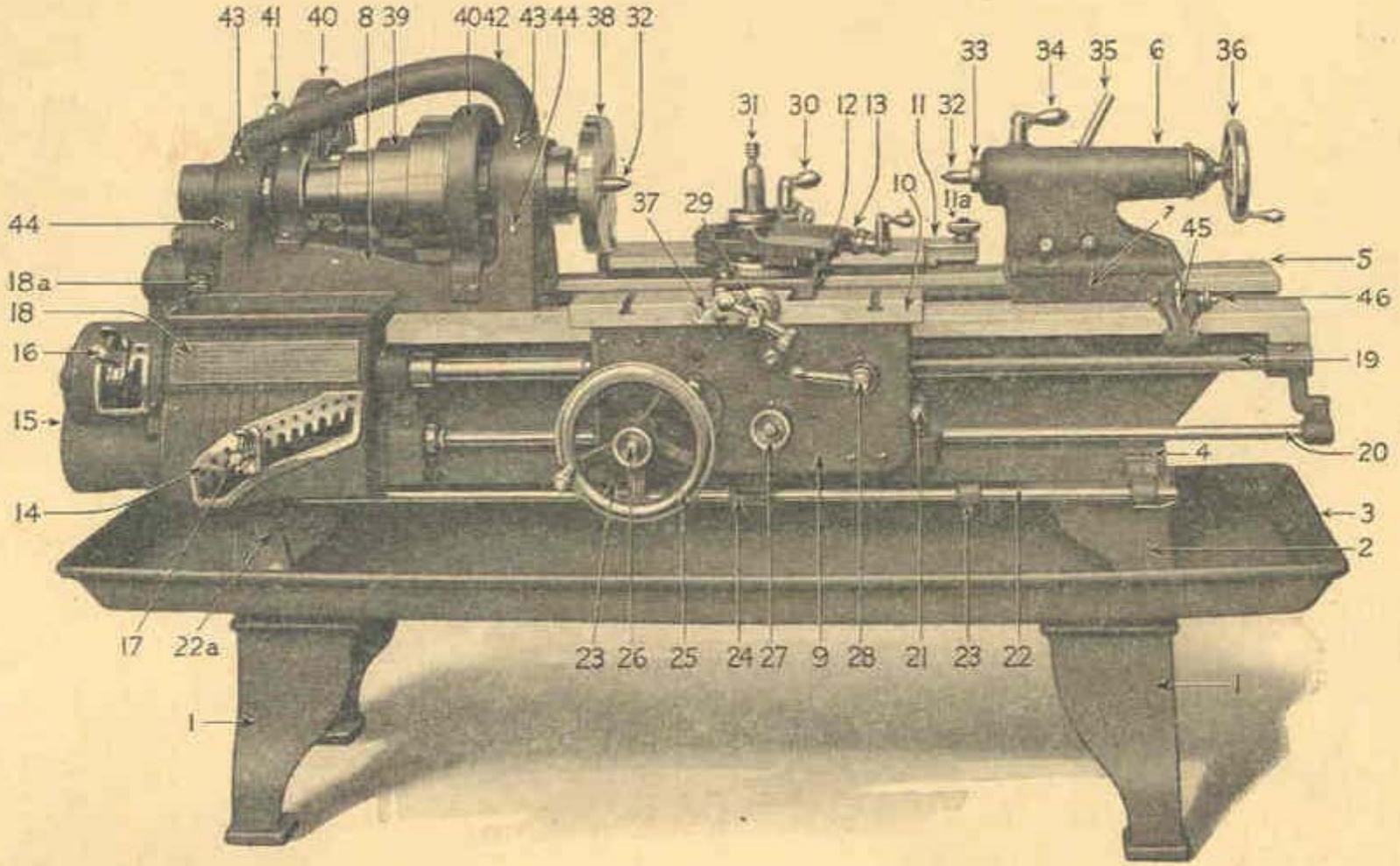
OPERATORS' HAND BOOK

FOR

HENDEY LATHES

THE HENDEY MACHINE CO.
TORRINGTON, CONN.

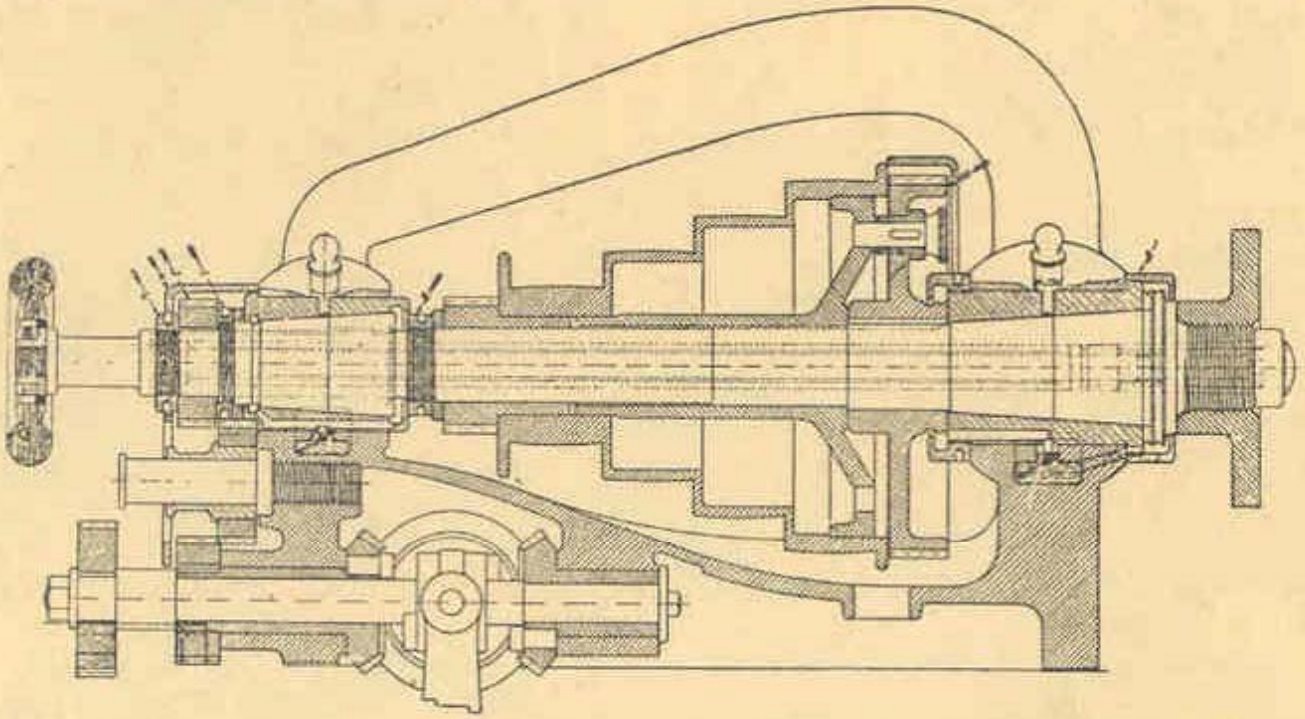

43 41 40 8 39 40 42 43 44 38 32
33 34 35 6 36
31 30 12 13 11 32
10 11a
37 29
45
44
18a
18
16
15
14
17 22a
1
23 26 25 24 27 9 28 21 23 22
5
46
19
20
4
3
2
1

Lathe Chart

1 Floor Legs
2 Pan Legs
3 Oil Pan
4 Bed
5 Ways of bed
6 Tail Stop Top
7 Tail Stop Base
8 Head Stock Casting
9 Apron
10 Carriage
11 Taper Attachment
11A Setting Grip Nut for Swivel Bar
12 Cross Slide
13 Compound Rest
14 Main Gear Box
15 Outer Compounding Gear Box
16 Outer Latched Lever Gear Shift
17 Main Latched Lever Gear Shift
18 Index Plate for Threads and Feeds
18A Feed or Stud Gear
19 Lead Screw
20 Reverse Rod
21 Reversing Lever
22 Automatic Stop Rod
22A Stop Rod to Bell Crank Lever
23 Automatic Stop Rod Dogs
24 Adjustable Feed Stop
25 Apron Hand Wheel
26 Longitudinal Feed Grip Nut
27 Cross Feed Grip Nut
28 Lever for Lead Screw Half Nuts
29 Cross Feed Screw Handle
30 Binding Handle for Taper Attachment Connection
31 Tool Post
32 Centers
33 Tail Stock Spindle
34 Tail Stock Spindle Binding Handle
35 Binding Lever for Tail Stock Clamp
36 Tail Stock Hand Wheel
37 Thread Stop for Cross Feed
38 Driver Plate
39 Cone Pulley
40 Front and Rear Gear Guards
41 Back Gear Lever
42 Tie Bar of Head Stock
43 Reservoir Oil Hole Plugs
44 Reservoir Level Sights
45 Micrometer Carriage Stop
46 Adjusting Screw for Micrometer Carriage Stop

Head Spindle and Bearings

The accompanying is a sectional view of our Improved Patented Spindle Construction with Taper Journals running in Annular Bearings as found in our Lathe Heads. This construction has been applied to thousands of our lathes and has demonstrated its ability in every way to meet the demands for maintenance of accuracy with little or no sign of wear existing after long service.



The Spindle is made from high carbon steel forging, furnished under scleroscope hardness specifications, to insure minimum wear in bearings after years of service.

Spindle has Taper Journals at either end, having independent adjustment in bearings, and allowing for contraction and expansion, without disturbing the running adjustment.

Bearings are Annular in Form, and automatically oiled with ring oilers, running in large reservoirs of oil contained in pockets in either housing.

A Constant Supply of Oil is distributed over bearings while spindle is in motion. Ample provision is made for catching and returning oil to the reservoirs.

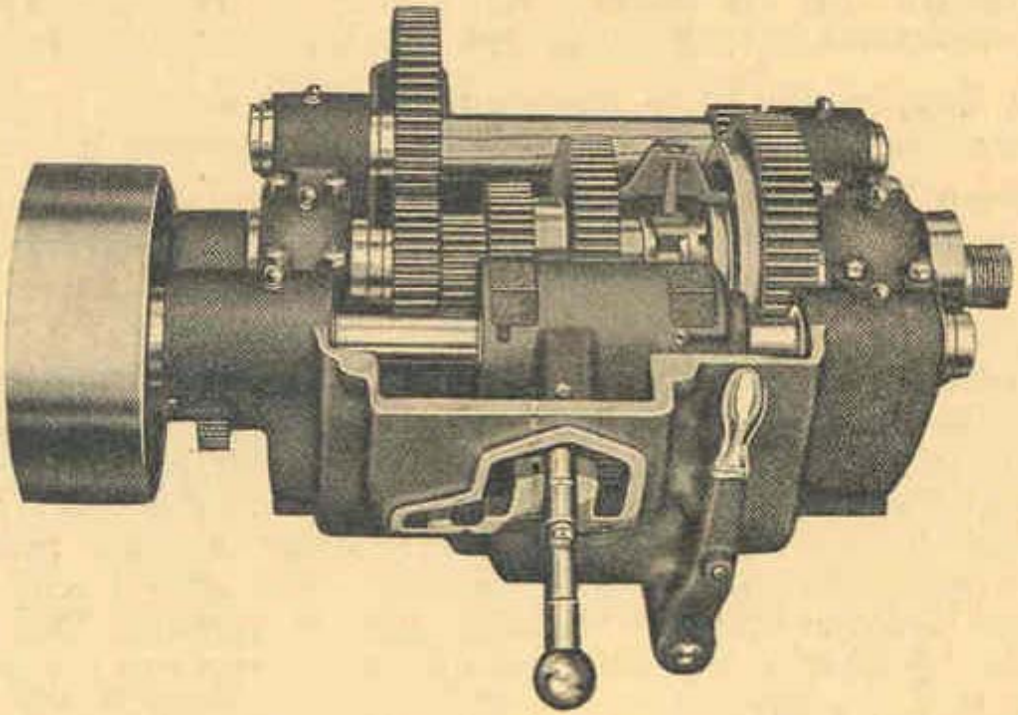
All End Thrust is Taken on Face of Front Bearing, the nicety of adjustment being such, however, that the journal is not wedged in bearing under heavy end thrust, nor does it shake when spindle is running free. This adjustment once made is retained, as the wear over both surfaces is uniform.

Instructions Showing how Spindle may be Removed or Adjusted: To remove the spindle, take off collar of front bearing at A, the guard K, and the collar L, then, by turning back the collar E, at the same time driving the spindle forward with a Babbitt hammer, it may be removed. In replacing it, turn up the collar E until the face gear hub is tight against the bearing A, then turn the collar E back enough to allow the cone pulley to run free. The gear J may now be put on and the collar L adjusted to take up the end play of spindle. The rear journal is keyed to but slides on the spindle and is adjusted by turning the collar I forward or backward as may be needed.

If ever necessary to remove a bearing, take out the spindle and the sleeve forming rear journal, then raise up the oil ring in its slot, and, with a block of wood and a light hammer, the bearing may be driven out.

Geared Head Lathes

All sizes of Hendey Lathes can be furnished with all geared drive heads in place of cone heads when so desired. The call for geared head lathes comes



Design of Heads Used on 12 to 20 Inch Swing Geared Head Lathes

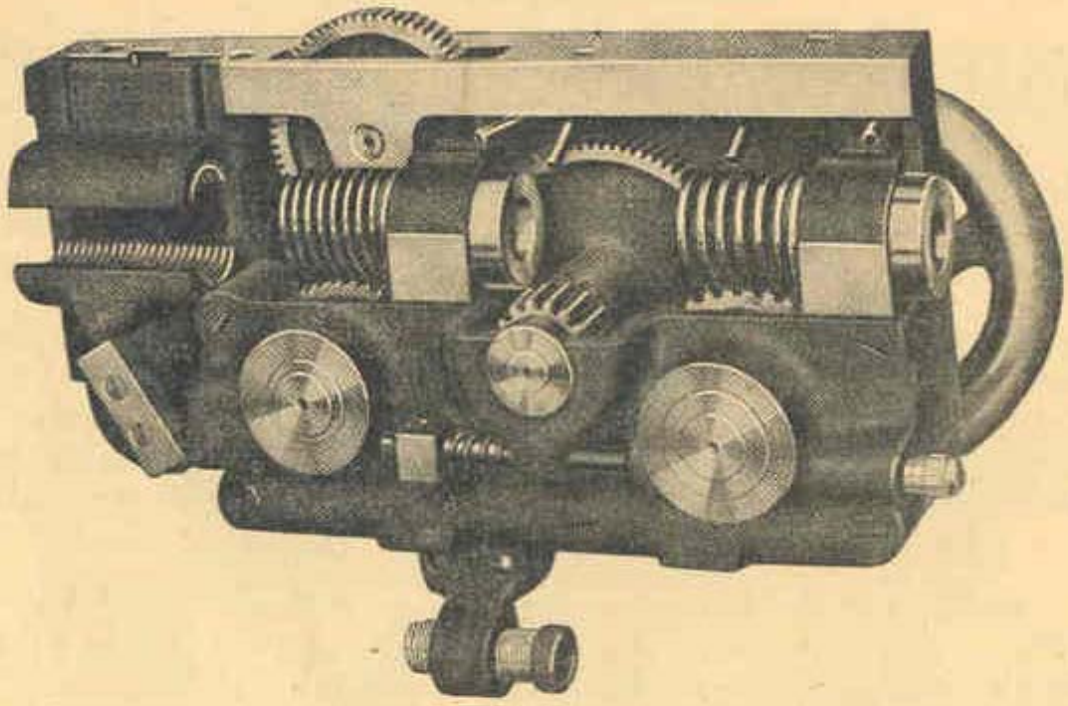
mainly when it is desired to get the utmost in the way of output, as from a manufacturing lathe, rather than for tool work.

The driving power applied to spindle is very materially increased over that in an ordinary lathe, particularly in the higher series of speeds, making them available for heavy cuts which would stall a plain lathe trying to approach the same speed. In addition, a valuable factor is the time saved in stopping and starting the spindle by clutch device when it is desired to change work on the centers instead of being compelled to stop from countershaft down.

The mechanical features of this head consists of Power Shaft on which is carried a Rocker with Driving Pinion and Intermediate Gears; the Main Spindle with a 3-gear cone, a Cone Pinion and Face Gear, all running free on spindle, a positive Tooth-clutch working between large gear of cone and face gear; and Back-Gear Quill with Large Gear and Pinion cast integral and pinned to back-gear shaft.

There are eight mechanical changes of speed for spindle in geometric progression with power shaft running at constant speed. Four of these changes are direct through the tumbler and gear cone and four through the back gearing. Back gears remain in mesh with spindle gearing and are engaged by the positive tooth-clutch keyed to but sliding on the main spindle and alternating between the two large gears. This clutch has immediate control over two spindle speeds and is also used to stop or start spindle instead of doing this by the countershaft as in ordinary practice. When making gear changes in the high runs, speed of power shaft should be reduced so as to prevent undue clashing of gears.

Note—Collar on rear end of spindle takes up end play. Collar touching rear bearing adjusts rear sleeve spindle bearing.



Double Wall Safety Type Apron for 12, 14, 16, 18 and 20 Inch Lathes

Illustrations clearly reveal the construction of this apron. **All shafts have outboard or double bearings.**

The inner wall or casting which supports the outboard bearing is so formed and bolted to the apron in such a way as to furnish a pocket for oil bath for gearing.

The rack pinion is supported on either side of its engagement with rack, making it impossible for pinion to be strained out of alignment.

The rack pinion is carried on eccentric shaft, and can be disconnected from rack for screw cutting by turning small lever on face of apron back of hand wheel. This allows carriage to run free and reduces strain in driving mechanism to a minimum.

The longitudinal feed and screw cutting mechanisms are interlocking. Before the split nut for thread cutting can be engaged, the feed friction must be loosened to the limit, likewise the split nut must be opened before the feed friction can be engaged.

Feed worms in apron are hardened.

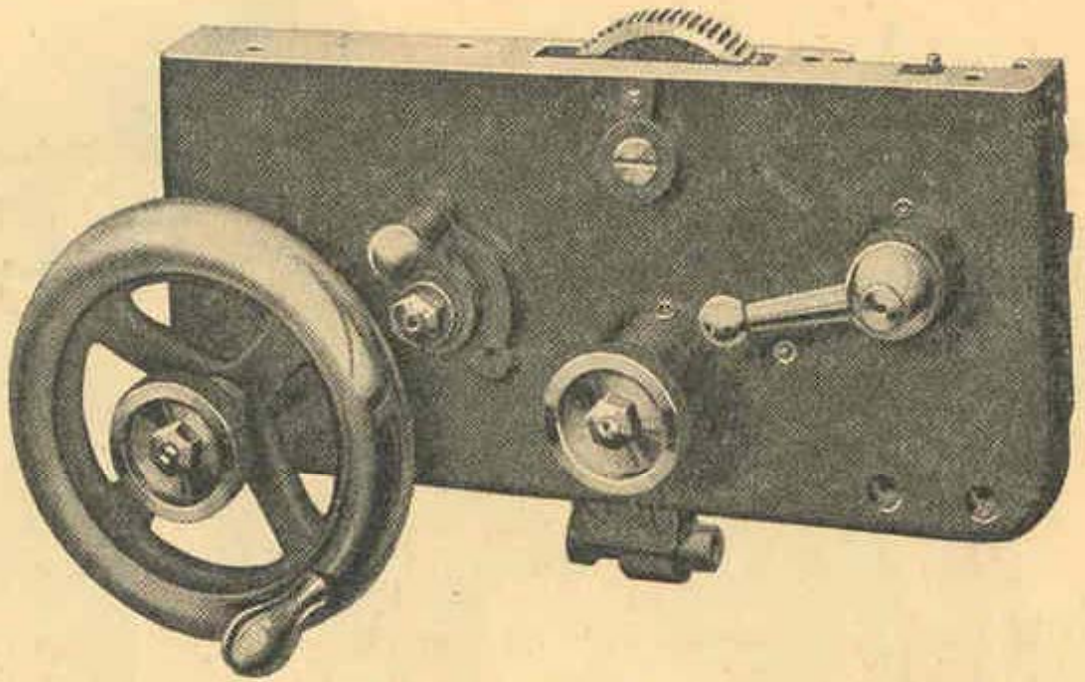
Increasing Range of Taper Attachment Through Apron Feed

The cross-feed and screw cutting mechanism of this apron are so designed that they can be used to increase the range of the taper attachment. Selecting a thread fine enough to be used as a feed and engaging the cross-feed at the same time the taper formed will be exactly 6″ to the foot.

In turning steep tapers, the simultaneous operation of the screw cutting with the cross-feed and using the taper attachment in combination will give tapers up to 9″ to the foot. It is to be noted that the range of the taper attachment alone is up to 3″ to the foot.

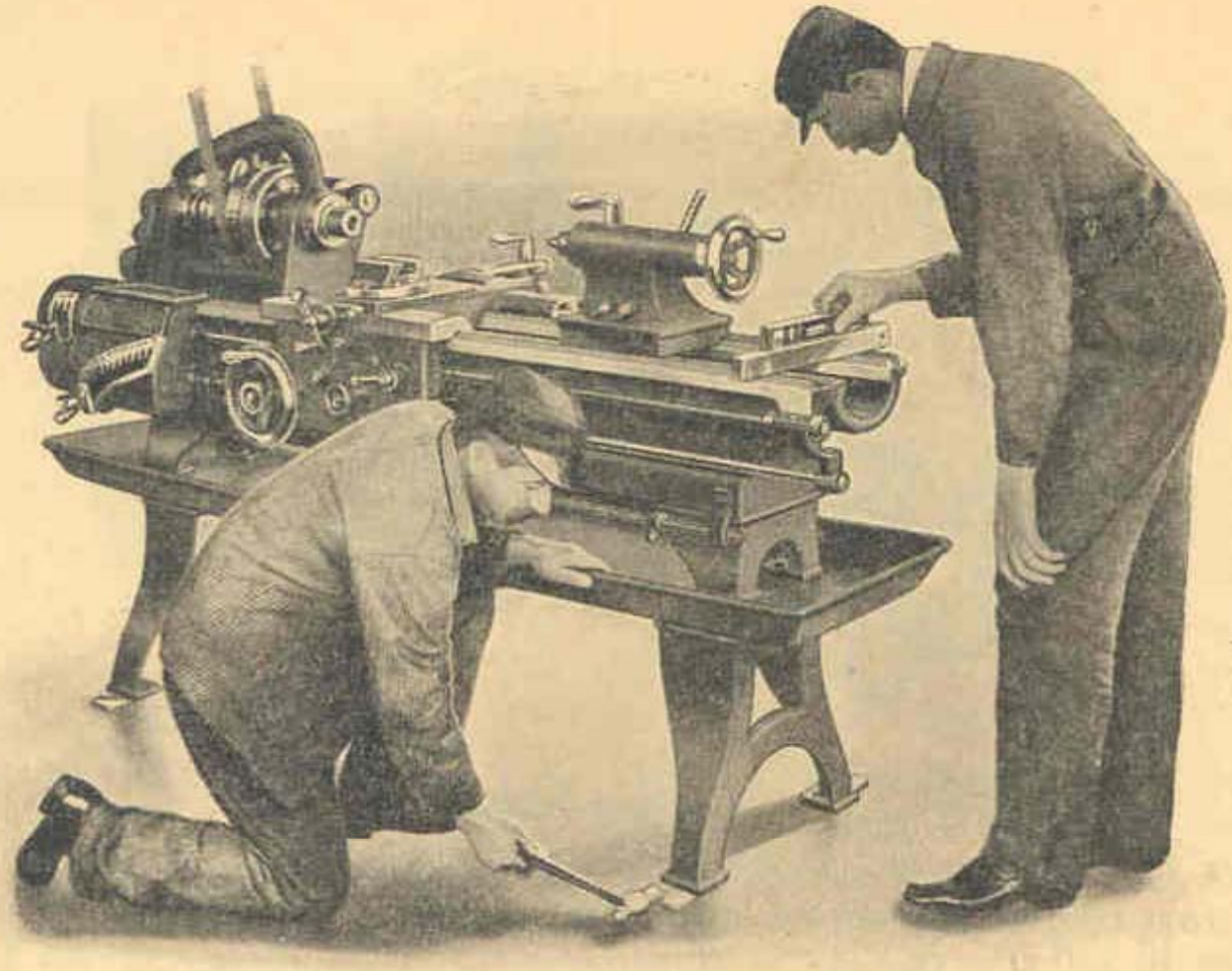
If the longitudinal and cross-feeds are engaged simultaneously, the tool will follow a path forming an angle 45 degrees with the center line.

By using the taper attachment in combination with these two feeds, the angle can be increased or decreased sufficiently to form a minimum angle of 41 degrees, and a maximum angle of 48½ degrees.



Cutting Scrolls

With this apron it is possible to cut scrolls or spirals as follows: The ratio of the cross-feed to the screw cutting is exactly 4 to 1 for 12, 14 and 16" and 6 to 1 for 18 and 20". Any pitch on the index plate multipled by the proper ratio will give the cross-feed pitch. Therefore, to cut a scroll of 16 threads per inch, in 16" lathe the gear box handles are placed in position indicating 4 threads, whereupon the cross-feed when engaged will travel at the proper rate to cut a scroll of 16 threads per inch, etc.



It is of course essential, before being operated or tested, that a lathe be first accurately leveled on the floor, as shown in illustration, to bring the bed into alignment.

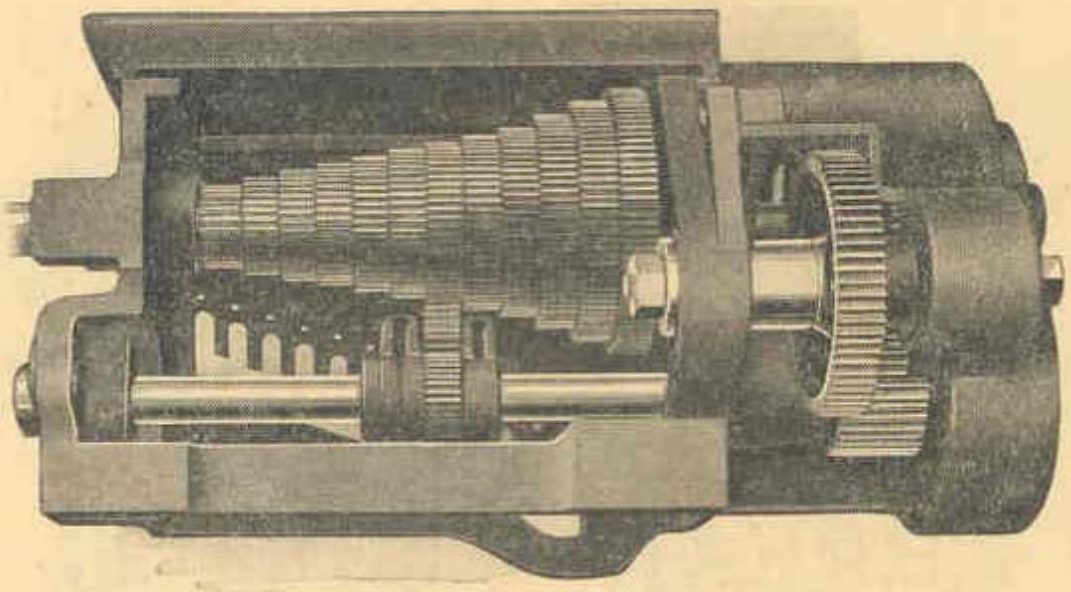
HELPS ON CHANGE GEARING

AND

THREAD CUTTING

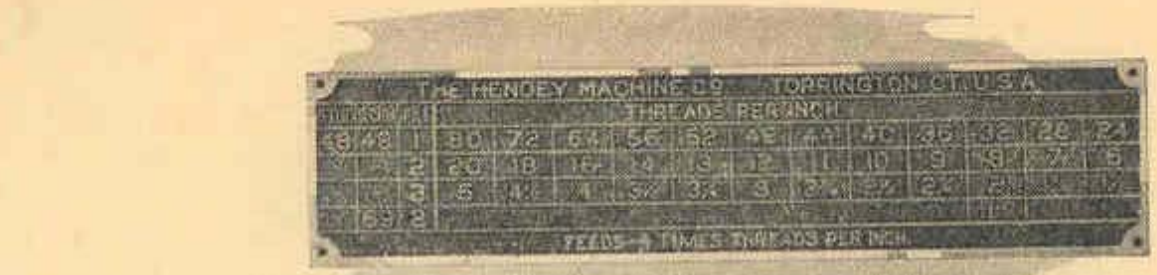
FOR USERS OF

HENDEY LATHES



Quick Change Gear Engine Lathes have been manufactured and improved by this company since the year 1892. Hendey Lathes were the first to have a commercially successful equipment of modern change gearing, and they have become more widely known and used than any other Quick Change Gear Lathe manufactured.

This Quick Change Gearing Equipment consists of a cone of twelve gears mounted either direct on lead screw or driving shaft, being inclosed and protected in main gear box, and controlled by one operating handle for twelve different speed changes. The outer or compound box gives three widely different speeds to the gearing in the main box, furnishing thirty-six different changes of speeds for threads and feeds, none being duplicates, as will be seen by reference to the index plate. This range is not the limit of the gear box for additional gears can be applied in train as on any ordinary lathe, any single gear working through the entire thirty-six changes. The number of threads and feeds that can be secured is therefore practically without limit.


THE HENDEY MACHINE Co TORRINGTON CT U.S.A.

STUD	SECTOR	HOLE	THREADS PER INCH											
48	48	1	80	72	64	56	52	48	44	40	36	32	28	24
		2	20	18	16	14	13	12	11	10	9	8	7	6
		3	5	4½	4	3½	3¼	3	2¾	2½	2¼	2	1¾	1½
	69	2						1¼						

FEEDS-4 TIMES THREADS PER INCH

12″ Lathe


THE HENDEY MACHINE CO TORRINGTON CT U.S.A.

STUD	SECTOR	HOLE	THREADS PER INCH											
48	48	1	80	72	64	56	52	48	44	40	36	32	28	24
		2	20	18	16	14	13	12	11	10	9	8	7	6
		3	5	4½	4	3½	3¼	3	2¾	2½	2¼	2	1¾	1½
	46	2						1½						

FEEDS-4 TIMES THREADS PER INCH

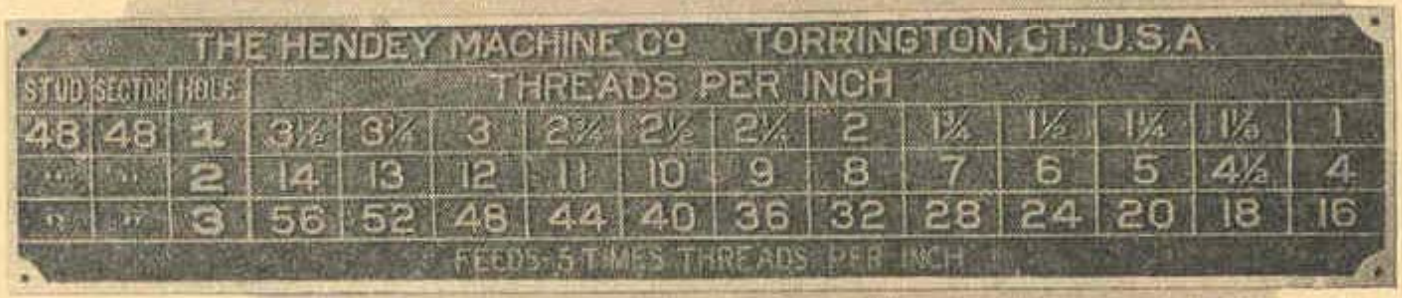
16″ Lathe


THE HENDEY MACHINE CO TORRINGTON CONN U.S.A.

STUD	SECTOR	HOLE	THREADS PER INCH											
48	48	1	56	52	48	44	40	36	32	28	24	20	18	16
		2	14	13	12	11	10	9	8	7	6	5	4½	4
		3	3½	3¼	3	2¾	2½	2¼	2	1¾	1½	1¼	1⅛	1
	46	2			11½									

FEEDS-6 TIMES THREADS PER INCH

18″ Lathe


THE HENDEY MACHINE Co TORRINGTON, CT., U.S.A.

STUD	SECTOR	HOLE	THREADS PER INCH											
48	48	1	3½	3¼	3	2¾	2½	2¼	2	1⅞	1½	1¼	1⅛	1
		2	14	13	12	11	10	9	8	7	6	5	4½	4
		3	56	52	48	44	40	36	32	28	24	20	18	16

FEEDS-5 TIMES THREADS PER INCH

24″ Lathe

Standard Index Plates Showing Range of Threads and Feeds

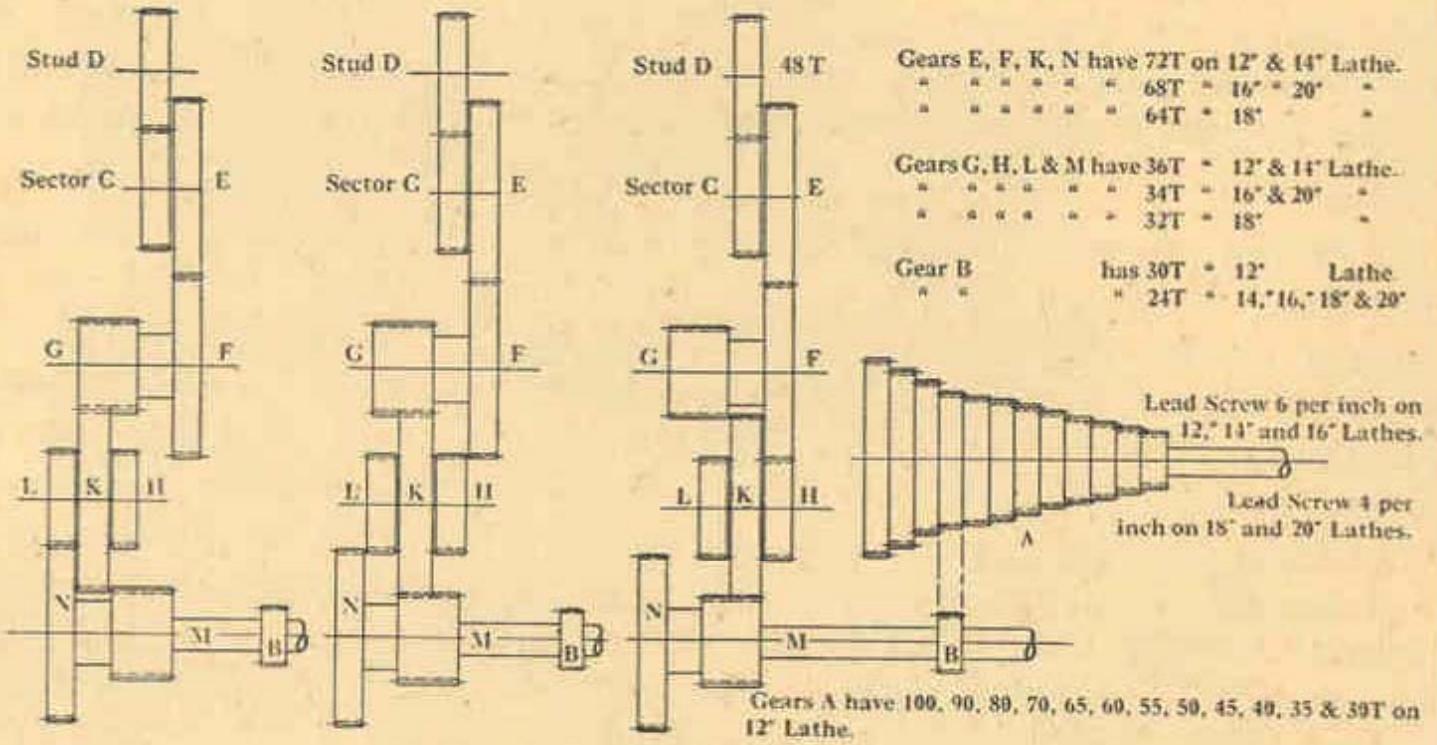
The run of threads covered by the gearing on our lathes is worthy of notice. 12″ to 16″ swing lathes cut 1½ to 80 threads per inch without gear change. 18″ to 24″ lathes cut 1 to 56 without gear change. Each lathe therefore cuts 36 threads without gear change, no two of which are duplicates. In this list there are very few fractional threads, and these are in the coarse run or confined below 5 per inch.

In setting up for a given thread, the figures in the vertical column under the word "hole," refer to the 1, 2, 3, cast on outer gear box. Threads per inch in horizontal columns are directly over the notches in the main gear box. To change from one thread to another in the horizontal row, as from 7 to 14, simply bring the latched handle directly under 14, allowing it to lock into place. To change from one thread to another in a vertical column, as from 32 to 2, locate handle in in outer gear box directly under figure arranged on the same horizontal line as thread desired. Any change is easily and quickly made, and there is no occasion for cutting the wrong pitch, as changes in the outer box are too widely separated (4-1) not to be instantly noticed, while the horizontal pitches can be read in no other way than directly over the controlling handle.

Additional threads obtained with extra change gears are shown on pages following.

FORMULAS FOR FIGURING GEARS FOR THREADS NOT GIVEN IN INDEX

Diagram of Feed Gears for 12," 14," 16," 18" & 20"
Hendey Engine Lathes.



Gears E, F, K, N have 72T on 12" & 14" Lathe.
" " " " " " 68T " 16" " 20" "
" " " " " " 64T " 18" "

Gears G, H, L & M have 36T " 12" & 14" Lathe.
" " " " " " 34T " 16" & 20" "
" " " " " " 32T " 18" "

Gear B has 30T " 12" Lathe
" " " 24T " 14," 16," 18" & 20"

Gears A have 100, 90, 80, 70, 65, 60, 55, 50, 45, 40, 35 & 39T on 12" Lathe.

Gears A have 80, 72, 64, 56, 52, 48, 44, 40, 36, 32, 28 & 24T on 14" & 16" Lathe.
" " " 84, 78, 72, 66, 60, 54, 48, 42, 36, 30, 27 & 24T " 18" & 20" "

Position of Gears with handle in "1 hole

Position of Gears with handle in "2 hole.

Position of Gears with handle in "3 hole.

Formulas for Figuring Gears for Threads not given in Index

First Formula:

When change is to be made at C: Multiply 48 by number of threads per inch wanted and divide the result by any number selected from Index, preferably one near number of threads per inch wanted. The result is the number of teeth of gear wanted for position C, gear D. having 48 T. If the result should not be a whole number select another divisor from Index.

When change is to be made at D: Divide 48 by threads per inch wanted and multiply result by a number selected on Index as above.

Example: To find gear necessary to cut 27 threads per inch, multiply 48 by 27. The result is 1296. Divide 1296 by 28, the nearest number to 27 in Index. The result is 46 8/28. As this will not do, then divide 1296 by 24. The result is 54. With Gear Box Handle in position to cut 24 threads per inch, and a 54 T. Gear at C, lathe will cut 27 threads per inch.

For all other threads cut, using same gears, divide 27 by 24 and multiply the result by the thread shown on Index corresponding to position of handle.

Example: $\frac{27}{24} \times 28 = 31\frac{1}{2}$ threads per inch.

Second Formula:

Multiply thread wanted and a thread selected from Index by same number, selecting one that will give a whole number for result, and, the number obtained by multiplying the Index number is the number of teeth wanted on stud or at D; the other one is the gear on Sector at C.

Example: Wanted to cut a screw having $2\frac{1}{3}$ threads per inch. We select 2 on Index, and multiplying by, say, 24, we have

$2 \times 24 = 48$ for gear on stud or D, and

$2\frac{1}{3} \times 24 = 56$ for gear on sector or C.

Other threads obtained with the same setting of gears are determined as shown on First Formula.

When a thread to be cut is given as a lead, put in threads per inch and use the foregoing formula.

Leads

In cases where fractional threads are such that even numbers cannot be obtained by changing gears C and D, a special gear may be used at E, thereby introducing the gear F into the formula. In this case several trials may be necessary to obtain the desired result.

If we represent the numbers shown on Index by O, the formula will be:

for threads per inch $\frac{O \times F \times C}{E \times D}$ = Threads per inch; for leads $\frac{D \times E}{C \times F \times O}$ = Lead in inches

F is the only known gear in this case; it has always the same number of teeth as E originally on the lathe. C, D, and E must be selected by trial.

Formula for Thread Cutting

Illustration with 6 per inch Lead Screw

Threads Per Inch

Handle in No. 1 Hole $\frac{6 \times A \times 4 \times C}{B \times D}$ = T.P.I.

Handle in No. 2 Hole $\frac{6 \times A \times C}{B \times D}$ = T.P.I.

Handle in No. 3 Hole $\frac{6 \times A \times C}{B \times D \times 4}$ = T.P.I.

Example for No. 3 Hole $\frac{6 \times 70 \times 48}{30 \times 48 \times 4}$ = 3½ T.P.I.

Lead in Inches

Handle in No. 1 Hole $\frac{D \times B}{C \times A \times 4 \times 6}$ = Lead.

Handle in No. 2 Hole $\frac{D \times B}{C \times A \times 6}$ = Lead.

Handle in No. 3 Hole $\frac{D \times B \times 4}{C \times A \times 6}$ = Lead.

Example for No. 3 Hole $\frac{48 \times 30 \times 4}{48 \times 70 \times 6}$ = $\frac{2}{7}$

With 4 per inch Lead Screws replace 6 where it appears by 4.

Formula for Cutting Metric Threads with English Lead Screw of 6 per Inch for 12″, 14″, and 16″ Lathes

Using Transposing Gears at C and D

Note: 1 inch=25.4 millimeters

Handle in No. 1 hole $\frac{D\times E\times 1\times B\times 25.4}{127\times F\times 4\times A\times 6}$ or $\frac{D\times E}{F\times A\times 4}$ = Pitch in millimeters.

Handle in No. 2 hole $\frac{D\times E\times B\times 25.4}{127\times F\times A\times 6}$ or $\frac{D\times E}{F\times A}$ = P. in M.

Handle in No. 3 hole $\frac{D\times E\times 4\times B\times 25.4}{127\times F\times A\times 6}$ or $\frac{D\times E\times 4}{F\times A}$ = P in M.

Formula for Cutting Metric Threads with English Lead Screw of 4 per Inch on 18″ and 20″ Lathes

Using Transposing Gears at C and D

Note: 1 inch=25.4 millimeters

Handle in No. 1 hole $\frac{D\times E\times B\times 25.4}{127\times F\times A\times 4\times 4}$ or $\frac{D\times 2.4}{A\times 4}$ = Pitch in millimeters.

Handle in No. 2 hole $\frac{D\times E\times B\times 25.4}{127\times F\times A\times 4}$ or $\frac{D\times 2.4}{A}$ = P. in M.

Handle in No. 3 hole $\frac{D\times E\times B\times 25.4\times 4}{127\times F\times A\times 4}$ or $\frac{D\times 2.4\times 4}{A}$ = P. in M.

12″ Lathe	E=120 T	F=72 T	12″, 14″, and 16″ Lead Screws are 6 per inch
14″ Lathe	E=120 T	F=72 T	
16″ Lathe	E=102 T	F=68 T	
18″ Lathe	E=128 T	F=64 T	18″ and 20″ Lead Screws are 4 per inch
20″ Lathe	E=136 T	F=68 T	

C=127 T for all lathes

Special Transposing Gears

For Cutting Leads Equal to the Circular Pitch Corresponding to the Different Diametral Pitches in Common Use

We can furnish for our new pattern lathes, a set of three gears which, when placed on the lathe, will enable the operator to chase hobs having lead equal to $\frac{\pi}{\text{Diametral Pitch}}$ or, in other words, equal to the corresponding circular pitch.

Without changing any gears after transposing gears are in place, the following diametral pitches are transposed into circular pitch:

3, 3½, 4, 4½, 5, 5½, 6, 6½, 7, 8, 9, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 32, 36, 40, 48, 56, 64, 72, 80, 88, 96, 104, 112, 128, 144, 160.

The results obtained are more accurate than if the value of π is taken at 3.1416, these gears giving the value of π as 3.141592.

12" or 14" Lathe

16" Lathe

Metric Transposing Plates

Illustration of Index Plates showing Metric threads as obtained on 12", 14", and 16" Lathes with English pitch Lead Screw and Compound Gear Box, using Transposing Gears.

All possible pitches are not illustrated, but any pitch between the coarsest and finest given on the Index can be cut by the use of extra change gears. See formula on page 21. Those illustrated are considered sufficient for ordinary use.

It is to be understood that metric threads can be cut by means of transposing gears in 18", 20" and 24" lathes with the same facility as in the smaller sizes, although index plates for the larger lathes are not herewith shown. See page 21.

Special Index for Extra Change Gears on Hendey Engine Lathes
For 12", 14" and 16" Only with 6-Pitch Lead Screw

Stud	Sector	Hole	Threads Per Inch											
48	44	1	73 1/3	66	58 2/3	51 1/3	47 2/3	44	40 1/3	36 2/3	33	29 1/3	25 2/3	22
.	45	..	75	67 1/2	60	52 1/2	48 3/4	45	41 1/4	37 1/2	33 3/4	30	26 1/4	22 1/2
..	46	..	76 2/3	69	61 1/3	53 2/3	49 5/6	46	42 1/6	38 1/3	34 1/2	30 2/3	26 5/6	23
..	47	..	78 1/3	70 1/2	62 2/3	54 5/6	50 11/12	47	43 1/12	39 1/6	35 1/4	31 1/3	27 5/12	23 1/2
..	49	..	81 2/3	73 1/2	65 1/3	57 1/6	53 1/12	49	44 11/12	40 5/6	36 3/4	32 2/3	28 7/12	24 1/2
..	50	..	83 1/3	75	66 2/3	58 1/3	54 1/6	50	45 5/6	41 2/3	37 1/2	33 1/3	29 1/6	25
..	51	..	85	76 1/2	68	59 1/2	55 1/4	51	46 3/4	42 1/2	38 1/4	34	29 3/4	25 1/2
.	52	..	86 2/3	78	69 1/3	60 2/3	56 1/3	52	47 2/3	43 1/3	39	34 2/3	30 1/3	26
..	53	..	88 1/3	79 1/2	70 2/3	61 5/6	57 5/12	53	48 7/12	44 1/6	39 3/4	35 1/3	30 11/12	26 1/2
..	54	..	90	81	72	63	58 1/2	54	49 1/2	45	40 1/2	36	31 1/2	27
..	55	..	91 2/3	82 1/2	73 1/3	64 1/6	59 7/12	55	50 5/12	45 5/6	41 1/4	36 2/3	32 1/12	27 1/2
..	56	..	93 1/3	84	74 2/3	65 1/3	60 2/3	56	51 1/3	46 2/3	42	37 1/3	32 2/3	28
..	57	..	95	85 1/2	76	66 1/2	61 3/4	57	52 1/4	47 1/2	42 3/4	38	33 1/4	28 1/2
..	58	..	96 2/3	87	77 1/3	67 2/3	62 5/6	68	53 1/6	48 1/3	43 1/2	38 2/3	33 5/6	29
..	59	..	98 1/3	88 1/2	78 2/3	68 5/6	63 11/12	59	54 1/12	49 1/6	44 1/4	39 1/3	34 5/12	29 1/2
	60	.	100	90	80	70	65	60	55	50	45	40	35	30
.	61	..	101 2/3	91 1/2	81 1/3	71 1/6	66 1/12	61	55 11/12	50 5/6	45 3/4	40 2/3	35 7/12	30 1/2
..	62	..	103 1/3	93	82 2/3	72 1/3	67 1/6	62	56 5/6	51 2/3	46 1/2	41 1/3	36 1/6	31
..	63	..	105	94 1/2	84	73 1/2	68 1/4	63	57 3/4	52 1/2	47 1/4	42	36 3/4	31 1/2
..	64	..	106 2/3	96	85 1/3	74 2/3	69 1/3	64	58 2/3	53 1/3	48	42 2/3	37 1/3	32
..	65	..	108 1/3	97 1/2	86 2/3	75 5/6	70 5/12	65	59 7/12	54 1/6	48 3/4	43 1/3	37 11/12	32 1/2
.	66	..	110	99	88	77	71 1/2	66	60 1/2	55	49 1/2	44	38 1/2	33
..	67	..	111 2/3	100 1/2	89 1/3	78 1/6	72 7/12	67	61 5/12	55 5/6	50 1/4	44 2/3	39 1/12	33 1/2
..	68	..	113 1/3	102	90 2/3	79 1/3	73 2/3	68	62 1/3	56 2/3	51	45 1/3	39 2/3	34
..	69	.	115	103 1/2	92	80 1/2	74 3/4	69	63 1/4	57 1/2	51 3/4	46	40 1/4	34 1/2
..	70	..	116 2/3	105	93 1/3	81 2/3	75 5/6	70	64 1/6	58 1/3	52 1/2	46 2/3	40 5/6	35

Group Covering Range of Pitches for Hole 1 of Outer Gear Box

NOTE: 44 to 47 Tooth Gears can be used on 16" Lathes only

Special Index for Extra Change Gears on Hendey Engine Lathes For 12", 14" and 16" Only with 6-Pitch Lead Screw

STUD GEAR	IDLER	Threads Per Inch.																								
48	44	2	18	16	14	12	11	11	9	8	7	6	5													
..	45	..	18	16	15	13	12	11	10	9	8	7	6	5												
..	46	..	19	17	15	13	12	11	10	9	8	7	6	5												
..	47	..	19	17	15	13	12	11	10	9	8	7	6	5												
..	49	..	20	18	16	14	13	12	11	10	9	8	7	6												
..	50	..	20	18	16	14	13	12	11	10	9	8	7	6												
..	51	..	21	19	17	14	13	12	11	10	9	8	7	6												
..	52	..	21	19	17	15	14	13	11	10	9	8	7	6												
..	53	..	22	19	17	15	14	13	12	11	9	8	7	6												
..	54	..	22	20	18	15	14	13	12	11	10	9	7	6												
..	55	..	22	20	18	16	14	13	12	11	10	9	8	6												
..	56	..	23	21	18	16	15	14	12	11	10	9	8	7												
..	57	..	23	21	19	16	15	14	13	11	10	9	8	7												
..	58	..	24	21	19	16	15	14	13	12	10	9	8	7												
..	59	..	24	22	19	17	15	14	13	12	11	9	8	7												
..	60	..	25	22	20	17	16	15	13	12	11	10	8	7												
..	61	..	25	23	20	17	16	15	13	12	11	10	8	7												
..	62	..	25	23	20	18	16	15	14	12	11	10	9	7												
..	63	..	26	23	21	18	17	15	14	13	11	10	9	7												
..	64	..	26	24	21	18	17	16	14	13	12	10	9	8												
..	65	..	27	24	21	18	17	16	14	13	12	10	9	8												
..	66	..	27	24	22	19	17	16	15	13	12	11	9	8												
..	67	..	27	25	22	19	18	16	15	13	12	11	9	8												
..	68	..	28	25	22	19	18	17	15	14	12	11	9	8												
..	69	..	28	25	23	20	18	17	15	14	12	11	10	8												
.	70	..	29	26	23	20	18	17	16	14	13	11	10	8												

Group Covering Range of Pitches for Hole 2 of Outer Gear Box

NOTE: 44 to 47 Tooth Gears can be used on 16" Lathes only

Special Index for Extra Change Gears on Hendey Engine Lathes
For 12″, 14″ and 16″ Only with 6-Pitch Lead Screw

Stud	Screw	Hole	Threads Per Inch											
48	44	3	4 7/12	4 1/8	3 2/3	3 5/24	2 47/48	2 3/4	2 25/48	2 7/24	2 1/16	1 5/6	1 29/48	1 3/8
..	45	..	4 11/16	4 7/32	3 3/4	3 9/32	3 3/64	2 13/16	2 37/64	2 11/32	2 7/64	1 7/8	1 41/64	1 13/32
..	46	..	4 19/24	4 5/16	3 5/6	3 17/48	3 11/96	2 7/8	2 61/96	2 19/48	2 5/32	1 11/12	1 65/96	1 7/16
..	47	..	4 43/48	4 13/32	3 11/12	3 41/96	3 35/192	2 15/16	2 133/192	2 43/96	2 13/64	1 23/24	1 137/192	1 15/32
..	49	..	5 5/48	4 19/32	4 1/12	3 55/96	3 61/192	3 1/16	2 155/192	2 53/96	2 19/64	2 1/24	1 151/192	1 17/32
..	50	..	5 5/24	4 11/16	4 1/6	3 31/48	3 37/96	3 1/8	2 83/96	2 29/48	2 11/32	2 1/12	1 79/96	1 9/16
..	51	..	5 5/16	4 25/32	4 1/4	3 23/32	3 29/64	3 3/16	2 59/64	2 21/32	2 25/64	2 1/8	1 55/64	1 19/32
..	52	..	5 5/12	4 7/8	4 1/3	3 19/24	3 25/48	3 1/4	2 47/48	2 17/24	2 7/16	2 1/6	1 43/48	1 5/8
..	53	..	5 25/48	4 31/32	4 5/12	3 83/96	3 113/192	3 5/16	3 7/192	2 73/96	2 31/64	2 5/24	1 179/192	1 21/32
..	54	..	5 5/8	5 1/16	4 1/2	3 15/16	3 21/32	3 3/8	3 3/32	2 13/16	2 17/32	2 1/4	1 31/32	1 11/16
..	55	..	5 35/48	5 5/32	4 7/12	4 1/96	3 139/192	3 7/16	3 29/192	2 83/96	2 37/64	2 7/24	2 1/192	1 23/32
	56	..	5 5/6	5 1/4	4 2/3	4 1/12	3 19/24	3 1/2	3 5/24	2 11/12	2 5/8	2 1/3	2 1/24	1 3/4
	57	..	5 15/16	5 11/32	4 3/4	4 5/32	3 55/64	3 9/16	3 17/64	2 31/32	2 43/64	2 3/8	2 5/64	1 25/32
..	58	..	6 1/24	5 7/16	4 5/6	4 11/48	3 89/96	3 5/8	3 31/96	3 1/48	2 23/32	2 5/12	2 11/96	1 13/16
..	59	..	6 7/48	5 17/32	4 11/12	4 29/96	3 191/192	3 11/16	3 73/192	3 7/96	2 49/64	2 11/24	2 29/192	1 27/32
..	60	..	6 1/4	5 5/8	5	4 3/8	4 1/16	3 3/4	3 7/16	3 1/8	2 13/16	2 1/2	2 3/16	1 7/8
.	61	..	6 17/48	5 23/32	5 1/12	4 43/96	4 25/192	3 13/16	3 95/192	3 17/96	2 55/64	2 13/24	2 43/192	1 29/32
..	62	..	6 11/24	5 13/16	5 1/6	4 25/48	4 19/96	3 7/8	3 53/96	3 11/48	2 29/32	2 7/12	2 25/96	1 15/16
..	63	..	6 9/16	5 29/32	5 1/4	4 19/32	4 17/64	3 15/16	3 39/64	3 9/32	2 61/64	2 5/8	2 19/64	1 31/32
..	64	..	6 2/3	6	5 1/3	4 2/3	4 1/3	4	3 2/3	3 1/3	3	2 2/3	2 1/3	2
..	65	..	6 37/48	6 3/32	5 5/12	4 71/96	4 77/192	4 1/16	3 139/192	3 37/96	3 3/64	2 17/24	2 71/192	2 1/32
..	66	..	6 7/8	6 3/16	5 1/2	4 13/16	4 15/32	4 1/8	3 25/32	3 7/16	3 3/32	2 3/4	2 13/32	2 1/16
..	67	..	6 47/48	6 9/32	5 7/12	4 85/96	4 103/192	4 3/16	3 161/192	3 47/96	3 9/64	2 19/24	2 85/192	2 3/32
..	68	..	7 1/12	6 3/8	5 2/3	4 23/24	4 29/48	4 1/4	3 43/48	3 13/24	3 3/16	2 5/6	2 23/48	2 1/8
..	69	..	7 3/16	6 15/32	5 3/4	5 1/32	4 43/64	4 5/16	3 61/64	3 19/32	3 15/64	2 7/8	2 33/64	2 5/32
..	70	..	7 7/24	6 9/16	5 5/6	5 5/48	4 71/96	4 3/8	4 1/96	3 31/48	3 9/32	2 11/12	2 53/96	2 3/16

Group Covering Range of Pitches for Hole 3 of Outer Gear Box

NOTE: 44 to 47 Tooth Gears can be used on 16″ Lathes only

SPECIAL INDEX

FOR 18", 20" AND 24" LATHES WITH LEAD SCREW 4 THREADS PER INCH

STUD	SECTOR	HOLE	THREADS PER INCH											
48	44	1	$51\frac{1}{3}$	$47\frac{2}{3}$	44	$40\frac{1}{3}$	$36\frac{2}{3}$	33	$29\frac{1}{3}$	$25\frac{2}{3}$	22	$18\frac{1}{3}$	$16\frac{1}{12}$	$14\frac{2}{3}$
48	45	1	$52\frac{1}{2}$	$48\frac{3}{4}$	45	$41\frac{1}{4}$	$37\frac{1}{2}$	$33\frac{3}{4}$	30	$26\frac{1}{4}$	$22\frac{1}{2}$	$18\frac{3}{4}$	$16\frac{7}{8}$	15
48	46	1	$53\frac{2}{3}$	$49\frac{5}{6}$	46	$42\frac{1}{6}$	$38\frac{1}{3}$	$34\frac{1}{2}$	$30\frac{2}{3}$	$26\frac{5}{6}$	23	$19\frac{1}{6}$	$17\frac{1}{4}$	$15\frac{1}{3}$
48	47	1	$54\frac{5}{6}$	$50\frac{11}{12}$	47	$43\frac{1}{12}$	$39\frac{1}{6}$	$35\frac{1}{4}$	$31\frac{1}{3}$	$27\frac{5}{12}$	$23\frac{1}{2}$	$19\frac{7}{12}$	$17\frac{5}{8}$	$15\frac{2}{3}$
48	49	1	$57\frac{1}{6}$	$53\frac{1}{12}$	49	$44\frac{1}{12}$	$40\frac{5}{6}$	$36\frac{3}{4}$	$32\frac{2}{3}$	$28\frac{7}{12}$	$24\frac{1}{2}$	$20\frac{5}{12}$	$18\frac{3}{8}$	$16\frac{1}{3}$
48	50	1	$58\frac{1}{3}$	$54\frac{1}{6}$	50	$45\frac{5}{6}$	$41\frac{2}{3}$	$37\frac{1}{2}$	$33\frac{1}{3}$	$29\frac{1}{6}$	25	$20\frac{5}{6}$	$18\frac{3}{4}$	$16\frac{2}{3}$
48	51	1	$59\frac{1}{2}$	$55\frac{1}{4}$	51	$46\frac{3}{4}$	$42\frac{1}{2}$	$38\frac{1}{4}$	34	$29\frac{3}{4}$	$25\frac{1}{2}$	$21\frac{1}{4}$	$19\frac{1}{8}$	17
48	52	1	$60\frac{2}{3}$	$56\frac{1}{3}$	52	$47\frac{2}{3}$	$43\frac{1}{3}$	39	$34\frac{2}{3}$	$30\frac{1}{3}$	26	$21\frac{2}{3}$	$19\frac{1}{2}$	$17\frac{1}{3}$
48	53	1	$61\frac{5}{6}$	$57\frac{5}{12}$	53	$48\frac{7}{12}$	$44\frac{1}{6}$	$39\frac{3}{4}$	$35\frac{1}{3}$	$30\frac{11}{12}$	$26\frac{1}{2}$	$22\frac{1}{12}$	$19\frac{7}{8}$	$17\frac{2}{3}$
48	54	1	63	$58\frac{1}{2}$	54	$49\frac{1}{2}$	45	$40\frac{1}{2}$	36	$31\frac{1}{2}$	27	$22\frac{1}{2}$	$20\frac{1}{4}$	18
48	55	1	$64\frac{1}{6}$	$59\frac{7}{12}$	55	$50\frac{5}{12}$	$45\frac{5}{6}$	$41\frac{1}{4}$	$36\frac{2}{3}$	$32\frac{1}{12}$	$27\frac{1}{2}$	$22\frac{11}{12}$	$20\frac{5}{8}$	$18\frac{1}{3}$
48	56	1	$65\frac{1}{3}$	$60\frac{2}{3}$	56	$51\frac{1}{3}$	$46\frac{2}{3}$	42	$37\frac{1}{3}$	$32\frac{2}{3}$	28	$23\frac{1}{3}$	21	$18\frac{2}{3}$
48	57	1	$66\frac{1}{2}$	$61\frac{3}{4}$	57	$52\frac{1}{4}$	$47\frac{1}{2}$	$42\frac{3}{4}$	38	$33\frac{1}{4}$	$28\frac{1}{2}$	$23\frac{3}{4}$	$21\frac{3}{8}$	19
48	58	1	$67\frac{2}{3}$	$62\frac{5}{6}$	58	$53\frac{1}{6}$	$48\frac{1}{3}$	$43\frac{1}{2}$	$38\frac{2}{3}$	$33\frac{5}{6}$	29	$24\frac{1}{6}$	$21\frac{3}{4}$	$19\frac{1}{3}$
48	59	1	$68\frac{5}{6}$	$63\frac{11}{12}$	59	$54\frac{1}{12}$	$49\frac{1}{6}$	$44\frac{1}{4}$	$39\frac{1}{3}$	$34\frac{5}{12}$	$29\frac{1}{2}$	$24\frac{7}{12}$	$22\frac{1}{8}$	$19\frac{2}{3}$
48	60	1	70	65	60	55	50	45	40	35	30	25	$22\frac{1}{2}$	20
48	61	1	$71\frac{1}{6}$	$66\frac{1}{12}$	61	$55\frac{11}{12}$	$50\frac{5}{6}$	$45\frac{3}{4}$	$40\frac{2}{3}$	$35\frac{7}{12}$	$30\frac{1}{2}$	$25\frac{5}{12}$	$22\frac{7}{8}$	$20\frac{1}{3}$
48	62	1	$72\frac{1}{3}$	$67\frac{1}{6}$	62	$56\frac{5}{6}$	$51\frac{2}{3}$	$46\frac{1}{2}$	$41\frac{1}{3}$	$36\frac{1}{6}$	31	$25\frac{5}{6}$	$23\frac{1}{4}$	$20\frac{2}{3}$
48	63	1	$73\frac{1}{2}$	$68\frac{1}{4}$	63	$57\frac{3}{4}$	$52\frac{1}{2}$	$47\frac{1}{4}$	42	$36\frac{3}{4}$	$31\frac{1}{2}$	$26\frac{1}{4}$	$23\frac{5}{8}$	21
48	64	1	$74\frac{2}{3}$	$69\frac{1}{3}$	64	$58\frac{2}{3}$	$53\frac{1}{3}$	48	$42\frac{2}{3}$	$37\frac{1}{3}$	32	$26\frac{2}{3}$	24	$21\frac{1}{3}$
48	65	1	$75\frac{5}{6}$	$70\frac{5}{12}$	65	$59\frac{7}{12}$	$54\frac{1}{6}$	$48\frac{3}{4}$	$43\frac{1}{3}$	$37\frac{11}{12}$	$32\frac{1}{2}$	$27\frac{1}{12}$	$24\frac{3}{8}$	$21\frac{2}{3}$
48	66	1	77	$71\frac{1}{2}$	66	$60\frac{1}{2}$	55	$49\frac{1}{2}$	44	$38\frac{1}{2}$	33	$27\frac{1}{2}$	$24\frac{3}{4}$	22
48	67	1	$78\frac{1}{6}$	$72\frac{7}{12}$	67	$61\frac{5}{12}$	$55\frac{5}{6}$	$50\frac{1}{4}$	$44\frac{2}{3}$	$39\frac{1}{12}$	$33\frac{1}{2}$	$27\frac{11}{12}$	$25\frac{1}{8}$	$22\frac{1}{3}$
48	68	1	$79\frac{1}{3}$	$73\frac{2}{3}$	68	$62\frac{1}{3}$	$56\frac{2}{3}$	51	$45\frac{1}{3}$	$39\frac{2}{3}$	34	$28\frac{1}{3}$	$25\frac{1}{2}$	$22\frac{2}{3}$
48	69	1	$80\frac{1}{2}$	$74\frac{3}{4}$	69	$63\frac{1}{4}$	$57\frac{1}{2}$	$51\frac{3}{4}$	46	$40\frac{1}{4}$	$34\frac{1}{2}$	$28\frac{3}{4}$	$25\frac{7}{8}$	23
48	70	1	$81\frac{2}{3}$	$75\frac{5}{6}$	70	$64\frac{1}{6}$	$58\frac{1}{3}$	$52\frac{1}{2}$	$46\frac{2}{3}$	$40\frac{5}{6}$	35	$29\frac{1}{6}$	$26\frac{1}{4}$	$23\frac{1}{3}$
48	72	1	84	78	72	66	60	54	48	42	36	30	27	24
48	80	1	$93\frac{1}{3}$	$86\frac{2}{3}$	80	$73\frac{1}{3}$	$66\frac{2}{3}$	60	$53\frac{1}{3}$	$46\frac{2}{3}$	40	$33\frac{1}{3}$	30	$26\frac{2}{3}$
48	96	1	112	104	96	88	80	72	64	56	48	40	36	32

SPECIAL INDEX

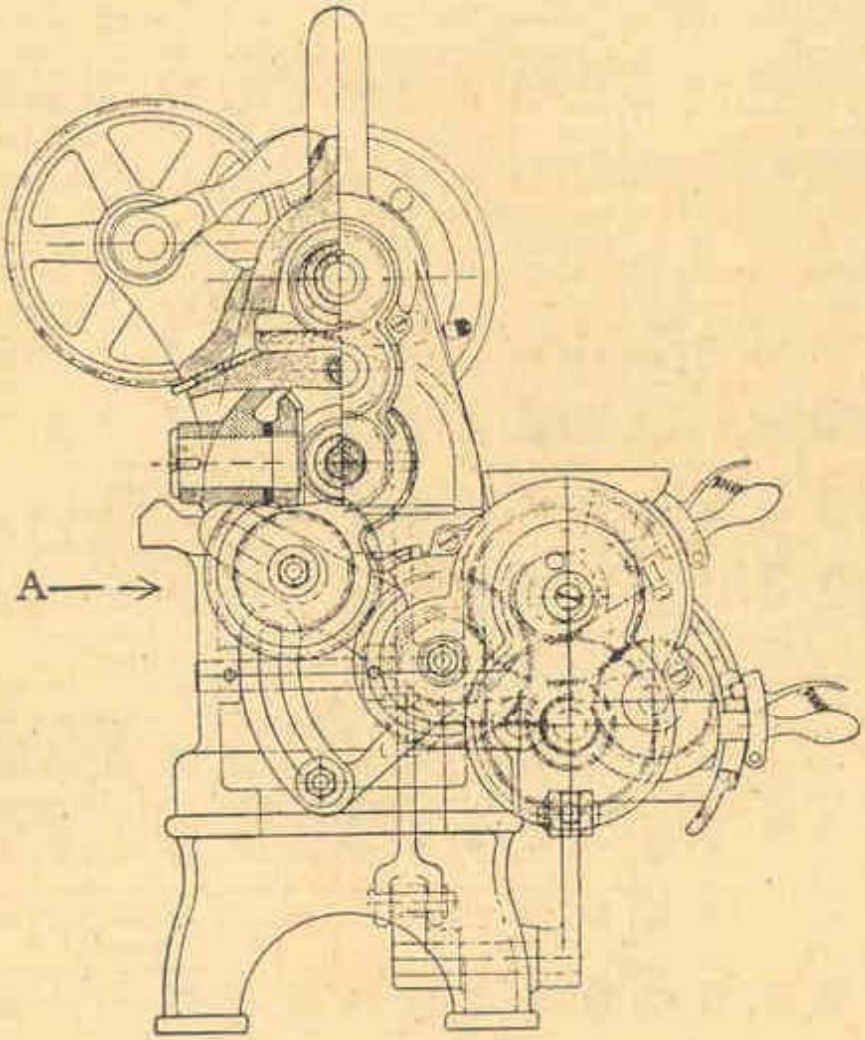
FOR 18", 20" AND 24" LATHES WITH LEAD SCREW 4 THREADS PER INCH

STUD	SECTOR	HOLE	THREADS PER INCH											
48	44	2	$12\frac{5}{6}$	$11\frac{11}{12}$	11	$10\frac{1}{12}$	$9\frac{1}{6}$	$8\frac{1}{4}$	$7\frac{1}{3}$	$6\frac{5}{12}$	$5\frac{1}{2}$	$4\frac{7}{12}$	$4\frac{1}{8}$	$3\frac{2}{3}$
48	45	2	$13\frac{1}{8}$	$12\frac{3}{16}$	$11\frac{1}{4}$	$10\frac{5}{16}$	$9\frac{3}{8}$	$8\frac{7}{16}$	$7\frac{1}{2}$	$6\frac{9}{16}$	$5\frac{5}{8}$	$4\frac{11}{16}$	$4\frac{7}{32}$	$3\frac{3}{4}$
48	46	2	$13\frac{5}{12}$	$12\frac{11}{24}$	$11\frac{1}{2}$	$10\frac{13}{24}$	$9\frac{7}{12}$	$8\frac{5}{8}$	$7\frac{2}{3}$	$6\frac{17}{24}$	$5\frac{3}{4}$	$4\frac{19}{24}$	$4\frac{5}{16}$	$3\frac{5}{6}$
48	47	2	$13\frac{17}{24}$	$12\frac{35}{48}$	$11\frac{3}{4}$	$10\frac{37}{48}$	$9\frac{19}{24}$	$8\frac{13}{46}$	$7\frac{5}{6}$	$6\frac{41}{48}$	$5\frac{7}{8}$	$4\frac{43}{48}$	$4\frac{13}{32}$	$3\frac{11}{12}$
48	49	2	$14\frac{7}{24}$	$13\frac{13}{48}$	$12\frac{1}{4}$	$11\frac{11}{48}$	$10\frac{5}{24}$	$9\frac{3}{16}$	$8\frac{1}{6}$	$7\frac{7}{48}$	$6\frac{1}{8}$	$5\frac{5}{48}$	$4\frac{19}{32}$	$4\frac{1}{12}$
48	50	2	$14\frac{7}{12}$	$13\frac{13}{24}$	$12\frac{1}{2}$	$11\frac{11}{24}$	$10\frac{5}{12}$	$9\frac{3}{8}$	$8\frac{1}{3}$	$7\frac{7}{24}$	$6\frac{1}{4}$	$5\frac{5}{24}$	$4\frac{11}{16}$	$4\frac{1}{6}$
48	51	2	$14\frac{7}{8}$	$13\frac{13}{16}$	$12\frac{3}{4}$	$11\frac{11}{16}$	$10\frac{5}{8}$	$9\frac{9}{16}$	$8\frac{1}{2}$	$7\frac{7}{16}$	$6\frac{3}{8}$	$5\frac{5}{16}$	$4\frac{25}{32}$	$4\frac{1}{4}$
48	52	2	$15\frac{1}{6}$	$14\frac{1}{12}$	13	$11\frac{11}{12}$	$10\frac{5}{6}$	$9\frac{3}{4}$	$8\frac{2}{3}$	$7\frac{7}{12}$	$6\frac{1}{2}$	$5\frac{5}{12}$	$4\frac{7}{8}$	$4\frac{1}{3}$
48	53	2	$15\frac{11}{24}$	$14\frac{17}{48}$	$13\frac{1}{4}$	$12\frac{7}{8}$	$11\frac{1}{24}$	$9\frac{15}{16}$	$8\frac{5}{6}$	$7\frac{35}{48}$	$6\frac{5}{8}$	$5\frac{25}{48}$	$4\frac{31}{32}$	$4\frac{5}{12}$
48	54	2	$15\frac{3}{4}$	$14\frac{5}{8}$	$13\frac{1}{2}$	$12\frac{3}{8}$	$11\frac{1}{4}$	$10\frac{1}{8}$	9	$7\frac{7}{8}$	$6\frac{3}{4}$	$5\frac{5}{8}$	$5\frac{1}{16}$	$4\frac{1}{2}$
48	55	2	$16\frac{1}{24}$	$14\frac{43}{48}$	$13\frac{3}{4}$	$12\frac{29}{48}$	$11\frac{11}{24}$	$10\frac{5}{16}$	$9\frac{1}{6}$	$8\frac{1}{48}$	$6\frac{7}{8}$	$5\frac{35}{48}$	$5\frac{5}{32}$	$4\frac{7}{12}$
48	56	2	$16\frac{1}{3}$	$15\frac{1}{6}$	14	$12\frac{5}{6}$	$11\frac{2}{3}$	$10\frac{1}{2}$	$9\frac{1}{3}$	$8\frac{1}{6}$	7	$5\frac{5}{6}$	$5\frac{1}{4}$	$4\frac{2}{3}$
48	57	2	$16\frac{5}{8}$	$15\frac{7}{16}$	$14\frac{1}{4}$	$13\frac{1}{16}$	$11\frac{7}{8}$	$10\frac{11}{16}$	$9\frac{1}{2}$	$8\frac{5}{16}$	$7\frac{1}{8}$	$5\frac{15}{16}$	$5\frac{11}{32}$	$4\frac{3}{4}$
48	58	2	$16\frac{11}{12}$	$15\frac{17}{24}$	$14\frac{1}{2}$	$13\frac{7}{24}$	$12\frac{1}{12}$	$10\frac{7}{8}$	$9\frac{2}{3}$	$8\frac{11}{24}$	$7\frac{1}{4}$	$6\frac{1}{24}$	$5\frac{7}{16}$	$4\frac{5}{6}$
48	59	2	$17\frac{5}{24}$	$15\frac{47}{48}$	$14\frac{3}{4}$	$13\frac{25}{43}$	$12\frac{7}{24}$	$11\frac{1}{16}$	$9\frac{5}{6}$	$8\frac{29}{48}$	$7\frac{3}{8}$	$6\frac{7}{48}$	$5\frac{17}{32}$	$4\frac{11}{12}$
48	60	2	$17\frac{1}{2}$	$16\frac{1}{4}$	15	$13\frac{3}{4}$	$12\frac{1}{2}$	$11\frac{1}{4}$	10	$8\frac{3}{4}$	$7\frac{1}{2}$	$6\frac{1}{4}$	$5\frac{5}{8}$	5
48	61	2	$17\frac{19}{24}$	$16\frac{25}{48}$	$15\frac{1}{4}$	$13\frac{47}{48}$	$12\frac{7}{24}$	$11\frac{7}{16}$	$10\frac{1}{6}$	$8\frac{43}{48}$	$7\frac{5}{8}$	$6\frac{17}{48}$	$5\frac{23}{32}$	$5\frac{1}{12}$
48	62	2	$18\frac{1}{12}$	$16\frac{19}{24}$	$15\frac{1}{2}$	$14\frac{5}{24}$	$12\frac{11}{12}$	$11\frac{5}{8}$	$10\frac{1}{3}$	$9\frac{1}{24}$	$7\frac{3}{4}$	$6\frac{11}{24}$	$5\frac{13}{16}$	$5\frac{1}{6}$
48	63	2	$18\frac{3}{8}$	$17\frac{1}{16}$	$15\frac{3}{4}$	$14\frac{7}{16}$	$13\frac{1}{8}$	$11\frac{13}{16}$	$10\frac{1}{2}$	$9\frac{3}{16}$	$7\frac{7}{8}$	$6\frac{9}{16}$	$5\frac{29}{32}$	$5\frac{1}{4}$
48	64	2	$18\frac{2}{3}$	$17\frac{1}{3}$	16	$14\frac{2}{3}$	$13\frac{1}{3}$	12	$10\frac{2}{3}$	$9\frac{1}{3}$	8	$6\frac{2}{3}$	6	$5\frac{1}{3}$
48	65	2	$18\frac{23}{24}$	$17\frac{29}{48}$	$16\frac{1}{4}$	$14\frac{43}{48}$	$13\frac{13}{24}$	$12\frac{3}{16}$	$10\frac{5}{6}$	$9\frac{23}{48}$	$8\frac{1}{8}$	$6\frac{37}{48}$	$6\frac{3}{32}$	$5\frac{5}{12}$
48	66	2	$19\frac{1}{4}$	$17\frac{7}{8}$	$16\frac{1}{2}$	$15\frac{1}{8}$	$13\frac{3}{4}$	$12\frac{3}{8}$	11	$9\frac{5}{8}$	$8\frac{1}{4}$	$6\frac{7}{8}$	$6\frac{3}{16}$	$5\frac{1}{2}$
48	67	2	$19\frac{13}{24}$	$18\frac{7}{48}$	$16\frac{3}{4}$	$15\frac{17}{48}$	$13\frac{23}{24}$	$12\frac{9}{16}$	$11\frac{1}{6}$	$9\frac{37}{48}$	$8\frac{3}{8}$	$6\frac{47}{48}$	$6\frac{9}{32}$	$5\frac{7}{12}$
48	68	2	$19\frac{5}{6}$	$18\frac{5}{12}$	17	$15\frac{7}{12}$	$14\frac{1}{6}$	$12\frac{3}{4}$	$11\frac{1}{3}$	$9\frac{11}{12}$	$8\frac{1}{2}$	$7\frac{1}{12}$	$6\frac{3}{8}$	$5\frac{2}{3}$
48	69	2	$20\frac{1}{8}$	$18\frac{11}{16}$	$17\frac{1}{4}$	$15\frac{13}{16}$	$14\frac{3}{8}$	$12\frac{15}{16}$	$11\frac{1}{2}$	$10\frac{1}{16}$	$8\frac{5}{8}$	$7\frac{3}{16}$	$6\frac{15}{32}$	$5\frac{3}{4}$
48	70	2	$20\frac{5}{12}$	$18\frac{23}{24}$	$17\frac{1}{2}$	$16\frac{1}{24}$	$14\frac{7}{12}$	$13\frac{1}{8}$	$11\frac{2}{3}$	$10\frac{5}{24}$	$8\frac{3}{4}$	$7\frac{7}{24}$	$6\frac{9}{16}$	$5\frac{5}{6}$
48	72	2	21	$19\frac{1}{2}$	18	$16\frac{1}{2}$	15	$13\frac{1}{2}$	12	$10\frac{1}{2}$	9	$7\frac{1}{2}$	$6\frac{3}{4}$	6
48	80	2	$23\frac{1}{3}$	$21\frac{2}{3}$	20	$18\frac{1}{3}$	$16\frac{2}{3}$	15	$13\frac{1}{3}$	$11\frac{2}{3}$	10	$8\frac{1}{3}$	$7\frac{1}{2}$	$6\frac{2}{3}$
48	96	2	28	26	24	22	20	18	16	14	12	10	9	8

SPECIAL INDEX

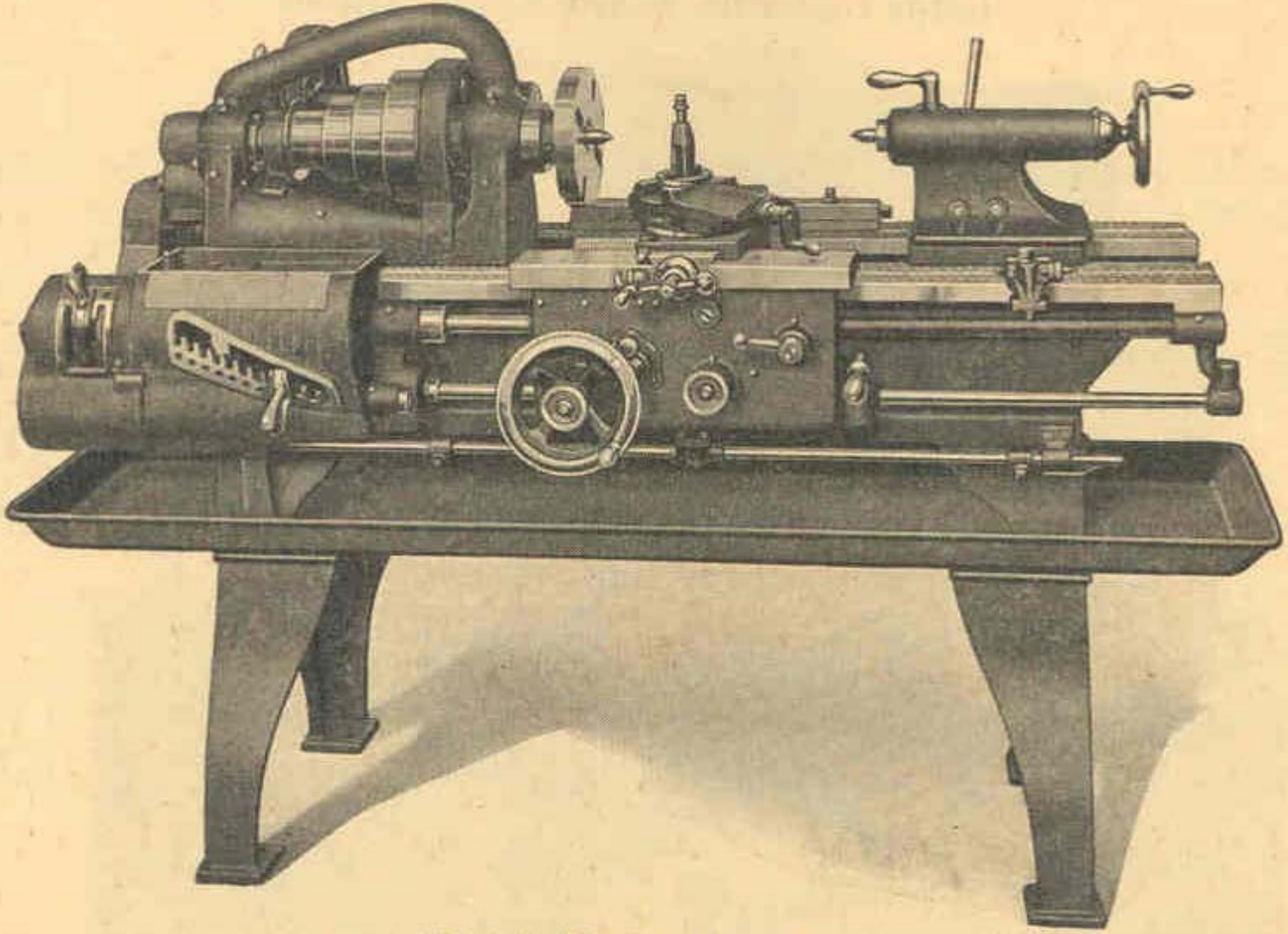
FOR 18", 20" AND 24" LATHES WITH LEAD SCREW 4 THREADS PER INCH

STUD	SECTOR	HOLE	THREADS PER INCH											
48	44	3	$3\frac{5}{24}$	$2\frac{47}{48}$	$2\frac{3}{4}$	$2\frac{25}{48}$	$2\frac{7}{24}$	$2\frac{1}{16}$	$1\frac{5}{16}$	$1\frac{29}{48}$	$1\frac{3}{8}$	$1\frac{7}{48}$	$1\frac{1}{32}$	$\frac{11}{12}$
48	45	3	$3\frac{9}{32}$	$3\frac{3}{64}$	$2\frac{13}{16}$	$2\frac{37}{64}$	$2\frac{11}{32}$	$2\frac{7}{64}$	$1\frac{7}{8}$	$1\frac{41}{64}$	$1\frac{13}{32}$	$1\frac{11}{64}$	$1\frac{7}{128}$	$\frac{45}{48}$
48	46	3	$3\frac{17}{48}$	$3\frac{11}{96}$	$2\frac{7}{8}$	$2\frac{61}{96}$	$2\frac{19}{48}$	$2\frac{5}{32}$	$1\frac{11}{12}$	$1\frac{65}{96}$	$1\frac{7}{16}$	$1\frac{19}{96}$	$1\frac{5}{64}$	$\frac{23}{24}$
48	47	3	$3\frac{41}{96}$	$3\frac{35}{192}$	$2\frac{15}{16}$	$2\frac{133}{192}$	$2\frac{43}{96}$	$2\frac{13}{64}$	$1\frac{23}{24}$	$1\frac{137}{192}$	$1\frac{15}{32}$	$1\frac{43}{192}$	$1\frac{13}{128}$	$\frac{47}{48}$
48	49	3	$3\frac{55}{96}$	$3\frac{61}{192}$	$3\frac{1}{16}$	$2\frac{155}{192}$	$2\frac{53}{96}$	$2\frac{19}{64}$	$2\frac{1}{24}$	$1\frac{151}{192}$	$1\frac{17}{32}$	$1\frac{53}{192}$	$1\frac{19}{128}$	$1\frac{1}{48}$
48	50	3	$3\frac{31}{48}$	$3\frac{37}{96}$	$3\frac{1}{8}$	$2\frac{83}{96}$	$2\frac{29}{48}$	$2\frac{11}{32}$	$2\frac{1}{12}$	$1\frac{79}{96}$	$1\frac{9}{16}$	$1\frac{29}{96}$	$1\frac{11}{64}$	$1\frac{1}{24}$
48	51	3	$3\frac{23}{32}$	$3\frac{29}{64}$	$3\frac{3}{16}$	$2\frac{59}{64}$	$2\frac{21}{32}$	$2\frac{25}{64}$	$2\frac{1}{8}$	$1\frac{55}{64}$	$1\frac{19}{32}$	$1\frac{21}{64}$	$1\frac{25}{128}$	$1\frac{1}{16}$
48	52	3	$3\frac{19}{24}$	$3\frac{25}{48}$	$3\frac{1}{4}$	$2\frac{47}{48}$	$2\frac{17}{64}$	$2\frac{7}{16}$	$2\frac{1}{6}$	$1\frac{43}{48}$	$1\frac{5}{8}$	$1\frac{17}{48}$	$1\frac{7}{32}$	$1\frac{1}{12}$
48	53	3	$3\frac{83}{96}$	$3\frac{113}{192}$	$3\frac{5}{16}$	$3\frac{7}{192}$	$2\frac{73}{96}$	$2\frac{31}{64}$	$2\frac{5}{24}$	$1\frac{179}{192}$	$1\frac{21}{32}$	$1\frac{73}{192}$	$1\frac{31}{128}$	$1\frac{5}{48}$
48	54	3	$3\frac{15}{16}$	$3\frac{21}{32}$	$3\frac{3}{8}$	$3\frac{3}{32}$	$2\frac{13}{16}$	$2\frac{17}{32}$	$2\frac{1}{4}$	$1\frac{31}{32}$	$1\frac{11}{16}$	$1\frac{13}{32}$	$1\frac{17}{64}$	$1\frac{1}{8}$
48	55	3	$4\frac{1}{96}$	$3\frac{139}{192}$	$3\frac{7}{16}$	$3\frac{29}{192}$	$2\frac{83}{96}$	$2\frac{19}{32}$	$2\frac{7}{24}$	$2\frac{1}{192}$	$1\frac{23}{32}$	$1\frac{83}{192}$	$1\frac{37}{128}$	$1\frac{7}{48}$
48	56	3	$4\frac{1}{12}$	$3\frac{19}{24}$	$3\frac{1}{2}$	$3\frac{5}{24}$	$2\frac{11}{12}$	$2\frac{5}{8}$	$2\frac{1}{3}$	$2\frac{1}{24}$	$1\frac{3}{4}$	$1\frac{1}{24}$	$1\frac{5}{16}$	$1\frac{1}{6}$
48	57	3	$4\frac{5}{32}$	$3\frac{55}{64}$	$3\frac{9}{16}$	$3\frac{17}{64}$	$2\frac{31}{32}$	$2\frac{43}{64}$	$2\frac{3}{8}$	$2\frac{5}{64}$	$1\frac{25}{32}$	$1\frac{31}{64}$	$1\frac{43}{128}$	$1\frac{3}{16}$
48	58	3	$4\frac{11}{48}$	$3\frac{89}{96}$	$3\frac{5}{8}$	$3\frac{31}{96}$	$3\frac{1}{48}$	$2\frac{23}{32}$	$2\frac{5}{12}$	$2\frac{11}{96}$	$1\frac{13}{16}$	$1\frac{49}{96}$	$1\frac{23}{64}$	$1\frac{5}{24}$
48	59	3	$4\frac{29}{96}$	$3\frac{191}{192}$	$3\frac{11}{16}$	$3\frac{73}{192}$	$3\frac{7}{16}$	$2\frac{49}{64}$	$2\frac{11}{24}$	$2\frac{29}{192}$	$1\frac{27}{32}$	$1\frac{103}{192}$	$1\frac{49}{128}$	$1\frac{11}{48}$
48	60	3	$4\frac{3}{8}$	$4\frac{1}{16}$	$3\frac{3}{4}$	$3\frac{7}{16}$	$3\frac{1}{8}$	$2\frac{13}{16}$	$2\frac{1}{2}$	$2\frac{3}{16}$	$1\frac{7}{8}$	$1\frac{9}{16}$	$1\frac{13}{32}$	$1\frac{1}{4}$
48	61	3	$4\frac{43}{96}$	$4\frac{25}{192}$	$3\frac{13}{16}$	$3\frac{95}{192}$	$3\frac{17}{96}$	$2\frac{55}{64}$	$2\frac{13}{24}$	$2\frac{43}{192}$	$1\frac{29}{32}$	$1\frac{113}{192}$	$1\frac{55}{128}$	$1\frac{13}{48}$
48	62	3	$4\frac{25}{48}$	$4\frac{19}{96}$	$3\frac{7}{8}$	$3\frac{53}{96}$	$3\frac{11}{48}$	$2\frac{29}{32}$	$2\frac{7}{12}$	$2\frac{25}{96}$	$1\frac{15}{16}$	$1\frac{59}{96}$	$1\frac{29}{64}$	$1\frac{7}{24}$
48	63	3	$4\frac{27}{32}$	$4\frac{17}{64}$	$3\frac{15}{16}$	$3\frac{39}{64}$	$3\frac{9}{32}$	$2\frac{61}{64}$	$2\frac{5}{8}$	$2\frac{19}{64}$	$1\frac{31}{32}$	$1\frac{41}{64}$	$1\frac{61}{128}$	$1\frac{5}{16}$
48	64	3	$4\frac{2}{3}$	$4\frac{1}{3}$	4	$3\frac{2}{3}$	$3\frac{1}{3}$	3	$2\frac{2}{3}$	$2\frac{1}{3}$	2	$1\frac{2}{3}$	$1\frac{1}{2}$	$1\frac{1}{3}$
48	65	3	$4\frac{71}{96}$	$4\frac{77}{192}$	$4\frac{1}{16}$	$3\frac{139}{192}$	$3\frac{37}{96}$	$3\frac{3}{64}$	$2\frac{17}{24}$	$2\frac{71}{192}$	$2\frac{1}{32}$	$1\frac{133}{192}$	$1\frac{67}{128}$	$1\frac{17}{48}$
48	66	3	$4\frac{13}{16}$	$4\frac{15}{32}$	$4\frac{1}{8}$	$3\frac{25}{32}$	$3\frac{7}{16}$	$3\frac{3}{32}$	$2\frac{3}{4}$	$2\frac{13}{32}$	$2\frac{1}{16}$	$1\frac{23}{32}$	$1\frac{35}{64}$	$1\frac{3}{8}$
48	67	3	$4\frac{85}{96}$	$4\frac{103}{192}$	$4\frac{3}{16}$	$3\frac{161}{192}$	$3\frac{47}{96}$	$3\frac{9}{64}$	$2\frac{19}{24}$	$2\frac{85}{192}$	$2\frac{3}{32}$	$1\frac{143}{192}$	$1\frac{73}{128}$	$1\frac{19}{48}$
48	68	3	$4\frac{23}{24}$	$4\frac{29}{48}$	$4\frac{1}{4}$	$3\frac{43}{48}$	$3\frac{13}{24}$	$3\frac{3}{16}$	$2\frac{5}{6}$	$2\frac{23}{48}$	$2\frac{1}{8}$	$1\frac{37}{48}$	$1\frac{19}{32}$	$1\frac{5}{12}$
48	69	3	$5\frac{1}{32}$	$4\frac{43}{64}$	$4\frac{5}{16}$	$3\frac{61}{64}$	$3\frac{19}{32}$	$3\frac{15}{64}$	$2\frac{7}{8}$	$2\frac{33}{64}$	$2\frac{5}{32}$	$1\frac{51}{64}$	$1\frac{79}{128}$	$1\frac{7}{16}$
48	70	3	$5\frac{5}{48}$	$4\frac{71}{96}$	$4\frac{3}{8}$	$4\frac{1}{96}$	$3\frac{31}{48}$	$3\frac{9}{32}$	$2\frac{11}{12}$	$2\frac{53}{96}$	$2\frac{3}{16}$	$1\frac{79}{96}$	$1\frac{41}{64}$	$1\frac{11}{24}$
48	72	3	$5\frac{1}{4}$	$4\frac{7}{8}$	$4\frac{1}{2}$	$4\frac{1}{8}$	$3\frac{3}{4}$	$3\frac{3}{8}$	3	$2\frac{5}{8}$	$2\frac{1}{4}$	$1\frac{7}{8}$	$1\frac{11}{16}$	$1\frac{1}{2}$
48	80	3	$5\frac{5}{6}$	$5\frac{5}{12}$	5	$4\frac{7}{12}$	$4\frac{1}{6}$	$3\frac{3}{4}$	$3\frac{1}{3}$	$2\frac{11}{12}$	$2\frac{1}{2}$	$2\frac{1}{12}$	$1\frac{7}{8}$	$1\frac{2}{3}$
48	96	3	7	$6\frac{1}{2}$	6	$5\frac{1}{2}$	5	$4\frac{1}{2}$	4	$3\frac{1}{2}$	3	$2\frac{1}{2}$	$2\frac{1}{4}$	2



Special index charts on pages 24 to 29 show a series of different pitches obtained with extra change gears through the whole 36 change combination, as afforded with the compound gear box used on all sizes of lathes up to and including 24″. These charts have been worked out for 12″ to 24″ inclusive. These several change gears are applied in position of **outer gear** at A on the sector, as shown in accompanying illustration.

It is better for customers to advise us pitch of thread they wish to cut, that we may select the proper gear in order to save possible error in filling of orders. Also be sure and state serial number and swing of lathe.

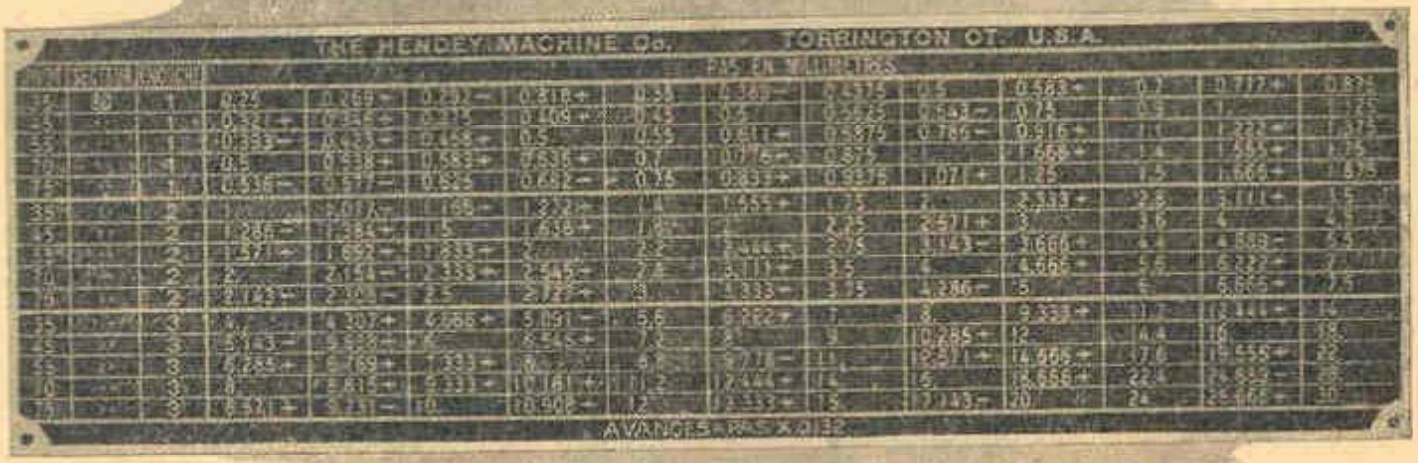


Metric Engine Lathe

Index Plates for Metric Engine Lathes

12″ Plate

14″ Plate



18″ Plate

In order to meet the demands of our foreign trade, we arrange all sizes of our lathes with metric pitch lead screw and special gearing so as to cut the Standard Pitches of the French and International Standards.

For 12″ to 20″ Metric Lathes we use special gear box with metric lead screw. For 24″ Metric Lathes we use the regular or standard gear box supplemented by metric lead screw and special change gears.

Extra change gears can be used, as on the regular lathes, to cut either special Metric or English pitches.

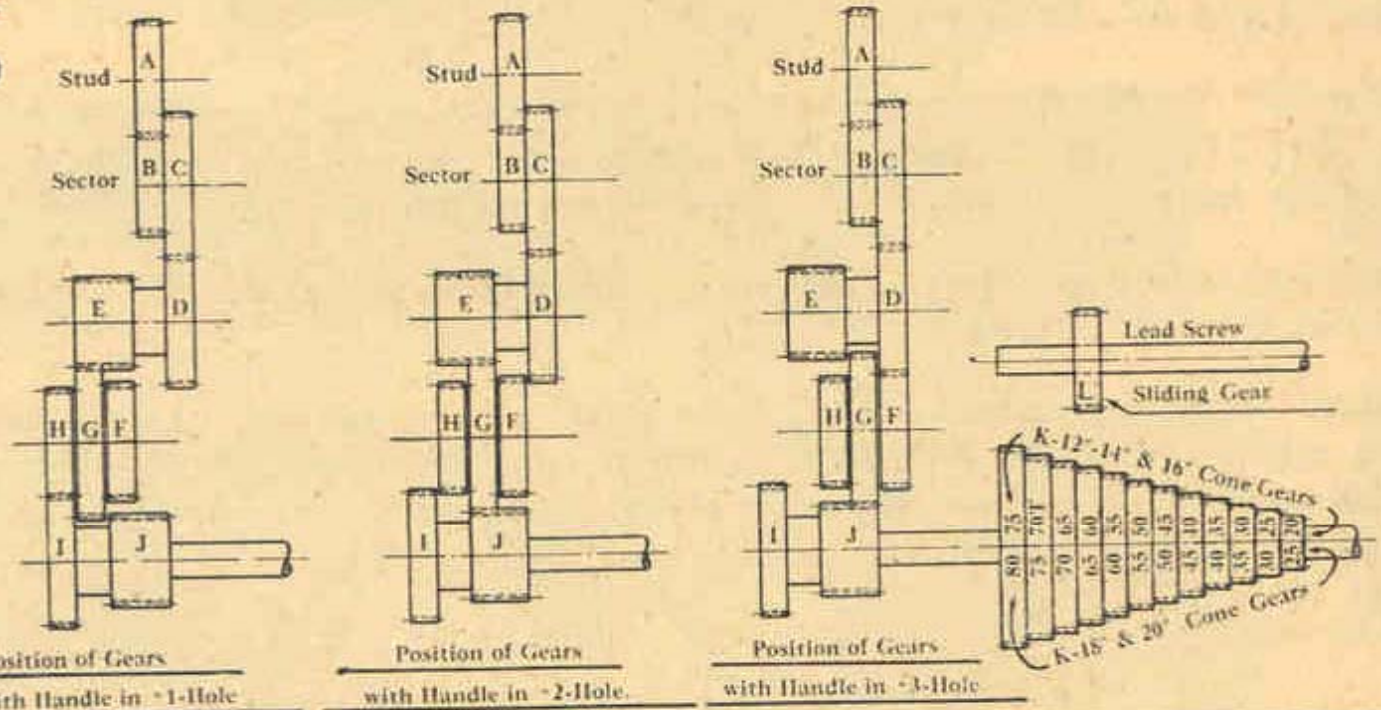
Lead screw, cross-feed screw, thread on nose of spindle, are all made to metric measurements; otherwise the general dimensions are the same for both English and Metric Lathes. Micrometer dial on cross-feed screw is graduated to read in decimals of m/m.

Carriage micrometer stop also has metric screw.

C-1115

METRIC ENGINE LATHE.

Diagram of Feed Gears for 12"-14"-16"-18" & 20" Lathes.



Position of Gears with Handle in "1-Hole

Position of Gears with Handle in "2-Hole.

Position of Gears with Handle in "3-Hole

Number of Teeth in Gears

P = Pitch of Lead Screw

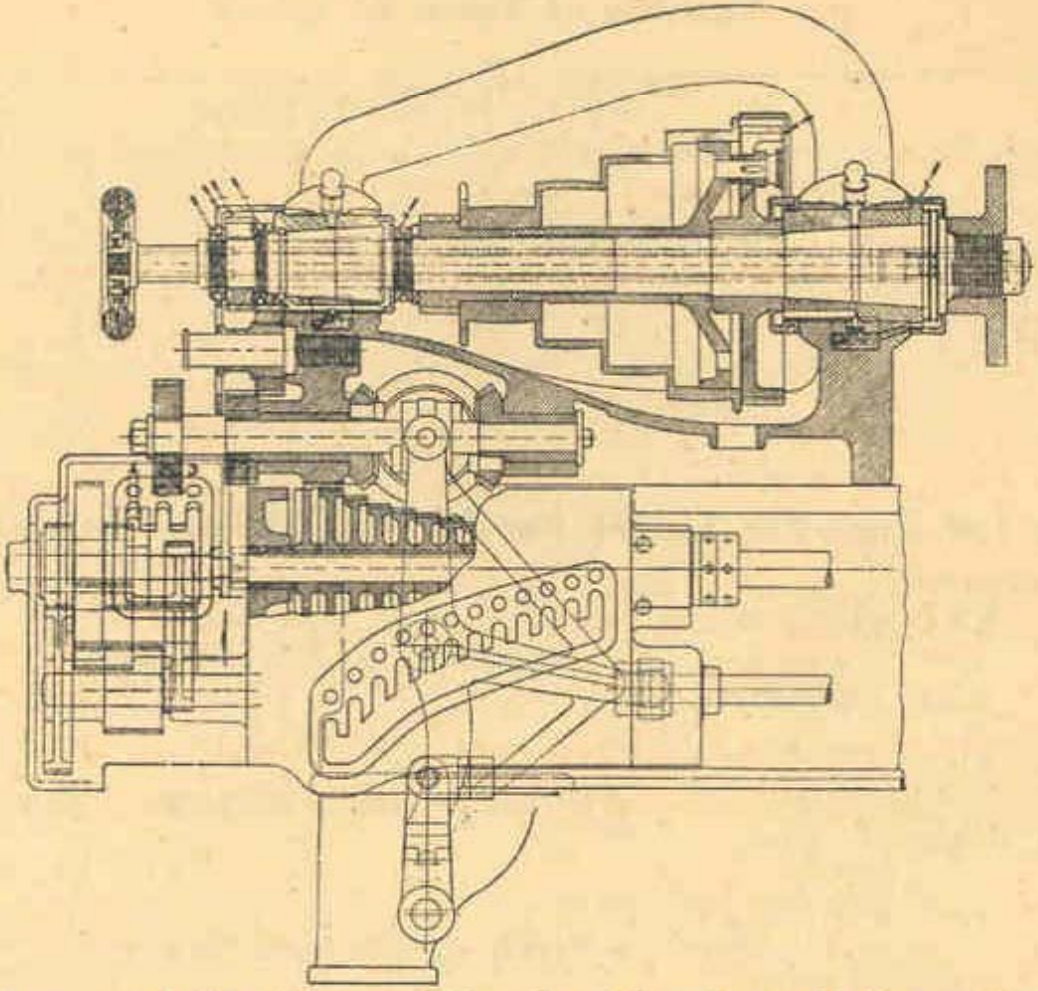
Lathe	C	D	E	F	G	H	I	J	L	P
12″	80	80	40	40	80	30	75	40	40	4 m/m
14″ & 16″	70	70	35	35	70	30	75	35	40	5 m/m
18″ & 20″	70	70	35	35	70	30	75	35	40	7 m/m

Formula for Figuring Gears for M/M Threads in Metric Lathes

Hole No. 1 $\dfrac{A \times C \times E \times H \times K \times P}{B \times D \times E \times G \times I \times L}$ = Pitch in Millimeters.

Hole No. 2 $\dfrac{A \times C \times E \times K \times P}{B \times D \times J \times L}$ = Pitch in Millimeters.

Hole No. 3 $\dfrac{A \times C \times G \times K \times P}{B \times F \times J \times L}$ = Pitch in Millimeters.



Section and Outline of Lathe Head and Gear Boxes

Automatic Stop for Carriage

This attachment automatically disengages sliding clutch and works in conjunction with the Apron Reversing Mechanism.

The attachment consists of a rod running the length of lathe bed and passing through a bracket attached to bottom of apron. At the head end, this rod connects with bell crank and reversing clutch. On the rod, either side of apron is a stop dog which can be clamped at any point, which, when brought into contact with the apron bracket by travel of carriage, serves to carry rod forward in line of travel until clutch is thrown free in head, stopping gear train, and the lead screw and carriage travel.

It is of the utmost value in thread cutting or boring to a required length or depth, working to and from shoulders, or in turning a number of pieces to a given length.

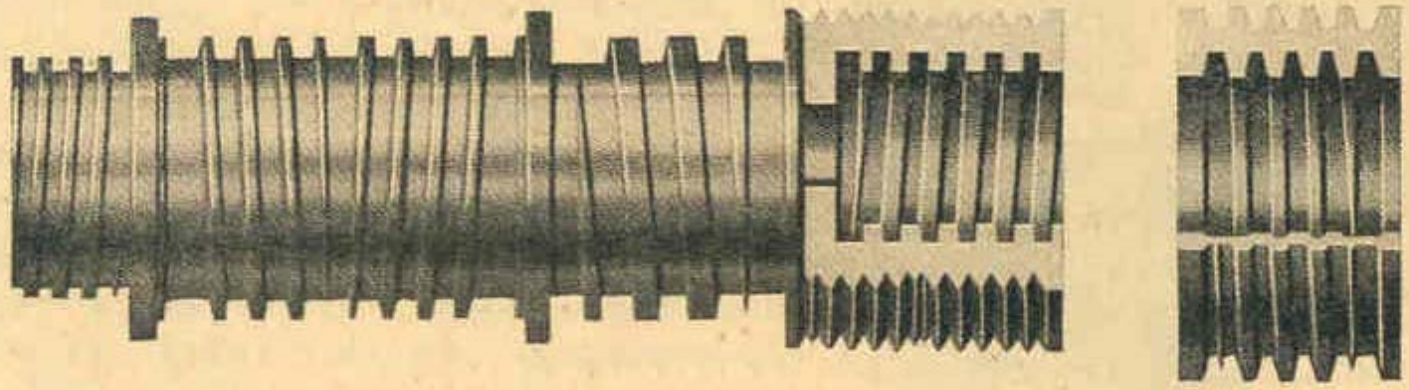
Carriage Reversing Mechanism

This feature enables operator to control the direction of travel of lathe carriage at will from apron. It is one of the most convenient and practical attachments to be had on a lathe. It does away with the working of countershaft shipper for reversing.

This attachment consists of a sliding clutch, working between reversing bevels of lathe head, the clutch being connected by bell crank with reversing rod running length of bed, and operated by lever attached to the side of apron.

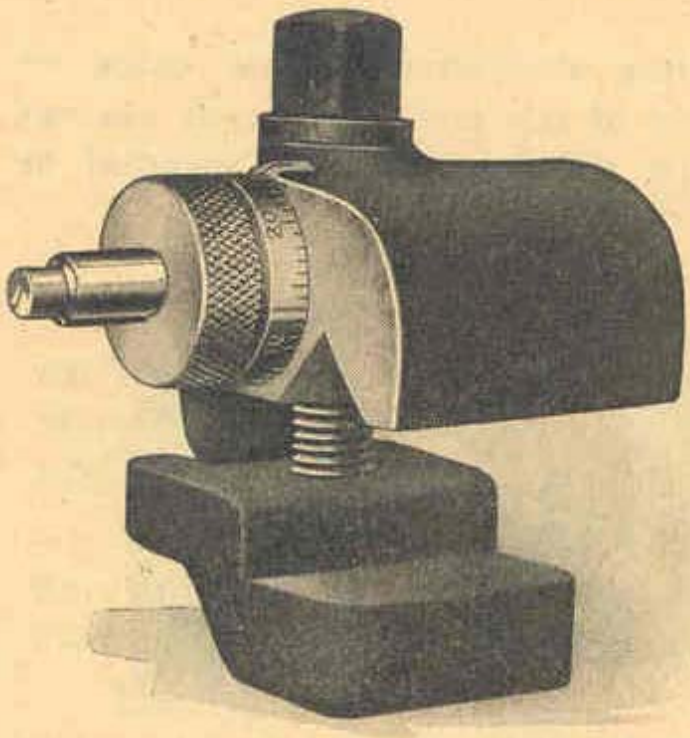
The engagement of clutch gives forward and reverse travel to lathe carriage through train of gear and lead screw, doing away with necessity of backing belt, allowing spindle to run in one direction, and giving **double the number of spindle speeds** by running both counter belts in cutting direction.

Accompanying illustration of thread cutting demonstrates the value of Apron Reverse and Automatic Stop Mechanisms of our lathes. Threads are cut to and from shoulders with ease and certainty, whether they are internal or external, right or left hand.



It is to be noted that in all uses of Apron Reverse and Automatic Stop Mechanisms, the spindle rotates in one direction only, there being no necessity to reverse the lathe from countershaft down.

Carriage Stop for Hendey Lathe



This Carriage Stop is valuable as a Micrometer Spacing Attachment. The spindle is threaded 20 per inch, and knurled nut has 50 graduations reading in thousandths. Spindle has travel in excess of one inch. By way of illustration, it will be seen that the stop can be used to advantage in accurately spacing for a number of grooves, or in squaring off any desired thickness of metal from face plate, etc. This carriage stop is always furnished as part of the regular equipment of each Hendey Lathe.

Directions for Use of Carriage Stop

For Quick Return in Cutting Long Threads

Set the Automatic Stop so as to stop the tool at the finished end of the cut. Leaving the carriage in this position, measure the length of screw you are about to cut from the tool to the end, then place the carriage stop on the bed, away from carriage a distance equal to length of screw and as much more as

will make the travel of the carriage in even inches or half inches, according to the pitch you are to cut.

If the thread being cut is an odd one, as 5, 7, 11, make the travel of carriage in FULL inches. If even, make the travel in inches or half inches.

For example: To cut 7 pitch, 10⅛" long, set the stop on the bed 11" from end of carriage, as the carriage stands at the end of the cut. To cut 14 pitch, 10⅛" long, set the stop 10½" from end of the carriage.

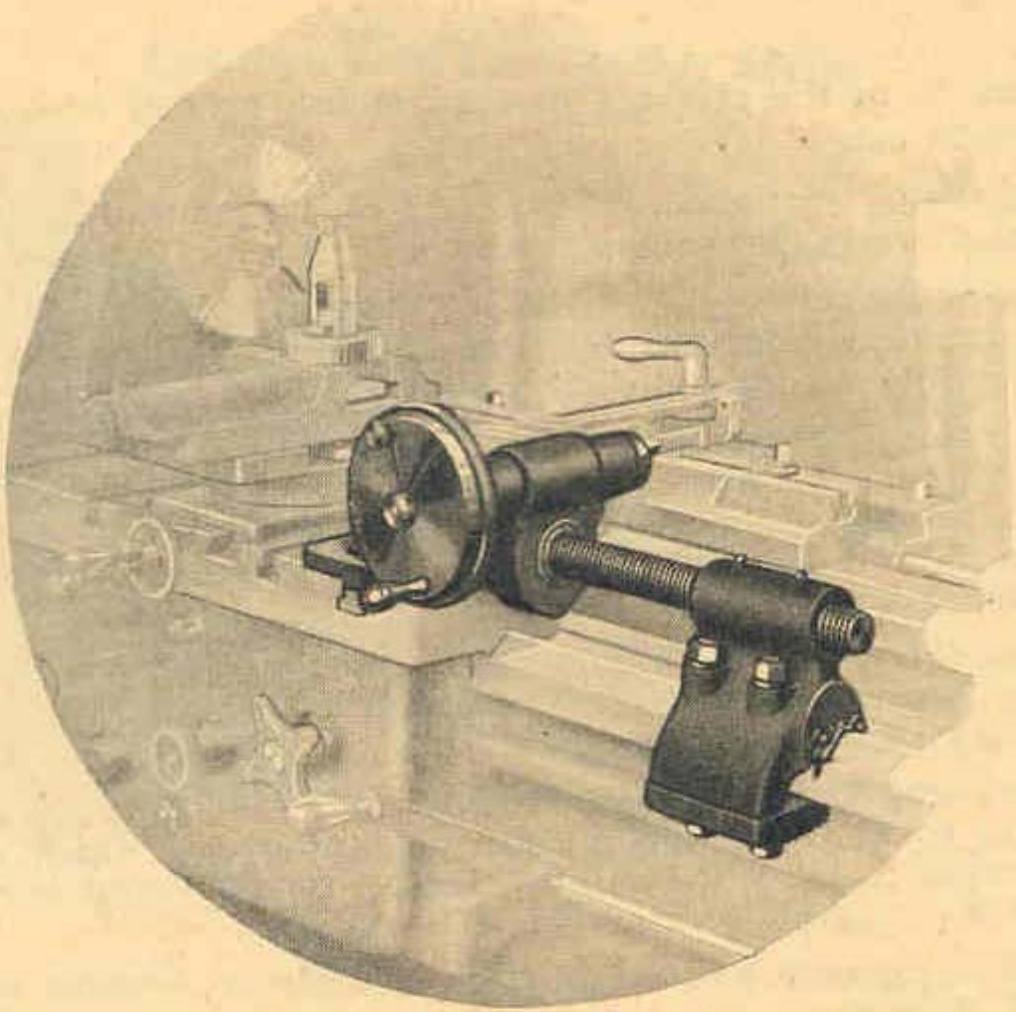
After setting the Carriage Stop, open the half nuts from the lead screw and bring the carriage back by hand until it comes in contact with the stop screw. Then lock the half nuts in the lead screw again, and start the carriage forward on the cut by means of the lever at the end of the apron. Repeat the operation until thread is finished.

It is seen that the spindle is running constantly in one direction until thread is finished, and lead screw is at rest after reaching end of thread and while returning carriage by hand and locking in half nuts.

For all short lengths of threads running under three inches, set the Automatic Stop so as to stop the tool at the beginning and finish of the thread, running the carriage back and forth by means of reversing lever at the end of the lathe apron.

Note—On short threads but of fine pitch it is better to make quick return by hand as for long threads.

Some multiple threads may be accurately spaced and the same chip taken over each thread successively by properly locating the carriage stop on the bed and returning the carriage by hand as explained above.



Carriage Spacing Attachment

This attachment is designed and furnished for the purpose of enabling toolmakers to secure carriage spacings accurately to .0001". To obtain this precision it necessarily means that all the working parts of this attachment must be made

accurately. The screw is cut with the same care that is applied to our precision lead screws. The nut is tapped with ground thread taps. The gearing is likewise cut with precision methods and every part is carefully inspected and tested.

The main casting is bolted to the front right wing of carriage. The nut is fitted to bracket casting which is clamped to front Vee of lathe bed, and nut can readily be replaced in event of excessive wear. Special pains are taken to insure accurate alignment of nut with screw.

The disc hand wheel is keyed to gear shaft, and has a roller handle. A binder of the split block type is applied to the hand wheel shaft, clamping it with horizontal thrust and preventing shaft from turning out of position after being set.

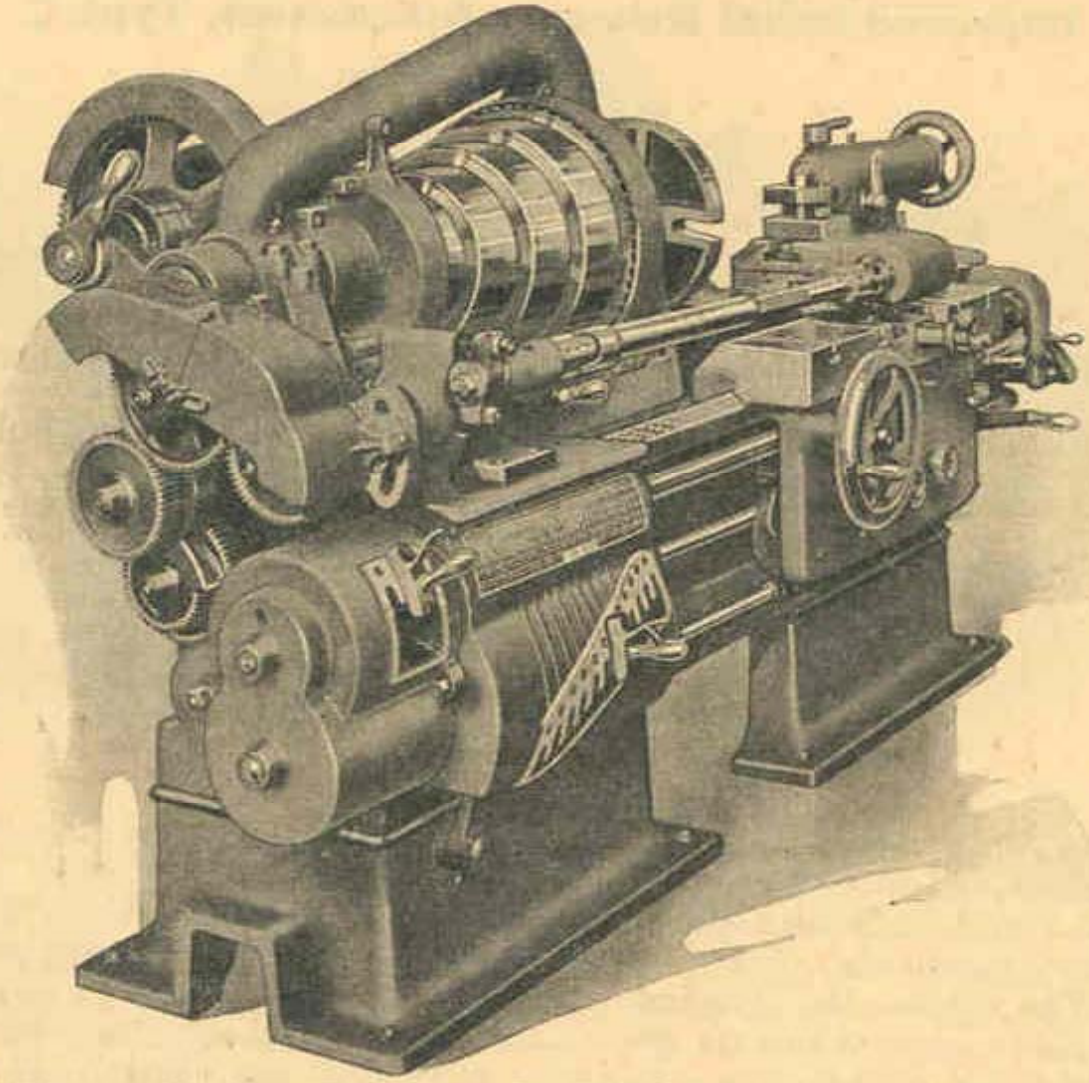
The graduated dial is entirely separate from the hand wheel and runs free on hub of wheel. The two are locked with Tee bolt running in annular slot in dial. the bolt having knurled binding nut as shown on the face of wheel. The advantage of free dial is that it can be brought back to zero for each subsequent reading, so avoiding the necessity of repeated additions.

The dials for 12″ to 20″ attachments are 6″ in diameter, the dial for 24″ attachment is 7″ in diameter, and all are graduated in tenths of thousandths of an inch, giving direct reading without the use of a vernier.

The screws for 12″ and 14″ attachments are ⅞″ diameter, 8 pitch, for 16″, 18″ and 20″ attachments 1¼″ diameter, 5 pitch, and 24″ attachment 1½″ diameter, 4 pitch.

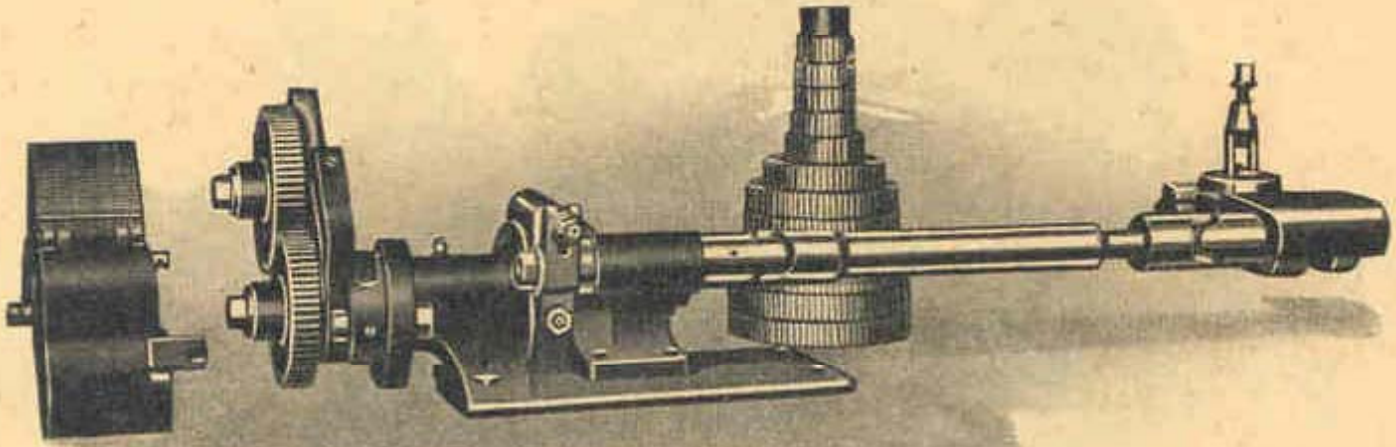
Relieving Attachments

For Hendey Engine Lathes

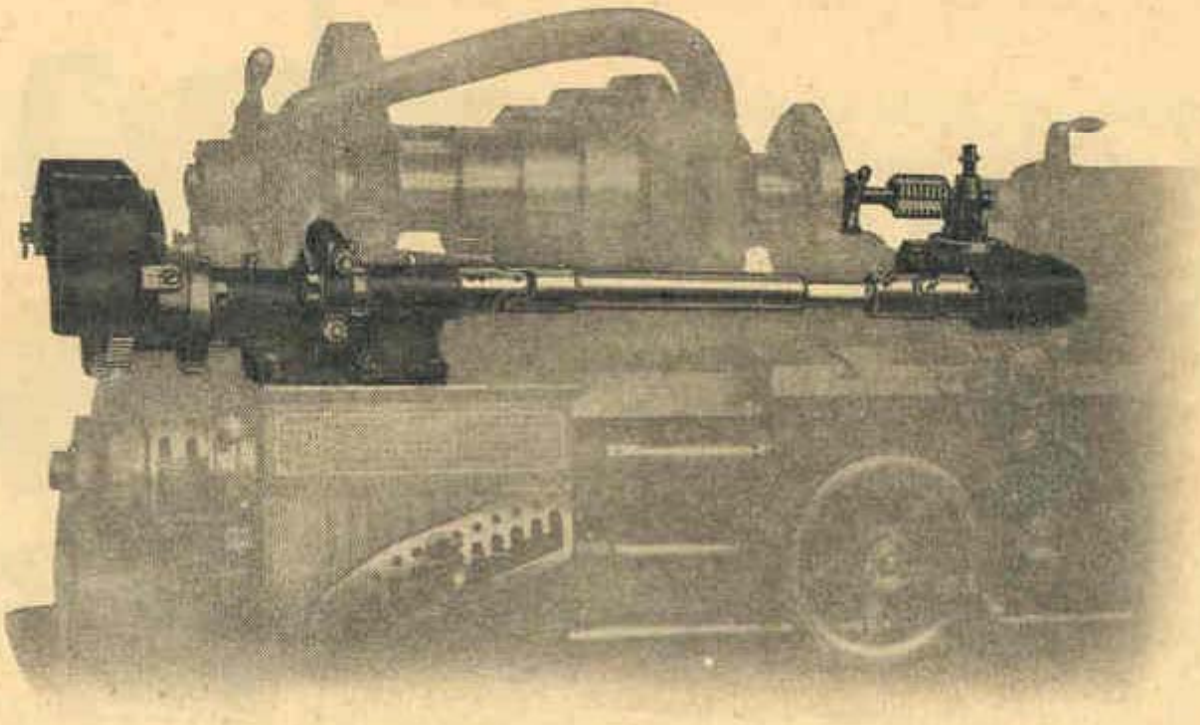


24″ Tool Room Lathe Equipped with Type C Relieving Attachment

Improved Spiral Relieving Attachment, Type C

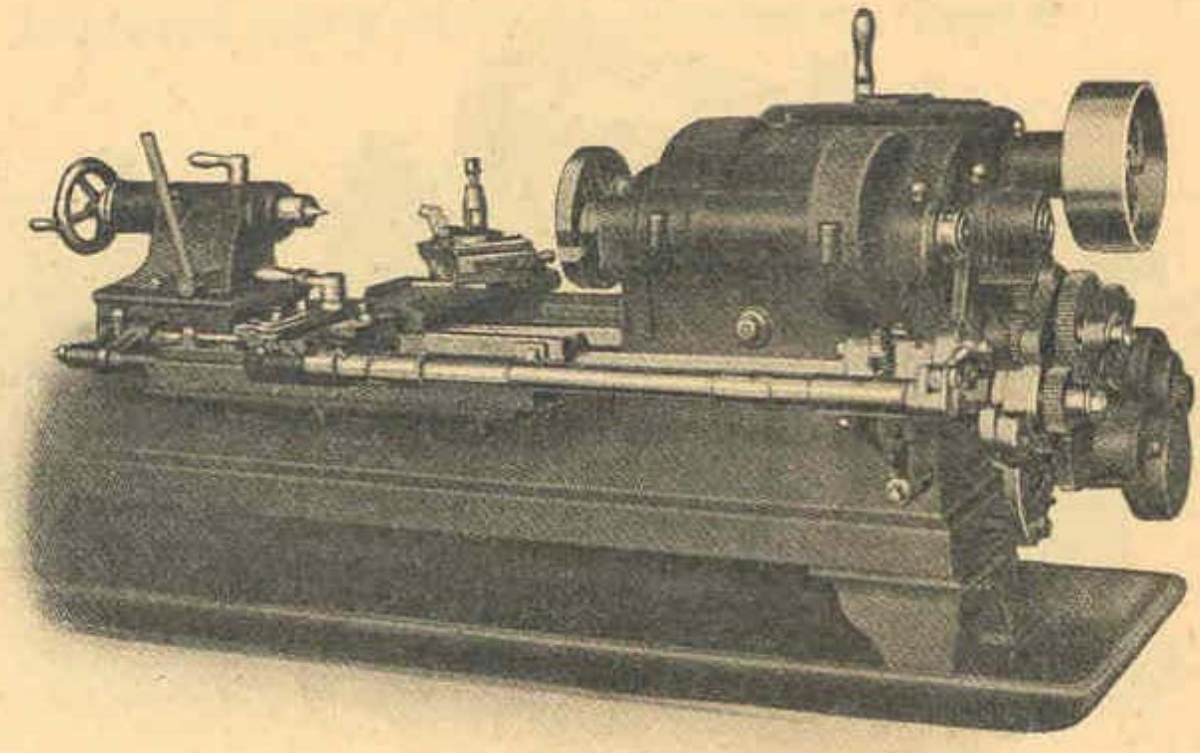


The value of relieving taps, hobs, and cutters by some mechanical means which will produce uniform results is self-evident and needs no elaborate demonstration. With this attachment we not only obtain all ordinary forms of relieving with straight flutes, but in addition thereto relieve taps and hobs with spiral flutes. The advantage of spiral over straight flutes in tools of this character with coarse leads is obvious. It gives the tool a cutting edge which is square with the body of tooth and so properly balanced, enabling such tools to cut better and faster.



Application of Attachment to Lathe

The actuating mechanism is mounted on main gear box, displacing tool pan or cover of same. The tool slide interchanges with compound or other rest on top of cross slide and incorporates the natural advantage of the swiveling feature on slide to secure suitable positions for side and end reliefs as shown in cuts on pages 58 and 59. The placing of complete attachment in position occupies but a very few minutes.



Improved Spiral Relieving Attachment, Type D

This type of relieving attachment is designed for use on Geared Head Lathes. Power is taken from feed stud gear of lathe head the same as for thread cutting. A sector or quadrant is employed to bring gearing into mesh with gear on end of cam shaft. But one cam is used and this is well protected by a casing which forms part of the main supporting bracket for attachment.

On outer end of camshaft is a T-slotted plate in which runs binding bolt for connecting rod which imparts reciprocating motion to universal joint shaft. Amount of travel is governed by the off-center setting given connecting-rod bolt. Eccentric shaft which operates cross slide is carried in a frame which travels on taper attachment slide and engages with cross-feed screw connecting block and top link similar to regular taper attachment connections. If lathe is furnished without taper attachment, a suitable bracket must be supplied to support this mechanism.

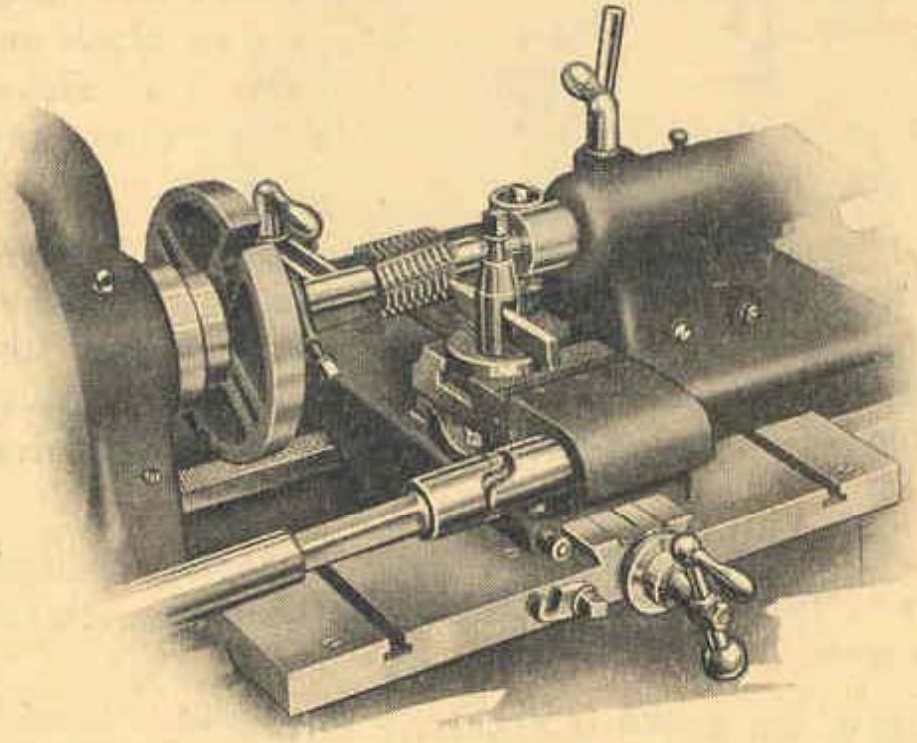
Where taper attachment is furnished, this relieving attachment can be used on taper as well as straight work; also handles all ordinary forms, as described in following pages, including spiral relief, but cannot be used for end or side relief, as described on pages 58 and 59. Methods of securing relief are the same as given for Type C Attachment. Range of flutes per revolution is 2 to 18, inclusive, and by even numbers beyond to 26.

Type D Attachment can be furnished with cone head lathes if desired. Three-speed countershaft is regularly furnished for lathe when relieving attachment is ordered.

Change gears are exposed in view, but guard is regularly furnished.

Special Directions for Relieving Spiral-Fluted Hobs and Taps

When a hob or tap is to have spiral flutes relieved on this attachment, first determine or select the pitch of the spiral and the gears necessary to drive the attachment. After the attachment is properly geared to suit the spiral and number of flutes, the lead screw is engaged and the backing off process can go on as for straight flutes. Be careful not to disengage the lead screw, but reverse the carriage by power, using for that the lever at right of apron.



Relieving Spiral-Fluted Hob

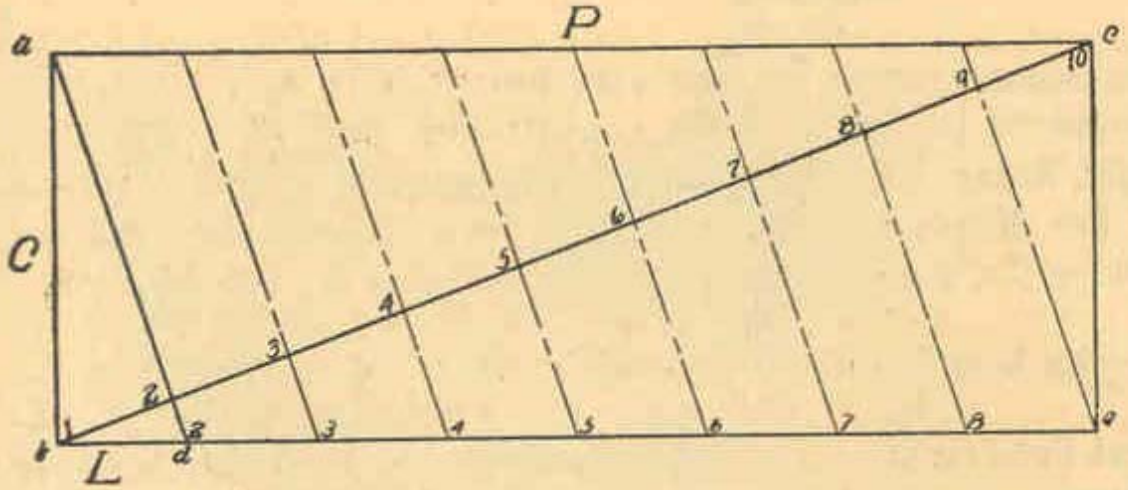
Pitch of Spiral

When determining the Pitch of Spiral it must be remembered that quite a variation in length can be made without any serious drawback.

To obtain the correct pitch of spiral at right angles to the thread the following formula may be used:

C=Circumference of hob at pitch line
L=Lead of Thread
P=Pitch of Spiral

$$\frac{C^2}{L}=P$$



Referring to Diagram where

C or a b=Circumference of hob at pitch line
L or b d=Lead of thread
P or a c=Pitch of spiral flutes
ad represents thread
bc represents flute or groove

It will be seen that the triangles *bac* and *dba* are similar. That is, they are both right angle triangles and the angles *bca* and *bad* are equal; so are *bda* and *abc*. Therefore, their corresponding sides are proportional and we have

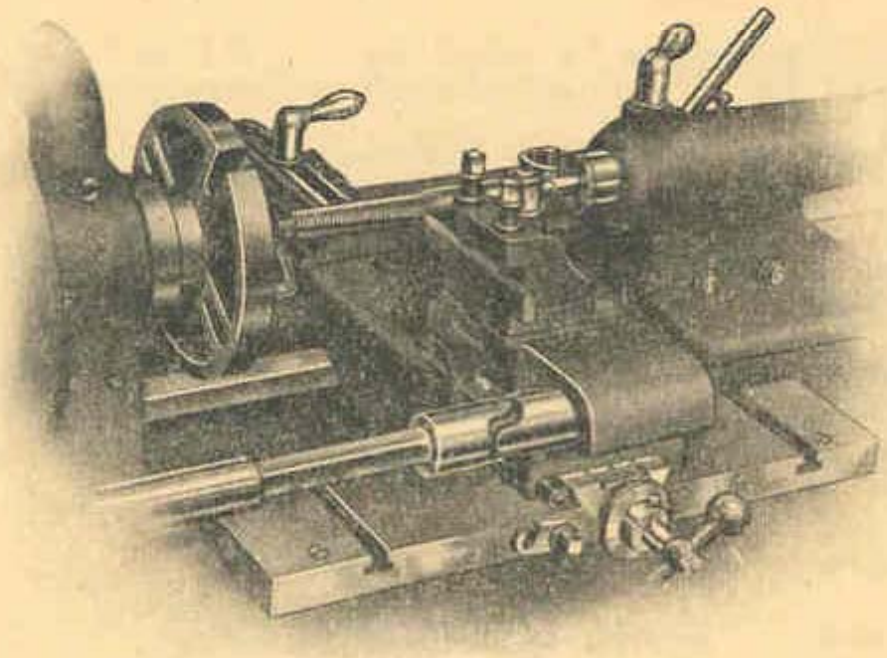
$$ac : ab :: ab : bd$$

Then $\frac{ac}{ab}=\frac{ab}{bd}$, $ab\times ab=ac\times bd$, $\frac{ab\times ab}{bd}=ac=\frac{ab^2}{bd}$ or $\frac{C^2}{L}=P$, equals pitch of spiral flutes or grooves.

The selecting of the gears to compensate for the spiral will decide if we are to use the correct pitch or change it for a more convenient one.

Gearing

To select gears for relieving spirals on our attachment it is well to at first ignore the number of flutes to be cut in hob, considering only the difference between spiral and straight flutes. For instance, we will assume a single thread hob having only *one* flute, see diagram dotted lines parallel to *ad* representing the thread and *bc* the spiral flute. In the case of a straight flute *ac* we would have a number of teeth equal to the length of hob divided by the lead of thread or $\frac{P}{L}$. But when we have a spiral flute *bc*, it will be seen by referring to diagram along line *bc* that there is *one more* tooth than on the straight flute. Then if M = number of teeth for straight flute, and N = number of teeth for spiral flute, we have $M = \frac{P}{L}$ $N = \frac{P}{L} + 1$. This establishes V the ratio of the gears wanted to compensate for the spiral, or $\frac{N}{M}$. For any number of flutes the gears called for on index are used as indicated for that number and the compensating gears added as compound.



Relieving Left Hand Tap with Spiral Flutes

Example

A hob with a pitch circumference of 3.25″ and a single thread of .75″ lead has 6 spiral flutes.

We have pitch of

$$\text{Spiral} = \frac{3.25^{3}}{.75} = 14.083''.$$

We take 14″ as being near enough for practical purposes.

$$\text{Then } M = \frac{14}{.75} = 18\tfrac{3}{4}$$

$$N = \frac{.75}{14} + 1 = 19\tfrac{3}{4}$$

$$\text{Ratio } \frac{19\frac{3}{4}}{18\frac{3}{4}} = \frac{59}{56}$$

Therefore the compensating gears can be 59 and 56 teeth respectively, 59 being the driver. Index for 6 flutes calls for 60 tooth gear on stud and 40 tooth gear on cam shaft.

Example

Placing the compensating gears on the radius bar, we have

Stud, 60,
Intermediate, 56—59,
Cam Shaft, —40.

It is understood that the position of gears 60 and 59 called drivers can be transposed, also the 56 and 40, known as driven. Should the gears M and N be too large, others may be found by using the following formula covering the whole train of gears:

F=Number of flutes or grooves.

4=Number of rises in cam.

Then $\frac{F \times N}{4 \times M}$ equals ratio of gearing for F flutes, milled spiral, and ignoring the index.

Example

A hob 1.84″ pitch diameter and a lead of ⅓″ is to have seven spiral flutes. Using the same symbols as previously, we have

$C = 1.84'' \times 3.1416 = 5.78'$.

$L = \frac{1}{3}''$.

$F = 7$.

Then $P = \frac{5.78^2}{\frac{1}{3}} = 100.225''$ and we take 100 as being near enough.

$M = \frac{100}{\frac{1}{3}} = 300 \qquad N = \frac{100}{\frac{1}{3}} + 1 = 301$

Then $\frac{7 \times 301}{4 \times 300} = \frac{2107}{1200} = \frac{49 \times 43}{30 \times 40}$ Drivers, Driven

as the gears wanted. But as the four gears obtained will not fill the center distance between stud and cam shaft, we multiply 43 and 30 each by two and we have

49×86 Drivers,
40×60 Driven

as the train of gears wanted.

Proper Use of Attachment

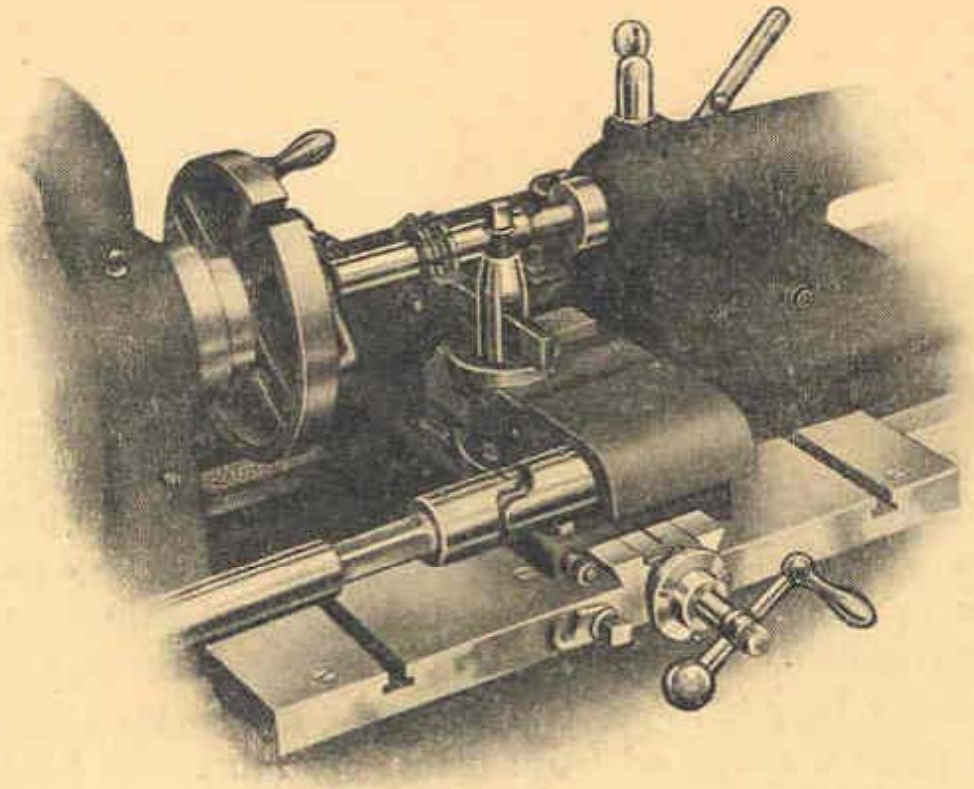
In order to do the work of relieving successfully it is necessary to observe certain conditions. First: The work should revolve much slower than for turning to give the tool slide time to operate properly. Approximately 180 teeth relieved per minute should be the maximum, and in cases where wide forming tools are used the speed may have to be reduced to as low as 8 teeth per minute. This requires very slow spindle speed which must be allowed for in countershaft R. P. M. or otherwise. Second: The tools should at all times have a keen edge. Third: The tool slide should work freely but without undue looseness in the dovetail.

A good plan after the cutter has been formed is to color it either by heating or dipping it in a strong solution of copper sulphate. That will enable the operator to see plainly the result of the work and stop relieving at the proper time. **Remilling after backing off insures a sharp edge and less grinding after hardening the cutter.**

Varying Amount of Relief

It is very often desirable to change the amount of relief from one type of cutter to another. This is accomplished in a simple and easy manner in Type C Attachment by providing ends of oscillating shaft and cam lever with a toothed coupling which permits us to change relative position of eccentric on tool slide to cam lever, thereby lengthening or shortening the reciprocating travel of tool. This adjustment gives a range of from 0 to approximately 5/32" motion to tool slide on 14, 16, and 18", $\frac{3}{16}$" on 20", and $\frac{1}{4}$" on 24".

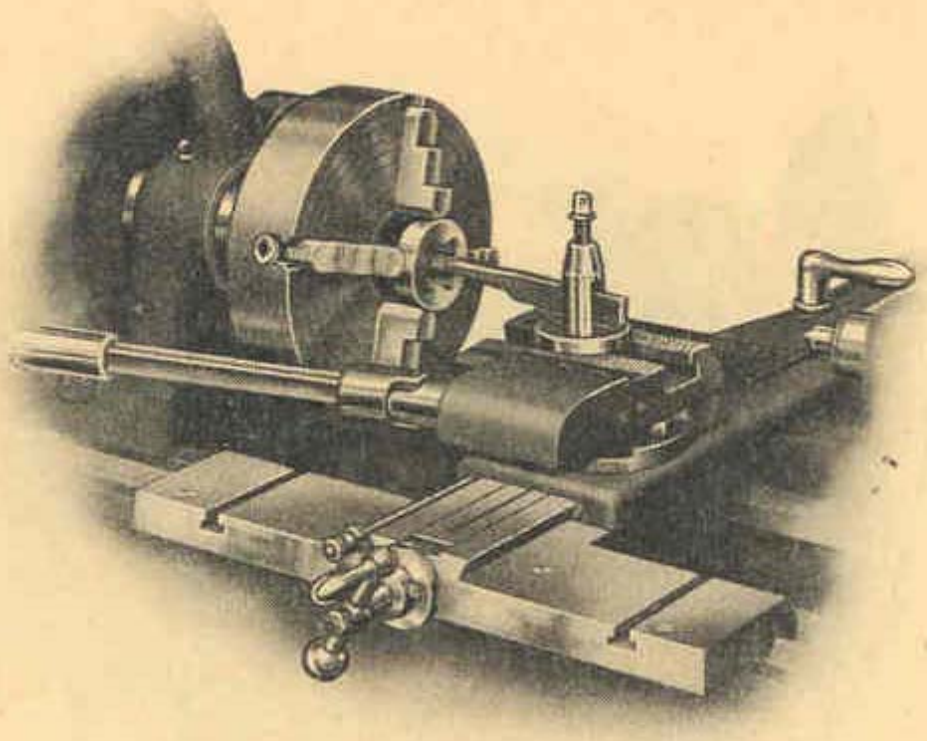
In Type D Attachment this is obtained by moving connecting-rod bolt to or from center in radial slot of cam shaft plate.



Relieving Formed Cutters

It is on this class of work that the attachment can be used to very material advantage. Special shapes are often wanted not listed in cutter catalogues, and to have them manufactured outside means high cost and long delivery. With a relieving attachment on hand, such cutters can be made any time they are wanted, the attachment thus becoming an important factor in the production of tools which maintain manufacturing efficiency.

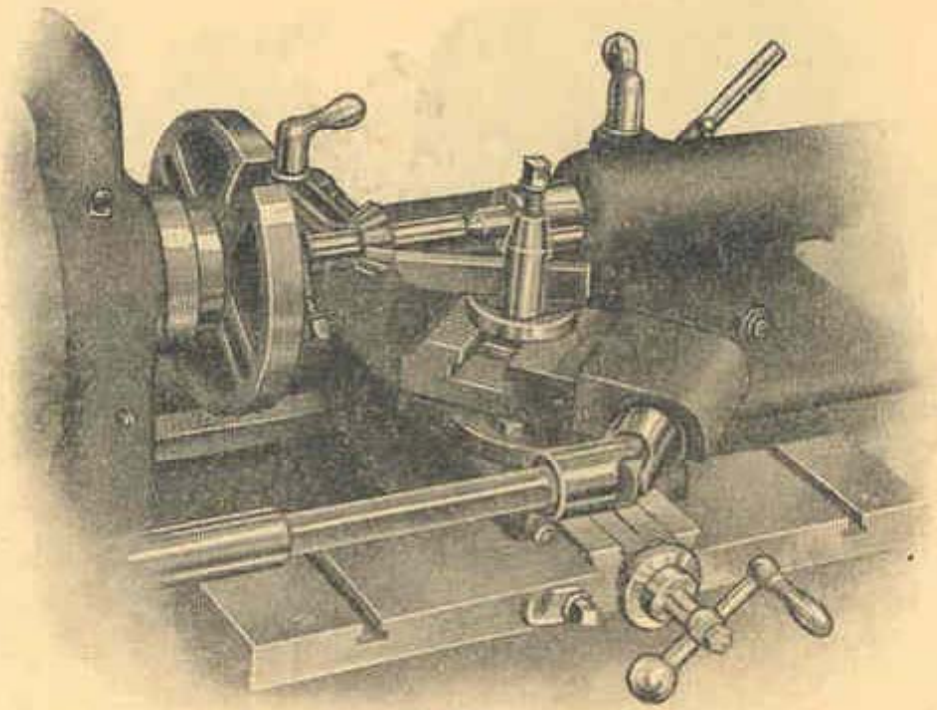
Working speeds at which cutters of this character are relieved are necessarily slow, being governed largely by width of cut taken.



Inside Relieving

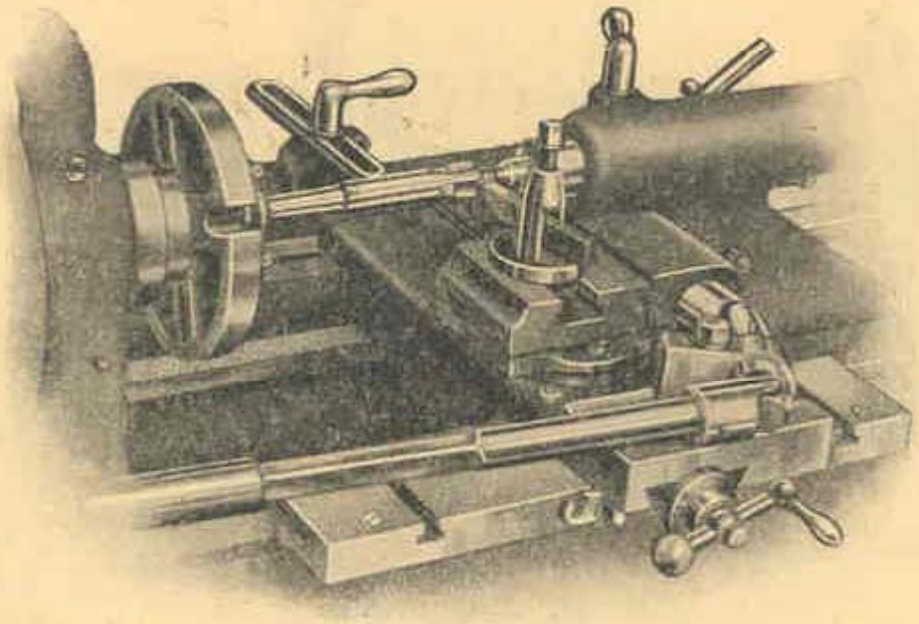
When used for inside work as on hollow mills and threading dies, the eccentric controlling travel of tool slide is to be set so that the relieving is done away from instead of toward the axis of cutter. This change is accomplished at the toothed coupling of cam lever and oscillating shaft, rolling the latter beyond the zero mark clockwise as much as necessary to get the desired amount of travel in tool slide. On Type D Attachment, however, this adjustment is made by setting connecting-rod bolt beyond center in rocker head slot.

For internal work it is also necessary to change the position of opposing spring in tool slide, so it will press against end of slide to prevent tool from jumping into work when in cut. The spring referred to is found in position by removing tool-slide hood.



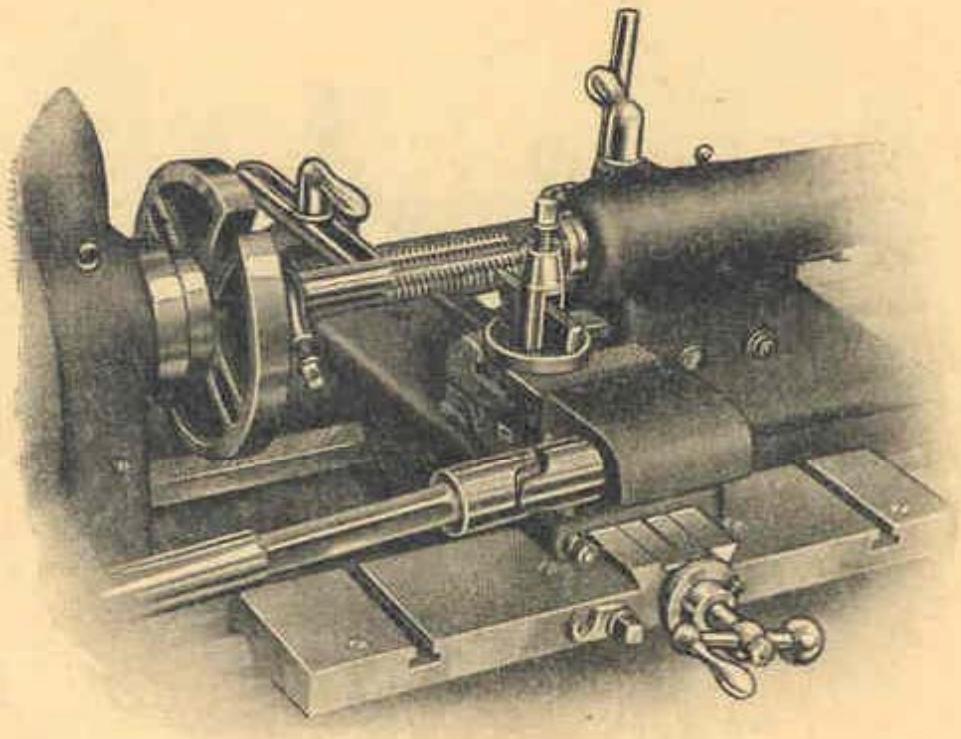
Relieving Sides of Angular Cutters

The wide application of attachment is shown in this illustration in that surfaces not only parallel with axis can be easily relieved, but by means of the swiveling feature of tool slide the tool can be brought into proper position for side relief as well.



Relieving Counterbores

Accomplished successfully by the use of two additional universal joints, block, and shaft, to permit the tool slide to be swung to a 90 degree angle.



Relieving Right-Hand Taps

The ordinary practice in setting up this attachment to relieve a right-hand tap is to first set tool as to cut thread, then engage it accurately in the thread space by rolling work in the dog, or dropping a tooth or two in the gear box; now arrange motion of tool slide so forward movement of tool will meet the head of tooth and return promptly after leaving end. **Work should always be fluted before relieving.**

Relieving Left-Hand Taps

These can be relieved by two different methods. First, the usual way of starting the cut at the cutting edge and ending at the heel, pushing the tool into the work; second, starting at the heel and leaving off at the cutting edge, drawing the tool out of the work during the cut.

When using the first method, the tap must be placed with the point toward the live spindle with the shank end supported by tail center. This is done by providing an extension or blank end at the point of tap sufficient to take the dog, and which can be removed later if desired. See illustration on page 51.

By the second method, the tap is held between centers as a right-hand tap, but the travel of tool slide is set as for inside relief. This is accomplished in Type C mechanism at the toothed coupling of cam lever and oscillating shaft by rolling the latter beyond the zero mark clockwise as much as necessary to secure desired amount of travel in tool slide, and in Type D by setting connecting rod bolt the other side of center in radial slot as required. The opposing spring, moreover, must be in the same position as for inside work.

Index Plate for Relieving Attachment

A Universal Plate is used for all sizes of lathes to which attachment is applied, namely, 14", 16", 18", 20", and 24". It will be noted that the number of flutes selected runs from 2 to 18, inclusive, and beyond to 26 in even numbers.

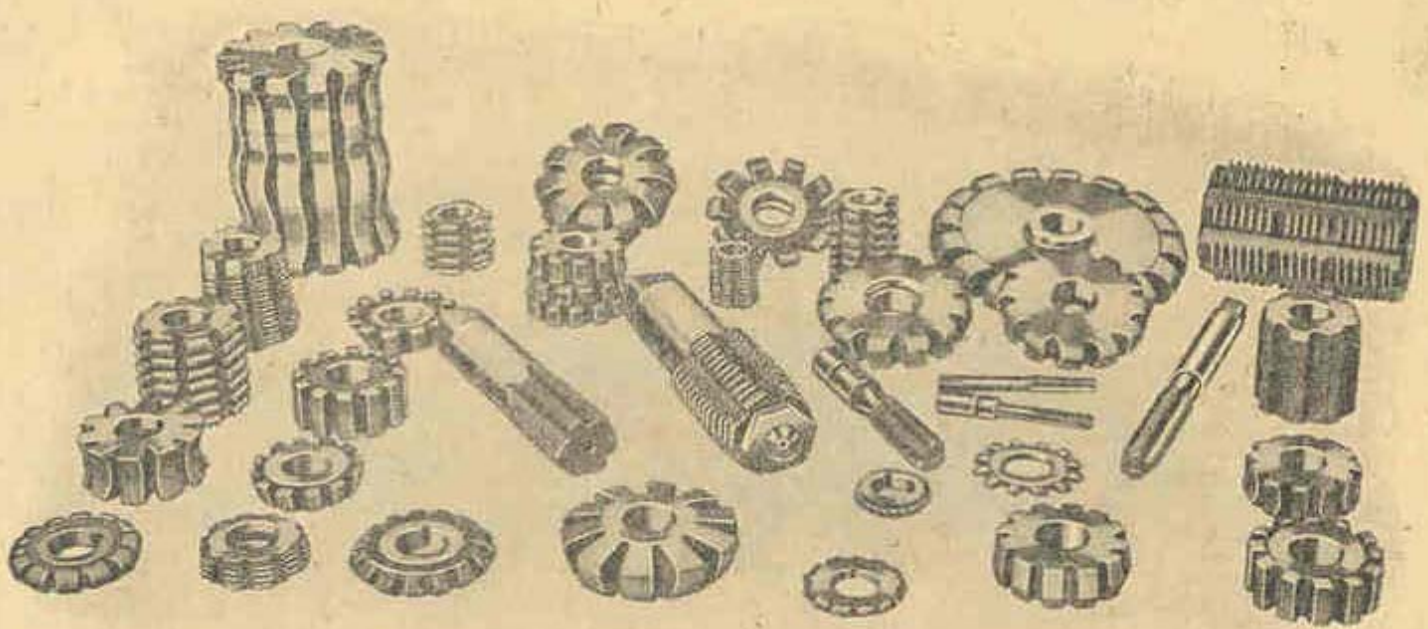
The change gearing indicated on plate and supplied with attachment has the same pitch and other dimensions as regular gearing in lathe train, and hence can be also used for cutting different threads not found on regular thread index, if desired.

Index plate for Type D Attachment differs in gearing combinations, but gives same number of teeth or flutes.

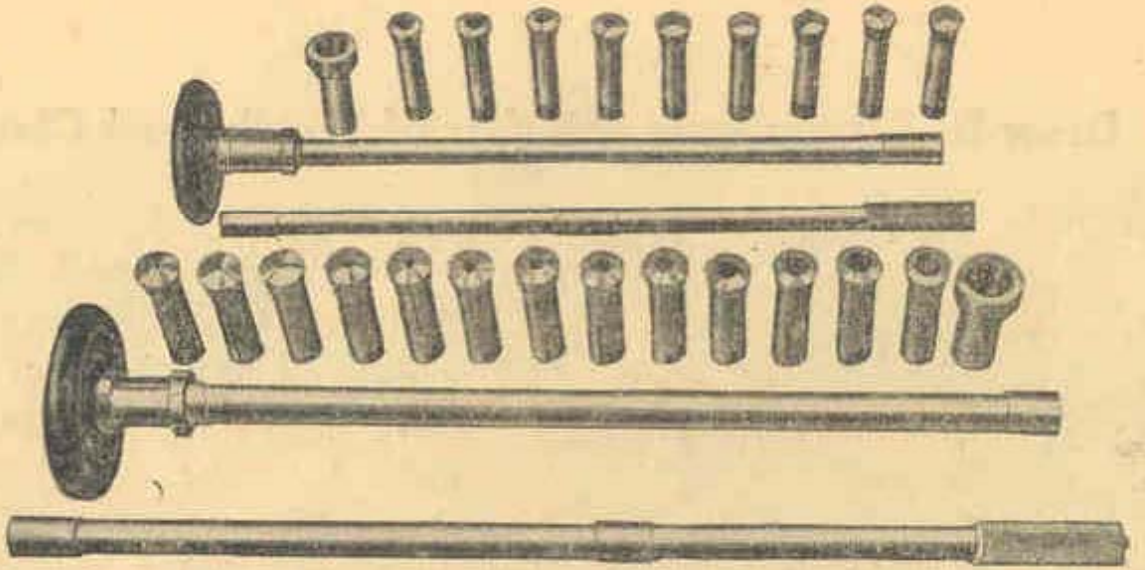
THE HENDEY MACHINE CO.
TORRINGTON, CONN. U.S.A.
LATHE RELIEVING ATTACHMENT

TEETH OR FLUTES	STUD GEAR	1ST INTER MEDIATE	2ND INTER MEDIATE	CAM SHAFT
2	30	60	32 FOR LEFT HAND THREADS ONLY	60
3	"	70		40
4	60	40		60
5	75	60		"
6	60	"		40
7	70	"		"
8	80	"		"
9	90	"		"
10	70	"		28
11	77	"		"
12	90	"		80
13	91	"		28
14	70	30–60		40
15	75	" — "		"
16	80	" — "		"
17	85	" — "		"
18	90	" — "		"
20	70	40–80		28
22	77	" — "		"
24	90	" — "		80
26	91	" — "		28

NOTE – FOR RELIEVING SPIRALS SEE SPECIAL INSTRUCTIONS



Other Examples of Relieved Work

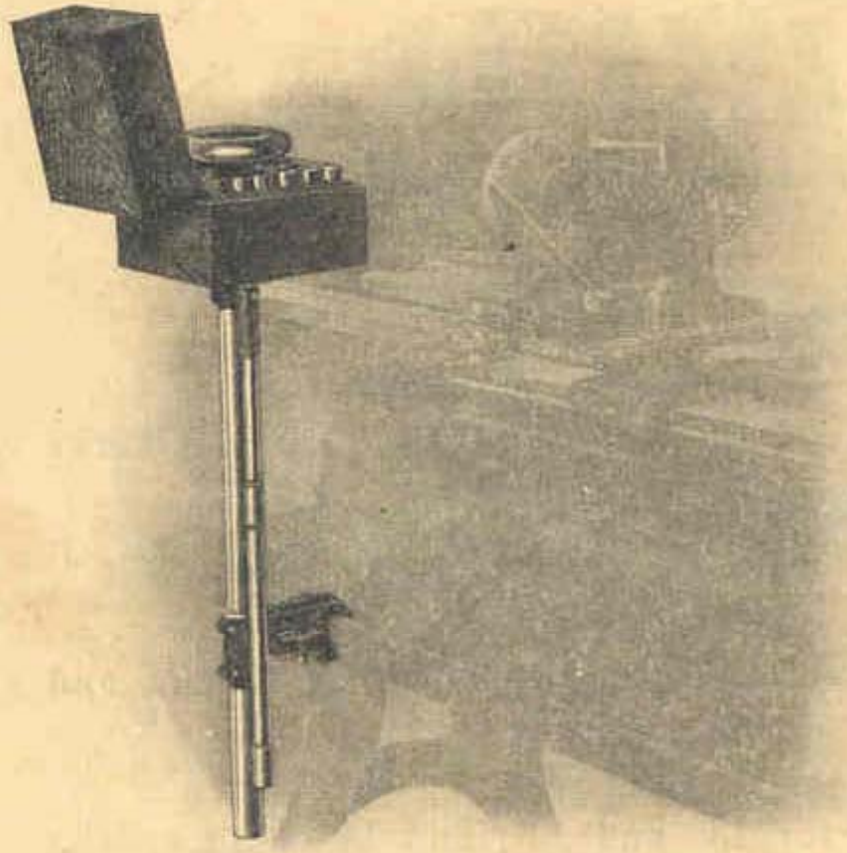


Draw-In Attachments and Sets of Watch Tool Chucks

For use with our Lathes we have four different sizes of Watch Tool Chucks designated as No. 2, 3, 6, and 8.

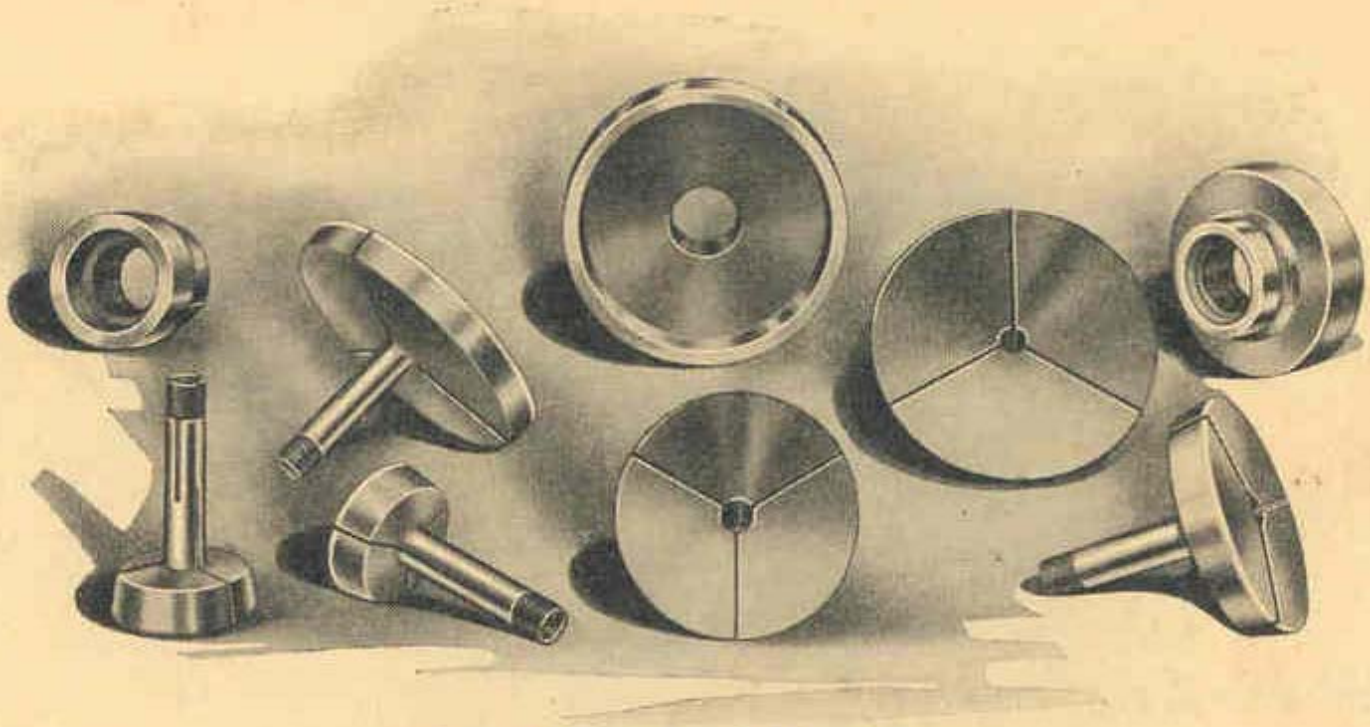
The No. 2 set consists of 9 chucks running from 1/8" to 5/8" by 16ths.
The No. 3 set consists of 13 chucks running from 1/8" to 7/8" by 16ths.
The No. 6 set consists of 15 chucks running from 1/8" to 1" by 16ths.
The No. 8 set consists of 15 chucks running from 3/8" to 1 1/4" by 16ths.
Each complete equipment consists of draw-in sleeve, closer, set of chucks, and knock-out rod.
The No. 2 equipment will be furnished for 12", 14", and 16" lathes only.
The No. 3 equipment will be furnished for 14", 16", 18", and 20" lathes.
The No. 6 equipment will be furnished for 18" and 20", and 16" with special spindle.
The No. 8 set will be furnished for 24", also 18" and 20" with special spindle.
Note — Chucks in intermediate sizes can also be furnished.

Draw-In Attachments and Sets of Watch Tool Chucks



are regularly furnished in a suitably devised box mounted on a tubular post which is mounted on back of bed or oil pan. The draw in sleeve is suspended in the post, and the chucks are set in a removable shelf. The knock-out rod is hung on a pin at side of post and lower end fits into a notch in bracket to keep it from swinging.

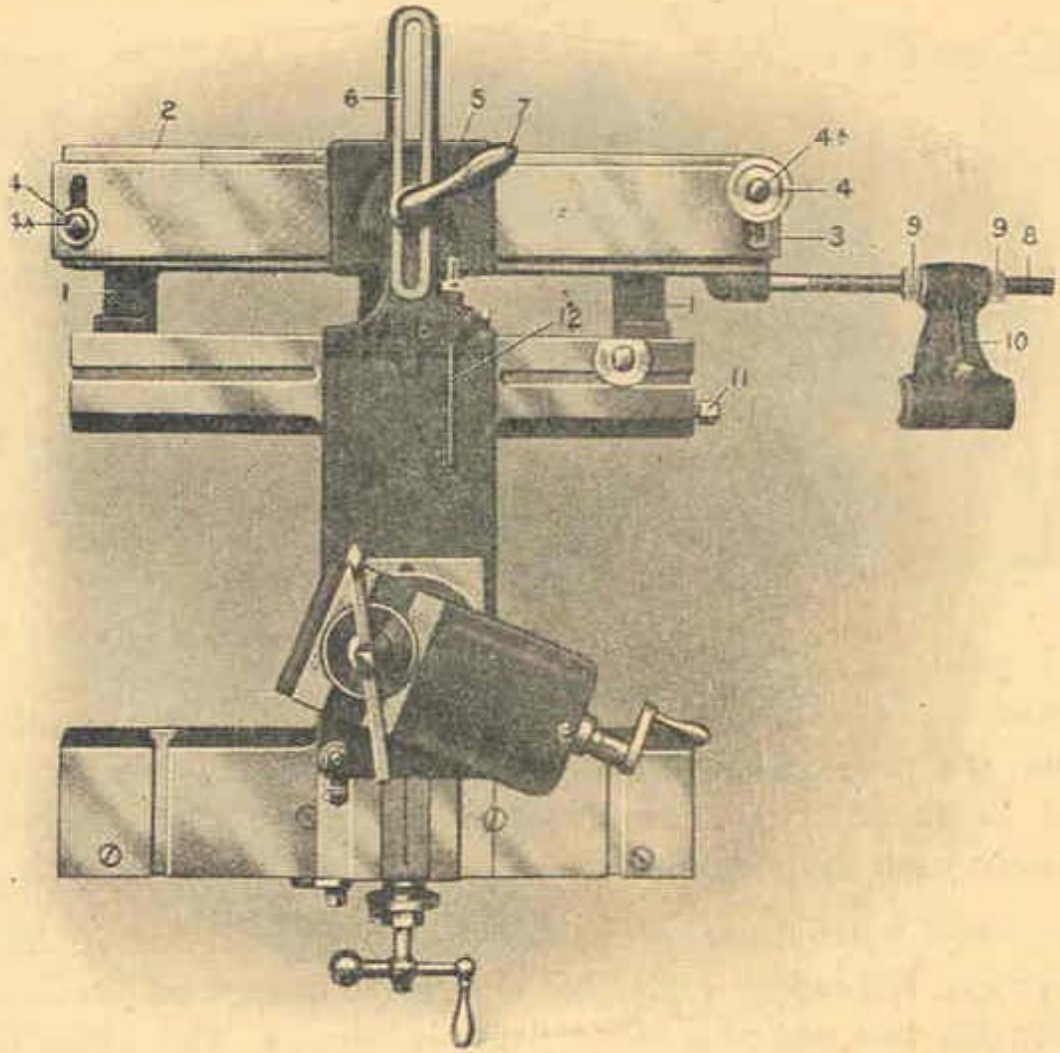
(The box is furnished only with complete sets.)



Step Chucks and Closers

These chucks are convenient for holding thin pieces such as rings, collars, etc., which must be faced true. They are left soft and blank for customers to recess to suit their own requirements.

The closers screw onto nose of spindle and have an inside bevel in which the chuck is closed. Threaded ends of chucks correspond in size with ends of watch tool chucks and use the same draw-in sleeve. The sizes as shown are 2", 4", and 6" maximum capacity and may be bought separately or as desired.



Taper Attachment for Hendey Lathes

The essential parts of the taper attachment are indicated by the following numbers:

1. Brackets of main casting.
2. Taper attachment slide.
3. Swivel bar.
4. Knurled grip nut for rack and pinion adjustment of swivel bar.

4A. Binding bolts for swivel bar.

5. Slide block on swivel bar connecting with cross slide.
6 Connecting link between slide block and cross slide.
7. Binding handle for stud, connecting slide block with cross slide link and cross-feed screw extension block.
8. Attachment slide connecting screw.
9. Knurled check nuts for connecting screw.
10. Connecting screw bed clamp.
11. Binding screw for cross-feed screw extension block.
12. Thread-stop rod, used when cutting taper threads.

Taper Attachment—Continued

The main bracket is securely attached to back of lathe carriage, after both are finished to a bearing surface to prevent any wind in attachment when bolted to position. It is also accurately leveled with top of lathe ways to insure free movement the full length of slide.

As the attachment travels with carriage, it is always in position ready for use. All operations necessary to use the attachment are made from front of carriage. They consist first in setting swivel bar at any desired degree by means of rack and pinion adjustment at No. 4, binding the connecting screw bed clamp to back V of lathe, loosening binding screw No. 11 at end of wing of carriage, which releases the cross-feed screw connecting block and then clamping the connecting link to slide block by means of binding handle No. 7. The connecting link and binding handle stud, which is fitted to reamed hole in head of extension block, furnish a double connection and one that is absolutely rigid between the cross slide of carriage and slide block of attachment preventing any back lash when slide block is properly gibbed up.

The attachment is graduated at both ends, one in degrees, the other in inches per foot, giving an included angle of 15 degrees, or approximately 3 inches in diameter per foot.

Maximum travel:	12″ Lathe 13″	18″ Lathe 18″
	14″ Lathe 14″	20″ Lathe 20″
	16″ Lathe 18″	24″ Lathe 24″