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OPERATORS' HANDBOOK

FOR

HENDEY LATHES

(Cone and Geared Head)

THIRD
EDITION
Revised

THE HENDEY MACHINE CO.
TORRINGTON, CONNECTICUT

FOREWORD

HENDEY LATHES are precision lathes, and as such should be given the care and consideration that any fine piece of workmanship merits.

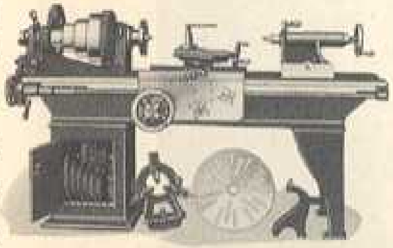
The Hendey Machine Company has been manufacturing machinery since 1874, and the spirit and high standards of the founder, Henry J. Hendey, still guide and dominate management and men with the steadfast purpose of producing the best that can be made. In brief, we are ever striving to live up to the high reputation which has been the priceless possession of The Hendey Machine Company for many years.

INDEX

1874 66 YEARS 1940

An Airplane View of the Plant of The Hendey Machine Company, Where Hendey Lathes, Shapers, and Centering Machines Are Manufactured

Our Doors Are Open to Men Who Are Interested to See How We Build for Quality



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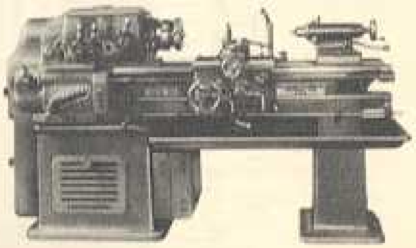

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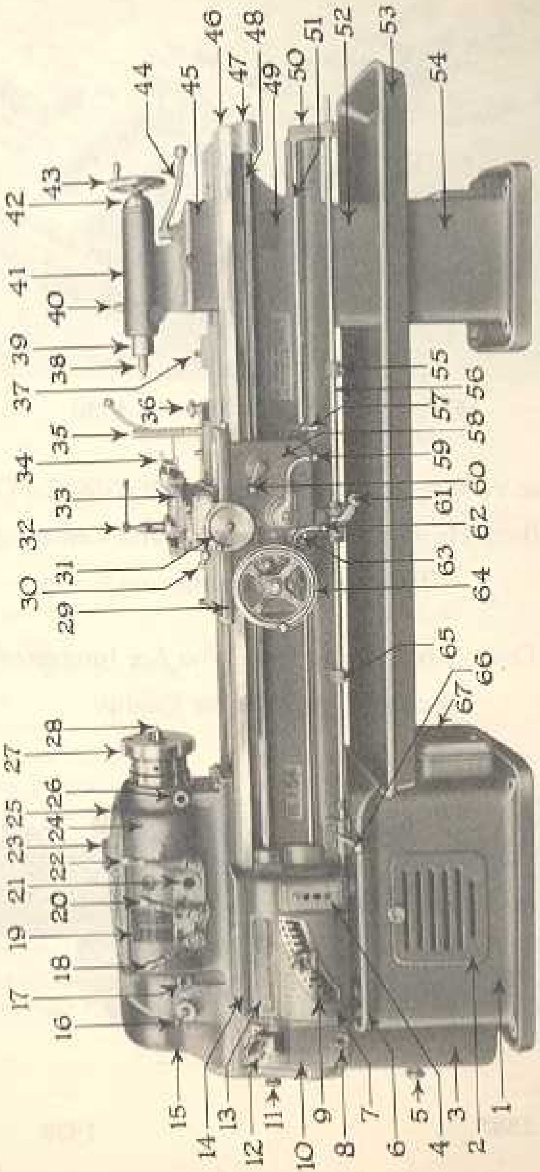
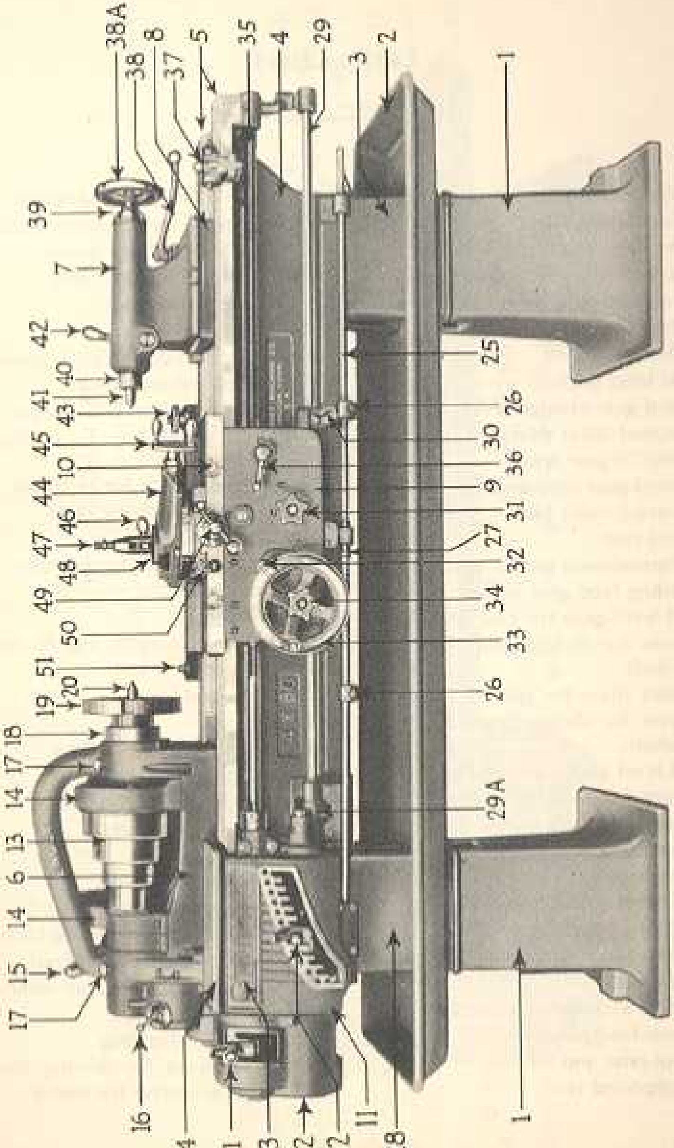


Lathe Chart

18-speed Geared Head

Nos.
1 Motor cabinet.
2 Ventilating cover.
3 Door for end of cabinet.
4 Push button station for motor.
5 Knob for end door.
6 Drip pan.
7 Main gear box.
8 Oil level gage.
9 Feed gear change lever.
10 3-speed outer gear box
11 Door to gear train.
12 Speed gear change lever.
13 Thread index plate.
14 Tool pan.
15 Transmission guard, top.
16 Sliding feed gear lever.
17 Oil level gage for rear bearing.
18 Lever for sliding gears on No. 3 shaft.
19 Index plate for spindle speeds.
20 Lever for sliding gears on No. 1 shaft.
21 Oil level gage for speed gearing
22 Lever for spindle driving clutch.
23 Inspection hole cover.
24 Headstock casting.
25 Headstock cover.
26 Oil level gage for front bearing.
27 Driving plate on spindle.
28 Live center.
29 Carriage.
30 Quick withdrawing handle.
31 Cross feed hand wheel.
32 Tool post and wrench.
33 Compound rest.

Nos.
34 Crank for C. R. feed screw.
35 Binding lever for cross slide bar.
36 T. Att. swivel bar setter.
37 Clamp for T. Att. slide.
38 Tail spindle center.
39 Tailstock spindle.
40 Binder handle for T. S. spindle.
41 Top half of tail stock.
42 Bearing cap for T. S. screw.
43 Hand wheel for T. S. spindle screw.
44 Clamping lever for tailstock.
45 Tailstock saddle or block.
46 Ways of bed.
47 End bearing for lead screw.
48 Lead screw.
49 Bed casting.
50 End bracket for S. and R. rods.
51 Apron reverse rod.
52 Pan-to-bed leg.
53 Chip pan.
54 Cabinet leg, pan-to-floor.
55 Automatic stop dog.
56 Automatic stop rod.
57 Apron reverse lever.
58 Apron.
59 Lever for cross feed.
60 Lever for half nuts on L. S.
61 Control lever for driving clutch.
62 Lever for longitudinal feed.
63 Oil level gage for apron reservoir.
64 Apron hand wheel.
65 Automatic stop dog.
66 Control lever for driving clutch.
67 Magnetic starter for motor.



Lathe Chart

(Cone Head)

1	Cabinet legs
2	Chip pan
3	Rear bed leg
4	Lathe bed
5	Ways of bed
6	Head stock
7	Tail stock top
8	Tail stock base
9	Apron
10	Carriage
11	Main feed gear box
12	3-speed outer gear box
13	Headstock cone
14	Gear guards
15	Back gear lever
16	Feed gear lever
17	Oil hole cups
18	Spindle bearing collar
19	Driving plate
20	Head center
21	Speed gear change lever
22	Feed gear change lever
23	Thread index
24	Tool pan
25	Automatic stop rod
26	Stop rod stops
27	Adjustable feed stop
28	Front bed leg
29	Reverse rod
29A	Reverse rod bell crank
30	Apron reverse lever
31	Cross feed knob
32	Rack pinion eccentric lever
33	Apron hand wheel
34	Longitudinal feed knob
35	Lead screw
36	Lead screw half nuts lever
37	Micrometer carriage stop
38	Tail stock binding lever
38A	Tail stock hand wheel
39	Tail stock barrel cap
40	Tail stock spindle
41	Tail stock center
42	Tail stock spindle binding lever
43	Taper attachment setting knob
44	Comp. rest slide
45	Comp. rest feed crank
46	Cross slide and taper attachment binder
47	Tool post
48	Tool post collar
49	Cross feed screw handle
50	Threading stop rod
51	Taper attachment binding bolt

2232

Hand scraping the ways of a lathe bed. When finished must hold tissue paper at center and both ends of long straight edge. Note: Accurate leveling always precedes scraping.

Supplementary test of scraped lathe bed with long straight edge mounted on cross parallels, in turn carried on precision Vee blocks placed on the bed Vees. This test enables the inspector to take diagonal readings on the bed to show if it is parallel and straight at all corners.

2233

2230

Scraping carriage to lathe bed. This follows the scraping and testing of bed ways shown on page 8.

The men who make up the Hendey hand scraper personnel are veterans and acknowledged experts in their line.

Testing alignment of inside ways for tailstock with outer ways after carriage has been finished scraped to bed.

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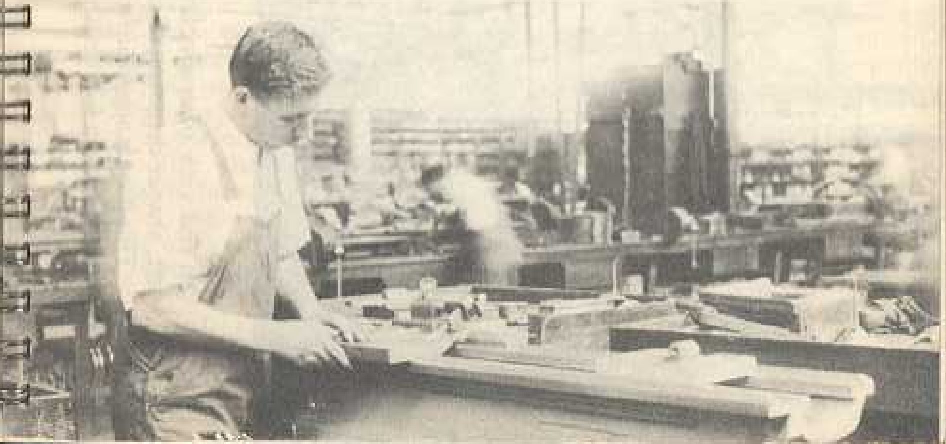
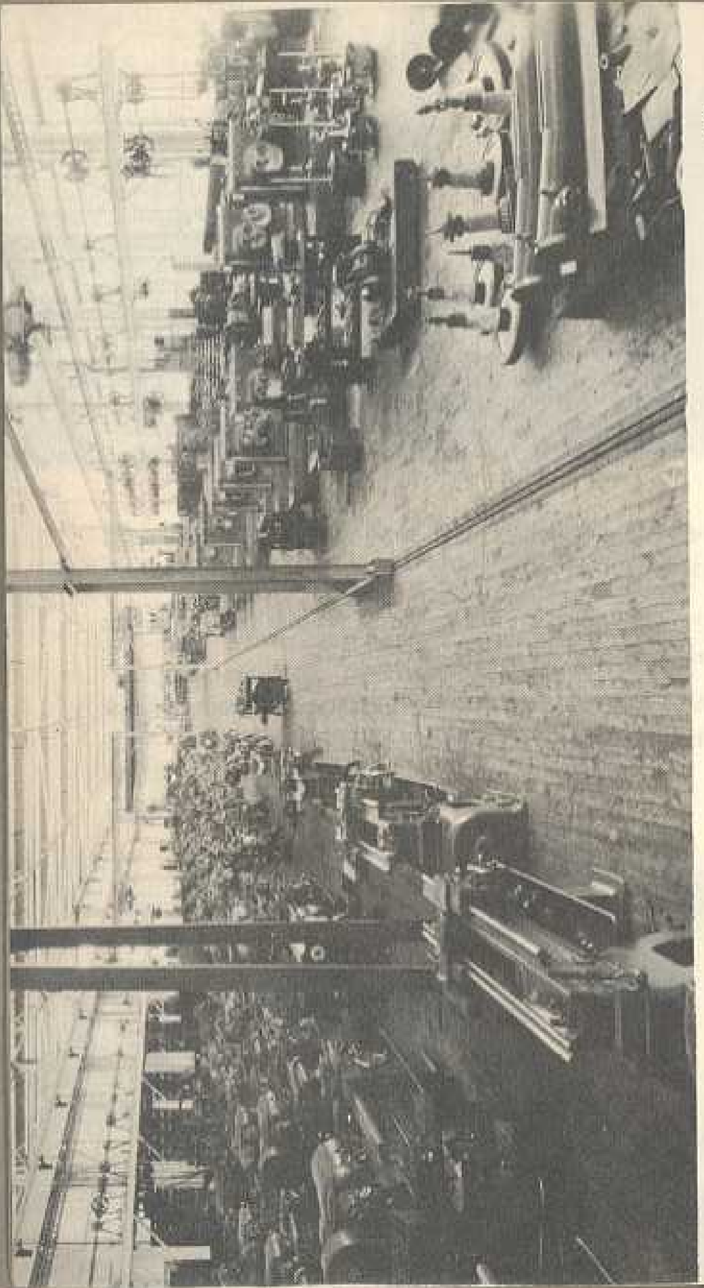
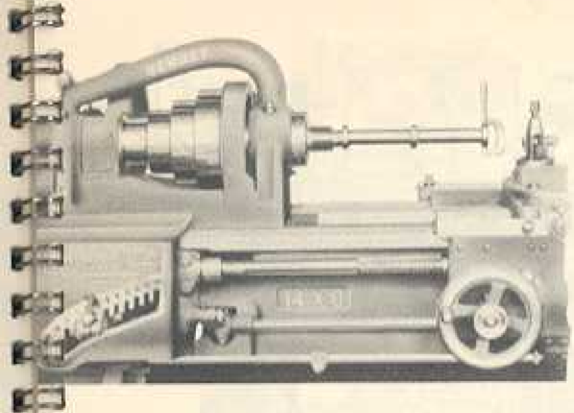




An end view of assembling and testing floor; with the lathe department on the left, shaper department on the right.

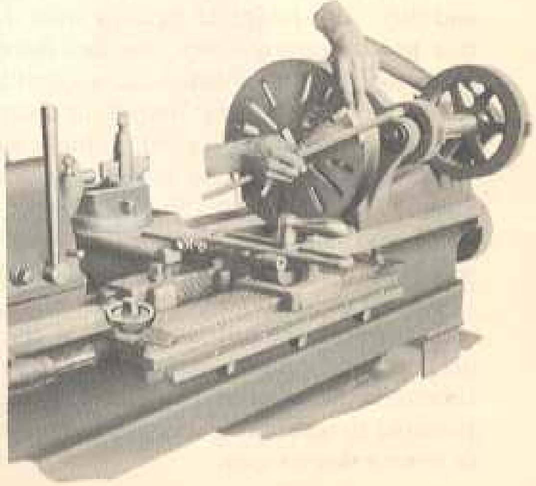
This floor is approximately 80′ wide by 360′ long, is serviced by one 10-ton bridge crane traveling full length of floor, and five gantry cranes.



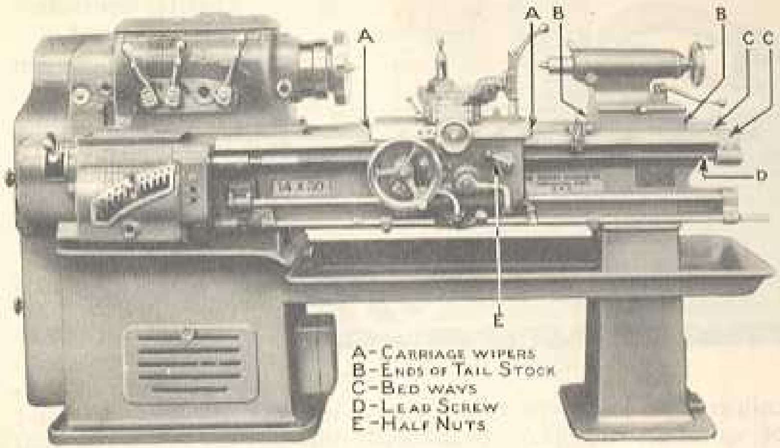
Testing Spindle Alignment

Test, taking alignment of spindle with ways of bed. This test uses proof bar 12″ long, having three turning collars, one each close to spindle nose, in center, and at outer end. The finest possible chip is taken over the collars with keen edge tool, after which they are micrometer-calipered to learn variation, if any, in their diameters. A limit of variation of .0005″ is allowed (but very seldom reached) between collar at nose and the one at outer end, and must show large at outer end, to offset possible spring of bar away from tool, and to favor hole in any boring operation running small at spindle end.

Face Plate Alignment



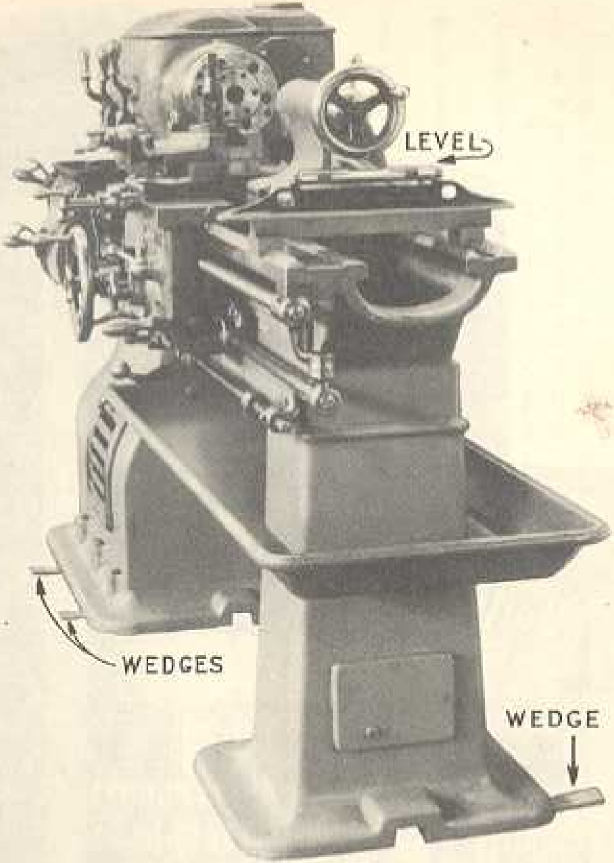
Second test shows alignment of cross slide travel with spindle and is taken after spindle alignment has been proved. The straight-edge-tissue-paper test used shows in the majority of cases a perfectly flat plate after the same has been faced with tool. A slight variation is allowed, however, toward concave on the plate not exceeding .00075″.



Instructions for Installing a New Lathe

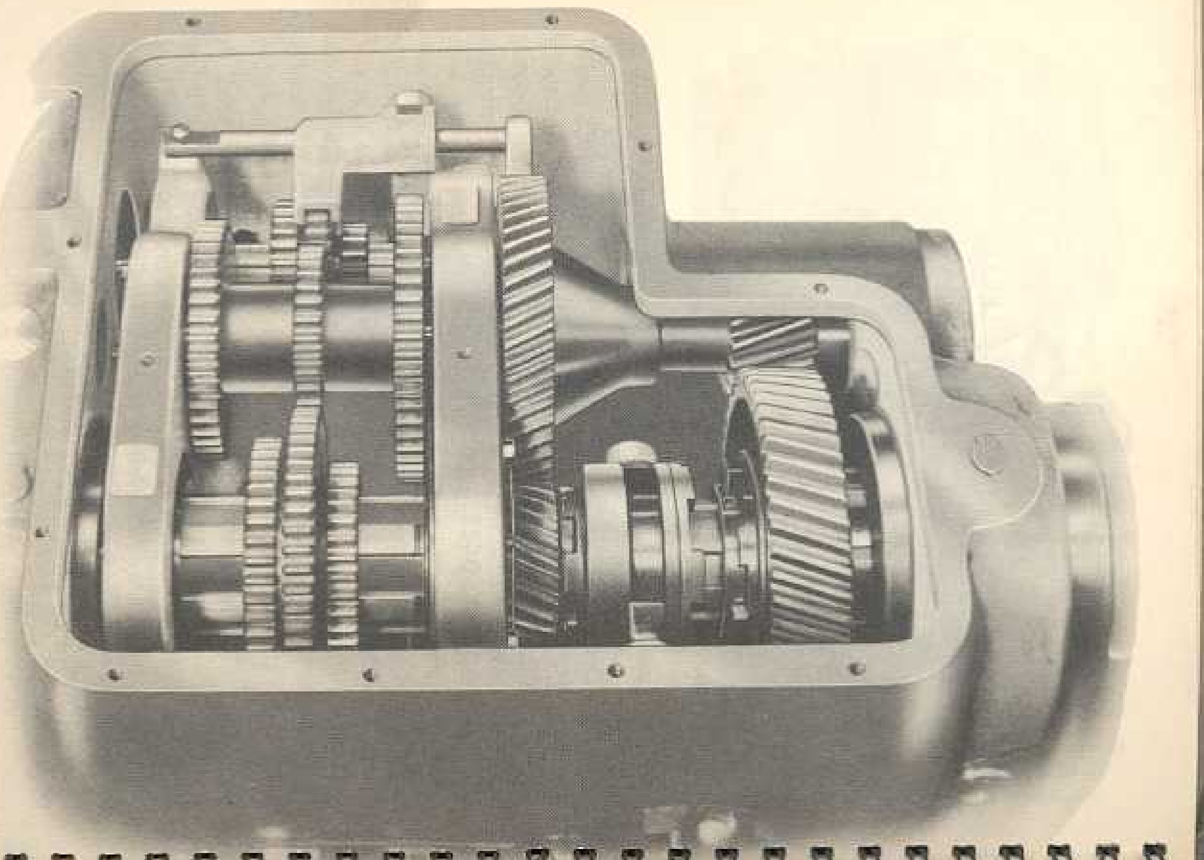
When the machine has been removed from its crate it should be placed in the location where it is to be used. The next step is a thorough cleaning of the machine to remove all slushing grease and dirt. This job must be done with the utmost care. Kerosene is a good cleaning agent, besides being economical. Particular attention must be given to the ways of the bed and the wipers on the ends of the carriage, both front and rear of the tailstock block where it contacts on the bed, to make sure that no grit is allowed to lodge between these surfaces. (Note indexed cut for references.) Of equal importance is the care used in cleaning the lead screw and half nuts. Any dirt allowed to remain on these parts will seriously affect the life and accuracy of the same, thereby impairing good thread cutting.

Temperature adjustment. If the machine has traveled to destination through a period of cold weather it should be allowed time to come to room temperature before being used. The period required to secure this unity of temperature may be several hours or even a day or two.



A lathe to do accurate work must be accurately leveled in position. To insure this an accurate and sensitive spirit level must be used. This leveling must be done at both ends across the bed and lengthwise as well. Leveling furthermore should be checked at intervals to make sure it is being maintained.

Note wedges under flanges and level on end of bed at rear of tailstock.



Hendey 18-Speed Geared Headstock

The head casting forms an oil tight reservoir containing an ample supply of lubricant with which the driving mechanism in headstock is kept completely filmed with oil when in motion through the pumping action of the gears.

All headstock gears are made from high grade forged alloy steel; the teeth are cut true to form by cutters generated for each particular size and type of gear. After heat treatment all gears are refinished for proper tooth profile.

The speed change unit is assembled into a heavy cradle which is securely bolted to the base of the headstock casting. Three shafts are mounted in the cradle. They are short, large in diameter, and run in heavy duty ball bearings.

Shaft No. 1 is the power input shaft, and carries a sliding three-gear unit.

Shaft No. 2 is the intermediate and has a fixed three-gear unit.

Shaft No. 3 is a sleeve and carries a sliding three-gear unit. This sleeve is axially mounted with spindle without making contact. The construction is such that it permits the removal of the lathe spindle at any time without disassembling or removing any other part of the headstock.

The four high and low speed transmission gears have helical cut teeth.

The face gear rotates freely upon spindle through a babbitted bearing.

Power is transmitted to spindle either direct from No. 3 shaft or from back gear train through a positive tooth clutch multiple keyed to but sliding on spindle.

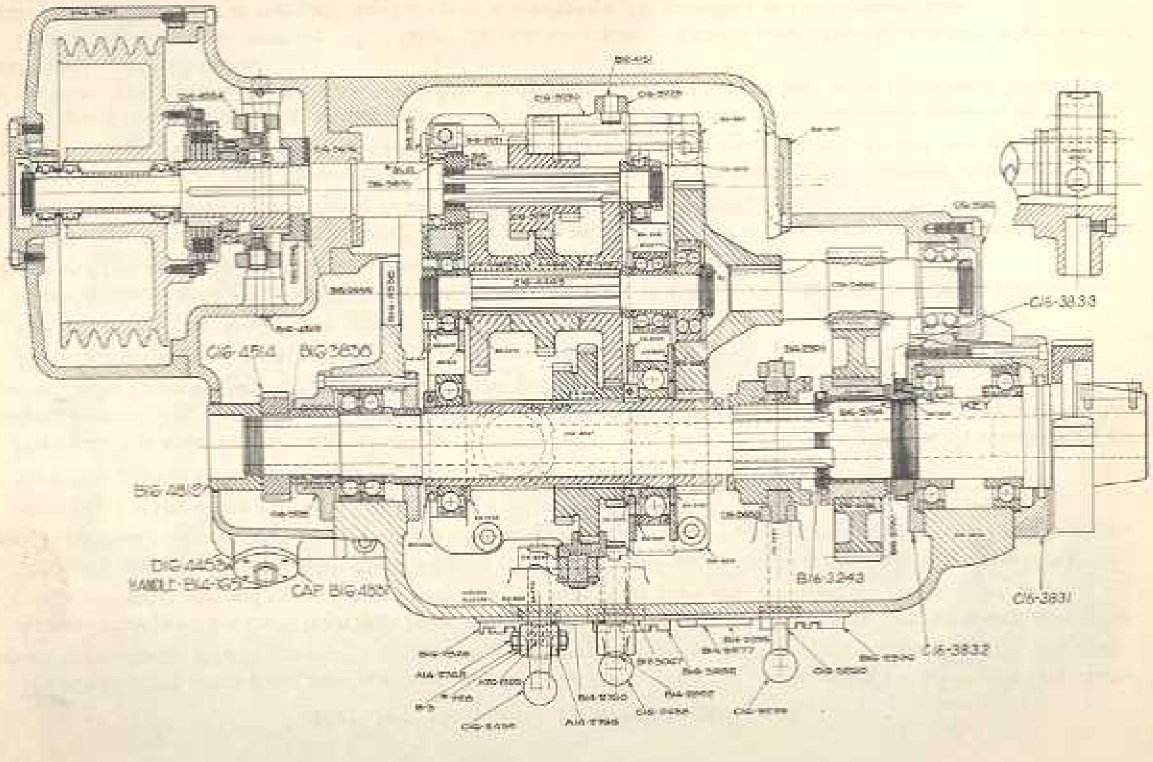
Spindle speed changes are controlled by three levers located on the face of headstock. Speeds of spindle for the different lever positions are given on a direct reading index plate above levers.

Driving pulley, shaft, and friction clutch, are mounted on anti-friction bearings in a separate housing which is rigidly bolted to the end of headstock casting. Driving pulley also has an anti-friction outboard bearing.

The friction clutch in driving pulley is operated by two levers which pivot on the automatic stop rod at the front of the lathe. One lever is in a fixed position below headstock to the right of gear box, while the other is bracketed to and travels with the apron.

These levers have three positions: when raised the clutch is engaged, when in center the clutch is free, when lowered with pressure the brake is engaged, slowing up or stopping spindle according to the pressure used.

With either lever it is a simple matter to jog the spindle so as to bring the work to any desired position.



To Remove Spindle of Hendey 18-Speed Geared Headstock with Anti-Friction Bearings

1 Remove the feed gear throw-out handle by removing the flange screws at B16-4531.

2 Remove the feed gear guard D16-4483A.

3 Remove screw holding front flange C16-3831 through holes in front collar.

4 Move the sliding clutch C16-4583 to the left as far as it will go. Loosen the set screw in threaded collar B16-3243 and turn collar back as far as possible.

5 Loosen set screw in collar C16-3833 and turn collar back until the key under the rear bearing of the front set can be picked out.

6 Remove threaded collar B16-4812 from the extreme left end of spindle.

7 Remove feed gear C16-4514, using gear puller. The filler B16-3838 can be removed with the fingers.

8 The best way to remove spindle is by means of a draw rod extending through the spindle and blocked on the nose end. If such method is not available it can be driven out. By either method care should be used not to jam the threaded collars and fillers. The threaded collars can not be entirely backed off until spindle has been partially moved forward. The inner race of front bearing is tight on spindle and will come out with spindle. The outer race will remain in the headstock housing. The entire rear bearing of the front set will remain in the headstock housing.

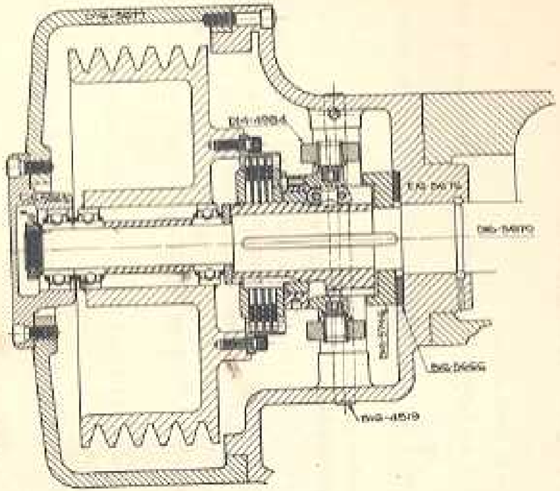
TO REPLACE THE SPINDLE REVERSE THE OPERATION

Care should be used not to jam the threaded collars and fillers during this operation. The Collars C16-3833 and B16-3243 must be started on before the spindle is entirely back in place.

When the spindle is in place draw the adjusting nut C16-3833 up as tight as possible by hand. (Do not drive the wrench with a hammer.)

Hit the spindle a few light blows in both directions to insure the bearings' being properly seated. Tighten the adjusting nut again if possible. It may be necessary to repeat this operation several times before the final adjustment.

For the final adjustment back off the adjusting nut C16-3833. Then tighten same until there is a solid metal to metal contact, then tighten further according to the pre-load desired for bearings.



Multiple Disc Clutch Driving Mechanism for 12″-14″-16″, 18-Speed Geared Head Lathes

To Take the Clutch Unit Apart

1 Remove the end cap C16-5663.

2 Remove the pulley guard D16-5677 which is held by cap screws through the housing flange.

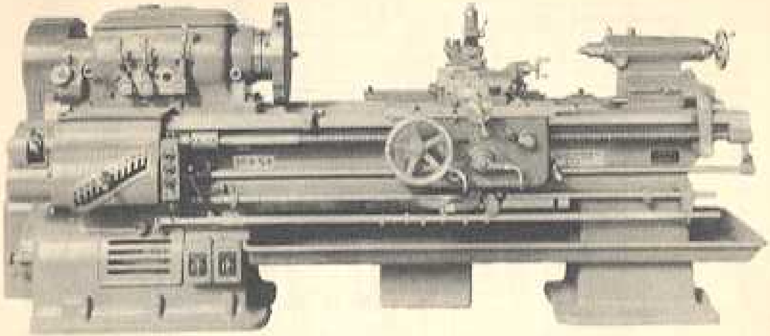
3 Remove the lock nut on the end of shaft D16-5670. This will allow the fillers, outboard ball bearing and pulley with its bearings to slide off the shaft.

4 Before attempting to remove the clutch proper, pull the clutch lever pin B16-4519. This pin will allow the clutch lever D14-4984 to drop through the opening in the lower part of the housing. The pin B16-4519 is held in place by a headless set screw on the under side of the outer boss.

5 The clutch can be removed together with the brake plate B16-5746, and brake disc B16-5666.

6 The clutch housing is fastened to the headstock by cap screws located on the inside of the housing.

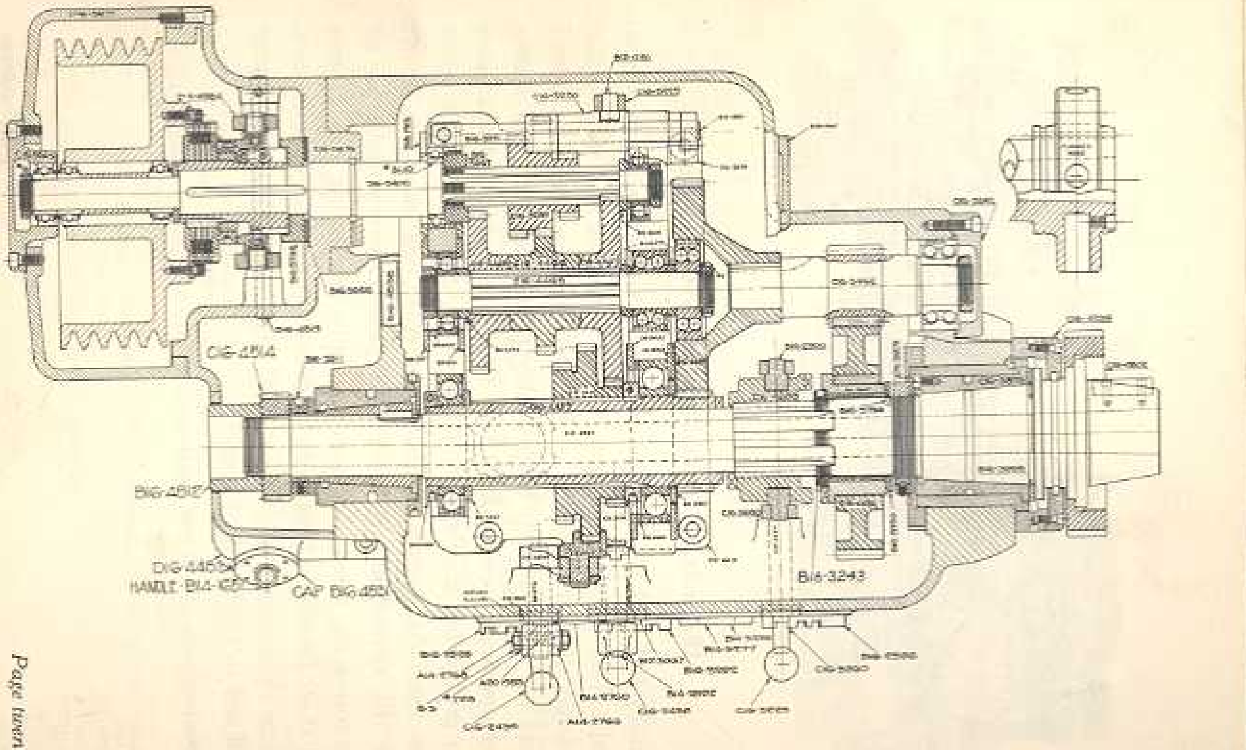
7 The shaft will remain in its cradle bearings.



18-Inch, 12-Speed Geared Head Lathe

Hendey 18″, 20″ and 24″ geared head lathes are alike in general details. They have 12 changes of spindle speeds, and spindle may be fitted with anti-friction or Hendey standard bearings. Headstocks are automatically lubricated. Apron feeds are quick acting, lever operated. Longitudinal feed and thread cutting have safety stop preventing dual engagement. Scrolls can be cut with apron cross feed. Any pitch on the index plate multiplied by 12 will give the corresponding cross feed pitch. Aprons have an oil reservoir with pump for automatically lubricating the gearing and shaft bearings. This same system supplies force feed lubrication to the carriage and cross slide ways. An oil sight level gage is affixed to the front of apron.

Lead screws are 2 per inch.



To Remove Spindle of 12 and 18 Speed Geared Headstock With Hendey Standard Taper Bearings (Present Model.)

1. Remove the feed gear throw-out assembly by removing the flange screws at B16-4531. Then guard D16-4483A, covering gears on rear of headstock, may be removed.

2. Remove halves of bronze front bearing collar C16-4239 by removing screws through holes in spindle nose nut C16-4802.

3. Slide spindle clutch C16-4583 to left, engaging with gear sleeve D16-4489. Loosen the set screw in threaded collar B16-3243 and turn collar back as far as possible.

4. Move face gear D16-4486 and collar B16-3790 to left; then small screw B16-3794 may be removed to permit turning back front bearing adjustment collar C16-3879. The removal of this small screw is only necessary where it extends above thread for collar C16-3879.

5. Remove threaded collar B16-4812 from the extreme left end of spindle.

6. Remove feed gear C16-4514, using gear puller.

7. The best way to remove the spindle is by means of draw bar extending through the spindle and blocked on the nose end. If such method is not available it can be gently driven out with a babbit hammer. By either method care should be used not to jam the threaded collars and fillers. The threaded collars cannot be entirely backed off until spindle has been partially moved forward.

TO REPLACE THE SPINDLE REVERSE THE OPERATION

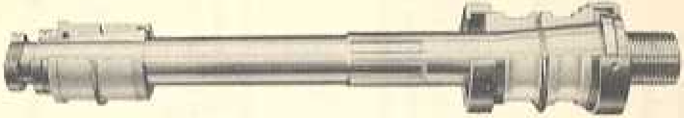
Care should be used not to jam the threaded collars and fillers during this operation. The collars C16-3879 and B16-3243 must be started on before the spindle is entirely back in place.

End thrust of spindle is taken on face of front bearing through a hardened and lapped steel collar B16-3998 interposed between face of bearing and spindle collar.

End play of spindle is taken up and adjusted by collar C16-3879 at rear of front bearing C16-3873.

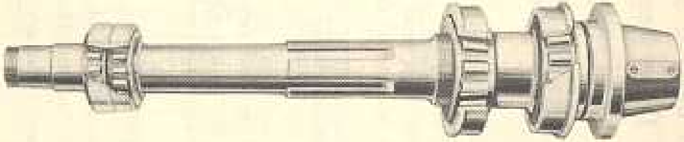
Looseness in rear bearing is taken up by adjustment collar B16-3311 and locked with small set screw in this collar.

Hendey lathe spindles are made from high carbon alloy steel forgings, and are properly heat-treated to secure necessary rigidity and maximum resistance to wear.



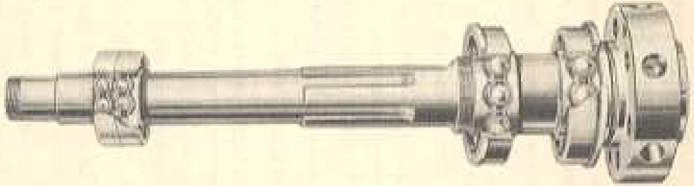
Spindle bearings for Geared Head Lathes are optional. Customer has the choice of Hendey standard taper journals running in annular ring oiling bearings, or, super-precision anti-friction bearings in either ball or roller type.

Hendey precision, the accepted standard for engine lathe requirements, is guaranteed with either type of bearing.



Anti-friction bearings are mounted double opposed, pre-loaded, and are recommended for high speeds and heavy duty.

Hendey taper bearings are automatically ring oiled from reservoir under either bearing. The super-precision anti-friction bearings are oiled by tracking through the oil in reservoirs.



Three oil sight gages are placed on the headstock casting, one at each bearing, and one in the center for the spindle drive gearing, to check the amount of oil in use. Sight gages for spindle bearings come on the geared heads only.

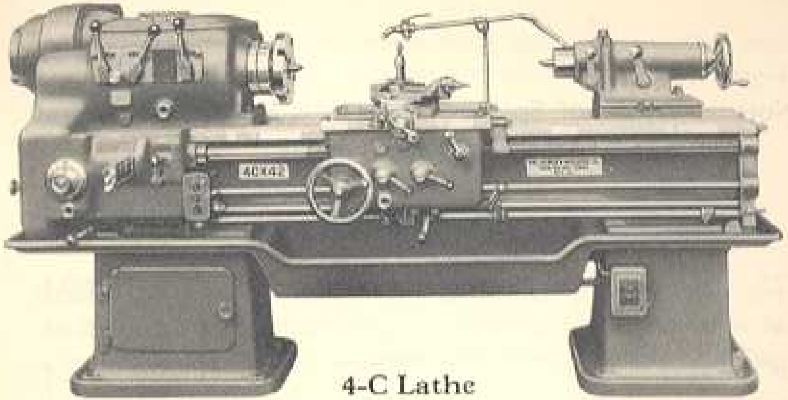
Normal Range of Spindle Speeds for Hendey Cone and Geared Head Lathes

Cone Head Lathes

12″	15–486 R.P.M.
14″	19–478 R.P.M.
16″	13–492 R.P.M.
18″	8–580 R.P.M.
20″	7–450 R.P.M.
24″	6–395 R.P.M.

Geared Head Lathes

12″	High Range	19–1000 R.P.M.
	Low Range	13– 700 R.P.M.
14″	High Range	19–1000 R.P.M.
	Low Range	12– 635 R.P.M.
16″	High Range	16–1000 R.P.M.
	Low Range	10– 652 R.P.M.
18″	Normal	16– 570 R.P.M.
20″	Normal	14– 560 R.P.M.
24″	Normal	14– 560 R.P.M.
4-C	High Range	30–1200 R.P.M.
	Low Range	16– 655 R.P.M.



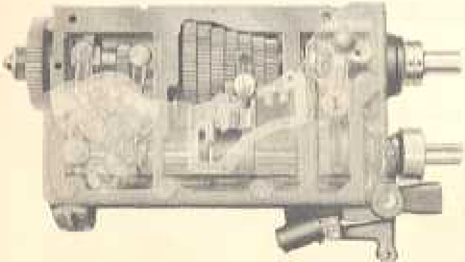
4-C Lathe

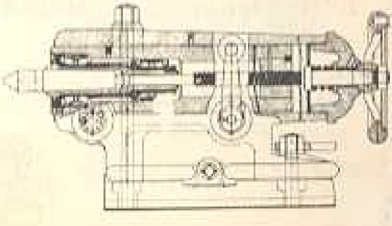
A heavy duty manufacturing lathe with a swing of 16$\frac{1}{16}$″ over the ways. It has 12 spindle speeds. The headstock is equipped with anti-friction bearings throughout. Motor is flange mounted on the end of headstock casting and coupled to drive shaft of head through multiple disc clutch, controlled from the lathe apron.

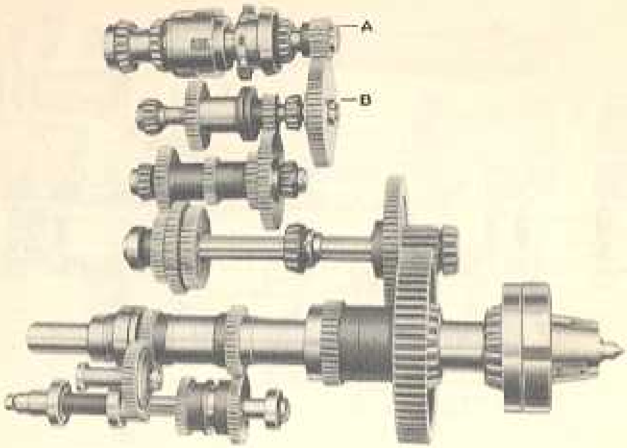
The gear box mechanism is partly revealed in the open treatment of the cover. In the left compartment there are four primary speeds, which combine with the seven in the cone to give 28 changes, running in the standard group, 2¾ to 40 threads per inch.

The heavy duty tail stock furnished with this lathe has a spindle 4⅛″ dia., and travel of 9½″. This spindle may also be furnished with a quill mounting for center running in precision anti-friction bearings. See sectional cut.

Further details of this lathe are given in bulletin of 4-C lathe, sent on request.







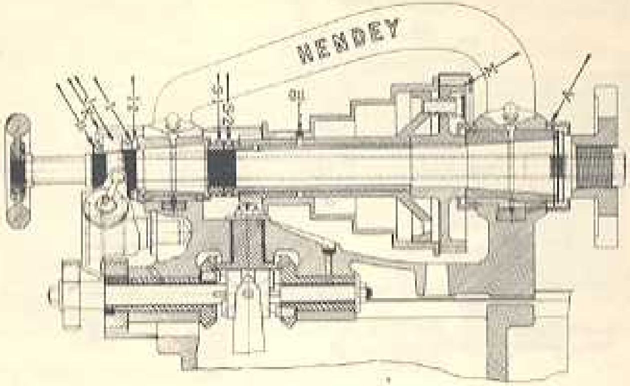
4-C Lathe

Speed transmission gear and shafts, together with spindle and bearings, and the feed gear group as assembled in the 4C lathe headstock.

All splined shafts and gears are made of oiled hardened alloy steel, properly heat treated to secure the best results in toughness and resistance to wear. Gear teeth are finished for correctness of tooth profile after tempering. Sliding gears and related shafts are multiple splined from the solid. The spindle is forged from alloy steel and oil quenched to secure proper grain structure and stiffness. The 12 speed changes to spindle are effected directly through 13 gears.

By using motors of different speeds and making changes in the gear ratio indicated at A and B a range of spindle speeds is available as follows:

Motor Speed	Spindle Speeds
1200 R.P.M.	16– 655 min.
	20– 800
	25–1000
	30–1200
1500 R.P.M.	20– 800 min.
	25–1000
	30–1200
1800 R.P.M.	25–1000
	30–1200
2-speed 900–1800 R.P.M.	13– 525 26–1057



Sectional view of headstock for 12"-14"-16" Cone Head Lathes.

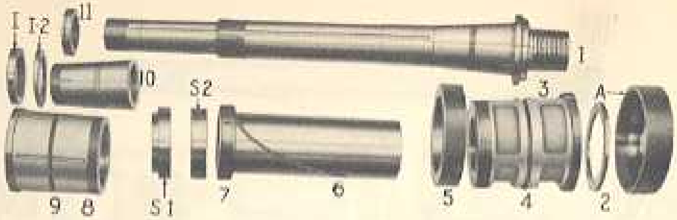
Lathe Headstock is the Hendey tie bar pattern, with annular housings for spindle bearings.

Spindle is made from heat treated alloy steel forging to controlled hardness specifications, insuring ample rigidity and minimum wear in bearings after years of service.

Spindle Journals are both taper. The rear journal is in the form of a splined sleeve which permits independent adjustment in bearings. This allows for ordinary contraction or expansion of spindle without disturbing the running adjustment.

Bearings are Annular (one-piece), and are automatically oiled with ring oilers from large reservoirs in housings. A constant stream of oil is supplied to bearings while spindle is running, and ample provision is made for collecting and returning the oil drip to the reservoirs.

End Thrust. All end thrust is taken on face of front bearing through a hardened and ground steel collar interposed between face of bearing and spindle collar. This thrust collar is carefully sized so that spindle will not wedge in its taper bearing under heavy end thrust, neither will it shake when running free. This running adjustment once made is retained for an indefinite time as the wear, if any, is uniform over taper bearing and thrust surfaces, and may be taken up with collar and check nuts S-1, S-2.



Spindle and Bearings Assembly for 12"-14"-16" Cone Head Lathes

Key A—Threaded collar for front bearing.
I—Adjusting collar for rear journal.
I-2—Thrust collar for rear journal.
S-1, S-2—Adjusting collars for spindle end thrust.
1—Spindle.
2—Front thrust collar.
3—Front bearing.
4—Front bearing oil ring.
5—Threaded collar for front bearing rear
6—Spindle sleeve carrying cone pulley.
7—Oil hole spring cover for sleeve.
8—Rear bearing.
9—Rear bearing oil ring.
10—Rear journal sleeve.
11—Threaded collar for end of Spindle.

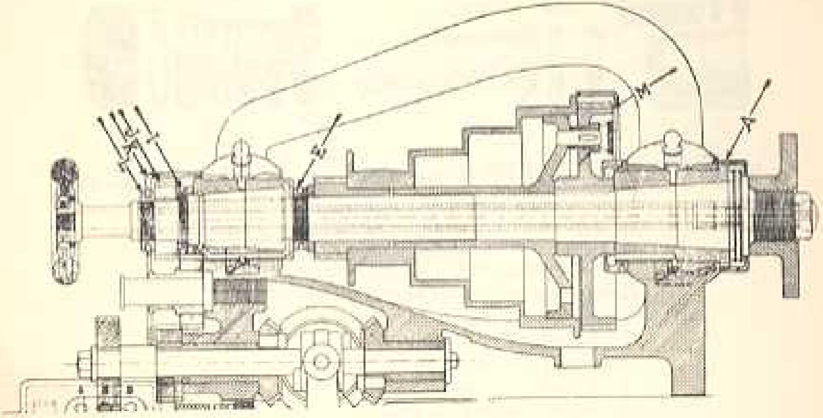
A large measure of the success of Hendey Lathes has been found in the spindle and bearing construction, with its long life and comparative freedom from wear.

Keyed to but sliding on the spindle is a long sleeve (6). On this sleeve revolves the cone driving pulley. Oil is fed to the pulley bearings through oil hole in flange of sleeve (7). The pulley engages with face gear through locking pin in the usual way and so imparts direct drive to the spindle. The head has also the customary back gear.

End Adjustment of Spindle is obtained by means of collar and check nuts (S-1, S-2) on spindle in front of rear bearing. The nuts push forward the long sleeve feathered to the spindle and abutting against the hub of the face gear which is in turn pushed against the front bearing thereby drawing the spindle backward.

To remove the Spindle from Headstock, take off collar of front bearing (A), the guard over end of spindle, the collar (11), then by turning back the collars (S-1, S-2), and at the same time driving the spindle forward with a soft hammer, it may be removed.

If Necessary to Remove a Bearing. After taking out the spindle and the sleeve forming the rear journal, the oiling ring must then be raised up in its slot. Then the bearing may be driven out by using a block of wood which should be nearly the diameter of the bearing.



Sectional view of headstock for 18"-20"-24" Cone Head Lathes.

Lathe Headstock is the Hendey tie bar pattern, with annular housings for spindle bearings.

Spindle is made from heat treated alloy steel forging to controlled hardness specifications, insuring ample rigidity and minimum wear in bearings after years of service.

Spindle Journals are both taper. The rear journal is in the form of a splined sleeve which permits independent adjustment in bearings. This allows for ordinary contraction or expansion of spindle without disturbing the running adjustment.

Bearings are Annular (one-piece), and are automatically oiled with ring oilers from large reservoirs in housings. A constant stream of oil is supplied to bearings while spindle is running, and ample provision is made for collecting and returning the oil drip to the reservoirs.

End Thrust. All end thrust is taken on face of front bearing through a hardened and ground steel collar interposed between face of bearing and spindle collar. This thrust collar is carefully sized so that spindle will not wedge in its taper bearing under heavy end thrust, neither will it shake when running free. This running adjustment once made is retained for an indefinite time as the wear, if any, is uniform over taper bearing and thrust surfaces, and may be taken up with collar.

In these larger heads the intermediate feed bevel is mounted in a horizontal position. The cone also runs direct on the spindle. This is standard practice, and is consistent with the larger swings and slower spindle speeds.

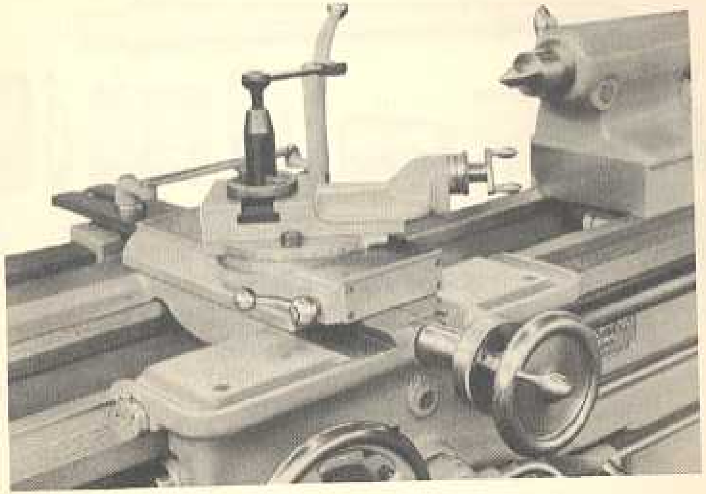
Spindle and Bearings Assembly for 18"-20"-24" Hendey Cone Head Lathes

Key A—Threaded collar for front bearing.
E—Adjusting collar for cone pulley.
E-2—End thrust collar for cone pulley.
I—Adjusting collar for rear journal.
I-2—Thrust collar for rear journal.
L—Adjusting collar for spindle end thrust.
1—Spindle.
2—Spindle thrust collar.
3—Front spindle bearing.
4—Oiling ring.
5—Threaded collar for front bearing rear.
8—Rear spindle bearing.
9—Oiling ring.
10—Rear sleeve journal.

End Play of Spindle is taken up and adjusted by collar L. This collar thrusts through spindle gear J, rear journal adjusting collars I and I-2 against flanged end of rear bearing 8. This end adjustment is governed by the end thrust at front bearing. It is to be noted that the rear journal has independent adjustment in its bearing.

To Remove the Spindle from Headstock, 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.

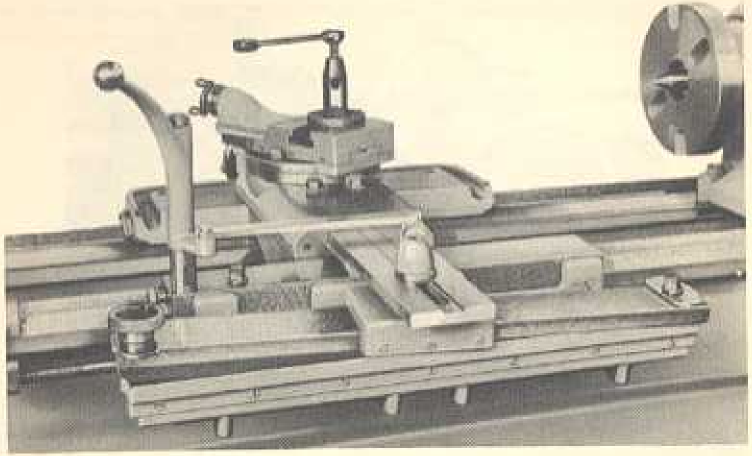
If Ever Necessary to Remove a Bearing, take out the spindle and the sleeve forming rear journal, then raise up the oil ring in its slot, and, with a block of wood and a light hammer, the bearing may be driven out.



Quick Withdrawing Attachment

Quick withdrawing attachment is regular equipment for 12″, 14″ and 16″ 18-speed geared head lathes. This attachment is controlled by means of ball handle shown in position at left front corner of slide, and gives ½″ of travel to the slide. Its purpose is to rapidly back out the tool at end of cut as in thread cutting. When not intended to be used, the two bolts in front of compound rest are to be tightened so as to bind slide with the long steel connecting bar underneath. See cut page 31.

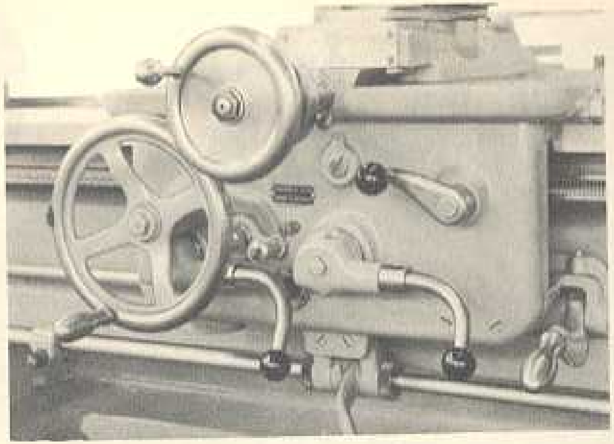
Elevated position of compound rest crank handle gives ample hand clearance at any angle. Compound rest feed has graduated dial reading to thousandths.



Clamping Device for Binding Cross Slide to Taper Attachment Slide, for 12″, 14″ and 16″ 18-Speed Geared Head Lathes

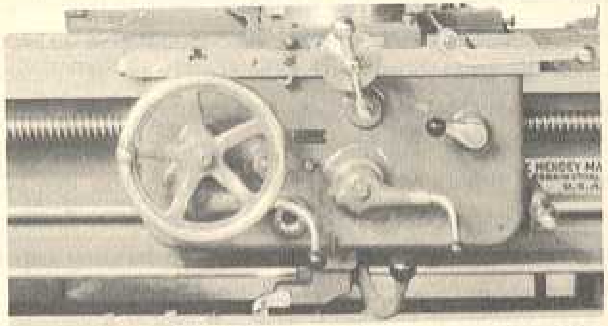
The ball end lever is elevated for convenience in handling when the work is large in diameter. Connection between slide on taper attachment and the cross slide is with a flat steel bar which passes through the slide and is clamped to it by the two hex head bolts shown in front of compound rest. This flat steel bar is slotted to receive the binding stud which in turn passes through the eye of a block carrying the end of cross feed screw and is finally firmly seated in the top of the taper slide. With the top binding cap tightened down there is no possibility of backlash between cross slide and taper attachment slide. This clamping device also used on 18″, 20″ and 24″ geared head lathes with regular cross slide.

Double Wall Safety Type Aprons for Hendey Lathes



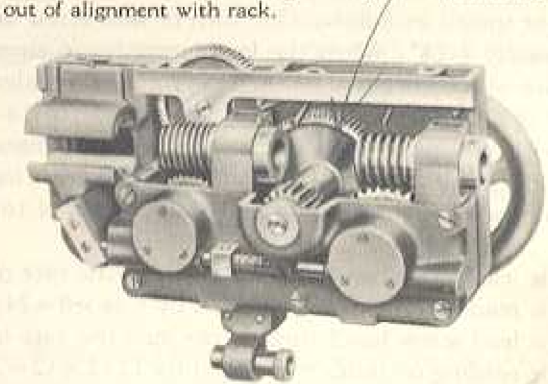
Apron for 12", 14" and 16" 18-speed Geared Head Lathes

Aprons for geared head lathes have friction drive for feeds as standard equipment. These feeds have lever action and quick release through spring acceleration. These aprons have oil reservoir with sight level gage, a pump for force feed to bearings in apron, while gears are splash oiled. This same system furnishes automatic lubrication to carriage ways on bed and cross slide ways.



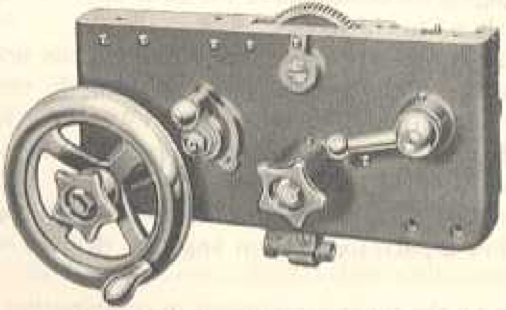
Apron for 18", 20" and 24" 12-speed Geared Head Lathes

All shafts have outboard bearings. The inner wall which supports the outboard bearings forms a pocket for oil reservoir for gearing lubrication. The rack pinion has an outboard bearing making it impossible for pinion to be strained out of alignment with rack.



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 have a safety stop. Before the half nuts can be engaged with screw for thread cutting the feed must be out, and likewise the half nuts must be off the screw before the feed can be operated. Feed worms are hardened.



Aprons for cone head lathes have friction feeds. They have an oil reservoir for gear lubrication, while feed worms, worm bearings and lead screw between worms are hand oiled.

Cutting Scrolls with Apron Cross Feed

The feed mechanism of Hendey lathe aprons makes it possible to cut scrolls or spirals as follows: One turn of lead screw advances the feed exactly 1-24". When the lead screw has 6 threads per inch the rate of feed is equal to the reading on the index multiplied by 4 (6×4=24). Example: To cut a scroll of 16 threads per inch with a 6 pitch lead screw, the gear box handles are placed in position indicating 4 threads, and the cross feed when engaged will travel at the proper rate to cut a scroll of 16 threads per inch.

When the lead screw has 4 threads per inch the rate of feed is equal to the reading on index multiplied by 6 (4×6=24).

When the lead screw has 2 threads per inch the rate of feed is equal to the reading on index multiplied by 12 (2×12=24).

Changes in lead of cross-feed for scroll cutting are made in the same manner as for changes in thread cutting.

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 both engaged, 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.

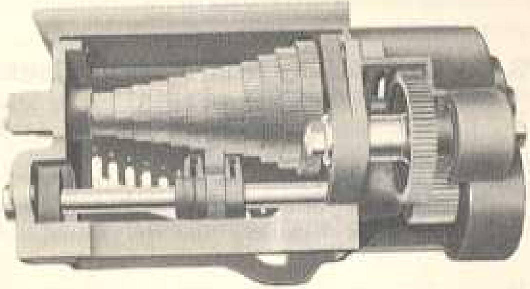
HELPS ON THREAD CUTTING FOR USERS OF HENDEY LATHES

Together with Formulas and Charts for Threads Not Shown on the Indexes, and Gearing Required for the Same.

In cutting threads in Hendey lathes a certain amount of preparation is necessary. To begin with, the ways of the lathe and lead screw should be carefully cleaned and then oiled to insure right operating conditions. Never start a job of thread cutting with an accumulation of chips from previous turning on the bed and carriage. Inspect the lead screw to see there is nothing lodged in its threads to interfere with the proper closing of the half nuts. The threading tool should be sharp and tested for accurate form required. The tool should be set on the center line, which can readily be done by using the line on the tailstock spindle applied for this purpose.

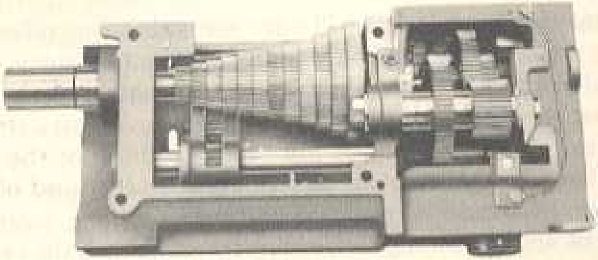
Cutting speeds and feeds will vary somewhat depending upon whether you are roughing or finishing. Thread finishing cannot be unduly hurried, either through speeds that are too fast or feeds that are too coarse, for if the work overheats then the correctness of the lead will be lost, and the finish of the thread poor. A liberal use of tool lube depending upon the kind of material being cut should be made at all times. On long screws this can best be applied through a feed line traveling with the carriage.

Quick Change Gear Boxes for Hendey Lathes



For Cone Head and 12-speed Geared Head Lathes

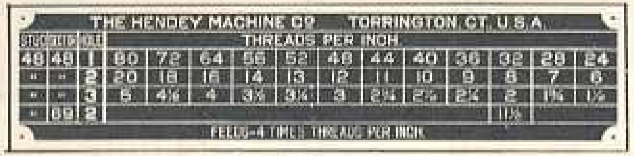
Hendey Lathes were the first to have a commercially successful equipment of quick change gearing. These lathes were first presented in the year 1892, and have since become more widely known and used than any other quick change gear lathe made. This Quick Change Gear Unit, made under W. P. Norton patents, consists of a 12-gear cone carried in the main gear box, with sliding rocker gear and one operating handle for securing the 12-speed changes. The outer or compound box gives three initial speeds to the rocker gear in the main box, furnishing 36 different changes of speeds for threads and feeds, none being duplicates. This standard range is not the limit of the gear box however for with extra pick-off gears applied in the feed gear train, the number of additional threads and feeds that can be secured is practically without limit. See indexes pages 42–44.



For 12", 14" and 16" 18-speed Geared Head Lathes

This gear box has anti-friction bearings for lead screw, compartment for motor push button station; oil sump and cam driven pump. Oil is piped to lead screw and rocker shaft bearings and gear studs.

Standard Index Plates Showing Normal Range of Threads and Feeds

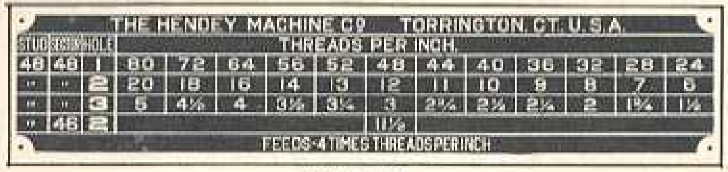


THE HENDEY MACHINE CO TORRINGTON CT. U.S.A.

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										11½		

FEEDS-4 TIMES THREADS PER INCH

12" and 14" Lathes

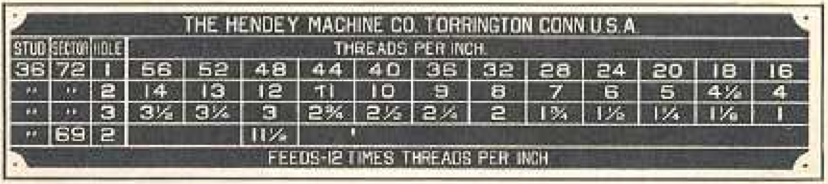


THE HENDEY MACHINE CO TORRINGTON, CT. U.S.A.

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						11½						

FEEDS-4 TIMES THREADS PER INCH

16" Lathe



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

STUD	SECTOR	HOLE	THREADS PER INCH											
36	72	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
"	69	2			11½									

FEEDS-12 TIMES THREADS PER INCH

18" and 20" Cone Head Lathes   18", 20" and 24" Geared Head Lathes

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 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 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 42-44.

Note. Where 18" and 20" lathes have a 4 per inch lead screw, the stud and sector gears have 48 and 48 teeth respectively, and the feeds are 6 times threads per inch.

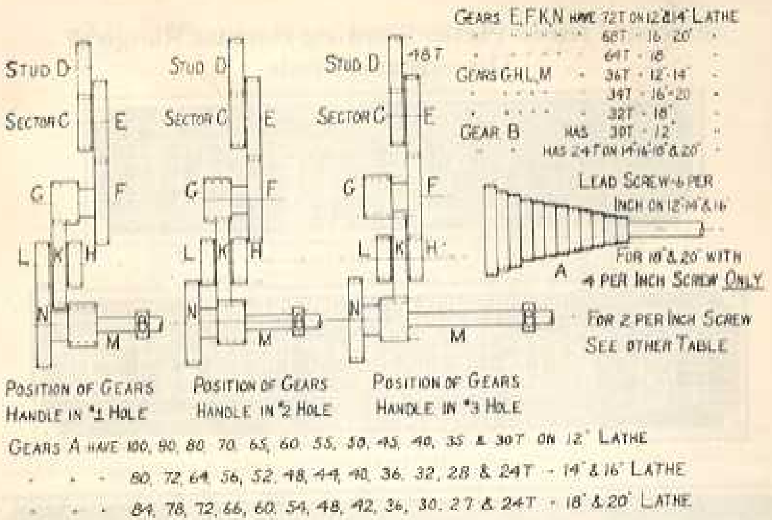


Diagram of Feed Gears for 12"-14"-16"-18"-20"
Hendey Engine Lathes

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.

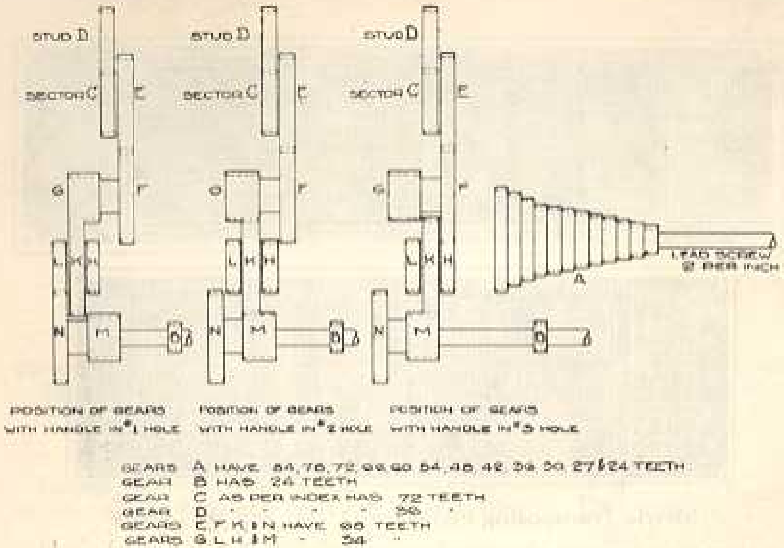


Diagram of Feed Gears for 18"-24" Lathes
with 2 per Inch Lead Screw

Leads

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

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

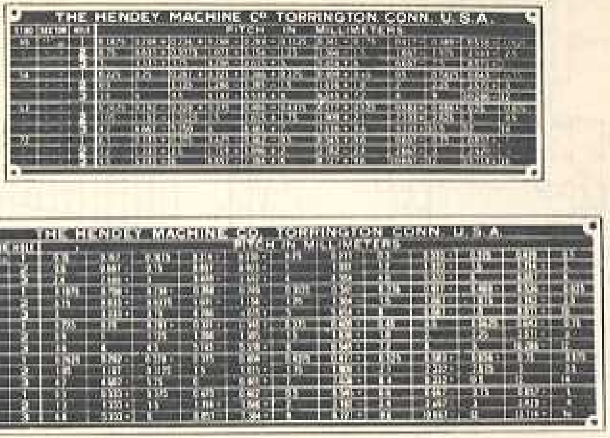
F is the only known gear in this case; it has always the same number of teeth as E originally on the lathe. C, D, and E must be selected by trial.

Formula for Thread Cutting

Illustration with 6 per inch Lead Screw

Threads per Inch		Lead in Inches	
Handle in No. 1 Hole	$\frac{6 \times A \times 4 \times C}{B \times D}$ = T.P.I.	Handle in No. 1 Hole	$\frac{D \times B}{C \times A \times 4 \times 6}$ = Lead.
Handle in No. 2 Hole	$\frac{6 \times A \times C}{B \times D}$ = T.P.I.	Handle in No. 2 Hole	$\frac{D \times B}{C \times A \times 6}$ = Lead.
Handle in No. 3 Hole	$\frac{6 \times A \times C}{B \times D \times 4}$ = T.P.I.	Handle in No. 3 Hole	$\frac{D \times B \times 4}{C \times A \times 6}$ = Lead.
Example for No. 3 Hole	$\frac{6 \times 70 \times 48}{30 \times 48 \times 4} = 3\frac{1}{2}$ T.P.I.	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.
With 2 per inch Lead Screws replace 6 where it appears by 2.



Metric Transposing Plates for 12"-14" and 16" Lathes

Formula for Cutting Metric Threads with English Lead Screw 6 per In.
Using Transposing Gears at C and D. 1 inch = 25.4 millimeters.

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

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

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

12" and 14" Lathe E = 120 T F = 72 T 16" Lathe E = 102 T F = 68 T

Formula for Cutting Metric Threads with English Lead Screw 4 per In.

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.

18" Lathe E = 128 T F = 64 T 20" Lathe E = 136 T F = 68 T

Metric Transposing Plate for Lathes
with Lead Screw of 2 Per Inch.

Formula for Cutting Metric Threads on Lathes with 2 per Inch Lead Screw and 127 T Gear at Position C and Given Change Gear at D

$$\frac{D\times 4}{10\times \text{number on index}} = \text{Pitch in mm.}$$

Example for No. 2 hole in outer gear box and last position to the right of main gear box: D = 50, and Index 4. Then $\frac{50\times 4}{10\times 4} = 5$ mm.

With handle in No. 3 hole and 2½ on the Index we have $\frac{50\times 4}{10\times 2.5} = 8$ mm.

In above examples 4 and 10 can be replaced by 2 and 5 or 1 and 2.5.

To find gear wanted for a certain metric pitch with other gears as above:

First: Select a number on Index giving a lead near the metric pitch wanted; multiply that number by the m/m pitch wanted and the result by 10; then divide by 4, and the result is number of teeth in gear at D. (Gear box handles must be in position for number selected on Index to cut thread required.)

Example: Wanted to cut 3.6 mm. thread. 7 per inch is near 3.6 mm. We have $\frac{7\times 3.6\times 10}{4} = 63$ T for D.

If gear 63 T is not on hand or not satisfactory try another position on Index, as $\frac{5\times 3.6\times 10}{4} = 45$ T for D.

Other positions in gear box are obtained by the first formula.

Special Transposing Gears

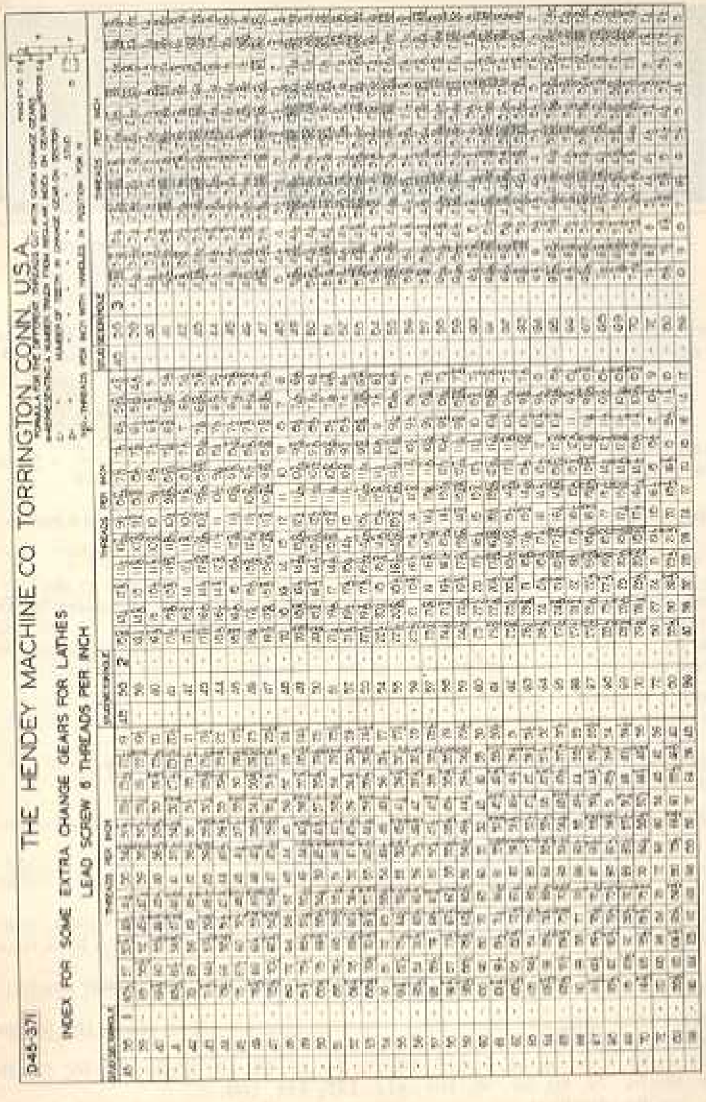
For Cutting Leads Equal to the Circular Pitch Corresponding to the Different Diametral Pitches in Common Use.

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 $\frac{\pi}{D.P.}$ 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.



D45-371

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

INDEX FOR SOME EXTRA CHANGE GEARS FOR LATHES

LEAD SCREW 6 THREADS PER INCH

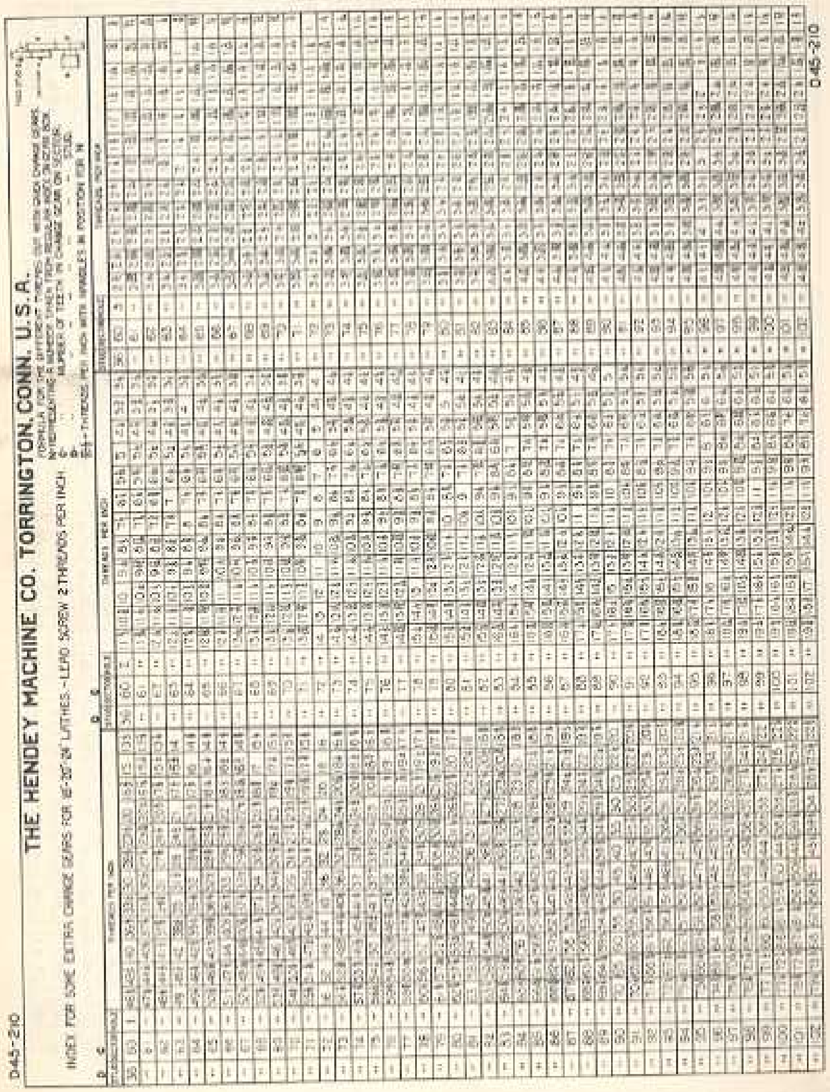
Index Plate for Extra Change Gears 12"-14"-16" Lathes

D45-726

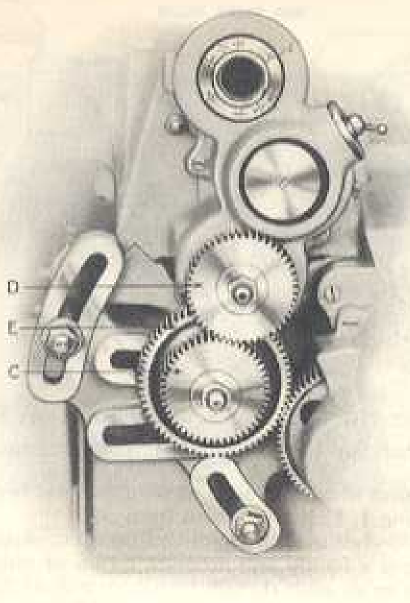
THE HENDEY MACHINE CO TORRINGTON, CONN. U.S.A.

INDEX FOR SOME EXTRA CHANGE GEARS FOR 16"-20"-24" LATHES - LEAD SCREW 4 THREADS PER INCH

Index for Extra Change Gears, 18"-20" Lathes with 4 Pi. Lead Screw



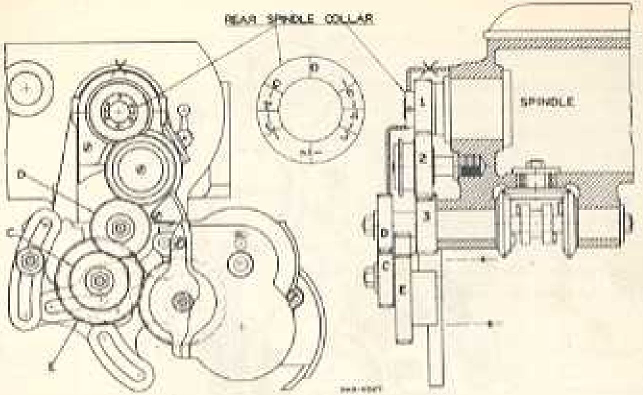
Index for Extra Change Gears
18"-20"-24" Lathes with 2 Pi Lead Screw



Applying Extra Change Gears

The extra change gears given on special indexes are applied in position of gear marked C on sector as shown in illustration. Further changes made at C-D-E will give an almost unlimited number of threads which it is possible to cut and not shown in these tables. For threads not shown we are glad to select the right gear for customer in order to avoid error. When enquiring for this information please give serial number found on end of lathe bed, also swing of lathe.

By the use of a standard set of transposing gears Hendey lathes will chase hobs having lead equal to $\frac{\pi}{\text{diametral pitch}}$, or equal to the circular pitch corresponding to any diametral pitch from 3 to 160. The results obtained are more accurate than if the value of π is taken as 3.1416, these gears giving the value of π as 3.141592.



Instructions for the Use of Graduations on Rear Spindle Collar for Cutting Multiple Threads

The rear spindle collar which is visible at all times has been provided with graduations indicating ½, ⅓, ¼, and ⅙ turn from zero.

These graduations, when matched with the fixed zero mark provided on the adjacent casting, give a handy and accurate means of indexing the spindle for two, three, four, or six start thread.

For example, to index a multiple start thread with three starts the process would be as follows:

1st. Cut the initial thread regardless of the index;

2nd. Then without disturbing the relation between the spindle and feed train, rotate the spindle by hand until the zero in the index is opposite the zero on the casting;

3rd. Disengage slip gear marked No. 2 in the sketch by means of small ball handle from gear No. 1.

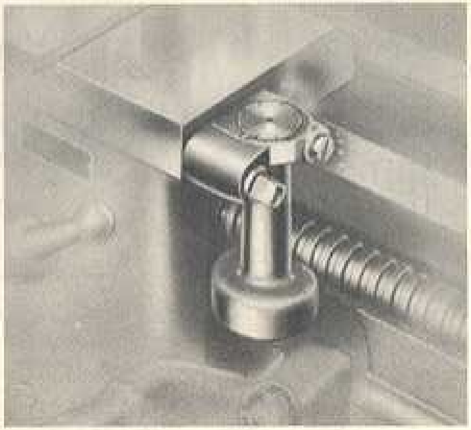
4th. With gear No. 2 disengaged, rotate spindle by hand until the ⅓ on the index is opposite the zero on the casting.

5th. Re-engage gears No. 2 and No. 1 and proceed with cutting the second thread. In re-engaging No. 2 and No. 1, it may prove necessary to oscillate gear No. 1 very slightly to effect engagement but care should be used to see that the graduations on casting and collar are in alignment when engagement is effected.

6th. The indexing for the third thread is done by repeating in the same order the operations second to fifth inclusive.

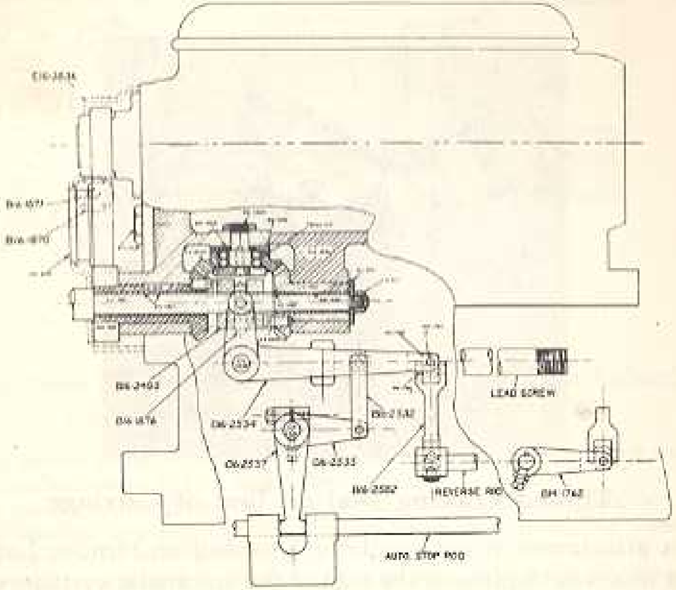
Although this handier index has been provided for threads with two, three, four and six starts, it is still possible to accurately index for nine, twelve, eighteen and thirty-six start threads by removing the cap on the gear guard marked X in the sketch and counting the teeth on gear No. 1 as heretofore.

Gears No. 1 and No. 3 have 36 teeth on all sizes of Hendey Lathes.



Thread Chasing Dial on End of Carriage

This attachment is not regularly furnished on Hendey Lathes, as it in a way duplicates the uses of the automatic carriage stop, apron reverse and micrometer carriage stop. A worm gear in the lower end of the bracket when engaged with the lead screw at the time of thread cutting is caused to rotate with the travel of carriage. This gear is connected with the graduated dial on top of the fixture so that the dial rotates in unison with the worm gear. With the lead screw brought to rest at the end of a thread through the automatic stop the carriage can then be run back by hand to a pre-determined starting point for the beginning of the cut, and a selection made on the dial graduations at which point the half nuts may readily be re-engaged with the lead screw and the screw started by means of the apron reversing lever. When not in use the worm gear is swung free of the screw.



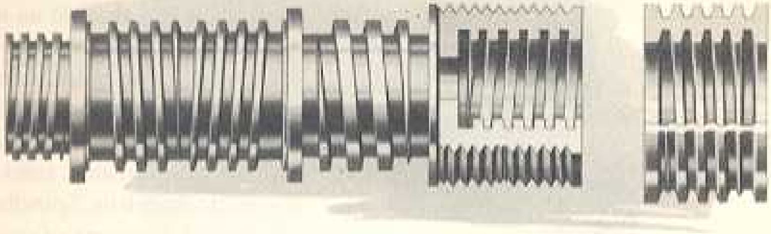
Automatic Stop for Carriage

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.

In the accompanying diagram and sectional view are shown the cranks and linkage connecting both automatic stop rod and reverse rod with feed reversing clutch B16-2495.



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.

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 gearing 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 with countershaft by running both counter belts in cutting direction.

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 same.

Carriage Stop for Hendey Lathe

This stop is valuable as a Micrometer Spacing Attachment. The spindle is engine lathe threaded 20 per inch, and knurled nut has 50 graduations reading in thousandths. Spindle has travel in excess of one inch. The stop can be used in accurately spacing grooves, or in squaring off any desired thickness of metal from face plate, etc.

Directions for Use of Carriage Stop

For Quick Return in Cutting Long Threads

Set Automatic Stop to stop tool at finished end of cut. Leaving the carriage in this position, measure the length of screw to be cut from the tool to the start, then set 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 carriage in even inches or half inches; according to the pitch to be cut.

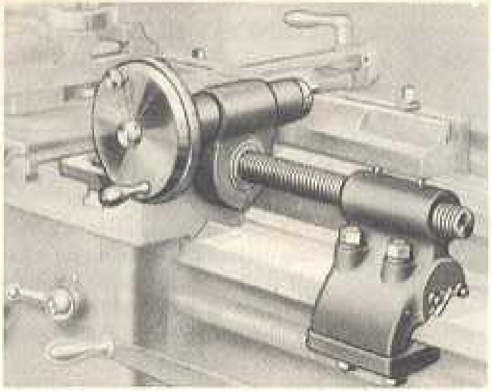
If the thread is an odd one, as 5, 7, 11, make the travel of carriage in FULL inches. If even, make the travel in inches or half inches.

Example: To cut 7 pitch, 10¼" 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, 10¼" 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 till it comes in contact with the stop screw. Then lock the half nuts in the lead screw, and start the carriage forward on the cut by means of the lever at the end of apron. Repeat the operation until thread is finished.

It is seen that the spindle runs 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.

Note. On short threads but of fine pitch make quick return by hand as for long threads.



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 the 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" attachments 1½" diameter, 4 pitch.

HENDEY SUB-HEADSTOCKS furnish the means to do a variety of work at low speeds through reduction gearing, such as:

Chasing of screw threads having exceptionally long leads.

Turning and relieving with wide forming cutters. (When using wide forming tools for Relieving or turning form milling cutters, very low speeds and increased belt power are available to great advantage.)

Turning and relieving hobs with long leads.

Relieving milling cutters with large numbers of teeth.

Turning on dead centers. (Having a dead center the Sub-Headstock presents the ideal condition for precision turning and facing.)

The mechanism consists of a reduction gearing assembled in compact form in a substantial housing, together with driving plate and dead center, forming a complete unit.

The Gearing is of alloy steel—heat treated. Driving plate has six Tee slots, and a special driver.

The Sub-Headstock housing is fitted to bed in same manner as lathe headstock and clamped by two bolts.

All work centered is carried on two dead centers, and is revolved by a suitable dog engaging with the plate driver. For internal threading and grooving, a chuck or piece of work can be readily strapped to driving plate.

Sub-head gearing gives a reduction of 6 to 1. That is, the driving plate revolves one turn to six of the spindle.

The feed gearing and lead screw are driven by spindle in the usual way.

If the gear box handles are set for the coarsest lead shown on the index of an 18", 20", or 24" lathe, i.e. 1", it is readily seen that for six turns of the spindle the carriage will have advanced six inches *while the driving plate revolves one turn.*

This involves no appreciable increase in pressure on feed gearing over that set up with lathe engaged in chasing one inch lead with regular equipment.

With regular gearing on Lathe, longest lead obtained is 6" for 18", 20", and 24" Lathes, and 4" for 12", 14", and 16" Lathes.

By using special change gears a lead as long as 10" or 12" can readily be obtained.

Open side tool block is regularly furnished with attachment, or special compound rest with strap tool post or compound four-way tool block can be used.

Sub Headstock—Thread Cutting

The work is held between centers in the usual way and can be driven with a bent tail dog or straight tail dog by means of the driver furnished.

The tool having been ground normal to the helix of thread, is located at the proper height.

With the spindle running continuously in one direction and the carriage reversed through the bevel gears in Headstock, we recommend using the automatic stop—especially at the starting end of the thread, proceeding as follows:

With the carriage brought to rest by the automatic stop dog and the tool properly advanced to take the first cut:

1st. Watch the driving plate as it revolves;

2nd. Taking one of the brass index numbers inserted in driving plate as a timing guide against some stationary part of the lathe, throw the clutch into engagement by the apron reverse lever;

3rd. The carriage then starts to move in the desired direction with the tool taking the first chip or pass;

4th. At the end of the cut reverse the carriage, allowing the automatic stop dog to stop it at the starting position.

If it is intended to cut a single thread screw or to finish one thread of a multiple thread screw, set the tool for the next chip and when the selected number on driving plate is in the same relative position (Par. 2) as when the first cut was started, throw the clutch in engagement and the tool will follow the same path as before.

If the screw being cut has **Multiple** threads such as: Two, Three, or Six, proceed as follows:

As an example take a triple thread screw:

1st. Start the first cut when the numeral (1) is in a selected position (as Par. 2 above);

2nd. When ready for the second cut, set the tool for the same depth of cut as at first, and engage the clutch when the numeral (3) comes on the previously selected position. This will then take the cut in the path of the second start;

3rd. Repeat the operation once more and this time engage the clutch when the numeral (5) is in the selected position. This cut follows the path of the third start and completes the cycle.

Having taken the same depth of cut successively over the three threads, the tool is now advanced and the next cut taken with the numerals (1), (3), (5) used as indexes in rotation for engaging the clutch. This is continued until the full depth of thread is attained. The spacing of the three threads will be correct, and the same result will be obtained with double or sextuple threads.

In the case of four or five multiple threads some other method must be used.

If operator wishes to use method of reversing rotation of spindle from countershaft, the hand reversing lever at the right of apron *must not be moved*, or the automatic stop used during the successive cuts taken over the work.

To Figure Gearing Necessary to Cut Leads With the Sub-Headstock That Cannot be Cut With the Regular Gearing.

Formula No. 1.

Reduce the lead desired to a common fraction, as: $3\frac{13''}{16}$ Lead $=\frac{61''}{16}$ Lead.

Properly place both gear box handles in position necessary to produce the lead nearest to the lead desired, bearing in mind the 6 to 1 ratio of the Sub-Headstock, as: 1½ Threads per inch.

Transpose this gear box reading of threads per inch into lead, as:

$1\frac{1}{2}$ T. P. I. $=\frac{3}{2}$ T. P. I. $=\frac{2''}{3}$ Lead.

Multiply the lead thus obtained by 6 to secure the lead that will result from using the Sub-Headstock, as: $\frac{2''}{3}\times 6=\frac{12''}{3}$ or 4" Lead.

Reduce the fraction representing the lead desired, and the fraction representing the lead the lathe will cut with the regular gearing and the Sub-Headstock to a common denominator.

as: $\frac{61''}{16}$ and $\frac{4''}{1}=\frac{61''}{16}$ and $\frac{64''}{16}$

After these fractions have been reduced to a common denominator the numerator of the first fraction, or the numerator of the fraction representing the lead desired, will represent the number (or a multiple of the number, or a sub-multiple of the number) of teeth one of the desired gears will have, and this gear will be the Driver, or the Stud Gear D (see Diagram of Feed Gears, page 47); and the numerator of the second fraction, or the numerator of the fraction representing the lead the lathe will cut with the regular gearing and the Sub-Headstock, will represent the number (or a multiple of the number, or a sub-multiple of the number) of teeth the other desired gear will have, and this gear will be the Driven, or Sector Gear C.

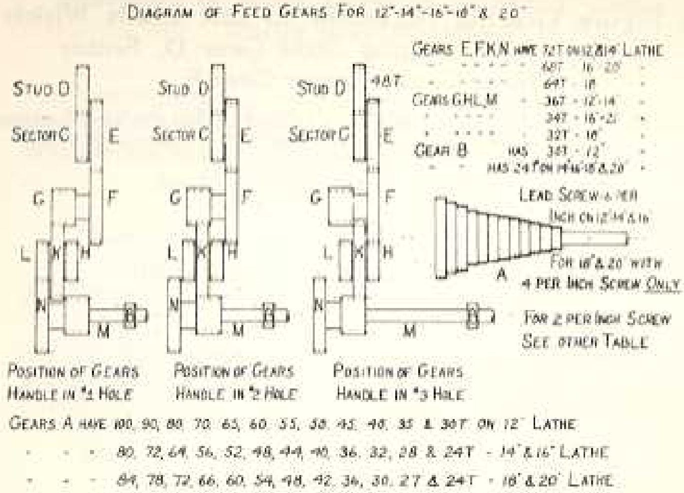
as: 61 Tooth Driver at D, or on Stud;
64 Tooth Driven ~~at C~~, or on Sector;
When the gear box handles are in position to cut 1½ T. P. I. as previously mentioned.

It will be found occasionally that a desired lead which it is possible to cut, cannot be cut by using the regular lead nearest to the desired lead; hence, if this formula should produce for the numer of teeth in the desired gears some prime numbers too large to be used, or some irreducible fractions, try the same process, using another position of the gear box handles.

To prove that the gears determined upon by the foregoing formula will cut the desired lead:

Produce a fraction, using the number of teeth of the Driving Gear D as the numerator, and the number of teeth of the Driven Gear C as the denominator, multiply this by the fraction representing the selected lead the regular gears will cut; and multiply this by six, representing the Sub-Headstock; the result will be the lead in inches that will be produced,

as: $\frac{61}{64}\times\frac{2}{3}\times\frac{6}{1}=\frac{61}{16}=3\frac{13''}{16}$..



To Figure Gearing Necessary When the Lead Desired IS REPRESENTED IN DECIMALS of the Inch

Formula No. 2. Example: To cut a lead of 2.760" with the Sub-Headstock:

Place both gear box handles in position necessary to cut the lead nearest to the lead desired, bearing in mind the 6 to 1 ratio of the Sub-Headstock, as: 2 threads per inch.

Transpose this gear box reading of threads per inch into lead, as: 2 T. P. I. = .500" Lead.

Multiply the lead thus obtained by six, to secure the lead that will result from using the Sub-Headstock, as: .500"×6=3" Lead.

As mentioned in previous formula:

2.76 is the exponent of gear D, 3.00 is the exponent of gear C,

or

276 for D, and 300 for C; and by reduction: $\frac{276}{300}=\frac{46}{50}$ or $\frac{69 \text{ for D}}{75 \text{ for C}}$

Should one of the numbers arrived at be a prime or irreducible number too large to be used, try another position from the index.

To Figure Gearing Necessary to Cut Leads Which Necessitates Changing Stud Gear D, Sector Gear C, and Sector Gear E

Formula No. 3. To cut a lead of 1.005″ on a 14″ lathe using the Sub-Headstock.

With formula No. 2: 1.005″ Lead $= \frac{1005}{1000}$ Lead.

Selecting 6 threads per inch $= \frac{1}{6}$ Lead. Multiply

by 6 for Sub-Headstock, $= \frac{1}{6} \times 6 = 1''$ Lead or $\frac{1000}{1000}$

Reduce the fractions: $\frac{1005}{1000}$ and $\frac{1000}{1000}$ to $\frac{201}{200}$ and $\frac{200}{200}$

As the fraction $\frac{201}{200}$ is irreducible, it follows that the Driving Gear D would have 201 teeth and the Driven Gear C would have 200 teeth, both of which are too large to use.

On the 14″ lathe the gear F must remain 72-T, but while the gear E is regularly 72-T, it may be changed.

To determine what the gears D, C, and E should be,

we find: $\frac{201\ (D) \times 72\ (E)}{200\ (C) \times 72\ (F)} = \frac{14472}{14400} = \frac{1809}{1800}$

From a table of prime and divisible numbers, we find that 1809 equals 27×67, and 1800 equals 25×72; then the formula becomes: $\frac{27 \times 67}{25 \times 72}$ or $\frac{54 \times 67}{50 \times 72}$

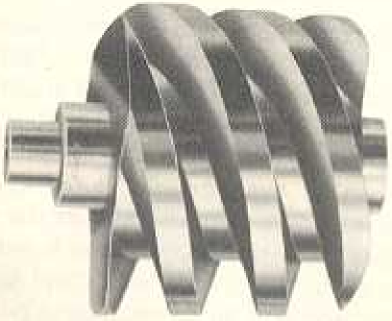
In other words: D = 54-T, C = 50-T, E = 67-T, F = 72-T as fixed.

Proof: $\frac{D}{C} \times \frac{E}{F} \times$ Lead Selected × 6 (Sub-Headstock Ratio) = Lead in inches that gearing will cut, or $\frac{54}{50} \times \frac{67}{72} \times \frac{1}{6} \times \frac{6}{1} = \frac{1809}{1800} = \frac{201}{200} = 1.005''$

Examples of Work Done in HENDEY Lathe Using Sub-Headstock

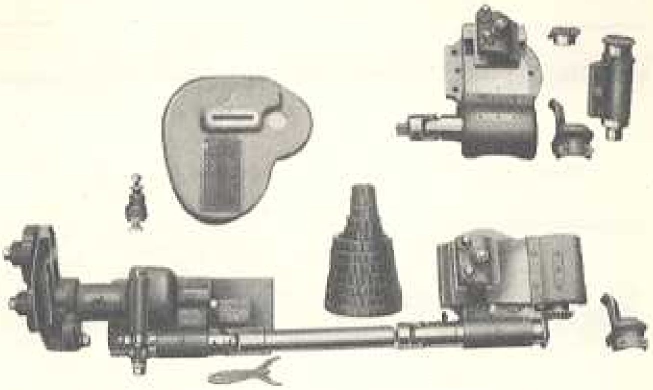
Shaft with Two Starts or Grooves of Six Inch Lead

Screw with Six Starts and Four Inch Lead



Shows Large Diameter Triple Thread Worm of Coarse Lead as Cut with Sub-Headstock

Note the narrow width of relief or neck in the two examples showing tool run out. This serves to prove the efficiency of the automatic stop, indicating there is practically no strain on the feed clutch drive of lathe head when the automatic stop starts to function.



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.

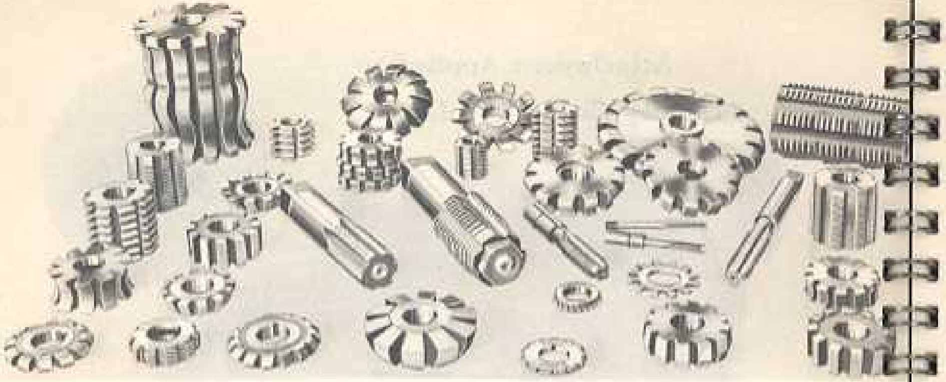
Illustration shows attachment with tool slide in parallel position ready for end relieving. Insert shows same tool slide set at right angles for radial relieving. The extra parts needed to operate tool slide in parallel position are, block with cam shaft extension for mitre gear, mating mitre which goes on eccentric shaft of tool block, and gear guard. The change from one set-up to the other is made in a very few minutes.

Attachment Applied to
Hendey Cone Head 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 63 and 64. The placing of complete attachment in position occupies but a very few minutes.

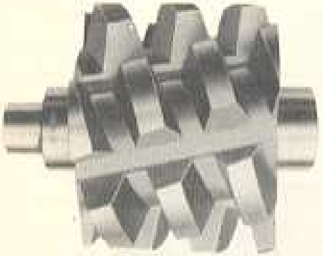
Three-speed countershaft is furnished with lathe having relieving attachment when not motor driven.

Attachment Applied to Geared Head Lathe

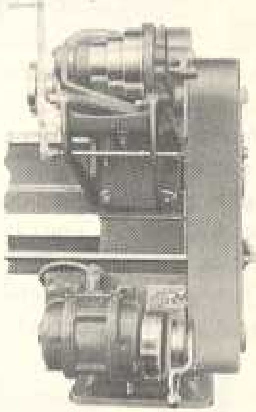


Various Examples of Relieved Work

The rigidity and smoothness of operation of the Hendey Twelve-Speed Geared Head Lathe makes it especially well adapted to the use of relieving attachment in the backing off of formed cutters having *Wide Cutting Faces*.



A triple worm hob 12" dia., D.P. 1, Triple Lead 9.875 which has been successfully backed off with relieving attachment, using a Hendey Sub-Headstock as the driving member to secure the necessary reduction in R.P.M.



Speed Reducer

Added to motor drive for either cone or geared head lathes (for the latter placed inside the cabinet leg with motor), when furnished with Relieving Attachment, and variable speed motor is not wanted. The reduction from motor speed is in the ratio of 1 to 4.

This Speed Reducer provides the slower spindle speeds needed for relieving attachment operations, while retaining the higher direct motor speeds used for ordinary turning and threading.

When relieving attachment is applied to a geared head lathe that is to be motor driven but without speed reducer, motor then should have at least two speeds not exceeding 900 and 1800 R.P.M.

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 R.P.M. of driving unit. 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. *Re-milling after backing off insures a sharp edge and less grinding after hardening the cutter.*

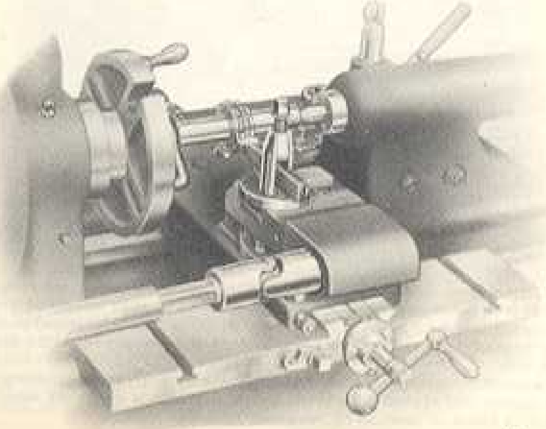
Varying Amount of Relief

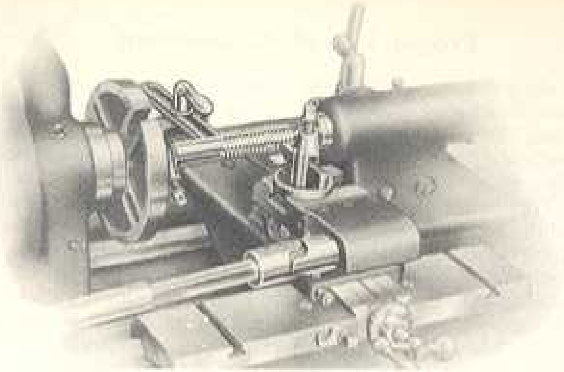
It is very often desirable to change the amount of relief from one type of cutter to another. This is accomplished in a simple and easy manner in Type C Attachment with ends of oscillating shaft and cam lever having a toothed coupling which permits changing position of eccentric on tool slide to cam lever, thereby lengthening or shortening the reciprocating travel of tool. This adjustment gives a range of from nearly zero to approximately ⅝" motion to tool slide on 14, 16, and 18", ⅜" on 20", and ½" on 24" lathe.

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.

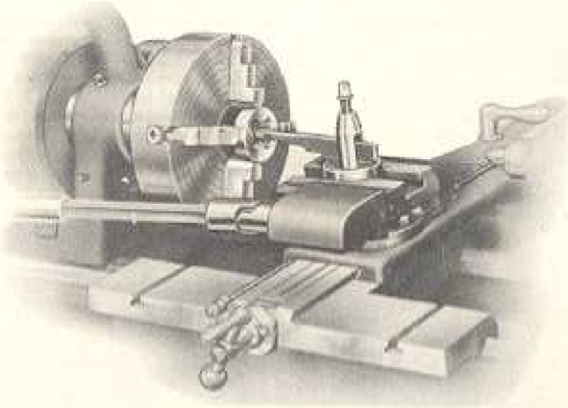
Working speeds at which cutters of this character are relieved are necessarily slow, being governed largely by the width of the cut taken.





Relieving Right-Hand Taps

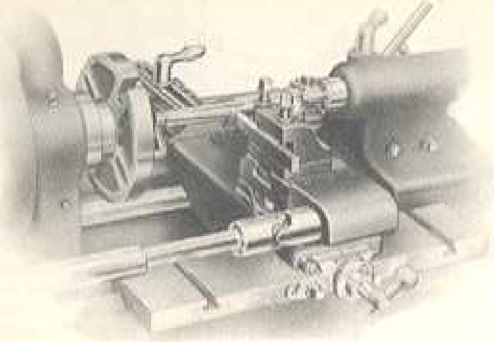
The ordinary practice in setting up this attachment to relieve a right-hand tap, is to first set tool as to cut thread, then engage it accurately in the thread space by rolling work in the dog, or dropping a tooth or two in the gear box; now arrange motion of tool slide so forward movement of tool will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



Internal 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.

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.

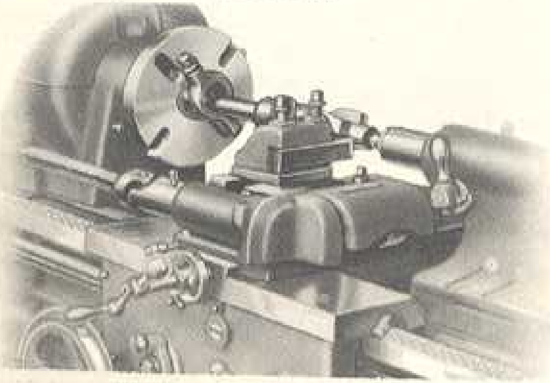


Relieving Left-Hand Taps

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.

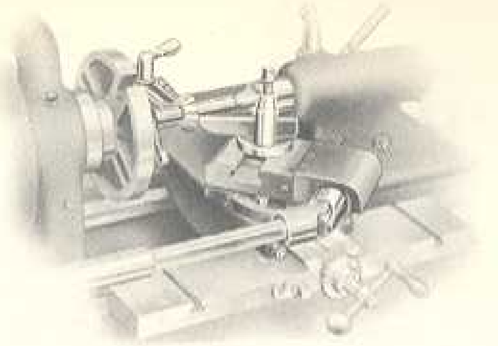
When using the first method, the tap must be placed with the point toward the live spindle with the shank end supported by tail center. This is done by providing an extension or blank end at the point of tap sufficient to take the dog, and which can be removed later if desired.

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. The opposing spring, moreover, must be in the same position as for inside work.



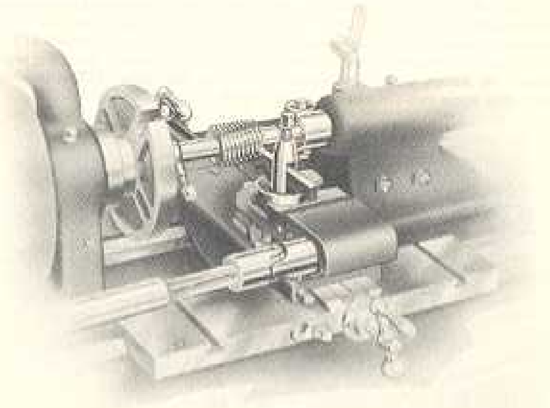
Relieving Counterbores

Accomplished successfully by setting the tool slide to a 90 degree angle and using a pair of mitre gears to engage cam shaft with eccentric shaft of tool slide. See cut at top of page 58.



Relieving Sides of Angular Cutters

The wide range 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 Spiral-Fluted Hobs and Taps

When a hob or tap having spiral flutes is to be relieved on this attachment, first determine the pitch of the spiral and select 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, being careful not to disengage the lead screw but reverse the carriage by power, using for that the lever at right of apron.

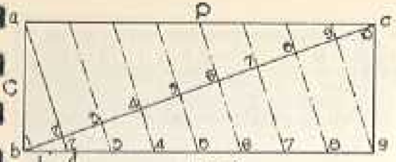


FIG. 9

WHEN FLUTES ARE AT
RIGHT ANGLE OR OPPOSITE
HAND TO THE THREAD.

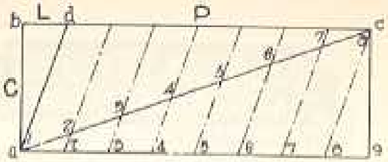


FIG. 10

WHEN FLUTES ARE
OF THE SAME HAND
AS THREAD.

Pitch of Spiral Flutes

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 Flutes

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

Referring to Diagram, Fig. 9, where
C or a b = Circ. 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 triangle *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 Fig. 9 (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* at right angle to the thread, it will be seen by referring to diagram 9 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 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.

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 Spiral $=\frac{3.25^2}{.75}=14.083''$.

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

$$\text{Then } M=\frac{14}{.75}=18\tfrac{2}{3} \qquad N=\frac{14}{.75}+1=19\tfrac{2}{3}$$

Ratio $\frac{19\frac{2}{3}}{18\frac{2}{3}}=\frac{59}{56}$. 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.

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

$$C=1.84''\times 3.1416=5.78''; \; L=\tfrac{1}{3}''; \; F=7.$$

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

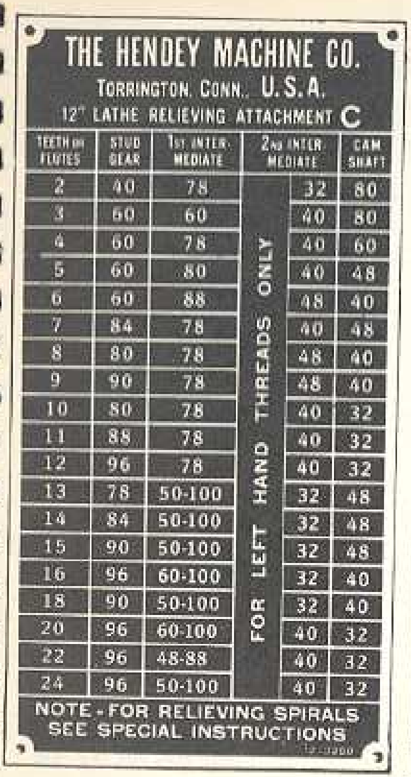
$$M=\frac{100}{\frac{1}{3}}=300 \quad N=\frac{100}{\frac{1}{3}}+1=301 \qquad \text{Then } \frac{7\times 301}{4\times 300}=\frac{2107}{1200}=\frac{49\times 43}{30\times 40}\,\frac{\text{Drivers,}}{\text{Driven}}$$

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

$$\frac{49\times 86 \text{ Drivers,}}{40\times 60 \text{ Driven}}$$ as the train of gears wanted.

Note. If spiral flutes are of the same hand as the thread, the formula becomes

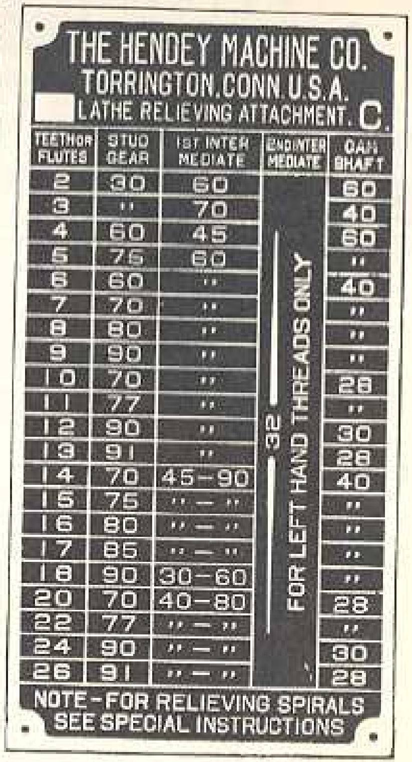
$M=\frac{P}{L}$, $N=\frac{P}{L}-1$ as shown by fig. 10.



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

TEETH or FLUTES	STUD GEAR	1ST INTER-MEDIATE	2ND INTER MEDIATE		CAM SHAFT
2	40	78	FOR LEFT HAND THREADS ONLY	32	80
3	60	60		40	80
4	60	78		40	60
5	60	80		40	48
6	60	88		48	40
7	84	78		40	48
8	80	78		48	40
9	90	78		48	40
10	80	78		40	32
11	88	78		40	32
12	96	78		40	32
13	78	50-100		32	48
14	84	50-100		32	48
15	90	50-100		32	48
16	96	60-100		32	40
18	90	50-100		32	40
20	96	60-100		40	32
22	96	48-88		40	32
24	96	50-100		40	32

NOTE - FOR RELIEVING SPIRALS
SEE SPECIAL INSTRUCTIONS



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

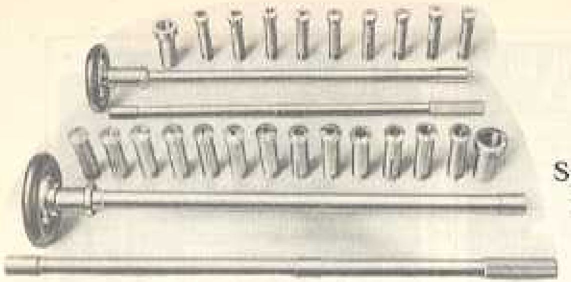
TEETH OR FLUTES	STUD GEAR	1ST INTER MEDIATE	2ND INTER MEDIATE	CAM SHAFT
2	30	60	32 FOR LEFT HAND THREADS ONLY	60
3	"	70		40
4	60	45		60
5	75	60		"
6	60	"		40
7	70	"		"
8	80	"		"
9	90	"		"
10	70	"		28
11	77	"		"
12	90	"		30
13	91	"		28
14	70	45–90		40
15	75	" – "		"
16	80	" – "		"
17	85	" – "		"
18	90	30–60		"
20	70	40–80		28
22	77	" – "		"
24	90	" – "		30
26	91	" – "		28

NOTE - FOR RELIEVING SPIRALS
SEE SPECIAL INSTRUCTIONS

Index Plates for
Type C Relieving Attachments

One plate is shown for Attachment when applied to 12″ over swing geared head lathe. The second plate illustrated is uniform for 14″, 16″, 18″ and 20″ cone and geared head lathes.

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.



Sets of Spring Collets for Hendey Lathes

For use with our lathes we have four different sizes of Spring Collets, Nos. 2, 3, 6, and 8.

The No. 2 set has 9 Collets ⅛" to ⅝" by 16ths.
The No. 3 set has 13 Collets ⅛" to ⅞" by 16ths.
The No. 6 set has 15 Collets ⅛" to 1" by 16ths.
The No. 8 set has 15 Collets ⅜" to 1¼" by 16ths.

Each set of Collets has standard equipment consisting of draw-in sleeve, closer and knockout rod; with cabinet and mount for same.

The No. 2 set is for 12", 14" and 16" lathes.
The No. 3 set is for 12"*, 14", 16", 18" and 20" lathes.
The No. 6 set is for 12"*, 14"*, 16", 18" and 20" lathes
The No. 8 set is for 18", 20" and 24" lathes.

*For Geared Head Lathe only.

Note. No. 3 set requires minimum hole in spindle of 1 1/16"
No. 6 set requires minimum hole in spindle of 1 3/8"
No. 8 set requires minimum hole in spindle of 1 9/16"

Collets in intermediate capacities can be furnished; and also for holding square or hex stock.

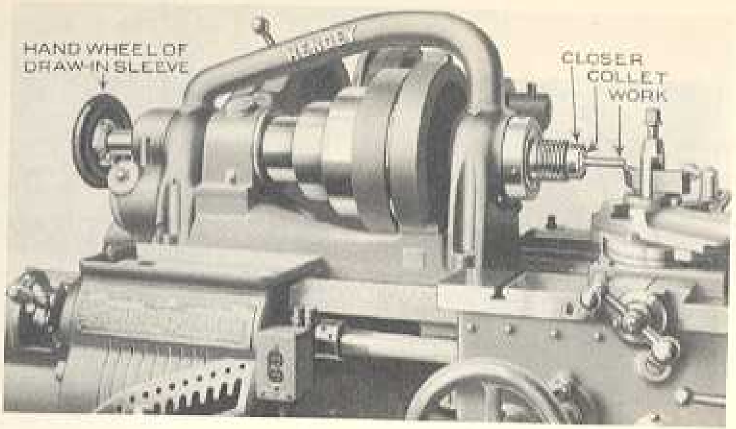
These collets will hold a test rod to a run-out of not to exceed .001" at 2" from end of collet.

Step Chuck and Closers

These chucks are for holding thin pieces of work such as rings or collars which must be faced or bored. They are left soft for customers to recess to suit their own work. Sizes are 2", 4" and 6" maximum capacity.

The closers screw onto nose of spindle and have an inside bevel in which the split chuck is tightened.

These chucks are operated with the same draw-in sleeve as used for the spring collets.



Spring Collet, Closer, and Draw-In Sleeve Assembled Ready for Use in Hendey Motor Driven Cone Head Lathe Spindle

Cabinet and Mount for Spring Collet Equipment

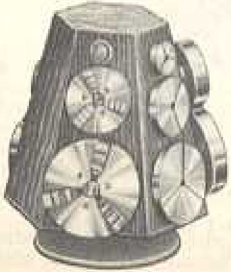
Sets of spring collets with equipment are furnished with a suitable cabinet and support for same (patent No. 1,337,387) to be attached to back of lathe bed.

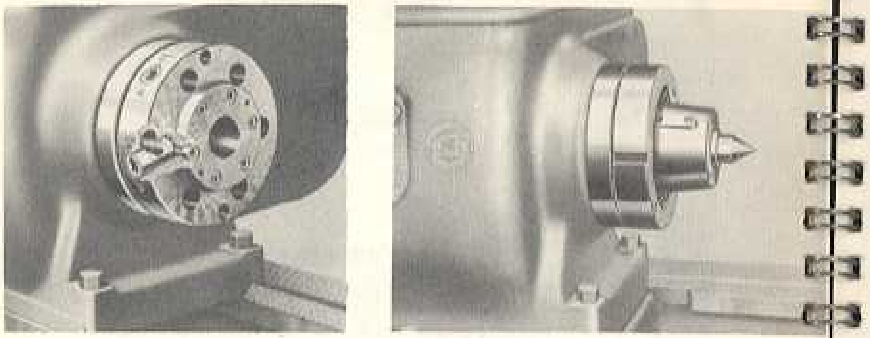
The tubular post supporting the cabinet also protects the draw-in sleeve which hangs in it. The collets are placed in a removable shelf. The knock-out rod hangs on a pin at the side of post, and rests in a notch in bracket to keep it in place.

The cabinet was designed to keep the set together and well protected.

Pyramid for Holding Chucks, etc.

We can furnish an attractively finished wood pyramid mounted to rotate on a cast iron pedestal, and with pins or studs fitted to the sides to carry chucks, face plates, etc. This makes a suitable companion piece for the cabinet for spring collets.

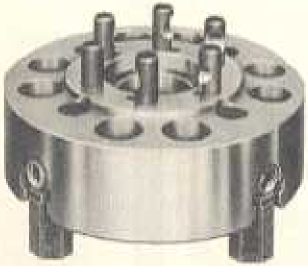




Spindle Noses and Chucks

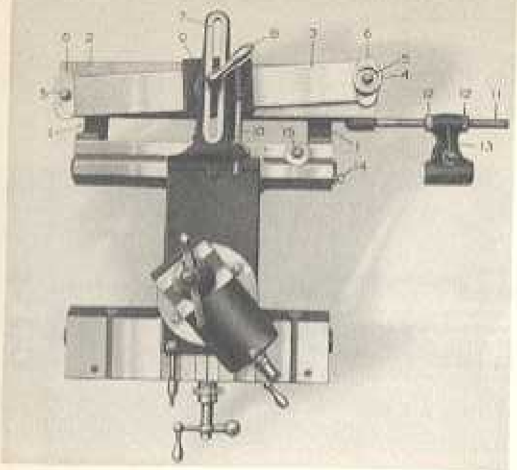
Hendey spindle noses are furnished in three patterns: the threaded type; the D-1 cam-lock flange type; and the long taper key type. On the D-1 type face plates and chucks are held by means of 6 cam locking studs as shown attached to back of chuck in illustration. The locking cams are held in the radial holes in the spindle flange.

The long taper type has a taper nose to center and seat the plates and chucks, a heavy key for driving, and a threaded collar for retaining the driven member in place. This collar is hooded over the flange back of spindle nose. Both types are approved by the American Standards Association.



Chuck Fitted for D-1 Cam-lock Spindle

Driving Plate and Collar for Long Taper Nose



Taper Attachment for Hendey Lathes

The essential parts of this 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.
5 Binding bolts for swivel bar.
6 Cover plates for bolt slots.
7 Connecting link between slide block and cross slide.
8 Binding handle for stud, connecting slide block with cross slide link and cross-feed screw extension block.
9 Slide block on swivel bar connecting with cross slide.
10 Thread-stop rod, used when cutting taper threads.
11 Attachment slide connecting screw.
12 Knurled check nuts for connecting screw.
13 Connecting screw bed clamp.
14 Binding screw for cross-feed screw extension block.
15 Binding bolt for carriage.

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.

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° 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°, and a maximum angle of 48½°.

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

Maximum travel:			
	12" Lathe 13"	16" Lathe 18"	20" Lathe 20"
	14" Lathe 15"	18" Lathe 18"	24" Lathe 20"

Multiple Cross and Longitudinal Feed Stops

The multiple cross feed stops device is a self contained unit to be screwed to the front and rear wings of the carriage, and may be used either on the right side or the left of the cross slide as desired.

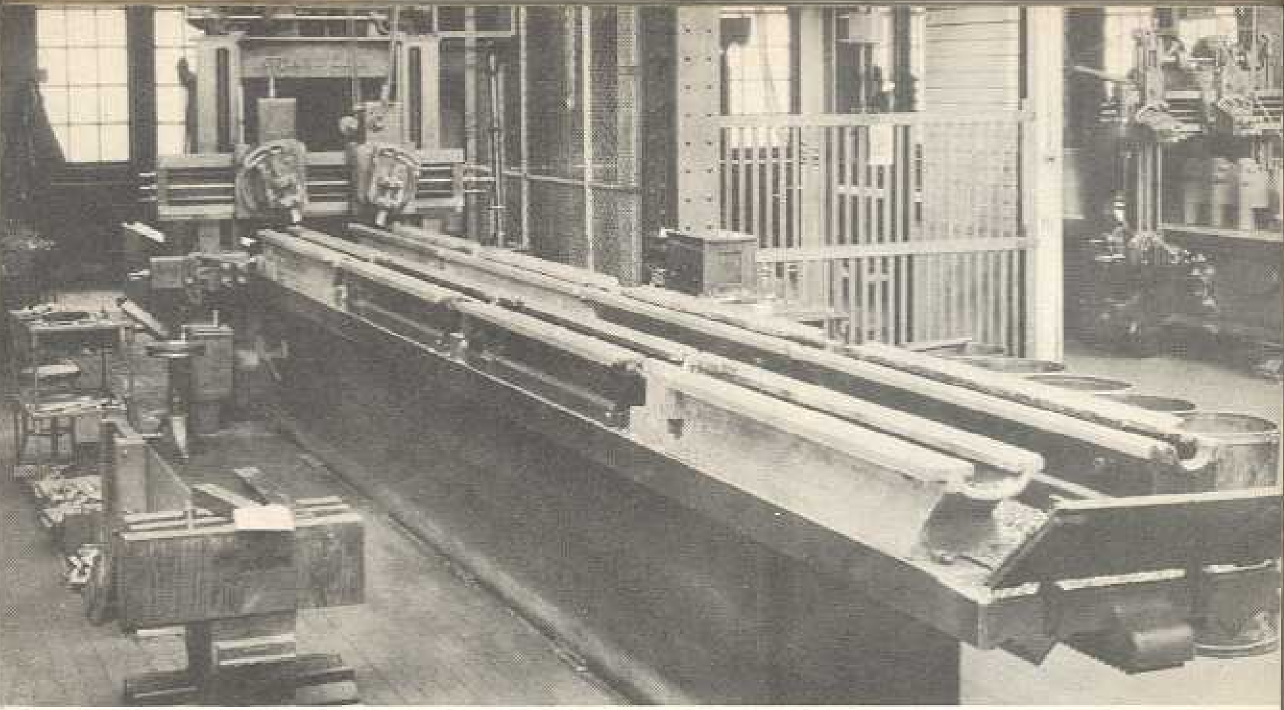
A stop lug needs to be attached to the side of the cross slide to contact the stop dogs on the fixture. There are five of these dogs, each mounted on its own key, and the stop assembly is rotated by hand to bring each stop into position at will.

Longitudinal stops require a separate rod, flat in form, which is mounted below the regular stop rod. This latter rod is retained because it carries two levers which in turn are connected to operate the main driving clutch. The longitudinal multiple stop rod regularly carries six stop dogs, one more than in the multiple cross stop assembly.

On the following pages are pictures of manufacturing methods in use in the shops of The Hendey Machine Company.

These processes go a long way towards keeping the product of the Company in the front rank of quality.

Hendey pioneered in the multiple planing of lathe beds, heads, carriages, tailstocks, etc., realizing that it made for interchangeability.

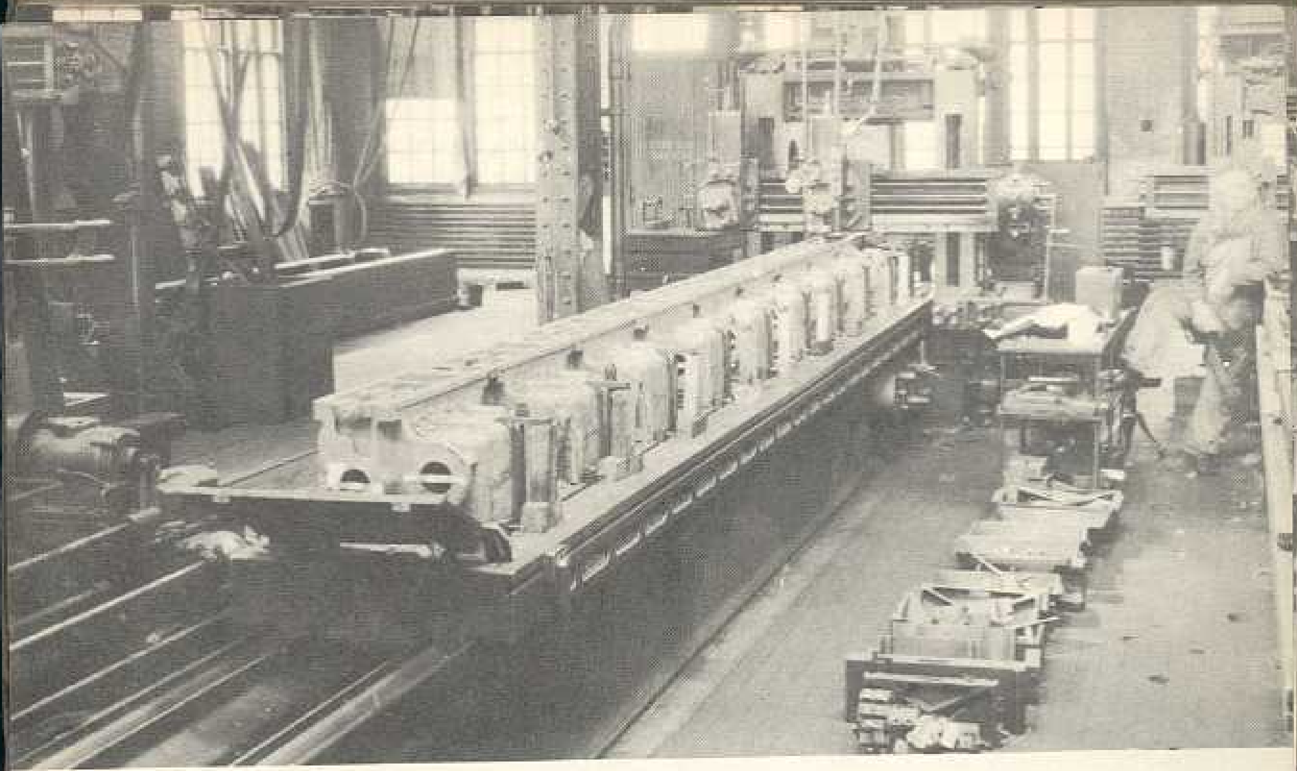


2215

Planing a battery of 8 14 x 6 lathe beds, 4 to the row. Planer has 4 tool heads, two on the cross rail, one each on the uprights. Before planed beds are released from planer they are tested with straight edge for surface accuracy.

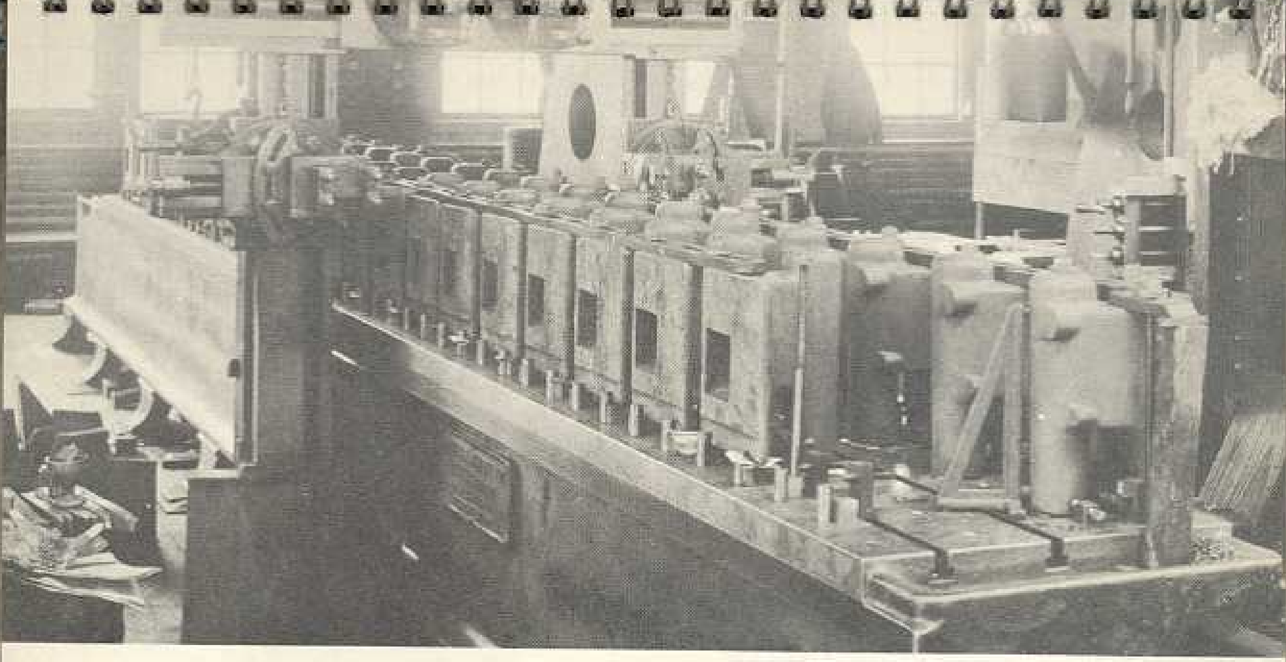
60

Two planers operating on lathe carriages. These planers are high speed and have narrow tables especially adapted for carriage planing.



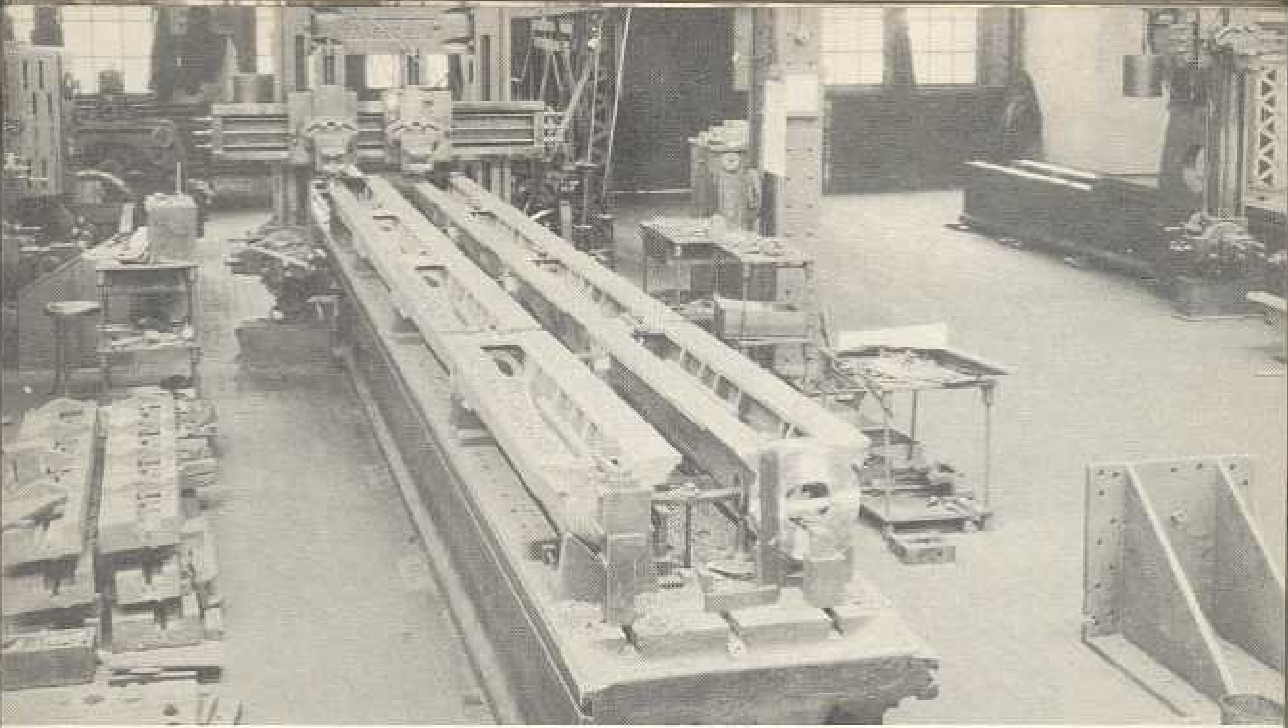
2213

Planing the bottoms of a row of 20″, 12-speed geared headstocks. After being finished planed these heads are hand scraped to a precision bearing on the lathe bed ways.



215

Planing parallel rows of tail stock top castings. Note these are set up in a vertical position, each row facing to the outside, with tooling done from the side heads.



Planing Shaper Rams

2214

Being large manufacturers of crank shapers, it is obvious that planing methods employed in the building of lathes would be followed in shaper work as well.

1156

General view of main floor of planer shop, where it may be seen that all classes of lathe and shaper parts are "in the works."

DECIMAL EQUIVALENTS

1/64 .0156	17/64 .2656	33/64 .5156	49/64 .7656
1/32 .0312	9/32 .2812	17/32 .5312	25/32 .7812
3/64 .0468	19/64 .2968	35/64 .5468	51/64 .7968
1/16 .0625	5/16 .3125	9/16 .5625	13/16 .8125
5/64 .0781	21/64 .3281	37/64 .5781	53/64 .8281
3/32 .0937	11/32 .3437	19/32 .5937	27/32 .8437
7/64 .1093	23/64 .3593	39/64 .6093	55/64 .8593
1/8 .125	3/8 .375	5/8 .625	7/8 .875
9/64 .1406	25/64 .3906	41/64 .6406	57/64 .8906
5/32 .1562	13/32 .4062	21/32 .6562	29/32 .9062
11/64 .1718	27/64 .4218	43/64 .6718	59/64 .9218
3/16 .1875	7/16 .4375	11/16 .6875	15/16 .9375
13/64 .2031	29/64 .4531	45/64 .7031	61/64 .9531
7/32 .2187	15/32 .4687	23/32 .7187	31/32 .9687
15/64 .2343	31/64 .4843	47/64 .7343	63/64 .9843
1/4 .25	1/2 .5	3/4 .75	1 1.0

MILLIMETER EQUIVALENTS

MM	INCHES	MM	INCHES	MM	INCHES	MM	INCHES
.1	.00394	21.	.82677	48.	1.88976	75.	2.95275
.2	.00787	22.	.86614	49.	1.92913	76.	2.99212
.3	.01181	23.	.90551	50.	1.96850	76.2	3. ins.
.4	.01575	24.	.94488	50.8	2. ins.	77.	3.03149
.5	.01968	25.	.98425	51.	2.00787	78.	3.07086
.6	.02362	25.4	1. in.	52.	2.04724	79.	3.11023
.7	.02756	26.	1.02362	53.	2.08661	80.	3.14960
.8	.03149	27.	1.06299	54.	2.12598	81.	3.18897
.9	.03543	28.	1.10236	55.	2.16535	82.	3.22834
1.	.03937	29.	1.14173	56.	2.20472	83.	3.26771
2.	.07874	30.	1.18110	57.	2.24409	84.	3.30708
3.	.11811	31.	1.22047	58.	2.28346	85.	3.34645
4.	.15748	32.	1.25984	59.	2.32283	86.	3.38582
5.	.19685	33.	1.29921	60.	2.36220	87.	3.42519
6.	.23622	34.	1.33858	61.	2.40157	88.	3.46456
7.	.27559	35.	1.37795	62.	2.44094	88.9	3.5 ins.
8.	.31496	36.	1.41732	63.	2.48031	89.	3.50393
9.	.35433	37.	1.45669	63.5	2.5 ins.	90.	3.54330
10.	.39370	38.	1.49606	64.	2.51968	91.	3.58267
11.	.43307	38.1	1.5 ins.	65.	2.55905	92.	3.62204
12.	.47244	39.	1.53543	66.	2.59842	93.	3.66141
12.7	.5 in.	40.	1.57480	67.	2.63779	94.	3.70078
13.	.51181	41.	1.61417	68.	2.67716	95.	3.74015
14.	.55118	42.	1.65354	69.	2.71653	96.	3.77952
15.	.59055	43.	1.69291	70.	2.75590	97.	3.81889
16.	.62992	44.	1.73228	71.	2.79527	98.	3.85826
17.	.66929	45.	1.77165	72.	2.83464	99.	3.89763
18.	.70866	46.	1.81102	73.	2.87401	100.	3.93700
19.	.74803	47.	1.85039	74.	2.91338	101.6	4. ins.
20.	.78740						

Table of Cutting Speeds

Feet per Minute	30	35	40	45	50	55	60	65	70	75	80	90	100	110	120	130	140	150
Diam., Inches	REVOLUTIONS PER MINUTE																	
1-2	229	267	306	344	382	420	458	497	535	573	611	688	764	840	917	993	1070	1146
5-8	183	214	244	275	306	336	367	397	428	458	489	550	611	672	733	794	856	917
3-4	153	178	204	229	255	280	306	331	357	382	407	458	509	560	611	662	713	764
7-8	131	153	175	196	218	240	262	284	306	327	349	393	437	480	524	568	611	655
1	115	134	153	172	191	210	229	248	267	287	306	344	382	420	458	497	535	573
1 1-8	102	119	136	153	170	187	204	221	238	255	272	306	340	373	407	441	475	509
1 1-4	91.7	107	122	138	153	168	183	199	214	229	244	275	306	336	367	397	428	458
1 3-8	83.3	97.2	111	125	139	153	167	181	194	208	222	250	278	306	333	361	389	417
1 1-2	76.4	89.1	102	115	127	140	153	166	178	191	204	229	255	280	306	331	357	382
1 5-8	70.5	82.3	94.0	106	118	129	141	153	165	176	188	212	235	259	282	306	329	353
1 3-4	65.5	76.4	87.3	98.2	109	120	131	142	153	164	175	196	218	240	262	284	306	327
1 7-8	61.1	71.3	81.5	91.7	102	112	122	132	143	153	163	183	204	224	244	265	285	306
2	57.3	66.8	76.4	85.9	95.5	105	115	124	134	143	153	172	191	210	229	248	267	287
2 1-4	50.9	59.4	67.9	76.4	84.9	93.4	102	110	119	127	136	153	170	187	204	221	238	255
2 1-2	45.8	53.5	61.1	68.8	76.4	84.0	91.7	99.3	107	115	122	138	153	168	183	199	214	229
2 3-4	41.7	48.6	55.6	62.5	69.5	76.4	83.3	90.3	97.2	104	111	125	139	153	167	181	194	208
3	38.2	44.6	50.9	57.3	63.7	70.0	76.4	82.8	89.1	95.5	102	115	127	140	153	166	178	191
3 1-4	35.3	41.1	47.0	52.9	58.8	64.6	70.5	76.4	82.3	88.2	94.0	106	118	129	141	153	165	176
3 1-2	32.7	38.2	43.7	49.1	54.6	60.0	65.5	70.9	76.4	81.9	87.3	98.2	109	120	131	142	153	164
3 3-4	30.6	35.7	40.7	45.8	50.9	56.0	61.1	66.2	71.3	76.4	81.5	91.7	102	112	122	132	143	153
4	28.7	33.4	38.2	43.0	47.7	52.5	57.3	62.1	66.8	71.6	76.4	85.9	95.5	105	115	124	134	143
4 1-2	25.5	29.7	34.0	38.2	42.4	46.7	50.9	55.2	59.4	63.6	67.9	76.4	84.9	93.4	102	110	119	127
5	22.9	26.7	30.6	34.4	38.2	42.0	45.8	49.7	53.5	57.3	61.1	68.8	76.4	84.0	91.7	99.3	107	115
5 1-2	20.8	24.3	27.8	31.3	34.7	38.2	41.7	45.1	48.6	52.1	55.6	62.5	69.5	76.4	83.3	90.3	97.2	104
6	19.1	22.3	25.5	28.6	31.8	35.0	38.2	41.4	44.6	47.8	50.9	57.3	63.7	70.0	76.4	82.8	89.1	95.5
6 1-2	17.6	20.6	23.5	26.4	29.4	32.3	35.3	38.2	41.1	44.1	47.0	52.9	58.8	64.6	70.5	76.4	82.3	88.2
7	16.4	19.1	21.8	24.5	27.3	30.0	32.7	35.5	38.2	40.9	43.7	49.1	54.6	60.0	65.5	70.9	76.4	81.9
7 1-2	15.3	17.8	20.4	22.9	25.5	28.0	30.6	33.1	35.7	38.2	40.7	45.8	50.9	56.0	61.1	66.2	71.3	76.4
8	14.3	16.7	19.1	21.5	23.9	26.3	28.7	31.0	33.4	35.8	38.2	43.0	47.7	52.5	57.3	62.1	66.8	71.6
8 1-2	13.5	15.7	18.0	20.2	22.5	24.7	27.0	29.2	31.5	33.7	36.0	40.4	44.9	49.4	53.9	58.4	62.9	67.4
9	12.7	14.9	17.0	19.1	21.2	23.3	25.5	27.6	29.7	31.8	34.0	38.2	42.4	46.7	50.9	55.2	59.4	63.6
9 1-2	12.1	14.1	16.1	18.1	20.1	22.1	24.1	26.1	28.2	30.2	32.2	36.2	40.2	44.2	48.3	52.3	56.3	60.3
10	11.5	13.4	15.3	17.2	19.1	21.0	22.9	24.8	26.7	28.7	30.6	34.4	38.2	42.0	45.8	49.7	53.5	57.3
11	10.4	12.2	13.9	15.6	17.4	19.1	20.8	22.6	24.3	26.0	27.8	31.3	34.7	38.2	41.7	45.1	48.6	52.1
12	9.5	11.1	12.7	14.3	15.9	17.5	19.1	20.7	22.3	23.9	25.5	28.6	31.8	35.0	38.2	41.4	44.6	47.8
13	8.8	10.3	11.8	13.2	14.7	16.2	17.6	19.1	20.6	22.0	23.5	26.4	29.4	32.3	35.3	38.2	41.1	44.1
14	8.2	9.5	10.9	12.3	13.6	15.0	16.4	17.7	19.1	20.5	21.8	24.5	27.3	30.0	32.7	35.5	38.2	40.9
15	7.6	8.9	10.2	11.5	12.7	14.0	15.3	16.6	17.8	19.1	20.4	22.9	25.5	28.0	30.6	33.1	35.7	38.2
16	7.2	8.4	9.5	10.7	11.9	13.1	14.3	15.5	16.7	17.9	19.1	21.5	23.9	26.3	28.7	31.0	33.4	35.8
17	6.7	7.9	9.0	10.1	11.2	12.4	13.5	14.6	15.7	16.9	18.0	20.2	22.5	24.7	27.0	29.2	31.5	33.7
18	6.4	7.4	8.5	9.5	10.6	11.7	12.7	13.8	14.9	15.9	17.0	19.1	21.2	23.3	25.5	27.6	29.7	31.8
Feet per Minute	30	35	40	45	50	55	60	65	70	75	80	90	100	110	120	130	140	150

Machinability Ratings

Machinability ratings and approximate cutting speeds in surface feet per minute, selected from charts published by Bliss & Laughlin, Inc., and Wyckoff Drawn Steel Co.

SAE 1112 is selected as having a standard of machinability of 100%. Percentages are approximate.

Grade of Steel	Machinability	Cutting Speeds in SFM.
High Sul. Bess.	120%	200–260
SAE 1112	100%	160
X-1314	85%	130
X-1315	85%	130
SAE 1120	80%	125
X-1335	75%	125
SAE 6135 annealed	65%	115 plus
SAE 4130 annealed	65%	115 plus
SAE 2330 annealed	65%	115 plus
SAE 4140 annealed	65%	115 plus
SAE 3140 annealed	65%	115 plus
SAE 1335 annealed	65%	115 plus
SAE 1045 annealed	60%	100 plus
SAE 1040	60%	110 plus
SAE 1035	60%	110
SAE 1020	60%	110
SAE 6115	60%	110
SAE 4615	60%	120
SAE 2345 annealed	60%	100 plus
SAE 3115	55%	100
SAE 1015	55%	100
SAE 2315	55%	115

Hardness Conversion Table for Structural Alloy Steels

(Approximate)

Scleroscope

Brinell	Vickers or Firth Diamond	Rockwell C Scale 150 kg. 120° Diamond Cone	Rockwell B Scale 100 kg., $\frac{1}{16}$" Ball	Shore Scleroscope	Tensile Strength 1000 Lbs. Sq. Inch
780	1220	68	...	96	...
745	1114	67	...	94	...
712	1021	65	...	92	354
682	940	63	...	89	341
653	867	62	...	86	329
627	803	60	...	84	317
601	746	58	...	81	305
578	694	56	...	78	295
555	649	55	...	75	284
534	608	53	...	73	273
514	587	51	...	71	263
495	551	50	...	68	253
477	534	48	...	66	242
461	502	47	...	64	233
444	474	46	...	62	221
429	460	44	...	60	211
415	435	43	...	58	202
401	423	42	...	56	193
388	401	41	...	54	185
375	390	39	...	52	178
363	380	38	...	51	171
352	361	37	...	49	165
341	344	36	...	48	159
331	335	35	...	46	154
321	320	34	...	45	148
311	312	32	...	43	143
302	305	31	...	42	139
293	291	30	...	41	135
285	285	29	...	40	131
277	278	28	...	38	127
269	272	27	...	37	124
262	261	26	...	36	121
255	255	25	...	35	117
248	250	24	100	34	115
241	240	23	99	33	112
235	235	22	99	32	109
229	226	21	98	32	107
223	221	20	97	31	105
217	217	18	96	30	103
212	213	17	95	30	100
207	209	16	95	29	98
197	197	14	93	28	95
187	186	12	91	27	91
179	177	10	89	25	87
170	171	8	87	24	84
163	162	6	85	23	81
156	154	4	83	23	78
149	149	2	81	22	76
143	144	0	79	21	74
137	136	−3	77	20	71

Data compiled by Research Lab., Development and Research Dept.,
The International Nickel Company, Inc., 67 Wall St., New York, N. Y.

Lubricants for Cutting Tools

Cutting Lubricants are used to keep the tools cool and to reduce the wear on the cutting edges, permitting fast cutting speeds.

Soluble Oil is the medium most generally used and is successful in cutting most grades of steel. It is a saponified oil, usually of a mineral oil base and readily mixes with water, the proportions of oil and water varying with the requirements.

Lard oil is highly efficient in specific cases when used in its pure or unadulterated state. It is however sometimes mixed with other oils or chemicals, for economic reasons, when it is not necessary to use it pure. Often in combination with sulphur it is highly efficient in tapping hard or tough metals. Such lubricant is called "Sulphur Base Oil."

Material	Drilling	Reaming	Milling	Turning	Tapping and Die Threading
Machinery Steel	Soluble Oil	Lard Oil	Soluble Oil	Soluble Oil	Soluble Oil Lard Oil
Tool Steel, Carbon and High Speed	Soluble Oil or Lard Oil	Lard Oil	Soluble Oil	Soluble Oil Lard Oil	Sulphur base or Lard Oil
Alloy Steel, Forgings, etc.	Soluble Oil or Lard Oil	Lard Oil	Lard Oil	Soluble Oil Lard Oil	Sulphur base or Lard Oil
Brass	Lard Oil and Kerosene Mixture	Soluble Oil	Soluble Oil or dry	Soluble Oil	Soluble Oil or Lard Oil
Bronze	Soluble Oil or dry	Soluble Oil or dry	Soluble Oil or dry	Soluble Oil	Soluble Oil or Lard Oil
Copper	Soluble Oil	Soluble Oil	Soluble Oil or dry	Soluble Oil	Soluble Oil or Lard Oil
Aluminum	Lard Oil and Kerosene Mixture	Lard Oil	Soluble Oil or dry	Soluble Oil	Soluble Oil or Lard Oil
Monel Metal	Lard Oil	Lard Oil	Soluble Oil	Soluble Oil	Lard Oil
Malleable Iron Castings, etc.	Soluble Oil	Soluble Oil	Soluble Oil	Soluble Oil	Soluble Oil
Cast Iron	Dry	Dry	Dry	Dry	Lard Oil

Courtesy Morse Twist Drill & Machine Co.

Definitions of Terms Relating to Heat Treating Operations

These definitions were prepared by a joint committee composed of representatives of the A.S.T.M., S.A.E., and A.S.S.T. They are listed here exactly as published in the National Metals 1930 Handbook (A.S.S.T.) American Society for Steel Treating.

1. **Heat Treatment**—An operation, or combination of operations, involving the heating and cooling of a metal or an alloy in the solid state.

   Note. This is for the purpose of obtaining certain desirable conditions or properties. Heating and cooling for the sole purpose of mechanical working are excluded from the meaning of this definition.

2. **Quenching**—Rapid cooling by immersion.

   Note. Immersion may be in liquids, gases or solids.

3. **Hardening**—Heating and quenching certain iron base alloys from a temperature either within or above the critical temperature range.

4. **Annealing**—Annealing is a heating and cooling operation of a material in the solid state.

   Note (A). Annealing usually implies a relatively slow cooling.

   Note (B). Annealing is a comprehensive term. The purpose of such a heat treatment may be:

   (a) To remove gases.
   (b) To remove stresses.
   (c) To induce softness.
   (d) To alter ductility, toughness, electrical, magnetic or other physical properties.
   (e) To refine the crystalline structure.

   In annealing, the temperature of the operation and the rate of cooling depend upon the material being heat treated and the PURPOSE of the Treatment.

   Certain specific heat treatments coming under the comprehensive term "annealing" are:

   A. **Full Annealing**—Heating iron base alloys above the critical temperature range, holding above that range for a proper time, followed by slow cooling through the range.

   Note. The annealing temperature is generally about 100 degrees Fahr. above the upper limit of the critical temperature range, and the time of holding is usually not less than one hour for each inch of section of the heaviest objects being treated. The objects being treated are ordinarily allowed to cool slowly in the furnace. They may, however, be removed from the furnace, and cooled in some medium which will prolong the time of cooling as compared to unrestricted cooling in the air.

   B. **Normalizing**—Heating iron base alloys above the critical temperature range followed by cooling to below that range in still air at ordinary temperature.

   C. **Tempering** (also termed drawing)—Reheating, after hardening, to some temperature below the critical temperature range followed by any desired rate of cooling.

   Note. (a) Although the terms "tempering" and "drawing" are practically synonymous as used in commercial practice, the term "tempering" is preferred.

   (b) Tempering, meaning the operation of hardening followed by reheating, is a usage which is illogical and confusing in the present state of the art of heat treating and should be discouraged.

5. **Carburizing** (Cementation)—Adding carbon to iron base alloys by heating the metal below its melting point in contact with carbonaceous material.

   Note. The term "carbonizing" used in this sense is incorrect so its use should be discouraged.

6. **Case Hardening**—Carburizing and subsequent hardening by suitable heat treatment, all or part of the surface portions of a piece of iron base alloy.

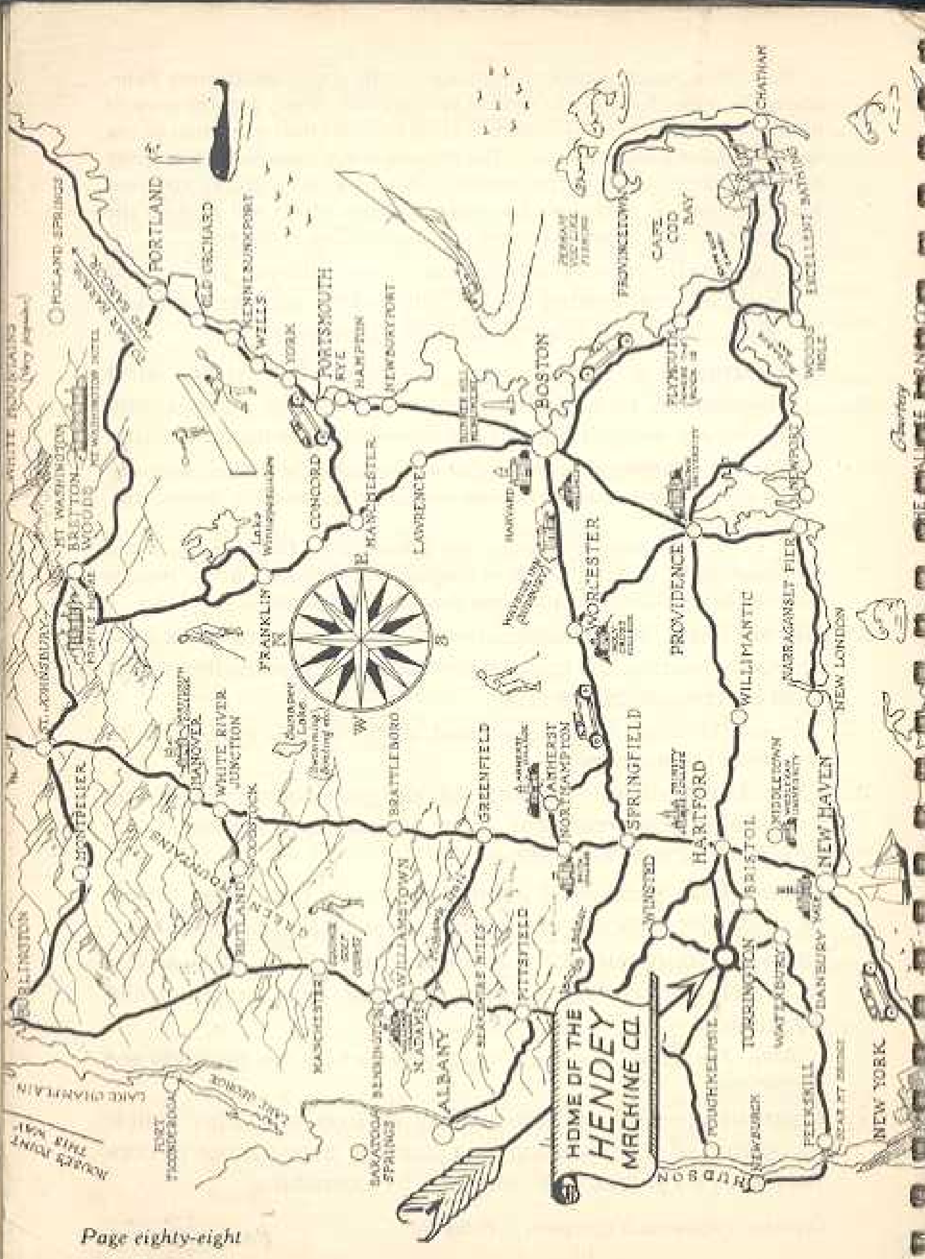
   Case—That portion of a carburized iron base alloy article in which the carbon content has been substantially increased.

   Core—That portion of a carburized iron base alloy article in which the carbon content has not been substantially increased.

   Note. The terms "case" and "core" refer to both case hardening and carburizing.

7. **Cyaniding**—Surface hardening of an iron base alloy article or portion of it by heating at a suitable temperature in contact with a cyanide salt, followed by quenching.

Courtesy, Heppenstall Company, Pittsburg



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