HENDEY

MACHINE TOOLS

LATHES

HIGH SPEED
HEAVY DUTY
TOOL ROOM
MANUFACTURING

SHAPERS

CENTERING MACHINES

The Hendey Machine Co., Torrington, Conn., U. S. A.

HENDEY

THE HENDEY MACHINE COMPANY
TORRINGTON, CONN.

12″-14″-16″-Swing

TWELVE HENDEY SPEED

Geared Head Lathes

Bulletin 1246L-12-38

The Hendey Machine Co., Torrington, Conn., U.S.A.

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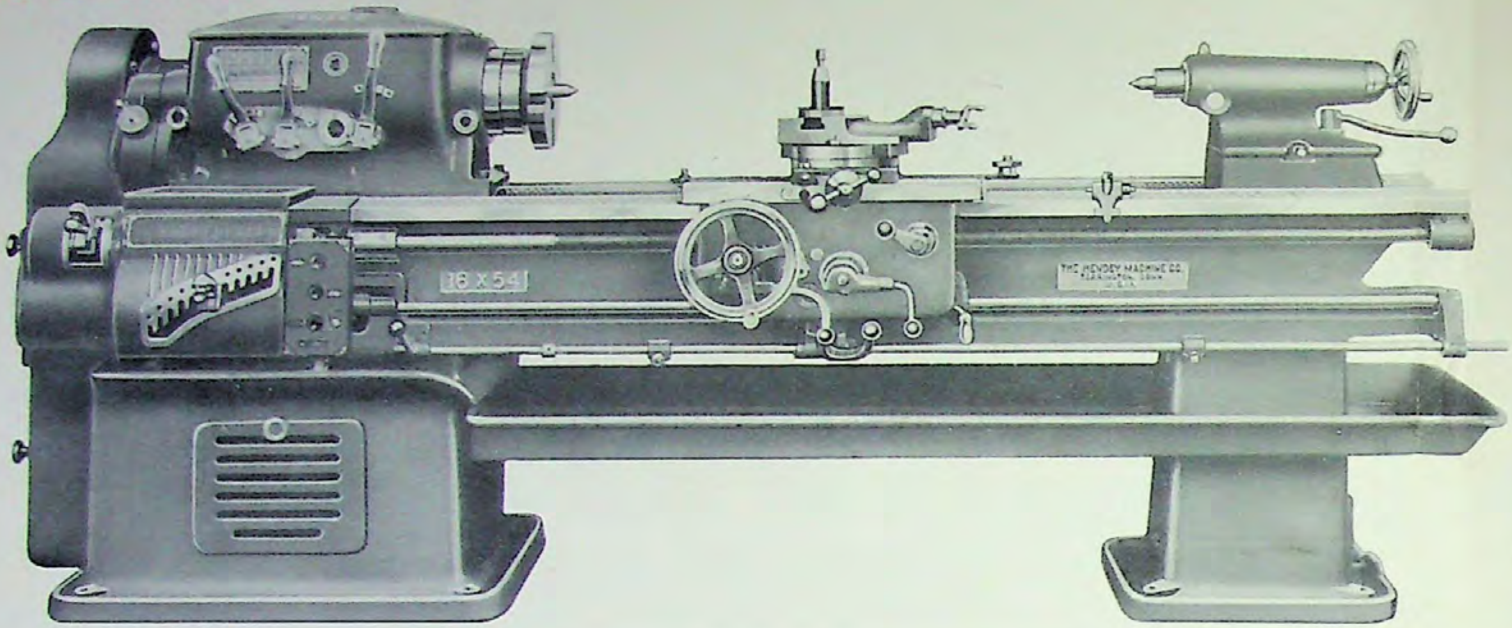
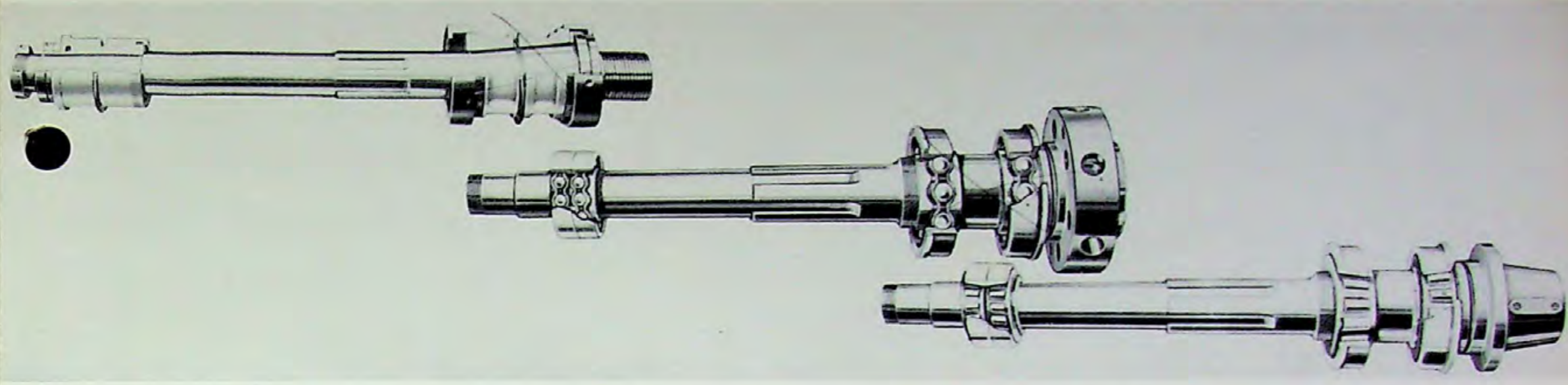


PRINCIPAL DIMENSIONS	Rated Size		
	12"	14"	16"
Swing over ways	14½"	16½"	18½"
Swing over cross slide	9"	10½"	12"
Center distance, base length	30"	30"	30"
Base bed length	6'	6'–6"	6'–10"
No. of spindle speeds	12	12	12
Range of spindle speeds	19–598 at 600	18–539 at 600	14–478 at 500
Spindle nose, optional (See Page 3)	——	——	——
Hole through spindle	1½"	1½"	1½"
No. and maximum capacity of spring collets	No. 6–⅛"–1"	No. 6–⅛"–1"	No. 6–⅛"–1"
Headstock bearing on bed	23"	24¾"	27⅜"
Carriage bearing on ways	17"	18¾"	22½"
Width of cross slide	6"	7"	8"
Tailstock spindle dia. and travel	2¼" x 4½"	2¼" x 5¾"	2⅝" x 6⅝"
Tailstock bearing on ways	9¼"	11"	12½"
Compound rest travel	3¼"	3¾"	3¾"
Size of tool	1" x ½"	1¼" x ⅝"	1¼" x ⅝"
Centers, Morse taper	No. 3	No. 3	No. 4
Center bushing, Morse outside taper	No. 5	No. 5	No. 5
Lead screw dia. and pitch	1"–6P	1⅛"–6P	1⅜"–6P
No. of thread and feed changes	36	36	36
Range of thread cutting	1½"–80P.I.	1½"–80P.I.	1½"–80P.I.
Center rest capacity	4"	5"	6"
Range of Taper Attachment			
Taper attachment will turn max. taper	3" per ft.	3" per ft.	3" per ft.
Length turned at one setting of taper attachment	13"	15"	18"
Taper turned with cross and screw cutting feeds only	6" per ft.	6" per ft.	6" per ft.
Taper turned with cross and screw cutting feeds and taper att. max.	9" per ft.	9" per ft.	9" per ft.
Angle turned with longitudinal and cross feeds only	45°	45°	45°
Angle turned with longitudinal and cross feeds and taper att. max.	48½°	48½°	48½°
Angle turned with longitudinal and cross feeds and taper att. min.	41°	41°	41°

The feed reverse mechanism in the head for threads and feeds, connected to both the apron reverse and automatic stop rods, is operative at high speeds, being facilitated through an impulse starting mechanism acting in advance of the positive tooth clutch engagement.

Motor Drive Data:

	12"	14"	16"
H. P. of motor required	2 to 3	3 to 5	5 to 7½
Speeds, using Vee Belts	1200	1200	1200



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

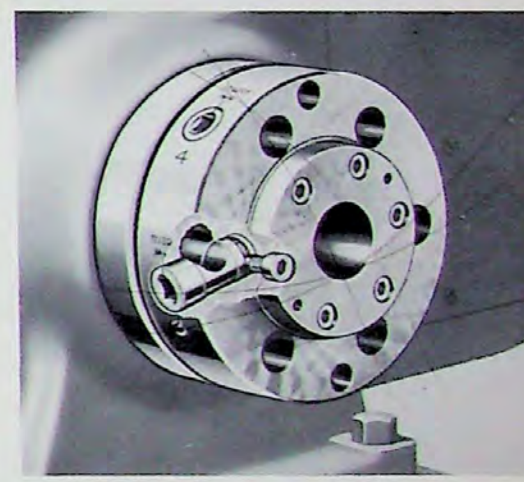
Three oil sight gages are placed on the headstock casting, one at each bearing, and one in the center for the spindle drive gearing, to check the amount of oil in use.

L Type Nose

Spindle noses may be furnished in three patterns: the threaded type; the long-taper key drive or the D-1 cam-lock flange type as preferred.

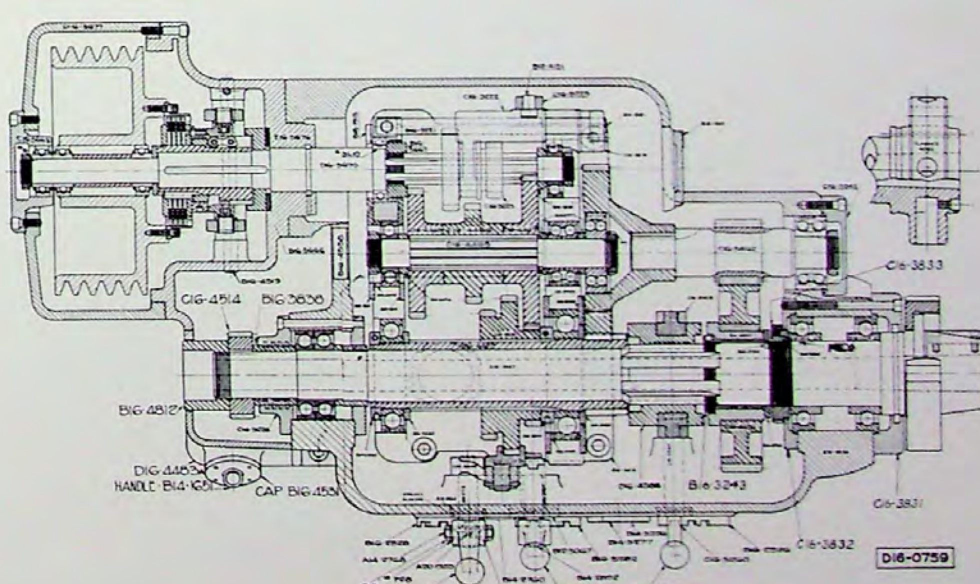
The long-taper type has a taper nose to center and seat the plates and chucks, a heavy key for driving member, and a threaded coupling collar for locking driven member in position. This collar is hooded over the flange back of spindle nose.

On the D-1 type the face plates and chucks are held by means of a series of cam locking studs which are attached to the back of the plate or chuck. The locking cams are mounted in the radial holes in the spindle flange.



D-1 Type Nose

Sectional-assembly view of 12-speed headstock, showing V-belt driving pulley with disc clutch and brake, shafts, gearing, bearing mounts, spindle with positive tooth clutch and long taper nose, and inset showing cam-lock flange type nose. All gears in headstock are forged from high grade alloy steel. The spindle driving gears have helical cut teeth. All sliding gears are oil hardened and tempered to secure high efficiency through non-abrasive qualities and refinement of tooth grain structure. Gear teeth are finished for correctness of tooth profile after tempering. All shafts in headstock are made of alloy steel, hardened and ground. Spindle is forged from alloy steel and oil quenched to secure grain refinement and toughness. Spindle bearings are super-precision, mounted in pairs, and run under preload, following best engineering practise. All shafts and sliding gears and driving clutch on spindle are multiple keyed, splined from the solid. Bearings are anti-friction throughout. Heads are automatically oiled.



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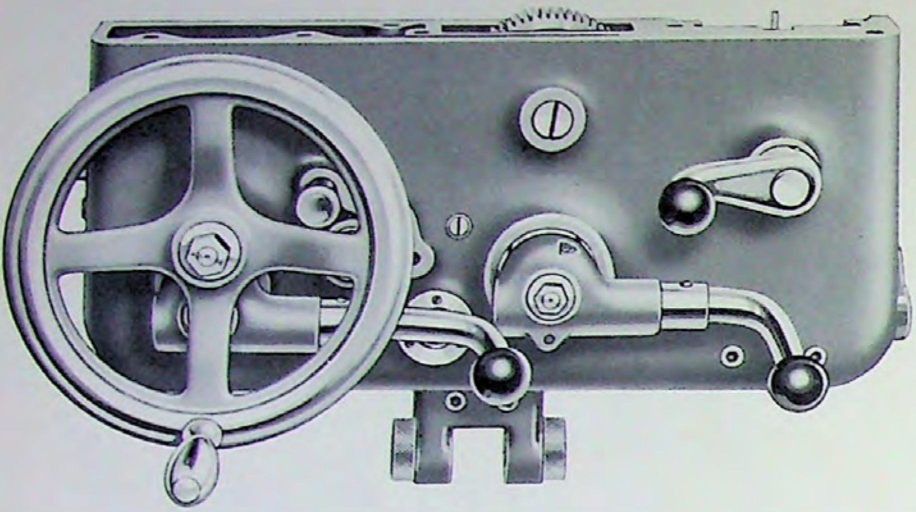


APRON

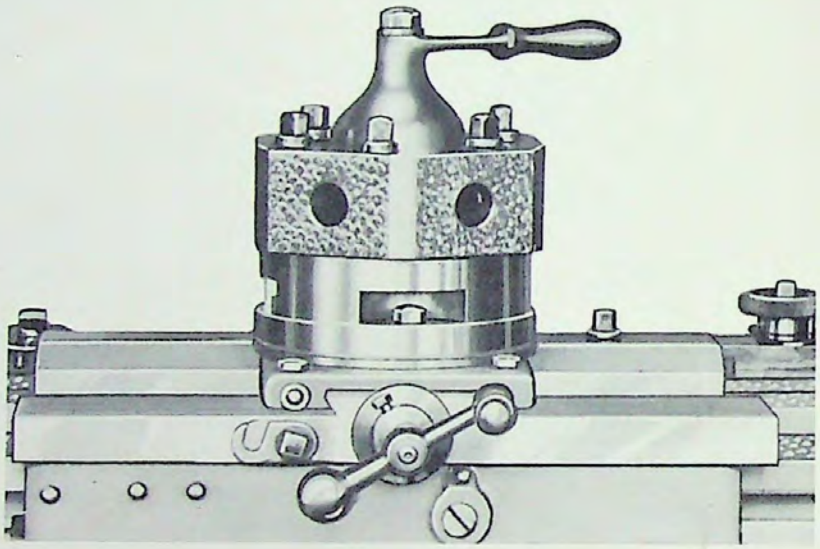
Apron Feeds have quick in-and-out action, friction driven lever controlled. Levers pull up to engage feed and drop to release. Longitudinal feed and thread cutting have safety lock preventing dual engagement Rack pinion runs on an eccentric shaft so it can be dropped out of mesh in thread cutting. Feed worms are hardened. APRON HAS AUTOMATIC OILING WITH SIGHT LEVEL GAUGE FOR OIL RESERVOIR ON FRONT PLATE.

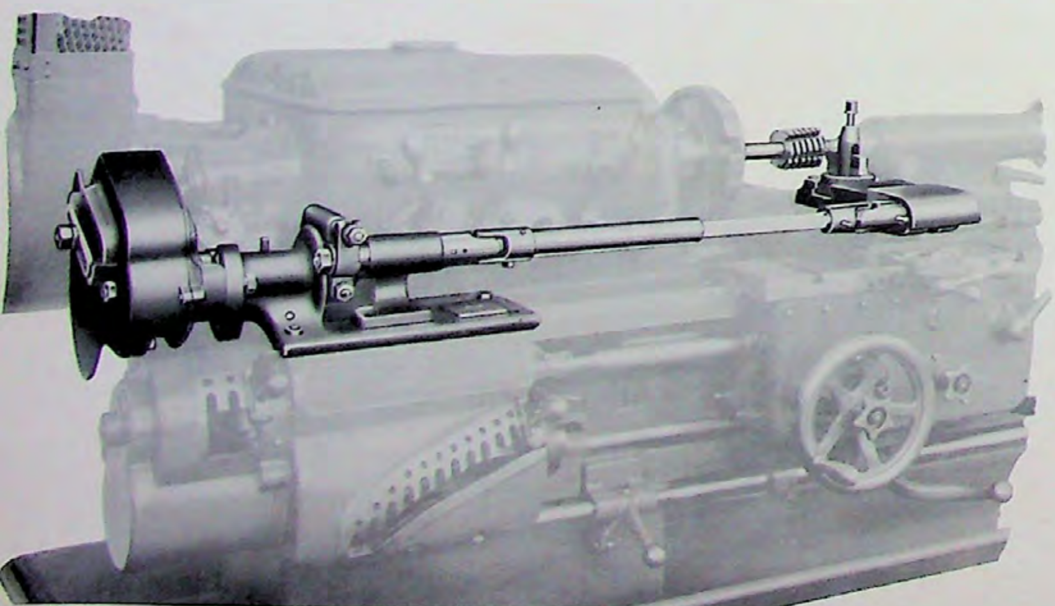
Scrolls can be cut with apron cross feed. Any pitch on the index plate multiplied by 4 will give the corresponding cross feed pitch. Graduated dial on cross feed screw is large in diameter with wide spacings for easy reading, and has quick re-setting feature.

CARRIAGE TURRETS

Size of Lathe	12″	14″	16″
Dia. of Turret across Flats	6½″	7″	8″
Diameter of Holes in Turret	1″	1¼″	1½″

Cross-slide turrets are under control of all the carriage feeds, and may be used with taper attachment.





RELIEVING ATTACHMENT

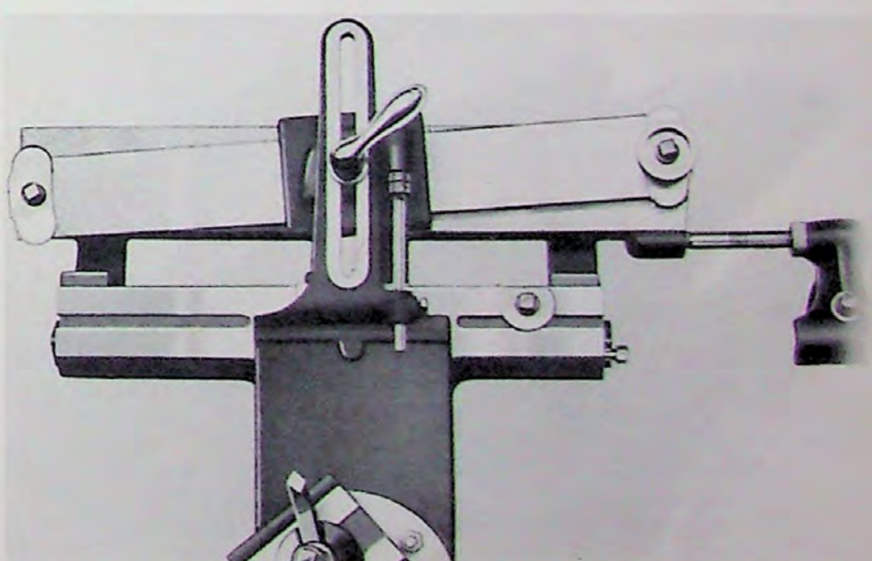
This attachment is full universal. It will relieve face, angular, end or internal cutters, also taps or hobs, right or left hand, with straight or spiral flutes. Normal travel of relief from 0″ to 5/32″ and up to 26 flutes. Range of Relieving Attachment is greatly increased when used with the Sub Headstock.

This attachment is a speed reducing unit; i. e., the driving plate revolves one turn to six turns of the spindle. The head center does not revolve, being a dead center. The sub-headstock is used for chasing screw threads with long leads beyond the range given on the index plate; cutting screws with multiple threads and long leads (see cut below). This attachment is of great value as a work driving unit when using the relieving attachment for relieving wide forming tools and hobs with long leads, and relieving cutters with large numbers of teeth.

SUB-HEADSTOCK

Screw with six starts and four inch lead. Cut with the aid of Sub-Headstock.

TAPER ATTACHMENT



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. 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.

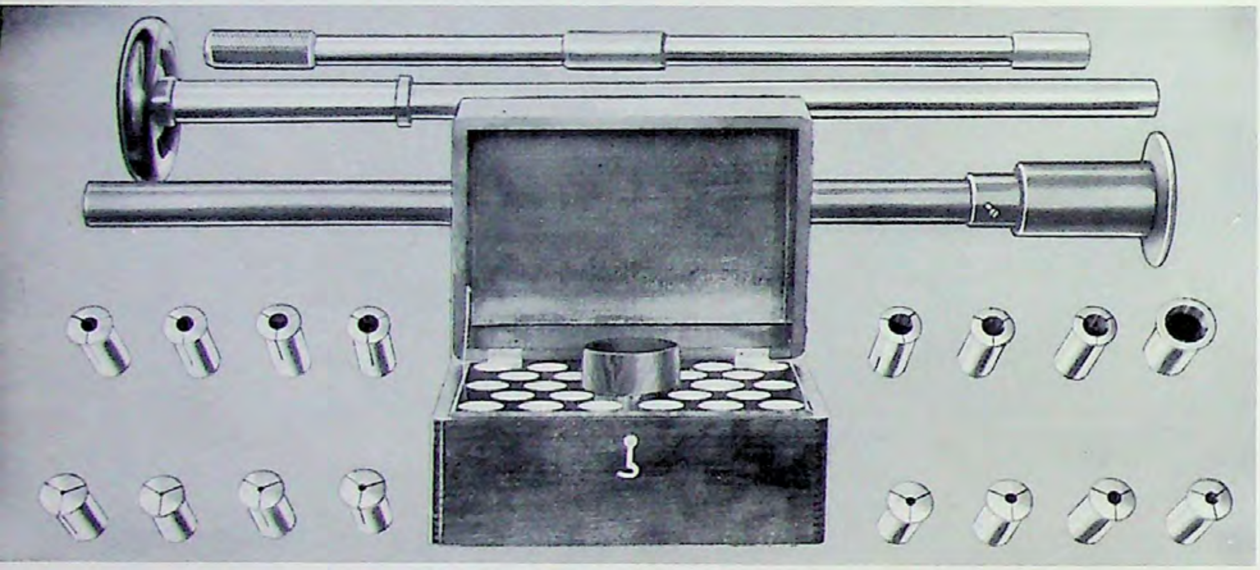
By using the taper attachment in combination with these two feeds, the angle can be increased or decreased sufficiently to form a minimum angle of 41°, and a maximum angle of 48½°.

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

Maximum travel: 12″ Lathe 13″ 14″ Lathe 15″ 16″ Lathe 18″

Spindles of the 12-14-16-inch, 12-speed HENDEY lathes have a 1½″ bore, enabling them to take spring collets up to 1″ capacity.

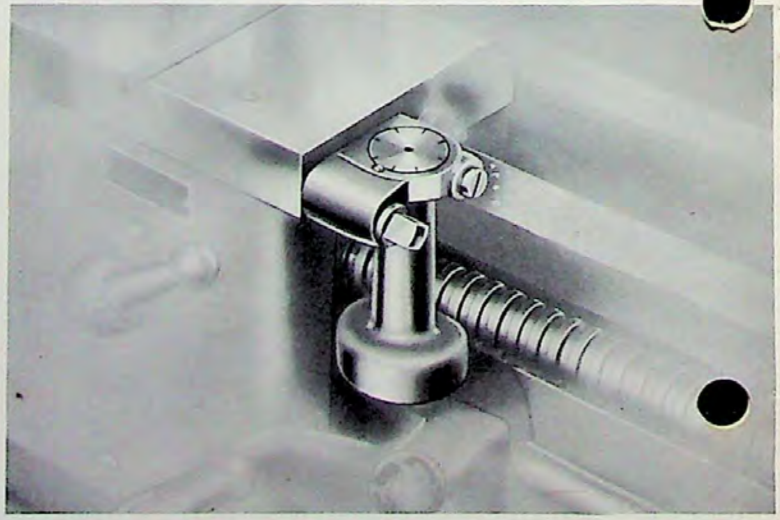
GRADUATIONS on end of spindle collar give an accurate means of indexing spindle for cutting multiple threads. The procedure is, first cut the initial thread; then turn spindle by hand until the zero on spindle and guard mark align; next, throw out slip gear by means of ball handle at right, then rotate spindle by hand to bring required division on spindle opposite line on guard; re-engage slip gear and then start thread cutting as before. Subsequent divisions are secured in the same manner.



STANDARD SPRING COLLETS for these lathes are Hendey No. 6, running ⅛″ to 1″ by 16ths, 15 in the set. Each set of Collets has standard equipment consisting of draw-in sleeve, closer and knock-out rod; with cabinet and mount for same.

THREAD CHASING DIAL

This attachment is furnished as an extra 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 predetermined 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.



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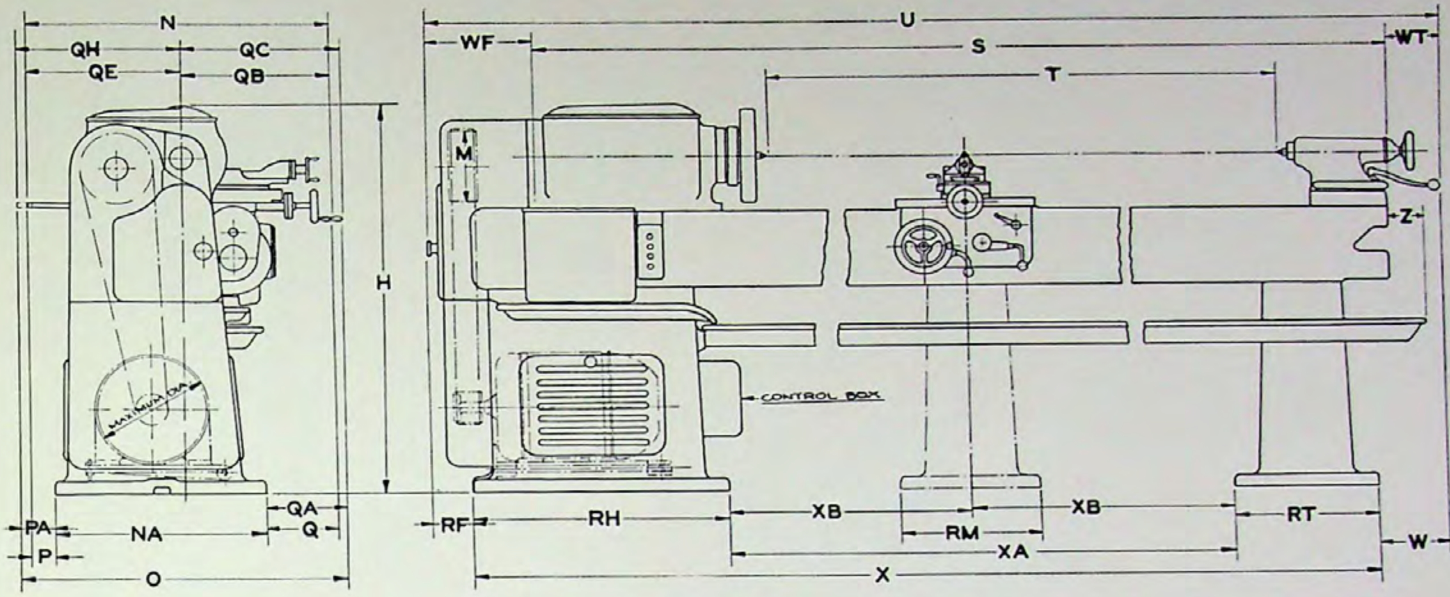

FLOOR PLAN

	TABLE OF DIMENSIONS	12"	14"	16"
M	Diameter and width of driving pulley	9" x 3 7/16"	10" x 3 7/16"	12" x 4¼"
N	Width of plain lathe over all	30½"	35¼"	40¾"
O	Width of taper att. lathe over all	35¼"	39½"	47"
P	Back over hang (plain lathe)	1½"	——	——
PA	Back over hang (taper att. lathe)	5½"	3½"	5½"
Q	Front over hang (plain lathe)	6¾"	9¼"	10¾"
QA	Front over hang (taper att. lathe)	5"	10"	11½"
QB	Center to front over hang (plain lathe)	17"	18¼"	21"
QC	Center to front over hang (taper att.)	17¾"	19"	21¾"
QE	Center to back over hang (plain lathe)	13½"	17"	19¾"
QH	Center to back over hang (taper att.)	17½"	20½"	25¼"
NA	Width of motor leg	24"	26"	30"
NB	Width of tail end leg	19¼"	20"	20½"
RF	Door over hang	6¾"	4¼"	4½"
RH	Length of motor leg	29"	33½"	37½"
RM	Length of middle leg	17½"	17½"	22"
RT	Length of tail end leg	17½"	17½"	22"
S	Length of bed	72"	78"	82"
T	Distance between centers	30"	30"	30"
U	Length over all	90¼"	96½"	103¼"
W	Rear end over hang	8"	9½"	12¾"
X	Length over legs	75½"	82¾"	86"
XA	Distance between end legs	28½"	31¾"	26½"
XB	Distance from center to end legs (½ of XA)	——	——	——
WF	Head front end over hang	11¾"	12½"	13½"
WT	Over hang of tail stock handle	6½"	6"	7¾"
Z	Over hang of pan	4¼"	3¾"	2½"
H	Over all height	50"	51"	51¼"

WEIGHTS AND BOXING DIMENSIONS	12"	14"	16"
Base bed center distance	12" x 30"	14" x 30"	16" x 30"
Over all length (for base bed length)	90¼"	96½"	103¼"
Over all width—plain	36¾"	38"	47"
Over all width—with taper	38¼"	39½"	49⅛"
Height highest point (top of headstock) approx	50¾"	51½"	51"
Net weight with regular equipment base length no motor or taper	2650 lbs.	3560 lbs.	4800 lbs.
Crated and skidded weight base length no motor or taper	3000 lbs.	3920 lbs.	5250 lbs.
Export box base bed length with regular equipment	93" x 59" x 41"	100" x 62" x 42½"	111" x 62" x 50"
Weight of box only for base length bed	1000 lbs.	1400 lbs.	1850 lbs.
Weight per 2' bed net	160 lbs.	230 lbs.	320 lbs.
Weight per 2' pan net	20 lbs.	23 lbs.	30 lbs.
Weight taper attachment net	70 lbs.	87 lbs.	115 lbs.
Weight relieving attachment net	155 lbs.	173 lbs.	240 lbs.
Weight forming attachment net	110 lbs.	130 lbs.	165 lbs.
Weight ball turning attachment net	53 lbs.	60 lbs.	83 lbs.
Weight sub headstock net	74 lbs.	106 lbs.	160 lbs.
Weight carriage turret net	90 lbs.	105 lbs.	130 lbs.
Weight bed turret net	160 lbs.	225 lbs.	330 lbs.

MECHANICAL DETAILS

HEADSTOCKS

The headstock gearing and shafts effecting spindle speed changes are assembled as a unit in what is technically called the cradle. This unit indicates simplified construction. The first or input shaft has a cluster of two sliding gears. No. 2 shaft carries three gears in a fixed position. Shaft No. 3 is tubular and also carries a cluster of three sliding gears. This No. 3 tubular shaft is axially mounted with the spindle but without contact or imposed load. The four gears forming the high and low speed transmission, direct to spindle, are engaged with it by means of a positive, tooth-clutch, sliding on and driving spindle through multiple keys cut from the solid. All sliding gear shafts have multiple, integral keys. The assembly is such that the spindle may be removed at any time without disturbing the speed change unit.

Super-Precision spindle bearings are matched in pairs for both front and rear bearings. These bearings run pre-loaded in accordance with recommendations of manufacturers. It is important to note that the spindle bearings have their own lubricating supply entirely apart from the oil in head used to lubricate the speed gearing.

LATHE BEDS

are cast in our own foundry of carefully selected irons combined with a high percentage of steel rail scrap, and alloyed with controlled amounts of nickel, chromium and manganese. This mixture forms an exceptionally close-grained casting having a selected Brinell hardness, possessing a high non-abrasive quality, making for maximum durability and with wear reduced to a minimum.

CARRIAGES

are well proportioned with ample bearing surfaces on bed to support tool stresses developed under maximum cutting conditions. Both front and rear ways of carriage and cross slide ways are automatically lubricated from the apron oiling system.

APRONS

have quick in and out friction feed clutches, lever operated. Longitudinal feed and thread cutting have safety lock, preventing simultaneous engagement. Scrolls can be cut with apron cross feed. Any pitch on the thread index plate multiplied by 4 will give the cross feed pitch. For example, to cut a scroll of 16 threads per inch, place gear box handles in position as to cut 4 threads per inch; then engage the cross feed and the tool will travel at the rate of 16 threads per inch. When cutting scrolls the carriage should be clamped to the bed through binder attached to carriage. Graduated dial on cross feed screw is large in diameter with wide spacings between graduations for easy reading, and dial has quick resetting feature.

LEAD SCREWS

Years of intensive application to the problem of making precision screws in keeping with the high character of our lathes have enabled us to develop methods and equipment with which we are able to furnish lead screws which are warranted to give satisfaction. Lathes which are wanted for fine gauge and tool work are supplied on order with Hendey Super-Precision lead screws, custom made, and held to a maximum error of .00015" plus or minus per inch of lead, and a maximum error of .0005" plus or minus per foot of lead. Each Super-Precision Screw is tested its full length and the test permanently recorded in engineering files. A copy of this test is furnished to the purchaser of the screw. All other lathes which are purchased to standard specifications are equipped with Hendey Commercial-Precision lead screws, which are held to a maximum error of .001" plus or minus per foot of lead. Screws which test well below these maximum allowances are not uncommon.

TAILSTOCKS

for these lathes are in keeping with modern high production demands. Tailstock barrel is annular in form and has a two-piece binder for spindle which draws to the center and with upward pressure on spindle keeping it in alignment with head spindle. The center can be ejected by backing against spindle feed screw. These tailstocks have off center adjustment.

Clamping device (Patent No. 1,666,484) is operated by lever underneath hand wheel. This device binds tailstock to the bed with a quick action and holds tailstock without slip. It is adjusted with one nut.

STANDARD EQUIPMENT: 12-speed Geared Headstock with all shafts multiple splined, hardened and running in anti-friction bearings; all sliding gears oil hardened and tempered and with teeth profile corrected after tempering; spindle forged from alloy steel and oil quenched; nose of spindle to be Long-Taper Key Drive or Cam Lock optional (Hendey standard threaded nose if wanted); rear end of spindle graduated for cutting multiple threads; main driving clutch in head to have 2-station lever control centered on automatic stop rod and with built-in brake; lead screw reversing mechanism with automatic stop in both directions of carriage travel; oil pan, power cross and longitudinal feeds; compound tool rest, large and small face plates, plain tool post, high speed centers, center rest, micrometer carriage stop, set of forged wrenches; motor drive arrangement with motor base, pulleys, belts and belt guards; electrical equipment including wiring in conduit, setting and testing of all electrical equipment. MOTOR, MOTOR STARTING SWITCH AND PUSH BUTTON STATION NOT PART OF REGULAR EQUIPMENT.

NOTE: Designs and dimensions are subject to engineering changes without notice.

THE HENDEY MACHINE COMPANY, Torrington, Conn.

THE KELLOGG & BULKELEY CO. HARTFORD CONN.
LITHO IN U. S. A.

HENDEY

THE HENDEY MACHINE COMPANY
TORRINGTON, CONN.

Sub-Headstock — Carriage Spacing
Taper — Ball Turning
Center Rests
Thread Chasing Dial

Bulletin 2220-L-A-5

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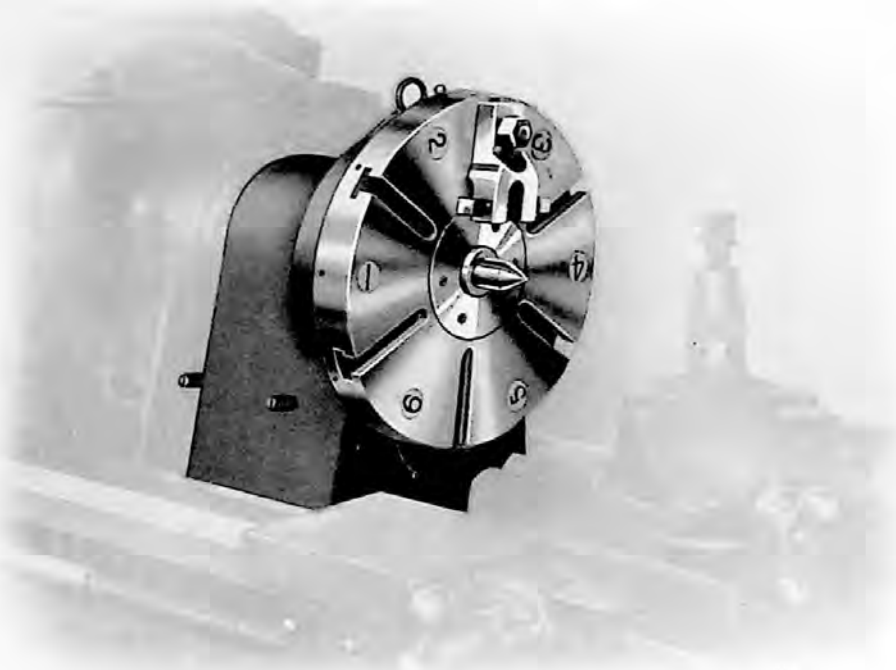
Hendey Sub-Headstock



The Sub-Headstock applied to Hendey lathes furnishes 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 driving power are available to 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 feed gearing and lead screw are driven by spindle in the usual way.

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.

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.

Thread Cutting with Sub-Headstock

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,) proceed as follows:

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

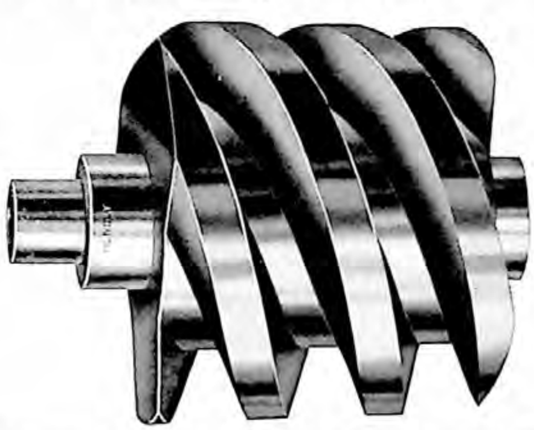
1st. Watch the driving plate as it revolves:

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 cutting 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.



Shows large diameter triple thread worm of coarse lead as cut with Sub-Headstock.

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 left column):

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 part:

Shaft with two starts or grooves of six inch lead.*

Screw with six starts and four inch lead.*

*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 as furnished on Hendey lathes.

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 reverse the rotation of spindle from countershaft or motor drive, 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.

Thread Cutting with Sub-Headstock

TO FIGURE GEARING NECESSARY TO CUT LEADS WITH THE SUB-HEADSTOCK THAT CANNOT BE CUT WITH THE REGULAR GEARING.

Formula No. 1.

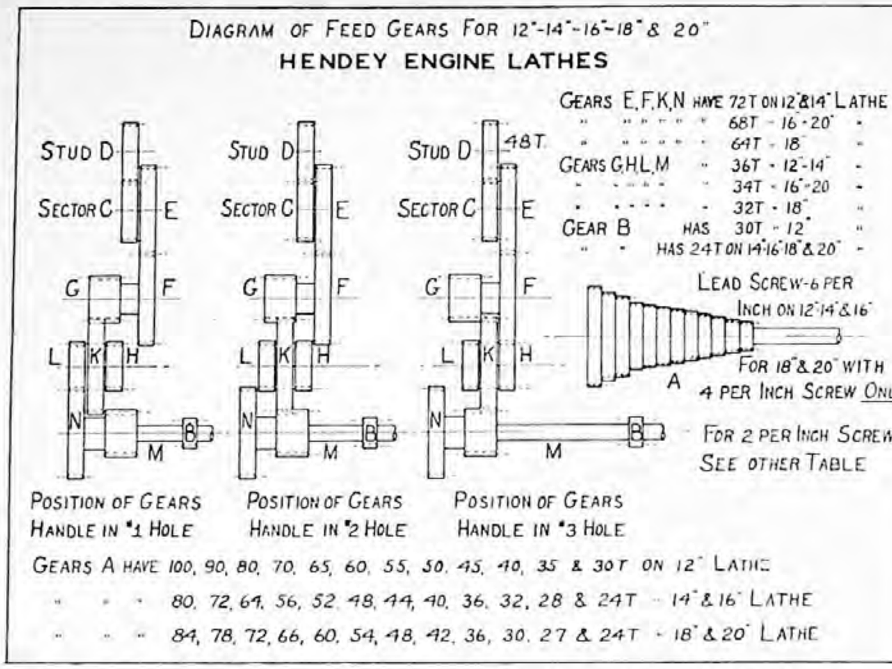
Reduce the lead desired to a common fraction, as:

$$3\frac{13''}{16}\text{ lead} = \frac{61''}{16}\text{ Lead.}$$

Properly place both gear box handles in position necessary to produce the lead nearest to the lead desired, bear-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:

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



Multiply the lead thus obtained by 6 to secure the lead that will result from using the Sub-Headstock, as:

$$\frac{2''}{3} \times 6 = \frac{12''}{3}\text{ or } 4''\text{ Lead.}$$

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.

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

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, above); 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.

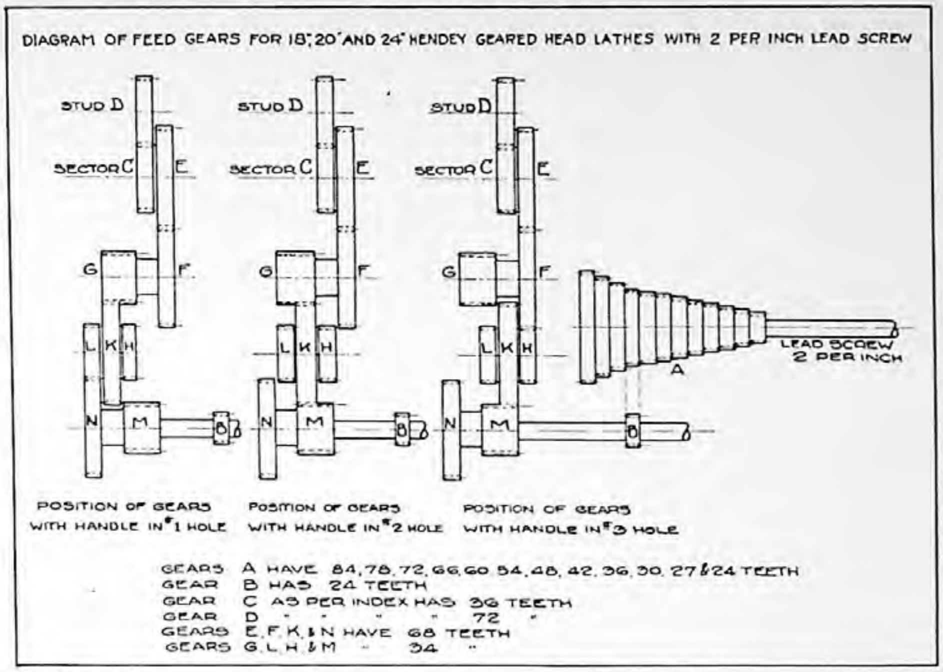
It will be found occasionally that a desired lead which it is possible to cut, cannot be cut by using the regular lead nearest to the desired lead: hence, if this formula should produce for the number of teeth in the desired gears some prime numbers too large to be used, or some irreducible fractions, 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,

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

Thread Cutting with Sub-Headstock



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:

$$\frac{276}{300} = \frac{46}{50} \text{ or } \frac{69 \text{ for D}}{75 \text{ for C}}$$

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 NECESSITATE 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:

$$1.005'' \text{ lead} = \frac{1005}{1000} \text{ Lead.}$$

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

Multiply by 6 for Sub-Headstock,

$$= \frac{1}{6} \times 6 = 1'' \text{ Lead or } \frac{1000}{1000}$$

Reduce the fractions:

$$\frac{1005}{1000} \text{ and } \frac{1000}{1000} \text{ to } \frac{201}{200} \text{ and } \frac{200}{200}$$

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:

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

From a table of prime and divisible numbers, we find that 1809 equals 27 × 67, and 1800 equals 25 × 72; then the formula becomes:

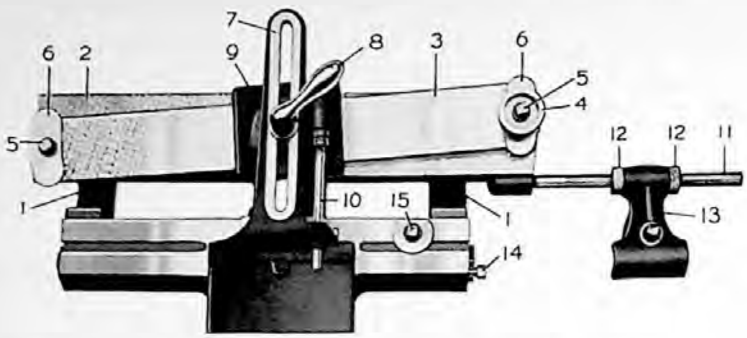
$$\frac{27 \times 67}{25 \times 72} \text{ or } \frac{54 \times 67}{50 \times 72}$$

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

$$\frac{54}{50} \times \frac{67}{72} \times \frac{1}{6} \times \frac{6}{1} = \frac{1809}{1800} = \frac{201}{200} = 1.005''$$

Taper Attachment



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

1. Main casting bracketed to carriage.
2. Top 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. Link connecting cross slide with swivel bar slide block.
8. Binding handle on stud, connecting slide block, cross slide link, and cross-feed screw extension block (not shown).
9. Slide block on swivel bar connecting with cross slide.
10. Thread stop-rod, used when cutting taper threads.
11. Top slide connecting screw.
12. Knurled check nuts for connecting screw.
13. Bed clamp for connecting screw.
14. Binding screw for cross-feed screw extension block.
15. Binding bolt for carriage gib.

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.

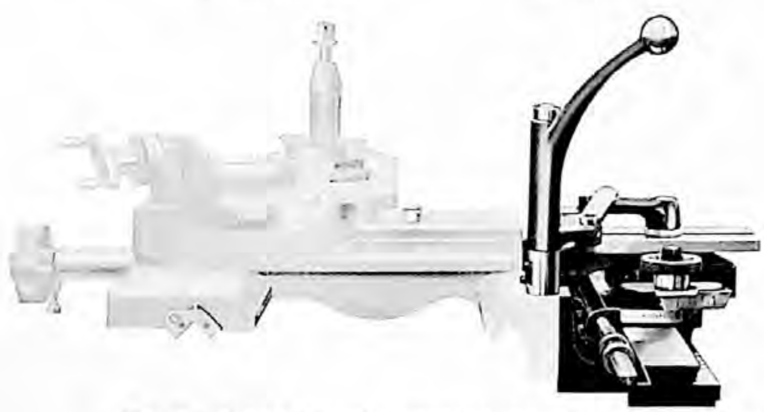
If the longitudinal and cross feeds are engaged simultaneously, the tool will follow a path forming an angle 45° with the center line.

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 degrees, or approximately 3 inches in diameter per foot.

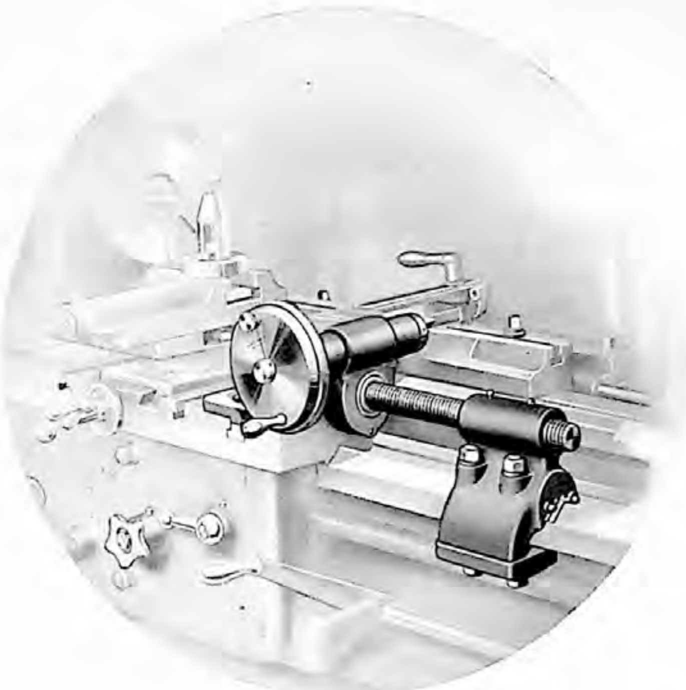
Maximum travel:

12″ Lathe 13″	18″ Lathe 18″
14″ Lathe 14″	20″ Lathe 20″
16″ Lathe 18″	24″ Lathe 24″



Taper attachment applied to 18-speed geared head lathes have a different mechanism for connecting up with cross slides. An auxiliary flat steel bar slide passes underneath cross slide and extends over taper attachment slide. The cross slide bolts to the auxiliary which in turn is attached to the cross feed nut. The auxiliary slide is slotted at the rear end through which the binding stud passes in the same way as through link shown at Fig. 7. The high position binding lever is for convenience in operating should the work being turned be large in diameter. This same type of binding mechanism is also used with 18″, 20″ and 24″ geared head lathes, but with regular one-piece cross slide and connecting link.

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 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 with horizontal thrust and preventing shaft from turning out of position after being set.

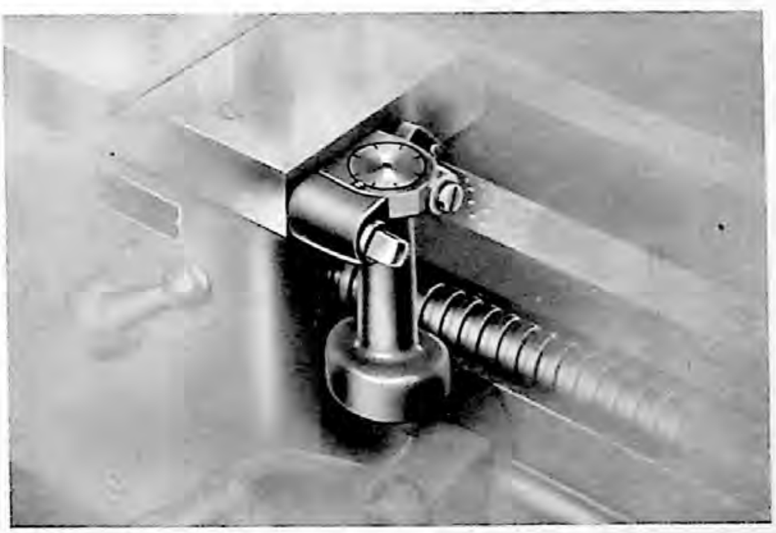
The graduated dial is entirely separate from the hand wheel and runs free on hub of wheel. The two are locked with a Tee bolt running in annular slot in dial, the bolt having knurled binding nut as shown on the face of wheel. The advantage of free dial is that it can be brought back to zero for each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

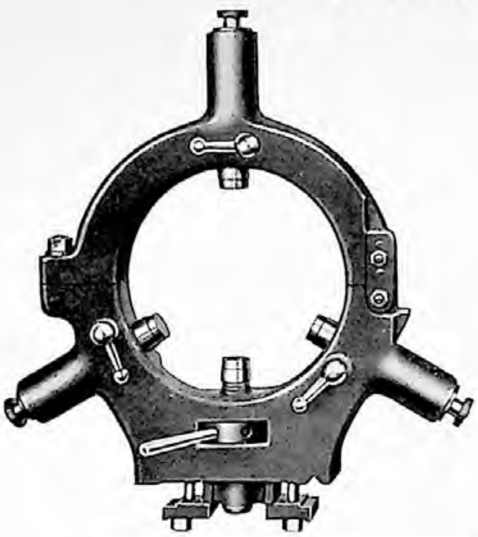
The screws for 12" and 14" attachments are 7/8" diameter, 8 pitch; for 16", 18", and 20" attachment 1 1/4" diameter 5 pitch, and 24" attachments 1 1/2" diameter, 4 pitch.

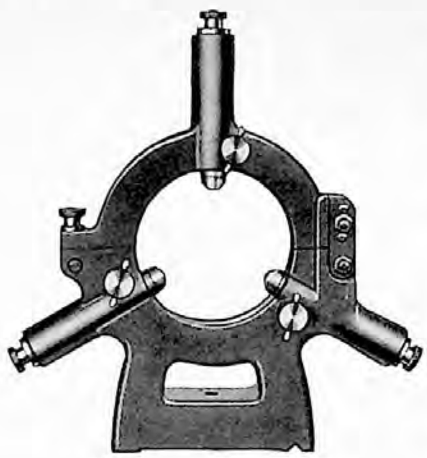
THREAD CHASING DIAL

This attachment is furnished as an extra 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 predetermined 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 reengaged 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.



NEW PATTERN CENTER RESTS FOR HENDEY LATHES





These rests have tubular jaws with removable contact tips for supporting work. This feature enables operator to use tips adapted to the class of work to be held. The tubular jaws are fitted with nuts and adjusting screws, and move in and out similar to the action of a tail stock spindle, with the knurled grip on end of screw remaining in a fixed position. These rests have box section castings making for stiffness and insuring adequate support of work under all conditions.

The heavy pattern rest shown at the left with the 4th jaw is *very special* made only for 24″ lathe, and having capacity of 16¾″. The cut at right indicates standard type of rest furnished for both regular and extra capacities.

CAPACITIES

	REGULAR		EXTRA	
	Cone-head	Gd.-head	Cone-head	Gd.-head
12″	4″	4″	..	8″
14″	4″	5″	..	9″
16″	6″	6″	..	10″
18″	6″	7″	..	11″
20″	7″	8″	..	12″
24″	..	10″	..	12″

BALL TURNING REST

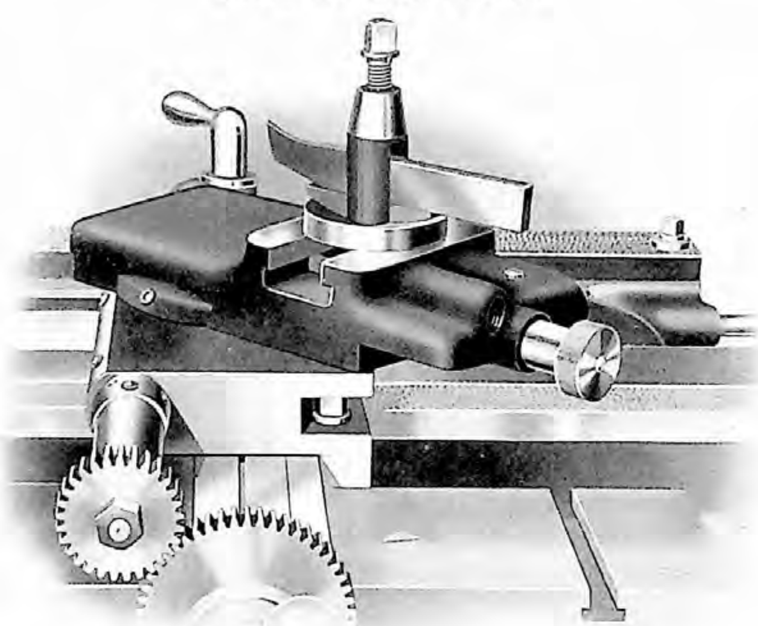
The ball turning rest is arranged to give direct hand feed with lever, a geared hand feed, operated from cross-feed screw handle, and a power feed obtained by locking in cross-feed friction.

A special slide or base replaces the regular cross slide and is located by taper pin so as to bring the axis of the tool rest in line with the lathe center. The tool rest is compound form and with screw adjustment in upper slide for setting tool for various diameters of work.

The power feed mechanism consists of a worm gear drive, the worm being mounted on the same shaft as the pinion meshing into spur gear which is keyed to the cross-feed screw. By locking cross-feed friction the screw is set in motion which in turn rotates the tool rest through the spur and worm gearing.

To use the lever feed, first unscrew and withdraw the sleeve carrying shaft and worm, after which the tool rest is free to move in any direction.

It is to be noted that cross-feed screw nut need not be removed from screw as it has ample room for travel when power feed is used provided it be left about in center of runway.



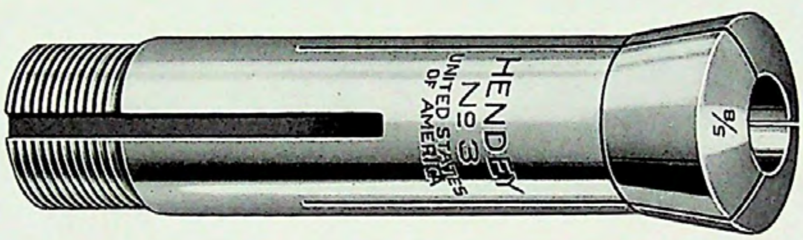
CAPACITIES

		Normal Swing Lathes	Raised Standard Lathes
12″	(hand feed only)	2⅛″	4″
14″	" " "	3½″	5″
16″	(hd. & pr. feed)	4⅝″	5½″
18″	" " "	5″	6½″
20″	" " "	...	8″

1000. 1/1/40

Printed in U. S. A.
R. S. Peck & Co., Inc.

HENDEY



Spring Collets — Step Chucks
Also Lathe and Drill Chucks
Fitted to Hendey Lathes

Bulletin 2260-L-C-C-5

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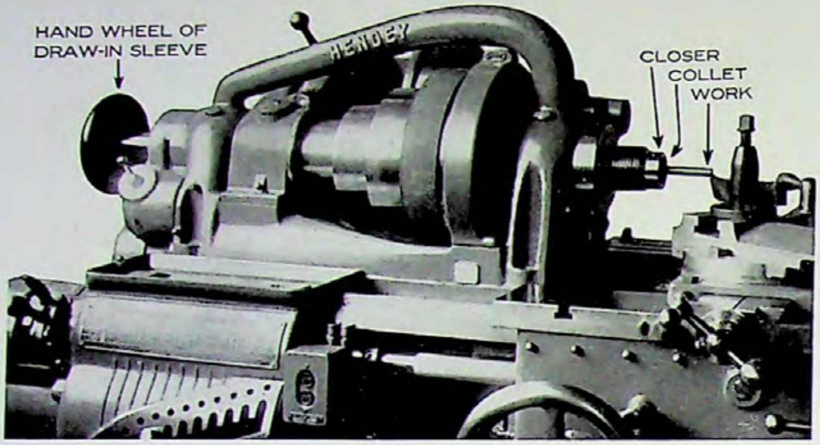
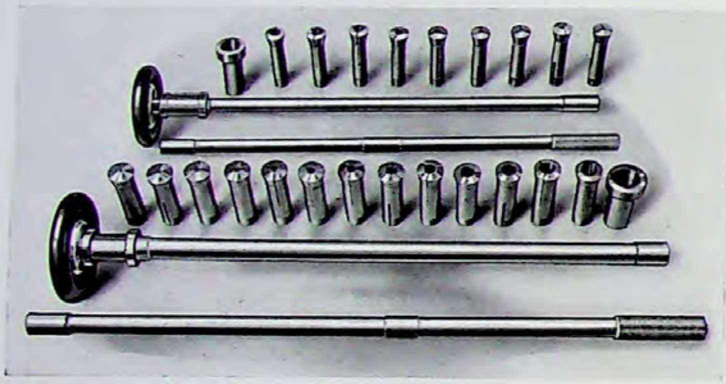


Spring collet, closer, and draw-in sleeve assembled ready for use in Hendey Motor Driven Cone Head Lathe Spindle.



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 $\frac{1}{8}''$ to $\frac{5}{8}''$ by 16ths.
The No. 3 set has 13 Collets $\frac{1}{8}''$ to $\frac{7}{8}''$ by 16ths.
The No. 6 set has 15 Collets $\frac{1}{8}''$ to $1''$ by 16ths.
The No. 8 set has 15 Collets $\frac{3}{8}''$ to $1\frac{1}{4}''$ by 16ths.

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

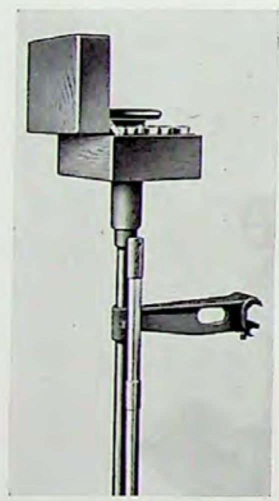
The No. 2 set is for 12″, 14″ and 16″ lathes.
The No. 3 set is for 12″*, 14″, 16″, 18″, and 20″ lathes.
The No. 6 set is for 12″*, 14″*, 16″, 18″, and 20″ lathes.
The No. 8 set is for 18″, 20″, and 24″ lathes.
*For Geared Head Lathes only.

Note: No. 3 set requires minimum hole in spindle of $1\frac{3}{16}''$.
No. 6 set requires minimum hole in spindle of $1\frac{1}{2}''$.
No. 8 set requires minimum hole in spindle of $1\frac{5}{8}''$.

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

Likewise a full range of metric collets in all numbers is available.

Cabinet and Mount for Spring Collet Equipment



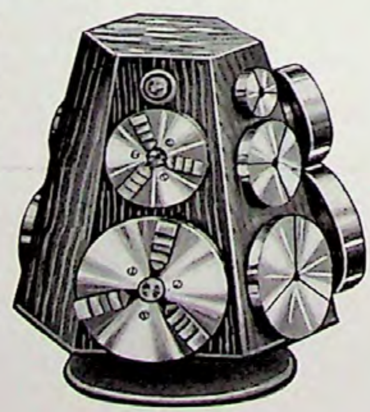
SETS of spring collets with equipment are furnished with a suitable cabinet and support for same (patent No. 1,337,387) to be attached to back of lathe bed or oil pan.

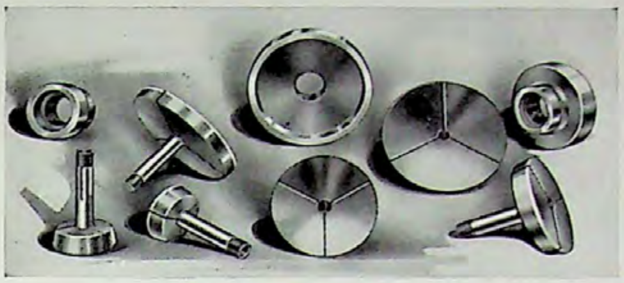
The tubular post supporting the cabinet also protects the draw-in sleeve which hangs in it. The collets are placed in a removable shelf. The knock-out rod hangs on a pin at the side of post, and rests in a notch in bracket to keep it in place.

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.





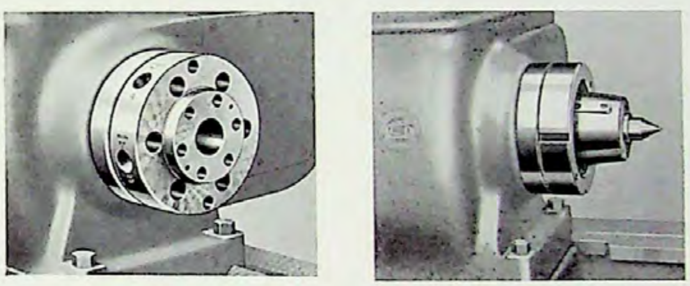
Step Chuck and Closers

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.

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.

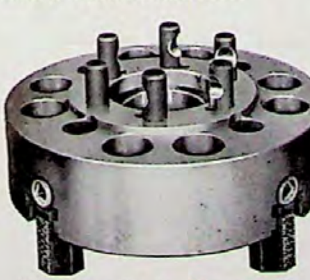
Sizes are 2″, 4″ and 6″ maximum capacity, and may be bought in sets or separately.



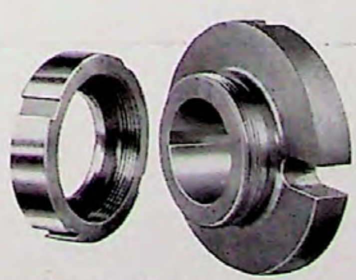
Spindle Noses, Chucks and Plates

HENDEY spindle noses are furnished in three patterns: the threaded type; the flange type; and the long taper key drive type. On the cam lock 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 of spindle noses are approved by the American Standards Association.



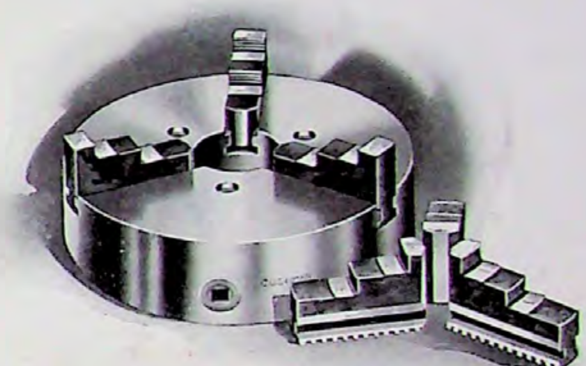
Independent Chuck for D-1 Spindle



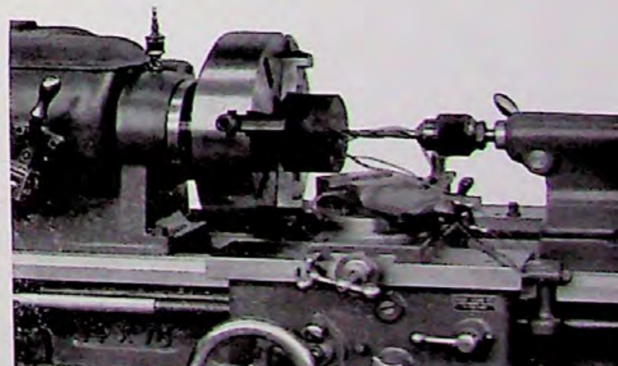
Driving Plate and Collar for Type L Nose

Lathe and Drill Chucks

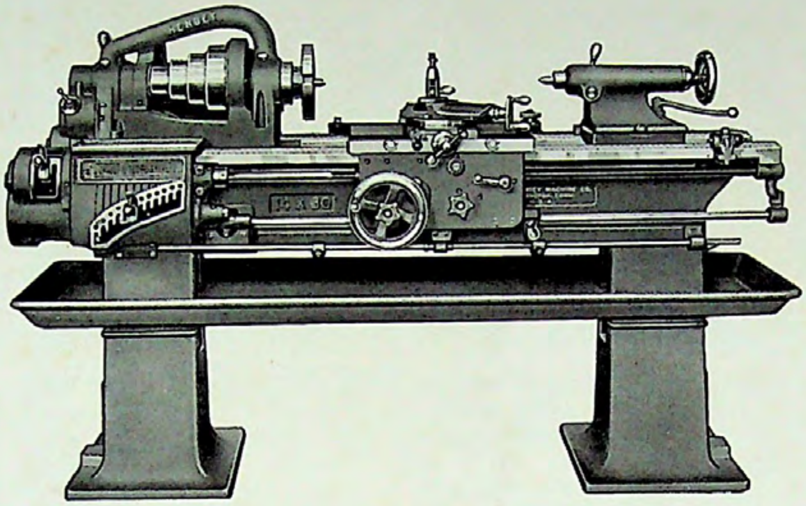
WE can furnish any style and make of lathe or drill chuck and fit same to spindle plate or center, making it ready for use, and at manufacturers' prices.



We advise that chucks for spindle mounting be smaller in diameter than the nominal swing of lathe, as a 10″ chuck for 12″ lathe, 12″ chuck for 14″ lathe, etc., to avoid possibility of jaws striking lathe bed ways where diameter of chuck is equal to swing of lathe.

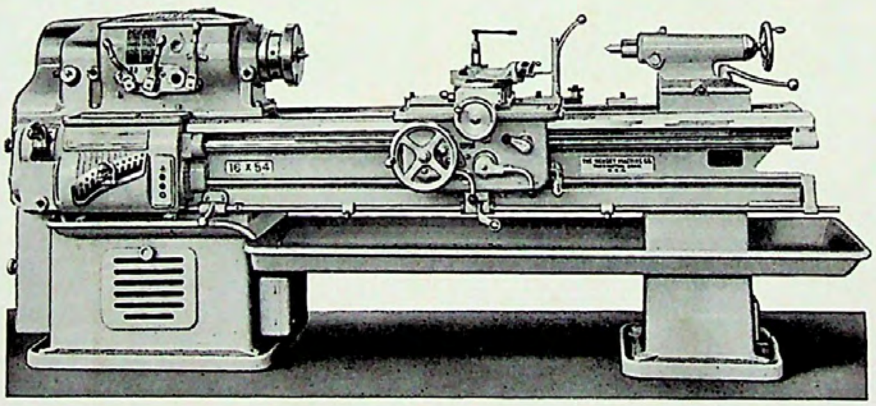


4-jaw independent chuck fitted to spindle of Hendey 14″ Geared Head Lathe. A drill chuck fitted with strip nut arbor or center is carried in tail stock spindle.



HENDEY CONE HEAD LATHES

Furnished in 12″, 14″, 16″, 18″, 20″ and 24″ swing and standard lengths between centers.



HENDEY GEARED HEAD LATHES

12″, 14″ and 16″ swing furnished in either 12-or 18-Speed.

18″, 20″ and 24″ swing furnished in 12-Speed only.

All geared head lathes furnished in standard center distances.

Printed in U. S. A., 5/1/40/750

HENDEY

Type C Relieving Attachment

Bulletin 210-R-A-4

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Montreal, Canada

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.

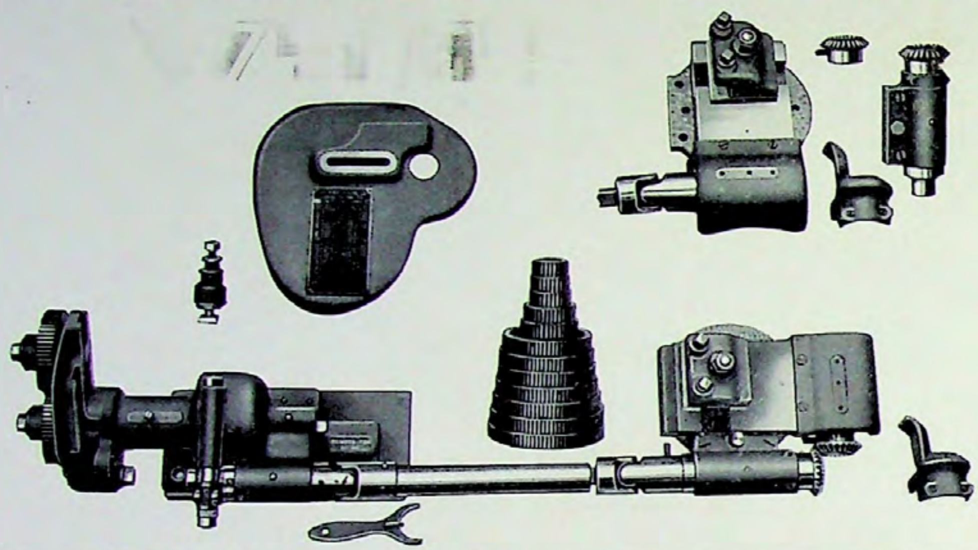
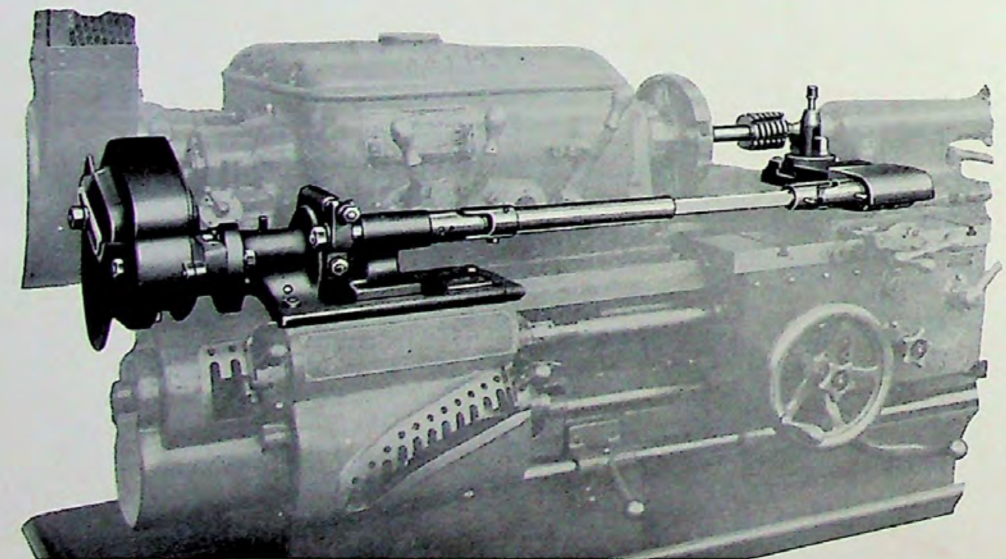
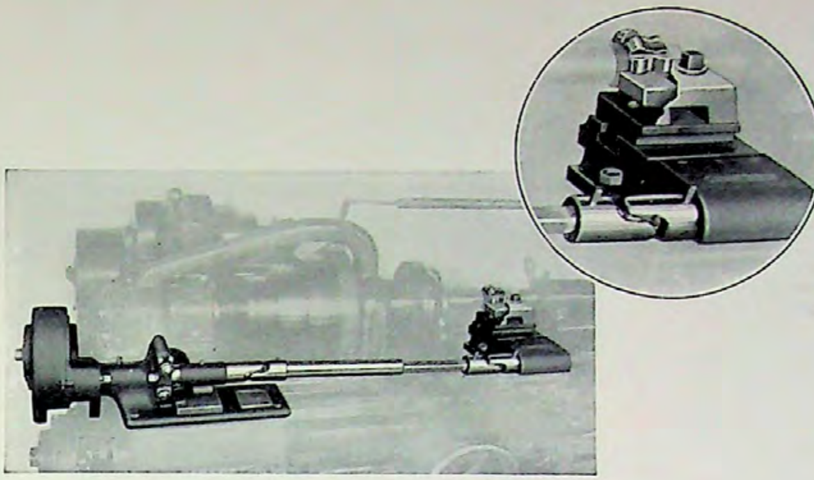
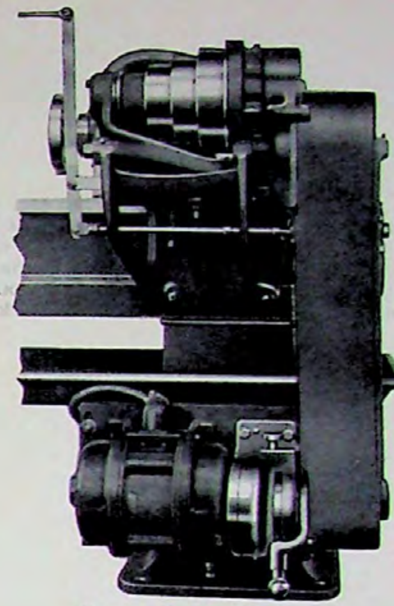


Illustration shows attachment with tool slide in parallel position ready for end relieving. Insert shows same tool slide set at right angles for radial relieving. The extra parts needed to operate tool slide in parallel position are, block with cam shaft extension for mitre gear, mating mitre which goes 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.



Type C Re. Att. Applied to HENDEY Geared Head Lathe





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 4 and 5. The placing of complete attachment in position occupies but a very few minutes.

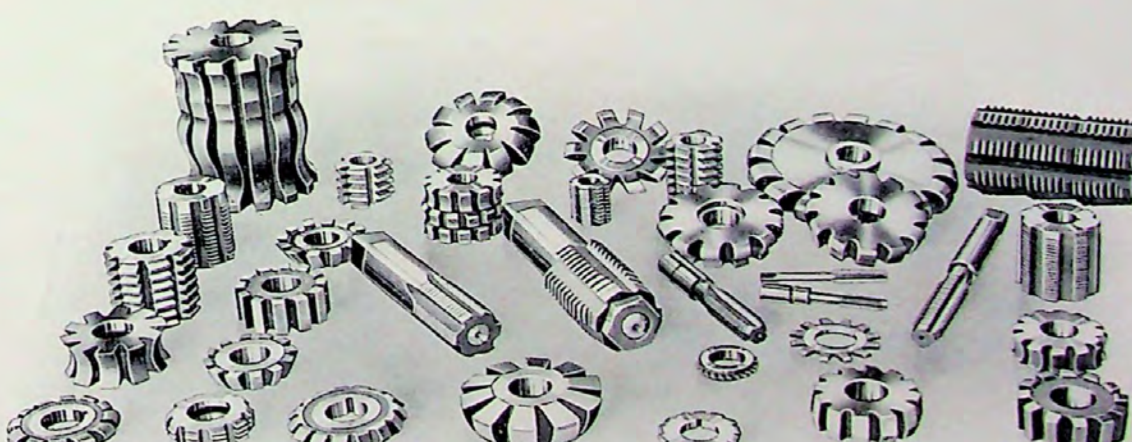
Three-speed countershaft is furnished with lathe having relieving attachment when not motor driven.

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.

The 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.



Various Examples of Relieved Work

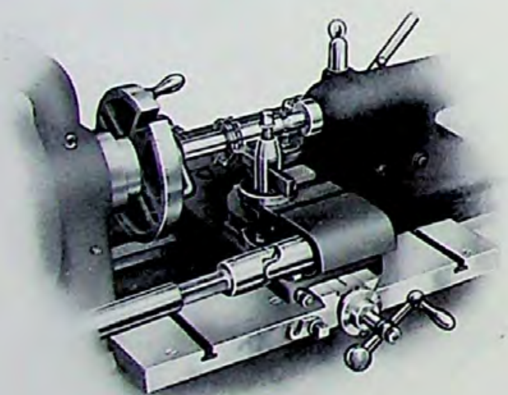
PROPER USE OF ATTACHMENT

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

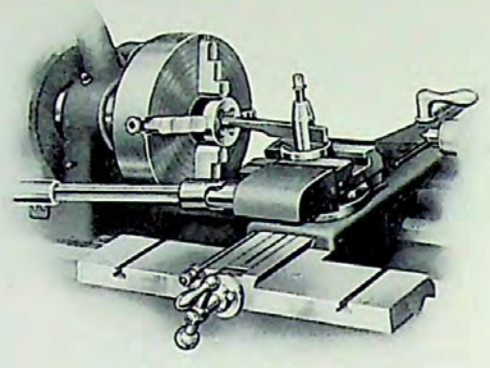
It is very often desirable to change the amount of relief from one type of cutter to another. This is accomplished in a simple and easy manner in Type C Attachment with ends of oscillating shaft and cam lever having a toothed coupling which permits changing position of eccentric on tool slide to cam lever, thereby lengthening or shortening the reciprocating travel of tool. This adjustment gives a range of from nearly zero to approximately 5/32″ motion to tool slide on 14, 16, and 18″, 3/16″ on 20″, and 1/4″ 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.

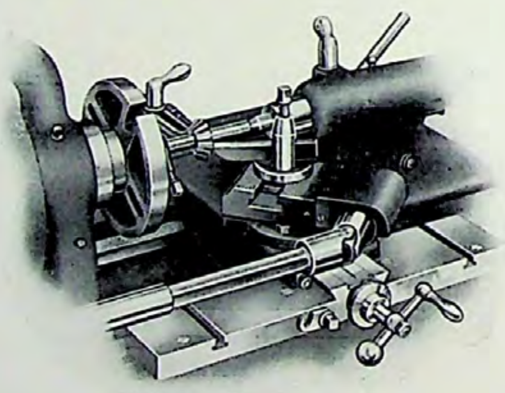
Working speeds at which cutters of this character are relieved are necessarily slow, being governed largely by the width of the cut taken.



INSIDE RELIEVING

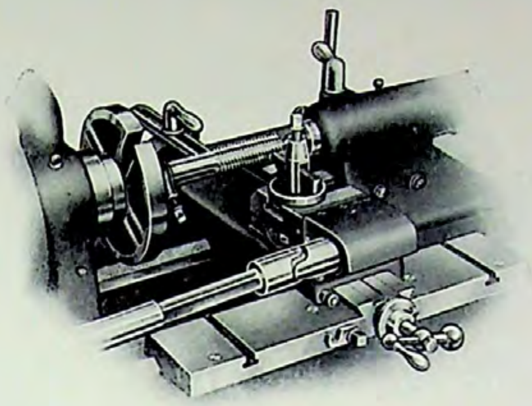
When used for inside work as on hollow mills and threading dies, the eccentric controlling travel of tool slide is to be set so that the relieving is done away from instead of toward the axis of cutter. This change is accomplished at the toothed coupling of cam lever and oscillating shaft, rolling the latter beyond the zero mark clockwise as much as necessary to get the desired amount of travel in tool slide.

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



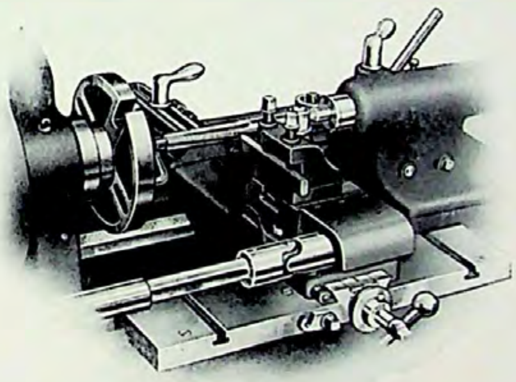
RELIEVING SIDES OF ANGULAR CUTTERS

The wide 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 RIGHT-HAND TAPS

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

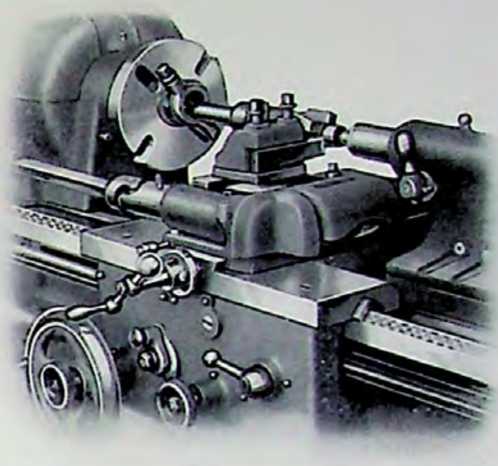


RELIEVING LEFT-HAND TAPS

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

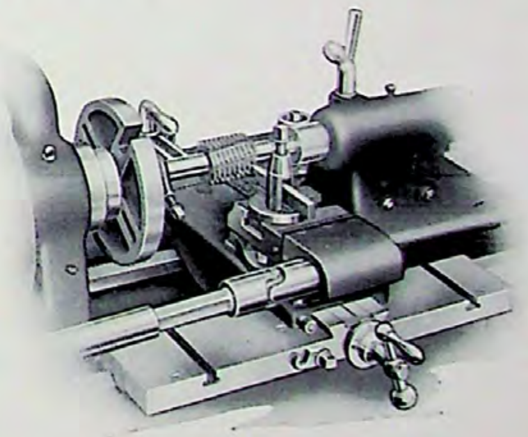
When using the first method, the tap must be placed with the point toward the live spindle with the shank end supported by tail center. This is done by providing an extension or blank end at the point of tap sufficient to take the dog, and which can be removed later if desired.

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 on top of page 2.



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.

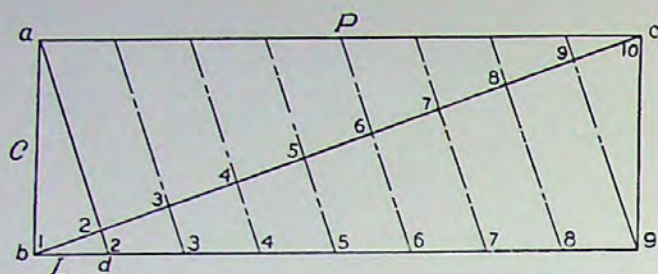


Fig. 9

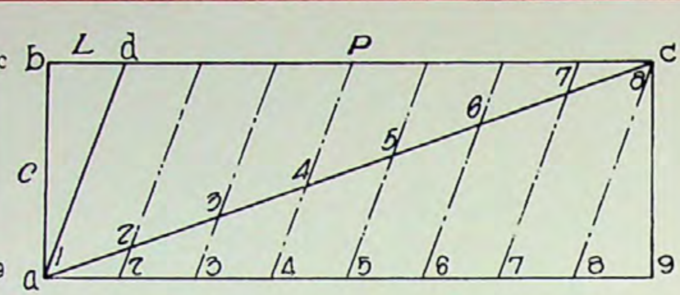


Fig. 10

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 = Circumference of hob at pitch line
L or b d = Lead of Thread
P or a c = Pitch of Spiral Flutes
ad represents thread
bc represents flute or groove.

It will be seen that the 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.

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

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

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

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

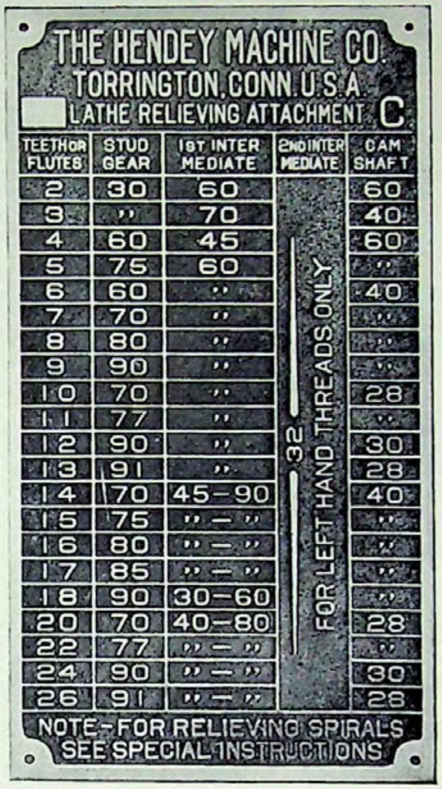
Then $\frac{7 \times 301}{4 \times 300} = \frac{2107}{1200} = \frac{49 \times 43 \text{ Drivers,}}{30 \times 40 \text{ Driven}}$

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.

Index Plate for Type C Relieving Attachment


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

TEETH OR FLUTES	STUD GEAR	1ST INTERMEDIATE	2ND INTERMEDIATE	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

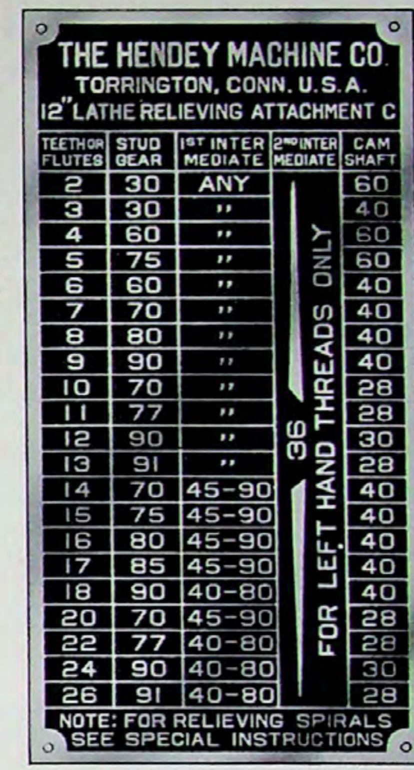
NOTE—FOR RELIEVING SPIRALS SEE SPECIAL INSTRUCTIONS

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.

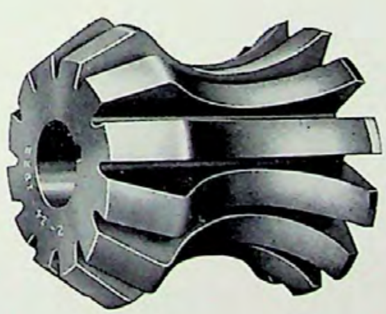
Net weight of Type C Relieving Attachments

Size	Weight
12″	155 lbs
14″	173 "
16″	240 "
18″	266 "
20″	339 "
24″	442 "

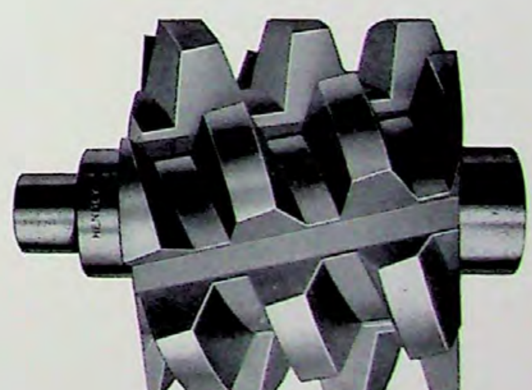

THE HENDEY MACHINE CO.
TORRINGTON, CONN. U.S.A.
12″ LATHE RELIEVING ATTACHMENT C

TEETH OR FLUTES	STUD GEAR	1ST INTERMEDIATE	2ND INTERMEDIATE	CAM SHAFT
2	30	ANY	36 FOR LEFT HAND THREADS ONLY	60
3	30	"		40
4	60	"		60
5	75	"		60
6	60	"		40
7	70	"		40
8	80	"		40
9	90	"		40
10	70	"		28
11	77	"		28
12	90	"		30
13	91	"		28
14	70	45–90		40
15	75	45–90		40
16	80	45–90		40
17	85	45–90		40
18	90	40–80		40
20	70	45–90		28
22	77	40–80		28
24	90	40–80		30
26	91	40–80		28

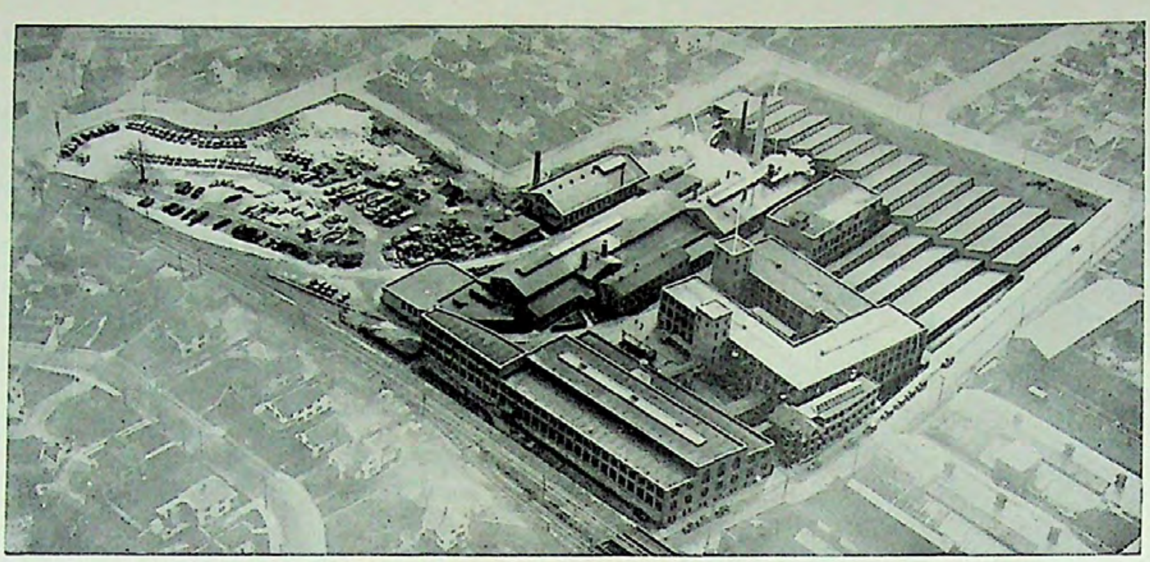
NOTE: FOR RELIEVING SPIRALS SEE SPECIAL INSTRUCTIONS



The rigidity and smoothness of operation of the **HENDEY 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.*



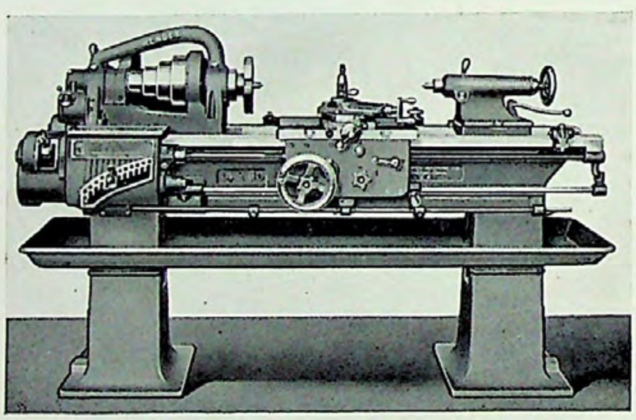
A triple worm hob 12″ Dia., D.P. 1, Triple Lead 9.875 which has been successfully backed off with relieving attachment, using a Hendey Sub-Headstock as the driving member to secure the necessary reduction in R.P.M.



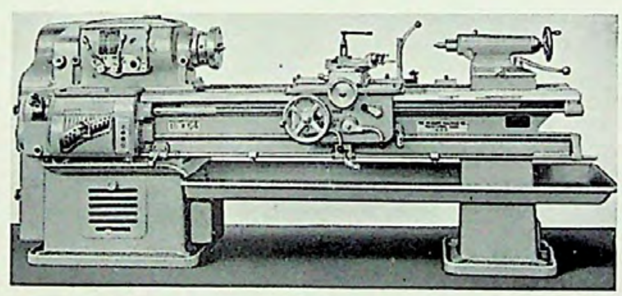
AIRPLANE VIEW OF PLANT

270,000 square feet of floor space

1874 — 66 YEARS — 1940



14″ Cone Head Lathe



16″ — 18-speed Gd. Hd. Lathe

HENDEY ENGINE LATHES

BOTH CONE AND GEARED HEADS

are made in

12-INCH, 18-INCH,
14-INCH, 20-INCH,
16-INCH, 24-INCH SWING

R. S. Peck & Co., Inc.
Hartford, Conn. 1000/7/1/40.

HENDEY

Index Plates for Hendey Lathes Cone and Geared Head

Bulletin 250-L-I-P-4

The Hendey Machine Co., Torrington, Conn., U. S. A.

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565 Washington Boulevard

ROCHESTER
Commerce Building

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69 Fair Oaks Avenue, Newtonville

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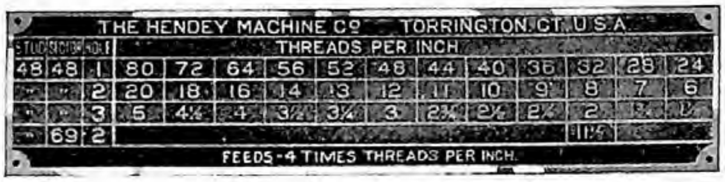
Toronto, Canada

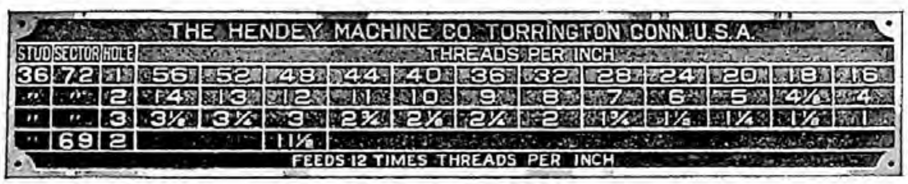
T. E. RYDER MACHINERY CO.
635 St. Paul St.,
Montreal, Canada

Standard Index Plates Showing Range of Threads and Feeds

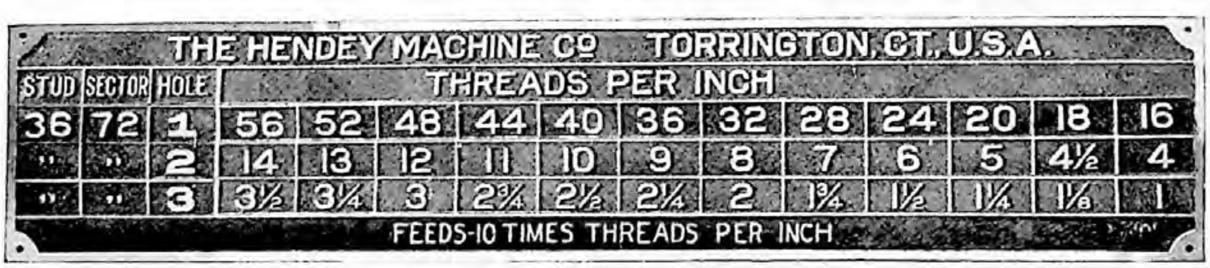


12″ and 14″ Lathes

16″ Lathe



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



24″ Cone Head Lathe only

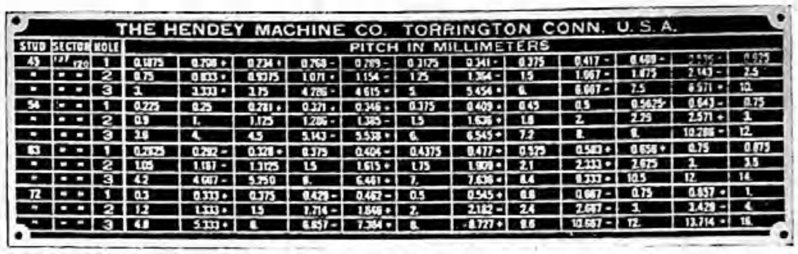
12″ to 16″ swing lathes cut 1½ to 80 threads per inch without gear change. 18″ to 24″ lathes cut 1 to 56 without gear change. Each lathe therefore cuts 36 threads without gear change, no two of which are duplicates. In this list there are very few fractional threads, and these are in the coarse run or 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.

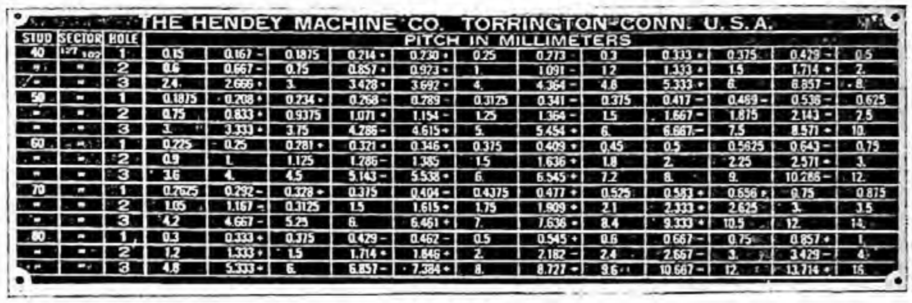
Additional threads obtained with extra change gears are shown on pages 4, 5 and 6.

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.

Metric Transposing Plates

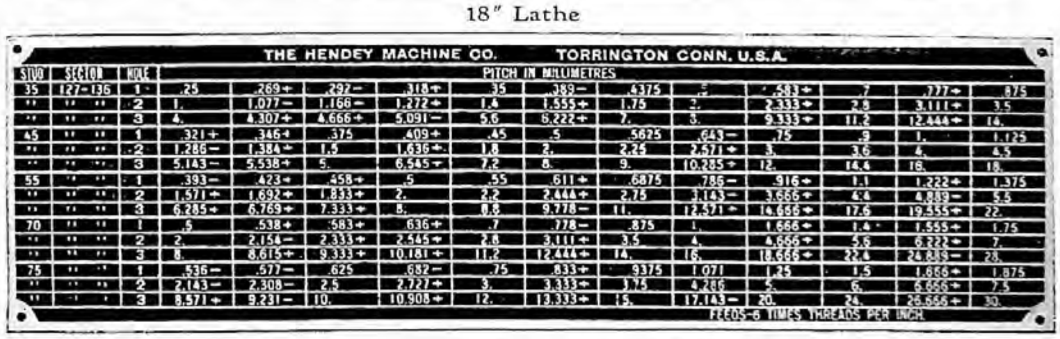


12″ or 14″ Lathe



16″ Lathe

18″ Lathe



20″ Lathe

ILLUSTRATION of Index Plates showing metric threads as obtained on 12″, 14″, 16″, 18″ and 20″ lathes with English pitch Lead Screw and Compound Gear Box, using Transposing Gears.

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

We recommend this arrangement to the attention of customers wishing to cut Metric as well as English Pitches in the same lathe. Also the cross-feed screw and nose of spindle may be furnished with metric pitch thread if desired as on a regular metric engine lathe.

Note: Where 18″ and 20″ lathes have a 2 per inch lead screw, the second sector gear is omitted, and the feeds are 12 times threads per inch.

Index for Extra Change Gears on Hendey Engine Lathes

12″ – 14″ and 16″ Only

$\frac{I \times C}{D}$ = Threads per inch with handles in position I.

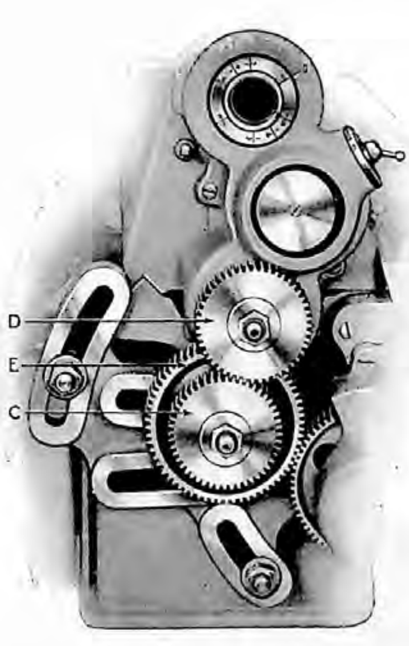
(See heading page 5)

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

Stud	Screw	Hole	Threads Per Inch											
48	44	2	18 1/3	16 1/2	14 2/3	12 5/6	11 11/12	11	10 1/12	9 1/6	8 1/4	7 1/3	6 5/12	5 1/2
..	45	..	18 3/4	16 7/8	15	13 1/8	12 3/16	11 1/4	10 5/16	9 3/8	8 7/16	7 1/2	6 9/16	5 5/8
..	46	..	19 1/6	17 1/4	15 1/3	13 5/12	12 11/24	11 1/2	10 13/24	9 7/12	8 5/8	7 2/3	6 17/24	5 3/4
..	47	..	19 7/12	17 5/8	15 2/3	13 17/24	12 35/48	11 3/4	10 37/48	9 19/24	8 13/16	7 5/6	6 41/48	5 7/8
..	49	..	20 5/12	18 3/8	16 1/3	14 7/24	13 13/48	12 1/4	11 11/48	10 5/24	9 3/16	8 1/6	7 7/48	6 1/8
..	50	..	20 5/6	18 3/4	16 2/3	14 7/12	13 13/24	12 1/2	11 11/24	10 5/12	9 3/8	8 1/3	7 7/24	6 1/4
..	51	..	21 1/4	19 1/8	17	14 7/8	13 13/16	12 3/4	11 11/16	10 5/8	9 9/16	8 1/2	7 7/16	6 3/8
..	52	..	21 2/3	19 1/2	17 1/3	15 1/6	14 1/12	13	11 11/12	10 5/6	9 3/4	8 2/3	7 7/12	6 1/2
..	53	..	22 1/12	19 7/8	17 2/3	15 11/24	14 17/48	13 1/4	12 7/48	11 1/24	9 15/16	8 5/6	7 35/48	6 5/8
..	54	..	22 1/2	20 1/4	18	15 3/4	14 5/8	13 1/2	12 3/8	11 1/4	10 1/8	9	7 7/8	6 3/4
..	55	..	22 11/12	20 5/8	18 1/3	16 1/24	14 43/48	13 3/4	12 29/48	11 11/24	10 5/16	9 1/6	8 1/48	6 7/8
..	56	..	23 1/3	21	18 2/3	16 1/3	15 1/6	14	12 5/6	11 2/3	10 1/2	9 1/3	8 1/6	7
..	57	..	23 3/4	21 3/8	19	16 5/8	15 7/16	14 1/4	13 1/16	11 7/8	10 11/16	9 1/2	8 5/16	7 1/8
..	58	..	24 1/6	21 3/4	19 1/3	16 11/12	15 17/24	14 1/2	13 7/24	12 1/12	10 7/8	9 2/3	8 11/24	7 1/4
..	59	..	24 7/12	22 1/8	19 2/3	17 5/24	15 47/48	14 3/4	13 25/48	12 7/24	11 1/16	9 5/6	8 29/48	7 3/8
..	60	..	25	22 1/2	20	17 1/2	16 1/4	15	13 3/4	12 1/2	11 1/4	10	8 3/4	7 1/2
..	61	..	25 5/12	22 7/8	20 1/3	17 19/24	16 25/48	15 1/4	13 47/48	12 17/24	11 7/16	10 1/6	8 43/48	7 5/8
..	62	..	25 5/6	23 1/4	20 2/3	18 1/12	16 19/24	15 1/2	14 5/24	12 11/12	11 5/8	10 1/3	9 1/24	7 3/4
..	63	..	26 1/4	23 5/8	21	18 3/8	17 1/16	15 3/4	14 7/16	13 1/8	11 13/16	10 1/2	9 3/16	7 7/8
..	64	..	26 2/3	24	21 1/3	18 2/3	17 1/3	16	14 2/3	13 1/3	12	10 2/3	9 1/3	8
..	65	..	27 1/12	24 3/8	21 2/3	18 23/24	17 29/48	16 1/4	14 43/48	13 13/24	12 3/16	10 5/6	9 23/48	8 1/8
..	66	..	27 1/2	24 3/4	22	19 1/4	17 7/8	16 1/2	15 1/8	13 3/4	12 3/8	11	9 5/8	8 1/4
..	67	..	27 11/12	25 1/8	22 1/3	19 13/24	18 7/48	16 3/4	15 17/48	13 23/24	12 9/16	11 1/6	9 37/48	8 3/8
..	68	..	28 1/3	25 1/2	22 2/3	19 5/6	18 5/12	17	15 7/12	14 1/6	12 3/4	11 1/3	9 11/12	8 1/2
..	69	..	28 3/4	25 7/8	23	20 1/8	18 11/16	17 1/4	15 13/16	14 3/8	12 15/16	11 1/2	10 1/16	8 5/8
..	70	..	29 1/6	26 1/4	23 1/3	20 5/12	18 23/24	17 1/2	16 1/24	14 7/12	13 1/8	11 2/3	10 5/24	8 3/4

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

Note:—44 to 47 Tooth Gears can be used on 16″ Lathes only.



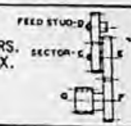
SPECIAL index chart shows a series of different pitches obtained with extra change gears through the whole 36 change combination, worked out for 12″, 14″ and 16″ lathes. These several change gears are applied in position of gear marked C on the sector, as shown in accompanying illustration.

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

Note: Graduations on spindle collar are for spacing multiple threads, etc.

INDEX FOR SOME EXTRA CHANGE GEARS FOR 18"-20"-24" LATHES.-LEAD SCREW 2 THREADS PER INCH.

FORMULA FOR THE DIFFERENT THREADS CUT WITH GIVEN CHANGE GEARS.
I-REPRESENTING A NUMBER TAKEN FROM REGULAR INDEX ON GEAR BOX.
C- " NUMBER OF TEETH IN CHANGE GEAR ON SECTOR.
D- " " " " " " " STUD.
$\frac{I \times C}{D \times 2}$ = THREADS PER INCH WITH HANDLES IN POSITION I.



D STUD	C SECTOR	HOLE	THREADS PER INCH											
36	60	1	46 2/3	43 1/3	40	36 2/3	33 1/3	30	26 2/3	23 1/3	20	16 2/3	15	13 1/3
"	61	"	47 4/9	44 1/18	40 2/3	37 5/18	33 8/9	30 1/2	27 1/9	23 13/18	20 1/3	16 17/18	15 1/4	13 5/9
"	62	"	48 2/9	44 7/9	41 1/3	37 8/9	34 4/9	31	27 5/9	24 1/9	20 2/3	17 2/9	15 1/2	13 7/9
"	63	"	49	45 1/2	42	38 1/2	35	31 1/2	28	24 1/2	21	17 1/2	15 3/4	14
"	64	"	49 7/9	46 2/9	42 2/3	39 1/9	35 5/9	32	28 4/9	24 8/9	21 1/3	17 7/9	16	14 2/9
"	65	"	50 5/9	46 17/18	43 1/3	39 13/18	36 1/9	32 1/2	28 8/9	25 5/18	21 2/3	18 1/18	16 1/4	14 4/9
"	66	"	51 1/3	47 2/3	44	40 1/3	36 2/3	33	29 1/3	25 2/3	22	18 1/3	16 1/2	14 2/3
"	67	"	52 1/9	48 7/18	44 2/3	40 17/18	37 2/9	33 1/2	29 7/9	26 1/18	22 1/3	18 11/18	16 3/4	14 8/9
"	68	"	52 8/9	49 1/9	45 1/3	41 5/9	37 7/9	34	30 2/9	26 4/9	22 2/3	18 8/9	17	15 1/9
"	69	"	53 2/3	49 5/6	46	42 1/6	38 1/3	34 1/2	30 2/3	26 5/6	23	19 1/6	17 1/4	15 1/3
"	70	"	54 4/9	50 5/9	46 2/3	42 7/9	38 8/9	35	31 1/9	27 2/9	23 1/3	19 4/9	17 1/2	15 5/9
"	71	"	55 2/9	51 5/18	47 1/3	43 7/18	39 4/9	35 1/2	31 5/9	27 11/18	23 2/3	19 13/18	17 3/4	15 7/9
"	72	"	56	52	48	44	40	36	32	28	24	20	18	16
"	73	"	56 7/9	52 13/18	48 2/3	44 11/18	40 5/9	36 1/2	32 4/9	28 7/18	24 1/3	20 5/18	18 1/4	16 2/9
"	74	"	57 5/9	53 4/9	49 1/3	45 2/9	41 1/9	37	32 8/9	28 7/9	24 2/3	20 5/9	18 1/2	16 4/9
"	75	"	58 1/3	54 1/6	50	45 5/6	41 2/3	37 1/2	33 1/3	29 1/6	25	20 5/6	18 3/4	16 2/3
"	76	"	59 1/9	54 8/9	50 2/3	46 4/9	42 2/9	38	33 7/9	29 5/9	25 1/3	21 1/9	19	16 8/9
"	77	"	59 8/9	55 11/18	51 1/3	47 1/18	42 7/9	38 1/2	34 2/9	29 17/18	25 2/3	21 7/18	19 1/4	17 1/9
"	78	"	60 2/3	56 1/3	52	47 2/3	43 1/3	39	34 2/3	30 1/3	26	21 2/3	19 1/2	17 1/3
"	79	"	61 4/9	57 1/18	52 2/3	48 5/18	43 8/9	39 1/2	35 1/9	30 13/18	26 1/3	21 17/18	19 3/4	17 5/9
"	80	"	62 2/9	57 7/9	53 1/3	48 8/9	44 4/9	40	35 5/9	31 1/9	26 2/3	22 2/9	20	17 7/9
"	81	"	63	58 1/2	54	49 1/2	45	40 1/2	36	31 1/2	27	22 1/2	20 1/4	18
"	82	"	63 7/9	59 2/9	54 2/3	50 1/9	45 5/9	41	36 4/9	31 8/9	27 1/3	22 7/9	20 1/2	18 2/9
"	83	"	64 5/9	59 17/18	55 1/3	50 13/18	46 1/9	41 1/2	36 8/9	32 5/18	27 2/3	23 1/18	20 3/4	18 4/9
"	84	"	65 1/3	60 2/3	56	51 1/3	46 2/3	42	37 1/3	32 2/3	28	23 1/3	21	18 2/3
"	85	"	66 1/9	61 7/18	56 2/3	51 17/18	47 2/9	42 1/2	37 7/9	33 1/18	28 1/3	23 11/18	21 1/4	18 8/9
"	86	"	66 8/9	62 1/9	57 1/3	52 5/9	47 7/9	43	38 2/9	33 4/9	28 2/3	23 8/9	21 1/2	19 1/9
"	87	"	67 2/3	62 5/6	58	53 1/6	48 1/3	43 1/2	38 2/3	33 5/6	29	24 1/6	21 3/4	19 1/3
"	88	"	68 4/9	63 5/9	58 2/3	53 7/9	48 8/9	44	39 1/9	34 2/9	29 1/3	24 4/9	22	19 5/9
"	89	"	69 2/9	64 5/18	59 1/3	54 7/18	49 4/9	44 1/2	39 5/9	34 11/18	29 2/3	24 13/18	22 1/4	19 7/9
"	90	"	70	65	60	55	50	45	40	35	30	25	22 1/2	20
"	91	"	70 7/9	65 13/18	60 2/3	55 11/18	50 5/9	45 1/2	40 4/9	35 7/18	30 1/3	25 5/18	22 3/4	20 2/9
"	92	"	71 5/9	66 4/9	61 1/3	56 2/9	51 1/9	46	40 8/9	35 7/9	30 2/3	25 5/9	23	20 4/9
"	93	"	72 1/3	67 1/6	62	56 5/6	51 2/3	46 1/2	41 1/3	36 1/6	31	25 5/6	23 1/4	20 2/3
"	94	"	73 1/9	67 8/9	62 2/3	57 4/9	52 2/9	47	41 7/9	36 5/9	31 1/3	26 1/9	23 1/2	20 8/9
"	95	"	73 8/9	68 11/18	63 1/3	58 1/18	52 7/9	47 1/2	42 2/9	36 17/18	31 2/3	26 7/18	23 3/4	21 1/9
"	96	"	74 2/3	69 1/3	64	58 2/3	53 1/3	48	42 2/3	37 1/3	32	26 2/3	24	21 1/3
"	97	"	75 4/9	70 1/18	64 2/3	59 5/18	53 8/9	48 1/2	43 1/9	37 13/18	32 1/3	26 17/18	24 1/4	21 5/9
"	98	"	76 2/9	70 7/9	65 1/3	59 8/9	54 4/9	49	43 5/9	38 1/9	32 2/3	27 2/9	24 1/2	21 7/9
"	99	"	77	71 1/2	66	60 1/2	55	49 1/2	44	38 1/2	33	27 1/2	24 3/4	22
"	100	"	77 7/9	72 2/9	66 2/3	61 1/9	55 5/9	50	44 4/9	38 8/9	33 1/3	27 7/9	25	22 2/9
"	101	"	78 5/9	72 17/18	67 1/3	61 13/18	56 1/9	50 1/2	44 8/9	39 5/18	33 2/3	28 1/18	25 1/4	22 4/9
"	102	"	79 1/3	73 2/3	68	62 1/3	56 2/3	51	45 1/3	39 2/3	34	28 1/3	25 1/2	22 2/3

D STUD	C SECTOR	HOLE	THREADS PER INCH											
36	60	2	11 2/3	10 5/6	10	9 1/6	8 1/3	7 1/2	6 2/3	5 5/6	5	4 1/6	3 3/4	3 1/3
"	61	"	11 31/36	11 1/72	10 1/6	9 23/72	8 17/36	7 5/8	6 7/9	5 67/72	5 1/12	4 17/72	3 13/16	3 7/18
"	62	"	12 1/18	11 7/36	10 1/3	9 17/36	8 11/18	7 3/4	6 8/9	6 1/36	5 1/6	4 11/36	3 7/8	3 4/9
"	63	"	12 1/4	11 3/8	10 1/2	9 5/8	8 3/4	7 7/8	7	6 1/8	5 1/4	4 3/8	3 15/16	3 1/2
"	64	"	12 4/9	11 5/9	10 2/3	9 7/9	8 8/9	8	7 1/9	6 2/9	5 1/3	4 4/9	4	3 5/9
"	65	"	12 23/36	11 53/72	10 5/6	9 67/72	9 1/36	8 1/8	7 2/9	6 23/72	5 5/12	4 37/72	4 1/16	3 11/18
"	66	"	12 5/6	11 11/12	11	10 1/12	9 1/6	8 1/4	7 1/3	6 5/12	5 1/2	4 7/12	4 1/8	3 2/3
"	67	"	13 1/36	12 7/72	11 1/6	10 17/72	9 11/36	8 3/8	7 4/9	6 37/72	5 7/12	4 47/72	4 3/16	3 13/18
"	68	"	13 2/9	12 5/18	11 1/3	10 7/18	9 4/9	8 1/2	7 5/9	6 11/18	5 2/3	4 13/18	4 1/4	3 7/9
"	69	"	13 5/12	12 11/24	11 1/2	10 13/24	9 7/12	8 5/8	7 2/3	6 17/24	5 3/4	4 19/24	4 5/16	3 5/6
"	70	"	13 11/18	12 23/36	11 2/3	10 25/36	9 13/18	8 3/4	7 7/9	6 29/36	5 5/6	4 31/36	4 3/8	3 8/9
"	71	"	13 29/36	12 59/72	11 5/6	10 61/72	9 31/36	8 7/8	7 8/9	6 65/72	5 11/12	4 67/72	4 7/16	3 17/18
"	72	"	14	13	12	11	10	9	8	7	6	5	4 1/2	4
"	73	"	14 7/36	13 13/72	12 1/6	11 11/72	10 5/36	9 1/8	8 1/9	7 7/72	6 1/12	5 5/72	4 9/16	4 1/18
"	74	"	14 7/18	13 13/36	12 1/3	11 11/36	10 5/18	9 1/4	8 2/9	7 7/36	6 1/6	5 5/36	4 5/8	4 1/9
"	75	"	14 7/12	13 13/24	12 1/2	11 11/24	10 5/12	9 3/8	8 1/3	7 7/24	6 1/4	5 5/24	4 11/16	4 1/6
"	76	"	14 7/9	13 13/18	12 2/3	11 11/18	10 5/9	9 1/2	8 4/9	7 7/18	6 1/3	5 5/18	4 3/4	4 2/9
"	77	"	14 35/36	13 65/72	12 5/6	11 55/72	10 25/36	9 5/8	8 5/9	7 35/72	6 5/12	5 25/72	4 13/16	4 5/18
"	78	"	15 1/6	14 1/12	13	11 11/12	10 5/6	9 3/4	8 2/3	7 7/12	6 1/2	5 5/12	4 7/8	4 1/3
"	79	"	15 13/36	14 19/72	13 1/6	12 5/72	10 35/36	9 7/8	8 7/9	7 49/72	6 7/12	5 35/72	4 15/16	4 7/18
"	80	"	15 5/9	14 4/9	13 1/3	12 2/9	11 1/9	10	8 8/9	7 7/9	6 2/3	5 5/9	5	4 4/9
"	81	"	15 3/4	14 5/8	13 1/2	12 3/8	11 1/4	10 1/8	9	7 7/8	6 3/4	5 5/8	5 1/16	4 1/2
"	82	"	15 17/18	14 29/36	13 2/3	12 19/36	11 7/18	10 1/4	9 1/9	7 35/36	6 5/6	5 25/36	5 1/8	4 5/9
"	83	"	16 5/36	14 71/72	13 5/6	12 49/72	11 19/36	10 3/8	9 2/9	8 5/72	6 11/12	5 55/72	5 3/16	4 11/18
"	84	"	16 1/3	15 1/6	14	12 5/6	11 2/3	10 1/2	9 1/3	8 1/6	7	5 5/6	5 1/4	4 2/3
"	85	"	16 19/36	15 25/72	14 1/6	12 71/72	11 29/36	10 5/8	9 4/9	8 19/72	7 1/12	5 65/72	5 5/16	4 13/18
"	86	"	16 13/18	15 19/36	14 1/3	13 5/36	11 17/18	10 3/4	9 5/9	8 13/36	7 1/6	5 35/36	5 3/8	4 7/9
"	87	"	16 11/12	15 17/24	14 1/2	13 7/24	12 1/12	10 7/8	9 2/3	8 11/24	7 1/4	6 1/24	5 7/16	4 5/6
"	88	"	17 1/9	15 8/9	14 2/3	13 4/9	12 2/9	11	9 7/9	8 5/9	7 1/3	6 1/9	5 1/2	4 8/9
"	89	"	17 11/36	16 5/72	14 5/6	13 43/72	12 13/36	11 1/8	9 8/9	8 47/72	7 5/12	6 13/72	5 9/16	4 17/18
"	90	"	17 1/2	16 1/4	15	13 3/4	12 1/2	11 1/4	10	8 3/4	7 1/2	6 1/4	5 5/8	5
"	91	"	17 25/36	16 31/72	15 1/6	13 65/72	12 23/36	11 3/8	10 1/9	8 61/72	7 7/12	6 23/72	5 11/16	5 1/18
"	92	"	17 8/9	16 11/18	15 1/3	14 1/18	12 7/9	11 1/2	10 2/9	8 17/18	7 2/3	6 7/18	5 3/4	5 1/9
"	93	"	18 1/12	16 19/24	15 1/2	14 5/24	12 11/12	11 5/8	10 1/3	9 1/24	7 3/4	6 11/24	5 13/16	5 1/6
"	94	"	18 5/18	16 35/36	15 2/3	14 13/36	13 1/18	11 3/4	10 4/9	9 5/36	7 5/6	6 19/36	5 7/8	5 2/9
"	95	"	18 17/36	17 11/72	15 5/6	14 37/72	13 7/36	11 7/8	10 5/9	9 17/72	7 11/12	6 43/72	5 15/16	5 5/18
"	96	"	18 2/3	17 1/3	16	14 2/3	13 1/3	12	10 2/3	9 1/3	8	6 2/3	6	5 1/3
"	97	"	18 31/36	17 37/72	16 1/6	14 59/72	13 17/36	12 1/8	10 7/9	9 31/72	8 1/12	6 53/72	6 1/16	5 7/18
"	98	"	19 1/18	17 25/36	16 1/3	14 35/36	13 11/18	12 1/4	10 8/9	9 19/36	8 1/6	6 29/36	6 1/8	5 4/9
"	99	"	19 1/4	17 7/8	16 1/2	15 1/8	13 3/4	12 3/8	11	9 5/8	8 1/4	6 7/8	6 3/16	5 1/2
"	100	"	19 4/9	18 1/18	16 2/3	15 5/18	13 8/9	12 1/2	11 1/9	9 13/18	8 1/3	6 17/18	6 1/4	5 5/9
"	101	"	19 23/36	18 17/72	16 5/6	15 31/72	14 1/36	12 5/8	11 2/9	9 59/72	8 5/12	7 1/72	6 5/16	5 11/18
"	102	"	19 5/6	18 5/12	17	15 7/12	14 1/6	12 3/4	11 1/3	9 11/12	8 1/2	7 1/12	6 3/8	5 2/3

STUD	SECTOR	HOLE	THREADS PER INCH											
36	60	3	2 11/12	2 17/24	2 1/2	2 7/24	2 1/12	1 7/8	1 2/3	1 11/24	1 1/4	1 1/24	15/16	5/6
"	61	"	2 139/144	2 217/288	2 13/24	2 95/288	2 17/144	1 29/32	1 25/36	1 139/288	1 13/48	1 17/288	61/64	61/72
"	62	"	3 1/72	2 115/144	2 7/12	2 53/144	2 11/72	1 15/16	1 13/18	1 73/144	1 7/24	1 11/144	31/32	31/36
"	63	"	3 1/16	2 27/32	2 5/8	2 13/32	2 3/16	1 31/32	1 3/4	1 17/32	1 5/16	1 3/32	63/64	7/8
"	64	"	3 1/9	2 8/9	2 2/3	2 4/9	2 2/9	2	1 7/9	1 5/9	1 1/3	1 1/9	1	8/9
"	65	"	3 23/144	2 269/288	2 17/24	2 139/288	2 37/144	2 1/32	1 29/36	1 167/288	1 17/48	1 37/288	1 1/64	65/72
"	66	"	3 5/24	2 47/48	2 3/4	2 25/48	2 7/24	2 1/16	1 5/6	1 29/48	1 3/8	1 7/48	1 1/32	11/12
"	67	"	3 37/144	3 7/288	2 19/24	2 161/288	2 47/144	2 3/32	1 31/36	1 181/288	1 19/48	1 47/288	1 3/64	67/72
"	68	"	3 11/36	3 5/72	2 5/6	2 43/72	2 13/36	2 1/8	1 8/9	1 47/72	1 5/12	1 13/72	1 1/16	17/18
"	69	"	3 17/48	3 11/96	2 7/8	2 61/96	2 19/48	2 5/32	1 11/12	1 65/96	1 7/16	1 19/96	1 5/64	23/24
"	70	"	3 29/72	3 23/144	2 11/12	2 97/144	2 31/72	2 3/16	1 17/18	1 101/144	1 11/24	1 31/144	1 3/32	35/36
"	71	"	3 65/144	3 59/288	2 23/24	2 205/288	2 67/144	2 7/32	1 35/36	1 209/288	1 23/48	1 67/288	1 7/64	71/72
"	72	"	3 1/2	3 1/4	3	2 3/4	2 1/2	2 1/4	2	1 3/4	1 1/2	1 1/4	1 1/8	1
"	73	"	3 79/144	3 85/288	3 1/24	2 227/288	2 77/144	2 9/32	2 1/36	1 223/288	1 25/48	1 77/288	1 9/64	1 1/72
"	74	"	3 43/72	3 49/144	3 1/12	2 119/144	2 41/72	2 5/16	2 1/18	1 115/144	1 13/24	1 41/144	1 5/32	1 1/36
"	75	"	3 31/48	3 37/96	3 1/8	2 83/96	2 29/48	2 11/32	2 1/12	1 79/96	1 9/16	1 29/96	1 11/64	1 1/24
"	76	"	3 25/36	3 31/72	3 1/6	2 65/72	2 23/36	2 3/8	2 1/9	1 61/72	1 7/12	1 23/72	1 3/16	1 1/18
"	77	"	3 107/144	3 137/288	3 5/24	2 271/288	2 97/144	2 13/32	2 5/36	1 251/288	1 29/48	1 97/288	1 13/64	1 5/72
"	78	"	3 19/24	3 25/48	3 1/4	2 47/48	2 17/24	2 7/16	2 1/6	1 43/48	1 5/8	1 17/48	1 7/32	1 1/12
"	79	"	3 121/144	3 163/288	3 7/24	3 5/288	2 107/144	2 15/32	2 7/36	1 265/288	1 31/48	1 107/288	1 15/64	1 7/72
"	80	"	3 8/9	3 11/18	3 1/3	3 1/18	2 7/9	2 1/2	2 2/9	1 17/18	1 2/3	1 7/18	1 1/4	1 1/9
"	81	"	3 15/16	3 21/32	3 3/8	3 3/32	2 13/16	2 17/32	2 1/4	1 31/32	1 11/16	1 13/32	1 17/64	1 1/8
"	82	"	3 71/72	3 101/144	3 5/12	3 19/144	2 61/72	2 9/16	2 5/18	1 143/144	1 17/24	1 61/144	1 9/32	1 5/36
"	83	"	4 5/144	3 215/288	3 11/24	3 49/288	2 127/144	2 19/32	2 11/36	2 5/288	1 35/48	1 127/288	1 19/64	1 11/72
"	84	"	4 1/12	3 19/24	3 1/2	3 5/24	2 11/12	2 5/8	2 1/3	2 1/24	1 3/4	1 11/24	1 5/16	1 1/6
"	85	"	4 19/144	3 241/288	3 13/24	3 71/288	2 137/144	2 21/32	2 13/36	2 19/288	1 37/48	1 137/288	1 21/64	1 13/72
"	86	"	4 13/72	3 127/144	3 7/12	3 41/144	2 71/72	2 11/16	2 7/18	2 13/144	1 19/24	1 71/144	1 11/32	1 7/36
"	87	"	4 11/48	3 89/96	3 5/8	3 31/96	3 1/48	2 23/32	2 5/12	2 11/96	1 13/16	1 49/96	1 23/64	1 5/24
"	88	"	4 5/18	3 35/36	3 2/3	3 13/36	3 1/18	2 3/4	2 4/9	2 5/36	1 5/6	1 19/36	1 3/8	1 2/9
"	89	"	4 47/144	4 5/288	3 17/24	3 115/288	3 13/144	2 25/32	2 17/36	2 47/288	1 41/48	1 157/288	1 25/64	1 17/72
"	90	"	4 3/8	4 1/16	3 3/4	3 7/16	3 1/8	2 13/16	2 1/2	2 3/16	1 7/8	1 9/16	1 13/32	1 1/4
"	91	"	4 61/144	4 31/288	3 19/24	3 137/288	3 23/144	2 27/32	2 19/36	2 61/288	1 43/48	1 167/288	1 27/64	1 19/72
"	92	"	4 17/36	4 11/72	3 5/6	3 37/72	3 7/36	2 7/8	2 5/9	2 17/72	1 11/12	1 43/72	1 7/16	1 5/18
"	93	"	4 25/48	4 19/96	3 7/8	3 53/96	3 11/48	2 29/32	2 7/12	2 25/96	1 15/16	1 59/96	1 29/64	1 7/24
"	94	"	4 41/72	4 35/144	3 11/12	3 85/144	3 19/72	2 15/16	2 11/18	2 41/144	1 23/24	1 91/144	1 15/32	1 11/36
"	95	"	4 89/144	4 83/288	3 23/24	3 181/288	3 43/144	2 31/32	2 23/36	2 89/288	1 47/48	1 187/288	1 31/64	1 23/72
"	96	"	4 2/3	4 1/3	4	3 2/3	3 1/3	3	2 2/3	2 1/3	2	1 2/3	1 1/2	1 1/3
"	97	"	4 103/144	4 109/288	4 1/24	3 203/288	3 53/144	3 1/32	2 25/36	2 103/288	2 1/48	1 197/288	1 33/64	1 25/72
"	98	"	4 55/72	4 61/144	4 1/12	3 107/144	3 29/72	3 1/16	2 13/18	2 55/144	2 1/24	1 101/144	1 17/32	1 13/36
"	99	"	4 13/16	4 15/32	4 1/8	3 25/32	3 7/16	3 3/32	2 3/4	2 13/32	2 1/16	1 23/32	1 35/64	1 3/8
"	100	"	4 31/36	4 37/72	4 1/6	3 59/72	3 17/36	3 1/8	2 7/9	2 31/72	2 1/12	1 53/72	1 9/16	1 7/18
"	101	"	4 131/144	4 161/288	4 5/24	3 247/288	3 73/144	3 5/32	2 29/36	2 131/288	2 5/48	1 217/288	1 37/64	1 29/72
"	102	"	4 23/24	4 29/48	4 1/4	3 43/48	3 13/24	3 3/16	2 5/6	2 23/48	2 1/8	1 37/48	1 19/32	1 5/12

Special Index

For 18", 20" and 24" Lathes with Lead Screw 4 Threads Per Inch

$\frac{1 \times C}{D}$ = Threads per inch with handles in position I.

(See heading page 5)

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

Stud	Sector	Hole	Threads per Inch											
48	44	2	12 5/6	11 11/12	11	10 1/12	9 1/6	8 1/4	7 1/3	6 5/12	5 1/2	4 7/12	4 1/8	3 2/3
"	45	"	13 1/8	12 3/16	11 1/4	10 5/16	9 3/8	8 7/16	7 1/2	6 9/16	5 5/8	4 11/16	4 7/32	3 3/4
"	46	"	13 5/12	12 11/24	11 1/2	10 13/24	9 7/12	8 5/8	7 2/3	6 17/24	5 3/4	4 19/24	4 5/16	3 5/6
"	47	"	13 17/24	12 35/48	11 3/4	10 37/48	9 19/24	8 13/16	7 5/6	6 41/48	5 7/8	4 43/48	4 13/32	3 11/12
"	49	"	14 7/24	13 13/48	12 1/4	11 11/48	10 5/24	9 3/16	8 1/6	7 7/48	6 1/8	5 5/48	4 19/32	4 1/12
"	50	"	14 7/12	13 13/24	12 1/2	11 11/24	10 5/12	9 3/8	8 1/3	7 7/24	6 1/4	5 5/24	4 11/16	4 1/6
"	51	"	14 7/8	13 13/16	12 3/4	11 11/16	10 5/8	9 9/16	8 1/2	7 7/16	6 3/8	5 5/16	4 25/32	4 1/4
"	52	"	15 1/6	14 1/12	13	11 11/12	10 5/6	9 3/4	8 2/3	7 7/12	6 1/2	5 5/12	4 7/8	4 1/3
"	53	"	15 11/24	14 17/48	13 1/4	12 7/48	11 1/24	9 15/16	8 5/6	7 35/48	6 5/8	5 25/48	4 31/32	4 5/12
"	54	"	15 3/4	14 5/8	13 1/2	12 3/8	11 1/4	10 1/8	9	7 7/8	6 3/4	5 5/8	5 1/16	4 1/2
"	55	"	16 1/24	14 43/48	13 3/4	12 29/48	11 11/24	10 5/16	9 1/6	8 1/48	6 7/8	5 35/48	5 5/32	4 7/12
"	56	"	16 1/3	15 1/6	14	12 5/6	11 2/3	10 1/2	9 1/3	8 1/6	7	5 5/6	5 1/4	4 2/3
"	57	"	16 5/8	15 7/16	14 1/4	13 1/16	11 7/8	10 11/16	9 1/2	8 5/16	7 1/8	5 15/16	5 11/32	4 3/4
"	58	"	16 11/12	15 17/24	14 1/2	13 7/24	12 1/12	10 7/8	9 2/3	8 11/24	7 1/4	6 1/24	5 7/16	4 5/6
"	59	"	17 5/24	15 47/48	14 3/4	13 25/48	12 7/24	11 1/16	9 5/6	8 29/48	7 3/8	6 7/48	5 17/32	4 11/12
"	60	"	17 1/2	16 1/4	15	13 3/4	12 1/2	11 1/4	10	8 3/4	7 1/2	6 1/4	5 5/8	5
"	61	"	17 19/24	16 25/48	15 1/4	13 47/48	12 17/24	11 7/16	10 1/6	8 43/48	7 5/8	6 17/48	5 23/32	5 1/12
"	62	"	18 1/12	16 19/24	15 1/2	14 5/24	12 11/12	11 5/8	10 1/3	9 1/24	7 3/4	6 11/24	5 13/16	5 1/6
"	63	"	18 3/8	17 1/16	15 3/4	14 7/16	13 1/8	11 13/16	10 1/2	9 3/16	7 7/8	6 9/16	5 29/32	5 1/4
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"	65	"	18 23/24	17 29/48	16 1/4	14 43/48	13 13/24	12 3/16	10 5/6	9 23/48	8 1/8	6 37/48	6 3/32	5 5/12
"	66	"	19 1/4	17 7/8	16 1/2	15 1/8	13 3/4	12 3/8	11	9 5/8	8 1/4	6 7/8	6 3/16	5 1/2
"	67	"	19 13/24	18 7/48	16 3/4	15 17/48	13 23/24	12 9/16	11 1/6	9 37/48	8 3/8	6 47/48	6 9/32	5 7/12
"	68	"	19 5/6	18 5/12	17	15 7/12	14 1/6	12 3/4	11 1/3	9 11/12	8 1/2	7 1/12	6 3/8	5 2/3
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"	80	"	23 1/3	21 2/3	20	18 1/3	16 2/3	15	13 1/3	11 2/3	10	8 1/3	7 1/2	6 2/3
"	96	"	28	26	24	22	20	18	16	14	12	10	9	8

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

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H
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12-INCH

High Speed

CRANK SHAPER

No. 312-H.S.S.-7

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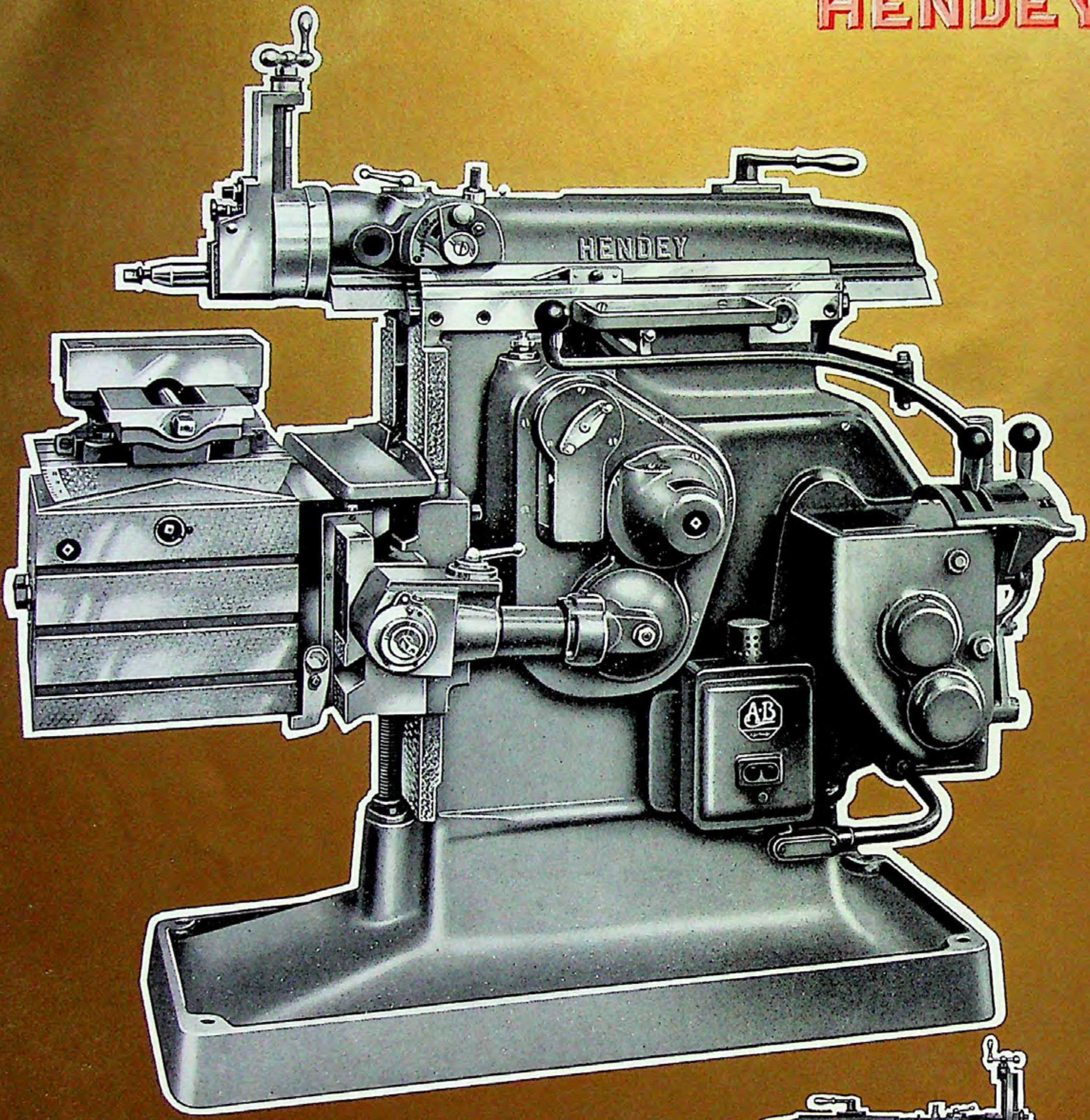


HENDEY 12-INCH CRANK SHAPER

A HIGH SPEED MACHINE that couples SPEED with POWER.

MAXIMUM CUTTING SPEED of 182 ft. per minute on 6-inch stroke.

Equally efficient on Tool or Machine Work.

Eight Speed Changes.

Crank Gear runs in massive Timken Bearings.

Universal Table with Tilting Top.

Motor frame bolted to column with straight line power transmission to input shaft through multiple disc clutch.

Dual start and stop control of ram, operates either side of shaper.

HENDEY 12-INCH High Speed CRANK SHAPER

SPECIFICATIONS

RAM

Length of ram	34″
Ram bearing in column	8″ × 23″
Length of stroke	12¾″
Strokes per minute	14 to 200
Speed changes	8
High speed on 12″ stroke	120′ per min.
High speed on 6″ stroke	182′ per min.
Low speed on 12″ stroke	23′ per min.
Low speed on 2″ stroke	4.5′ per min.

HEAD

Diameter of swivel	6″
Vertical travel of slide	4⅝″
Power down feed range by steps of .0025″	.0025″ to .030″
Size of tool opening	1½″ × $\frac{11}{16}$″

UNIVERSAL TABLE

Size of plain surface	11″ × 12½″
Size of tilting top	10″ × 12″
Top tilts either way	15°
Width of tee slots	$\frac{9}{16}$″
Maximum distance to ram for plain surface	15½″
Maximum distance to ram for tilting top	14$\frac{9}{16}$″
Maximum distance top of vise to ram	8$\frac{13}{16}$″
Maximum rotation of table	360°
Horizontal travel	17⅝″
Vertical movement	14¼″
Power cross feed range by steps of .0025″	.0025″ to .090″

CROSS RAIL

Length of bearing on column	11⅛″
Width of bearing on column	13¼″
Width of saddle bearing on C.R.	9″
Length of saddle bearing on C.R.	12½″

VISE

Height of jaws	2¼″
Length of jaws	10″
Maximum opening	10½″
Height of vise to top of jaws	5¾″
Weight	100 lbs.

MOTOR

A.C. or D.C. Flange mounted

Gear reduction or direct speed type

H.P. 2

R.P.M. of rotor shaft 600

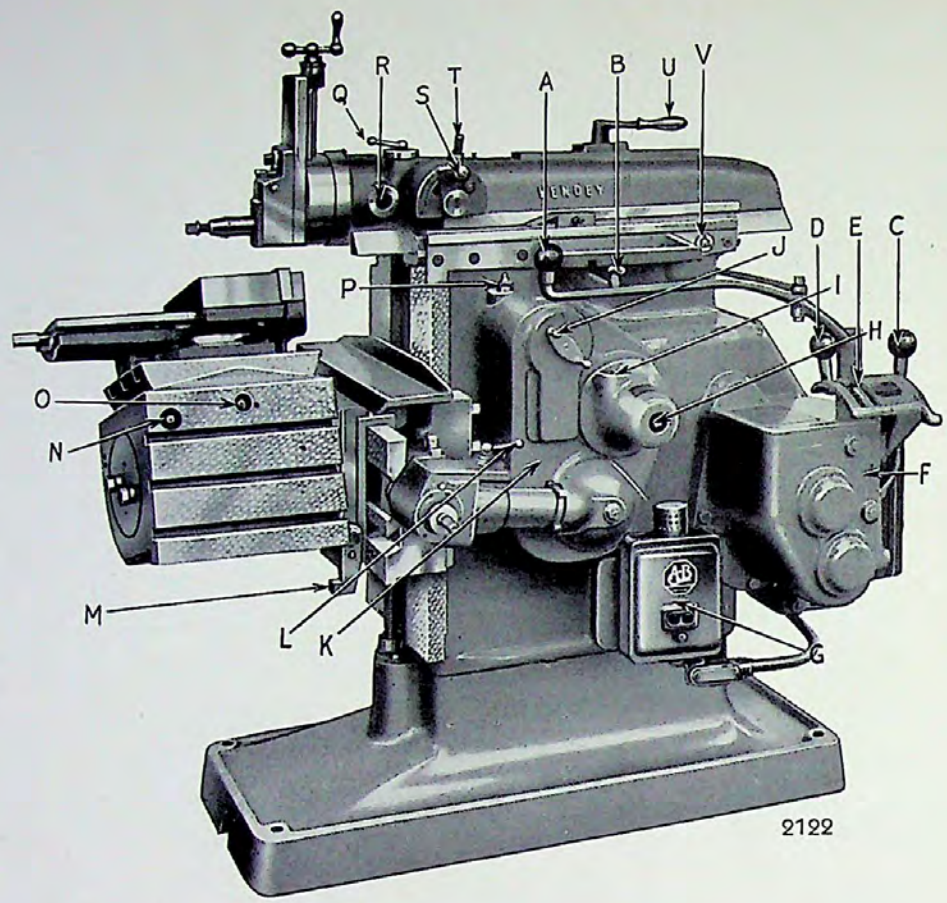
Net weight of Shaper with motor approx.	2825 lbs.
Floor space required	46″ × 68″

Note. Design and dimensions subject to engineering changes without notice.

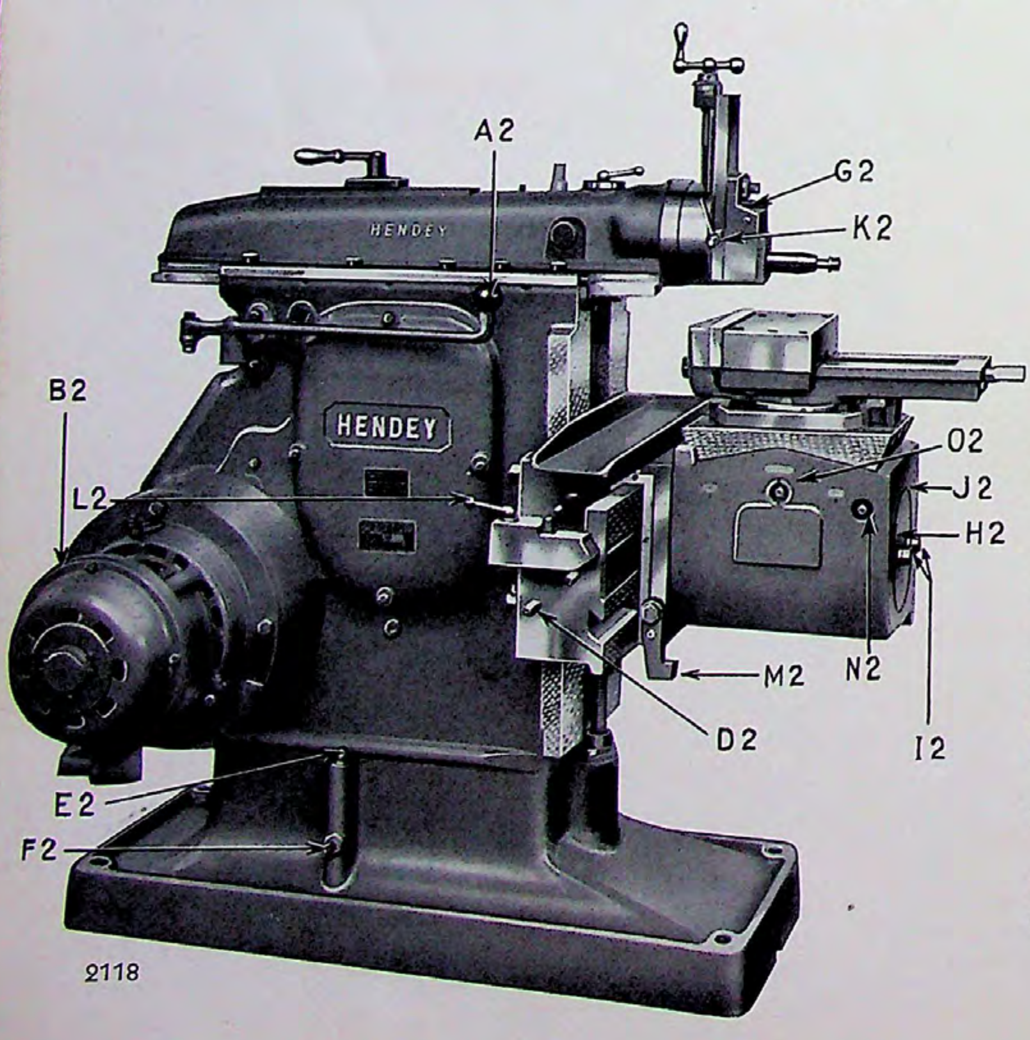
HENDEY

KEY TO INDEX

A Start and stop clutch lever.
B Safety lock for starting lever.
C High and low gear speed lever.
D Speed change gear shift lever.
E H-plate for speed lever positions.
F Speed change gear box.
G Push button station for motor.
H Shaft for changing stroke of ram.
I Index dial for ram stroke length.
J Cross feed range adjustment.
K Carrier plate for cross feed mechanism.
L Cross feed engagement lever.
M Stop for cross horizontal alignment of tilting top.
N Worm shaft for rotating table.
O Binding screw for tilting top.
P Contact spring for feed cam roller.
Q Down feed clutch lever.
R Pilot hole for geared wrench to bind swivel head to ram.
S Down feed range lever and sector.
T Ram positioning shaft.
U Ram nut binder.
V Flow indicator for automatic oiling system.



2122

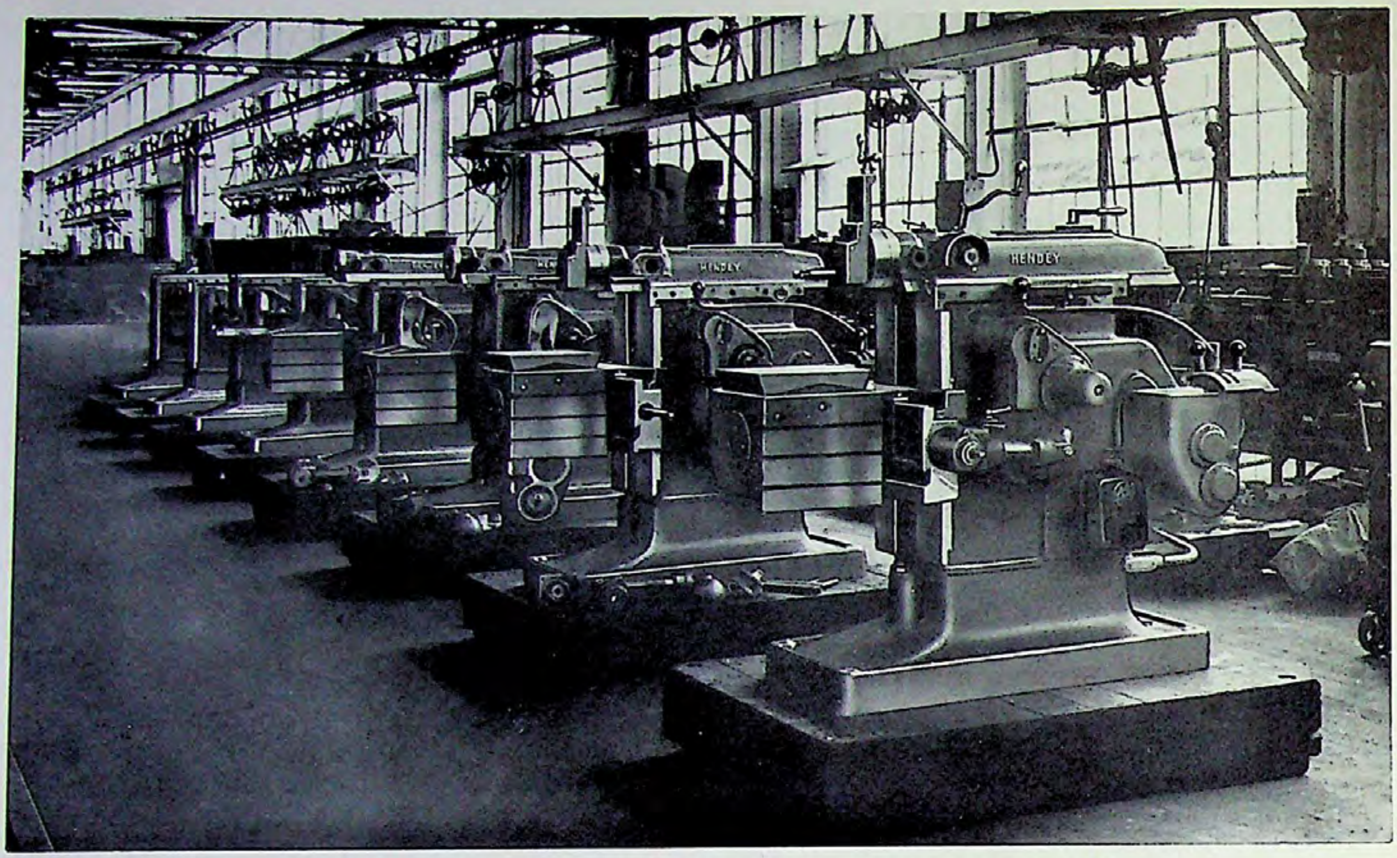


2118

KEY TO INDEX

A2 Second start and stop clutch lever.
B2 Gear reduction motor with flange mounting.
D2 Shaft for elevating screw.
E2 Filler plug for oil reservoir.
F2 Drain plug for reservoir.
G2 Seating spring for clapper.
H2 Worm shaft for setting tilting top.
I2 Bolts binding table to saddle.
J2 Graduated ring for angular settings of table.
K2 Binder for down feed slide.
L2 Second cross feed engagement lever. See L cut 2122.
M2 Stop for hosizontal alignment of plain face of table.
N2 Worm shaft for rotating table.
O2 Binding screw for tilting top.

HENDEY

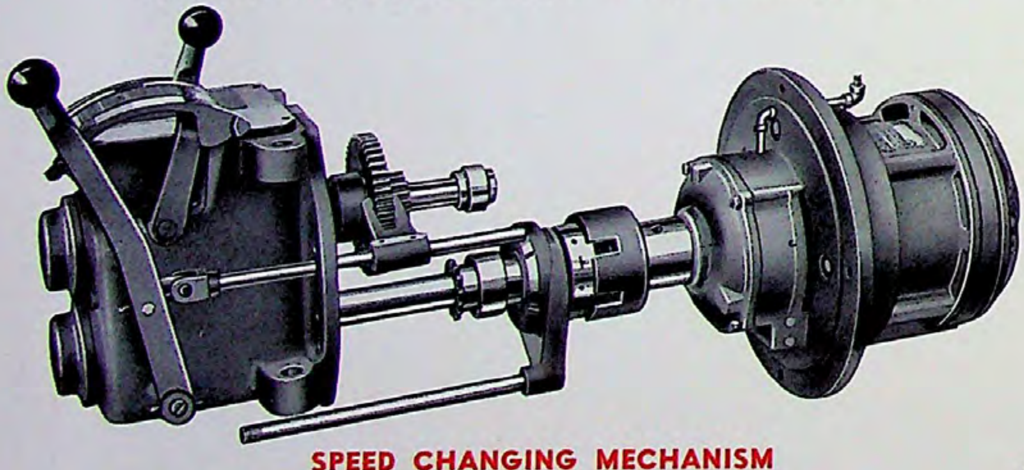


A GROUP OF 12-INCH CRANK SHAPERS ON THE ASSEMBLY FLOOR

THE MOTOR DRIVE

The motor drive for this shaper features simplicity and straight line power transmission.

The motor may be either one of two types: one having a speed reducing gear unit with output shaft running at 600 R.P.M. which is the operating speed of power input shaft of the shaper: in the other type the motor is built to provide a speed of 600 R. P. M. on the rotor shaft direct, eliminating the reducing gear unit.



In either case the frame of motor is suitably flange mounted to a drum like carrier on shaper column. With the motor and input shafts brought into axial alignment a highly efficient straight line transfer of power from motor to shaper is thereby made possible and secured through the medium of a standard multiple disc clutch. A cone type friction brake is mounted on power shaft and is engaged by full reverse motion of clutch lever.

Push button control for motor has pilot light indicating when motor is running.

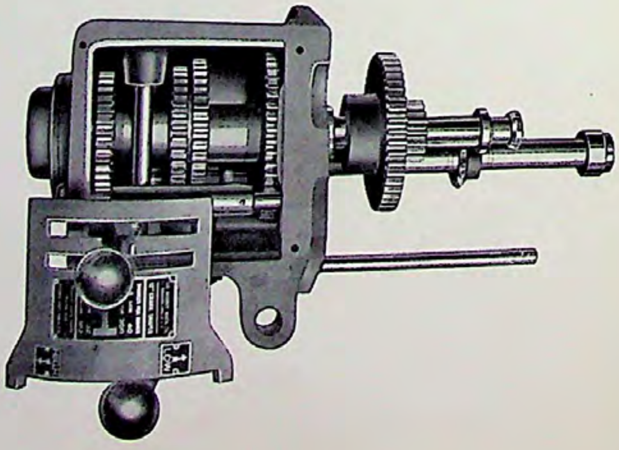
SPEED CHANGING MECHANISM

The speed changing mechanism is of unit construction.

The complete assembly includes the speed gear box with shafts, gearing, H plate and shifter handles, also the high and low speed transfer gears on output shaft.

The shafts run in ball bearings of maximum capacity. All gears are of alloy steel, electrically heat treated, with tooth profile refinished after hardening, and with ends of gear teeth rounded to facilitate speed changes.

Eight geared speed changes are provided for ram travel with the four initial speeds in the gear box doubled through the high and low speed transmission gear. (See page 6.) These changes give a range of 14 strokes per minute minimum to 200 strokes per minute maximum.



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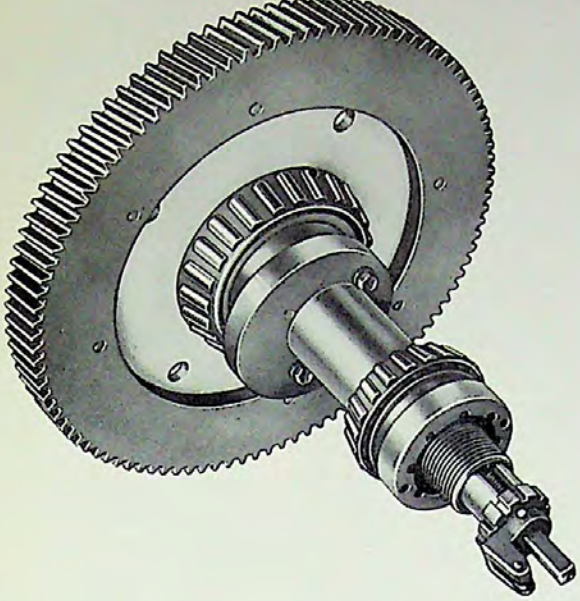
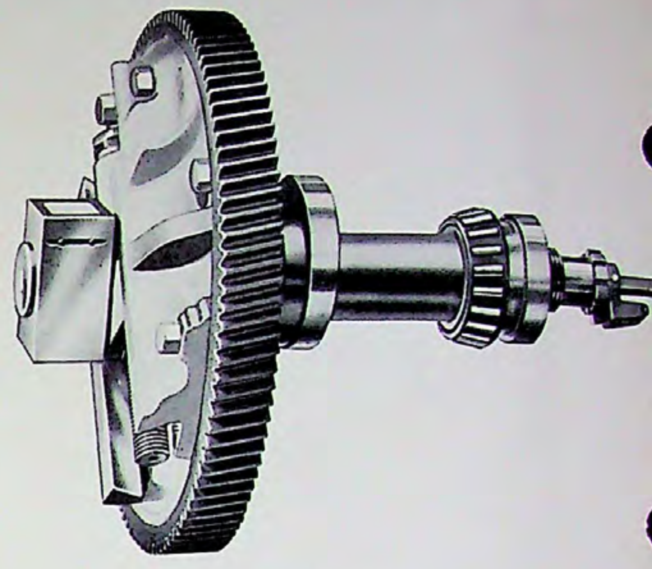


CRANK GEAR

The crank gear and hub are of two-piece construction. The gear ring is cast of special material having high physical properties, and with teeth cut helical to insure smoothness of operation. The hub runs on two massive Timken bearings. These bearings are pre-loaded, insuring a smooth flow of power under maximum working conditions. The feed cam, crank pin and block, stroke adjusting shaft and shaft lock are shown in these assemblies.

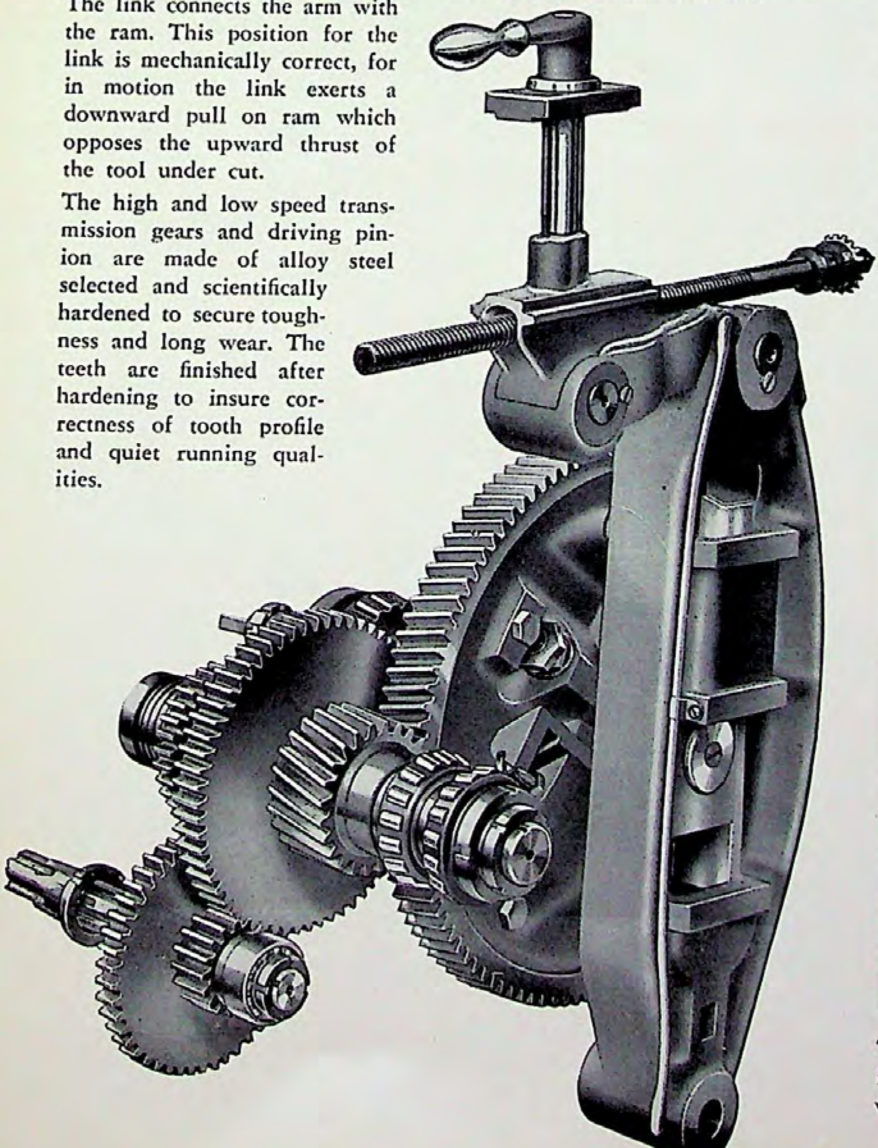


RAM DRIVING GEAR

The rocker arm is pivoted in the base, at which point the weight of the arm is carried and not by the ram. This bottom pivoting neutralizes the tendency of crank pin to raise the ram on the first half of cutting stroke and exert unnecessary pressure on ram ways on second half.

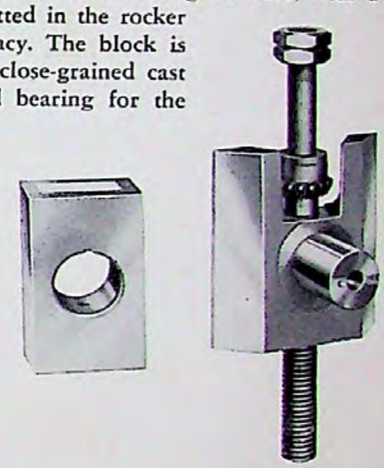
The link connects the arm with the ram. This position for the link is mechanically correct, for in motion the link exerts a downward pull on ram which opposes the upward thrust of the tool under cut.

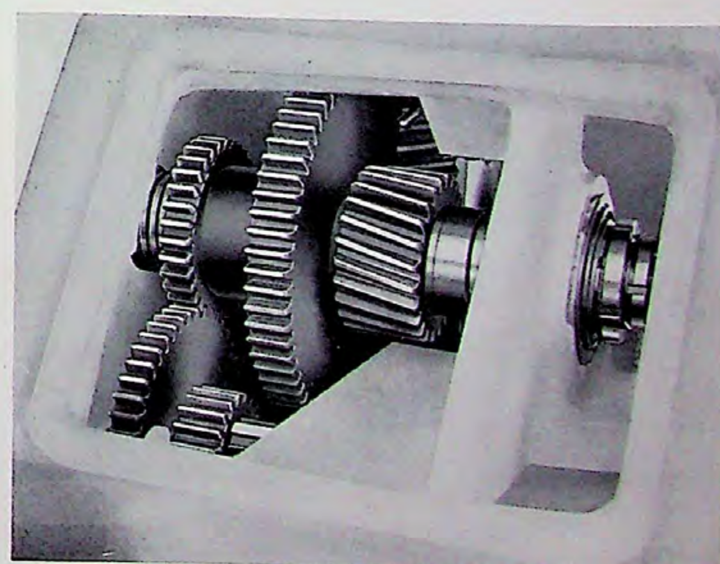
The high and low speed transmission gears and driving pinion are made of alloy steel selected and scientifically hardened to secure toughness and long wear. The teeth are finished after hardening to insure correctness of tooth profile and quiet running qualities.



CRANK PIN AND BLOCK

The crank pin is designed for heavy duty service. The guide ways of pin are carefully fitted and taper gibbed to dove-tail slide in the hub head. Bearing surfaces of block are glass hard, with a very high lapped finish, and fitted in the rocker arm ways with extreme accuracy. The block is bushed with a sleeve of hard close-grained cast iron, furnishing an unexcelled bearing for the crank pin. Both the pin and block receive high volume lubrication when in operation, creating an ideal working condition with wear virtually non-existent.



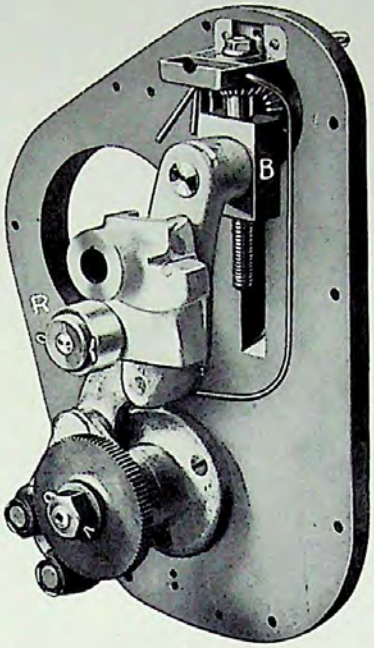


Transmission gears of 12″ crank shaper as viewed through the opening in rear of column. Gears are in mesh in the high speed position which gives a maximum travel of 120′ per min. on 12″ stroke.

HENDEY

CROSS FEED

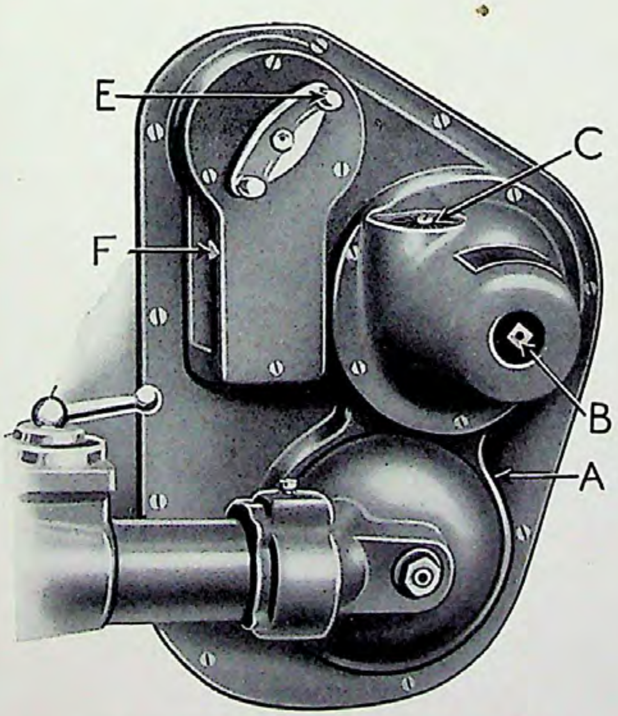
The feed mechanism is mounted on plate A which is screwed and doweled to the flanged opening on the column. The feed is actuated from a cam on the hub of crank gear as seen in the cut on page 6. This cam engages with roller on rocker indicated at R. When the feed slide block B is at its top position the feed is at zero. The maximum feed is obtained when the block is moved to its low position.



The feed changes are controlled by the double crank E. The amount of feed is indicated by a pointer F moving on front edge of auxiliary plate and within direct view of the operator. Range of feed is from .0025 to .090".

The cross feed takes place on the reverse stroke and is of the slow motion type, carried through the return stroke period.

Thrust on cross feed screw is taken on two Timken roller bearings. Cross feed is engaged at either end of rail by levers L, fig. 2122 and L2, fig. 2118, see page 4. A safety stop rod disengages power feed at either end of table travel.



CHANGING LENGTH OF RAM STROKE

This operation is simple. First the hand crank is applied to the end of shaft at B. This engagement automatically releases the shaft lock (see crank gear cuts page 6). Turning this shaft moves crank pin block in its dovetail guide until desired length of stroke is indicated on dial C.

When the hand crank is removed the shaft is automatically locked.

CROSS RAIL

Cross Rail is double walled with a bearing 11⅛ inches high on column and is narrow gibbed.

Rail clamps, adjusted by countersunk screws, hold cross rail to column in close sliding contact, while heavy binding bolts lock rail securely to column when taking cut.

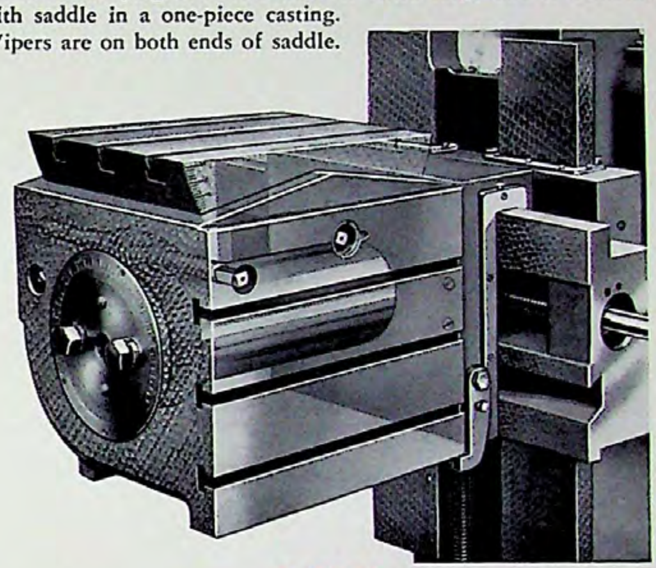
Wipers on top of cross rail bear against column, and a metal guard on cross rail further protects ways on column from chips and dirt. Nut for elevating screw has a ball thrust bearing to reduce the frictional load.

SADDLE

The saddle has three bearings on cross rail with dovetail tongue having taper gib running on narrow guideway.

Trunnion carrying universal table is extra large and is combined with saddle in a one-piece casting.

Wipers are on both ends of saddle.



TABLES

The universal table will rotate through 360 degrees, and has positive stop M, fig. 2122, and M2, fig. 2118, page 4 for either horizontal position. Worm and gear for rotating table are shown in the transparency above.

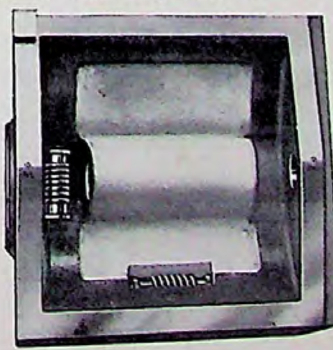
For angular settings readings are made on the large graduated dial shown on front end of trunnion.

TILTING TOP

The tilting top is seated with a full length accurately fitted circular bearing in the table proper and when clamped in working position is absolutely firm under heaviest cuts.

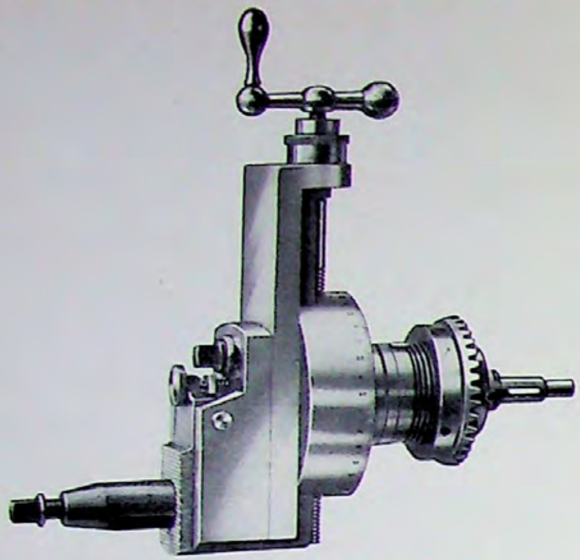
The tilting top can be set at an angle of 15 degrees either side of horizontal. Graduations are on right forward side of top and are read from the adjacent rim of table. Settings are made through worm shaft, H2, fig. 2118, page 4. Binding of top with table is done with opposed wedges operated by screw indicated at 0, fig. 2122, page 4.

This shaper may be furnished with a plain box table in place of the universal if preferred.



Binding Wedges and Screw

HENDEY

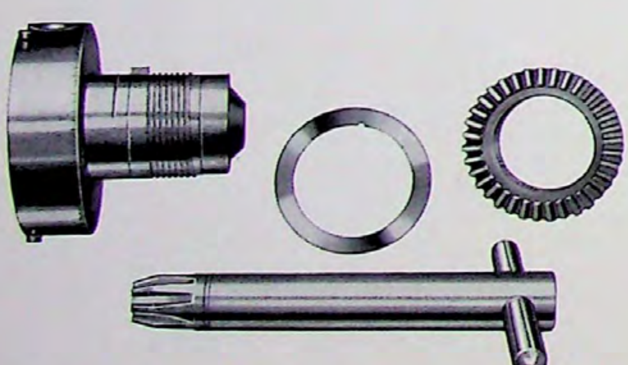


TOOL SLIDE

The tool or down feed slide is 11¼″ in length, 3½″ wide, and has a travel of 4⅝″. The tool post is slotted to take tool shank of 1¼″ x ⅝″. The tool slide has a binder shown at K2, fig. 2118, page 4, to keep slide from creeping when taking a cross cut. It is taper gibbed for wear, and upward thrust on feed screw is taken by large collar nut below crank handle.

SWIVEL HEAD

The swivel head is clamped to head of ram without distortion by means of large geared nut running on threaded sleeve keyed to ram head.



This nut is easily tightened or loosened by means of pinion-wrench which is inserted through pilot hole shown at R, fig. 2122. When properly tightened the swivel head will not slip.

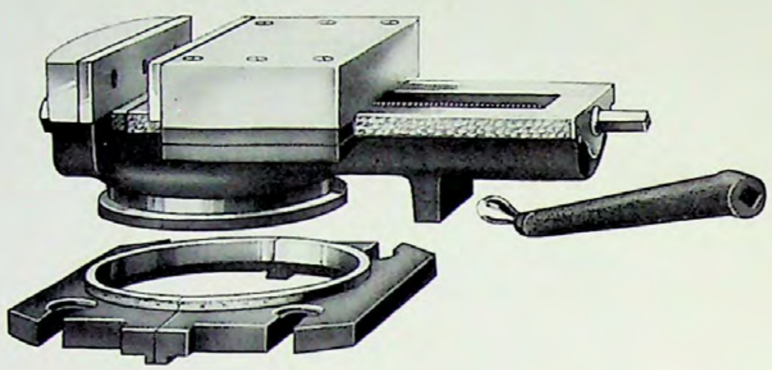
POWER DOWN FEED

The power down feed is optional on the 12-inch Shaper *(see* Q and S, fig. 2122) page 4. It has a range of .0025-inch to .030-inch.

VISE

Vise is of the single screw type with gibbed sliding block. Jaws are faced with hardened and ground alloy steel plates.

Thrust of screw is taken at head end of main casting on a large washer and nut on the out-



side. The screw is in tension thus relieving the base casting of all unnecessary stress.

The graduated clamping ring is of 2-piece construction. It has four bolts, and exerts a direct downward pull on flange of vise hub, preventing it from slipping under heaviest cuts. A boss is cast on under side of vise block at the rear, which furnishes added support when vise is used in line with table.

Vise has maximum opening of 10½″ between jaws. (See general dimensions page 3.)

AUTOMATIC LUBRICATION

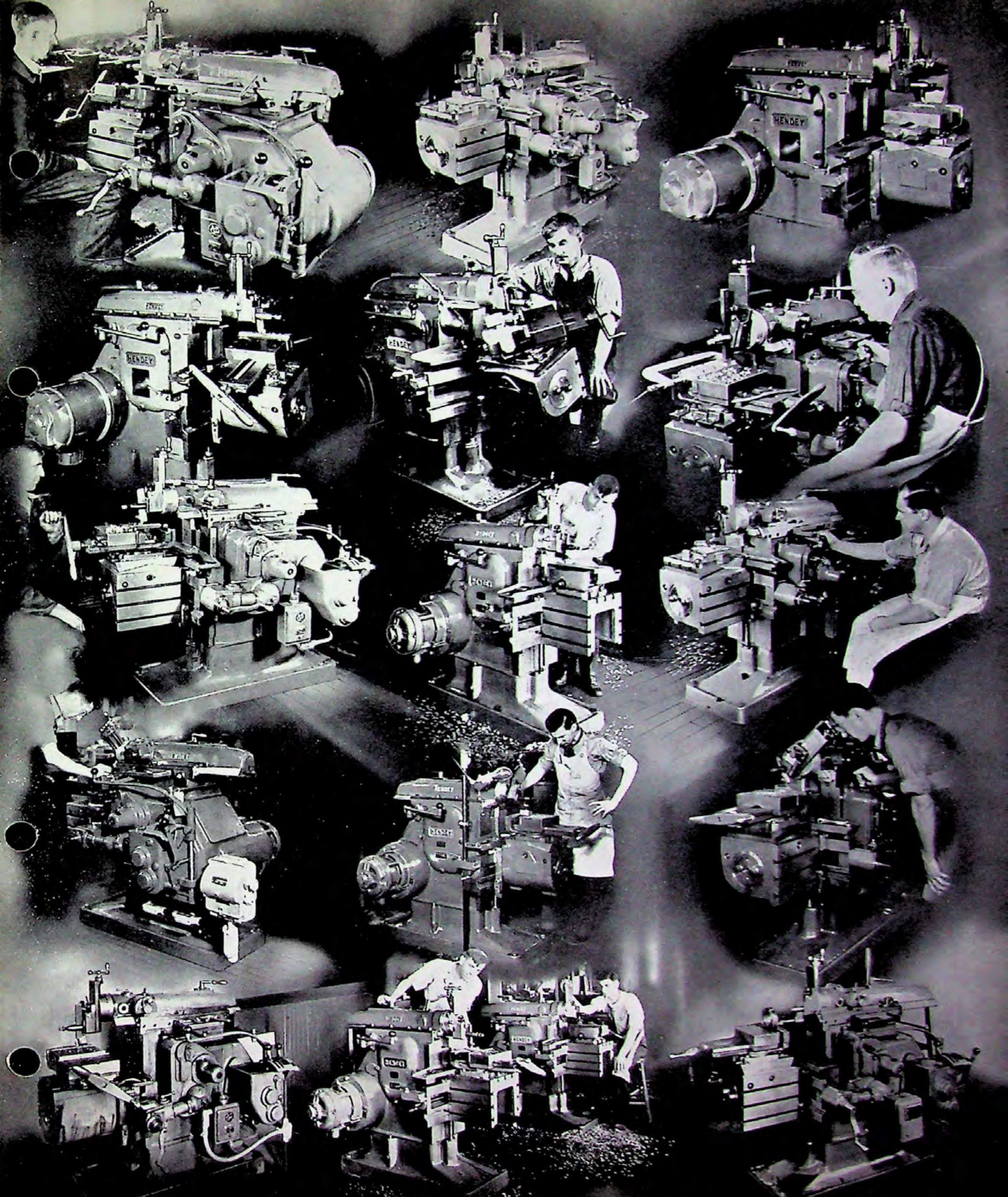
The entire driving mechanism is automatically lubricated

The speed change gears run in oil circulating through the gear box.

The crank gear, driving pinion and back gearing, each has its independent supply of oil flowing to it under positive circulation, and which contributes effectively to noiseless operation.

Oil is also pumped to and distributed over the ram ways, rocker arm ways, crank pin and block, and the feed mechanism, the circulation being shown at the flow indicator *(see* V, fig. 2122) page 4.

All oil in circulation is filtered before entering the distributing system.



FACTORY INSTALLATIONS OF HENDEY 12-INCH CRANK SHAPERS

HENDEY

12-INCH High Speed CRANK SHAPER

A MACHINE THAT HAS ESTABLISHED NEW RECORDS

This small shaper has found a permanent and dominating place in scores of nationally known shops throughout the country because of its exceptional merit, expressed in a grade of performance hitherto unapproached in facility of operation, high rate of production, and accuracy of work.

A HIGH SPEED TOOL

Primarily, it is a high speed cutting tool.

On 6-inch stroke it has a maximum cutting speed of 182 feet per minute; and on 12-inch stroke a high cutting speed of 120 feet per minute.

Through the skillful design and employment of light weight alloy material of high physical properties in the ram, rocker arm and head the reciprocations of ram travel at high speeds are effectively balanced and cushioned, securing complete freedom from shock or machine vibration.

This 12-inch Shaper is not limited, however, to the high working speeds. For forming tool cuts and other heavy duty work there is ample power and range in the slower speeds as needed, the minimum being 23 feet per minute on 12-inch stroke and 4.5 feet per minute on 2-inch stroke.

Ease of handling of this shaper is facilitated through right and left side starting and stopping levers for ram motion, (see A and A2, page 4,) and right and left side levers for engagement of table cross feed (see L and L2, page 4). These conveniences make for high efficiency of operation and are sure to please the tool maker.

This shaper is extensively used by representative manufacturers of

BALL BEARINGS

ROLLER BEARINGS

AUTOMOTIVE PARTS

AUTOMOBILES

TYPEWRITERS

SMALL ARMS

ELECTRICAL MACHINERY

SILVERWARE

SPORTING GOODS

PAPER BOXES

SMALL HARDWARE

CAN MACHINERY

TOOLS AND DIES

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