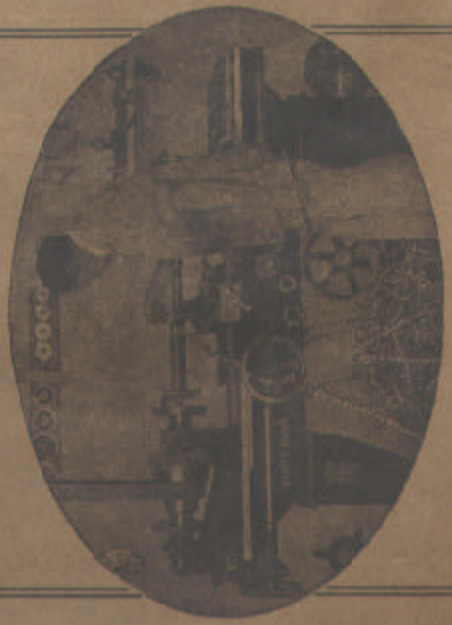
HOW TO RUN A LATHE

PRICE 50 CENTS



SOUTH BEND LATHE WORKS

South Bend, Ind., U. S. A.

South Bend Lathes are built in the following 39 Sizes

No. and Swing of Lathe	Length of Bed						
	4 Ft.	5 Ft.	6 Ft.	7 Ft.	8 Ft.	10 Ft.	12 Ft.
No. 28 – 11"	11"x4"	11"x5"	11"x6"				
No. 29 – 11"	11"x4"	11"x5"	11"x6"				
No. 30 – 12"		12"x5"	12"x6"	12"x7"	12"x8"		
No. 32 – 13"		13"x5"	13"x6"	13"x7"	13"x8"	13"x10"	
No. 34 – 13"		13"x5"	13"x6"	13"x7"	13"x8"	13"x10"	
No. 35 – 13"		13"x5"	13"x6"	13"x7"	13"x8"	13"x10"	
No. 37 – 15"			15"x6"	15"x7"	15"x8"	15"x10"	
No. 40 – 16"			16"x6"	16"x7"	16"x8"	16"x10"	16"x12"
No. 44 – 18"			18"x6"	18"x7"	18"x8"	18"x10"	18"x12"

"HOW TO RUN A LATHE"

By a Practical Machinist and Mechanical Engineer

This little book calls attention to some of the practical and necessary details that the beginner should be familiar with in operating a screw cutting engine lathe.

It has been said, that if a man of mechanical turn of mind learns how to run a lathe and will observe the three fundamental rules of the shop, he can become a first-class mechanic. Following are the rules:

Keep your lathe clean and well oiled.

Keep your tools sharp.

Take your measurements accurately.

A copy of this little book, "How to Run a Lathe," is included free, and will be found packed in the box with the regular equipment of each South Bend Lathe.

"How to Run a Lathe" would make an excellent gift to a friend who is interested in mechanics. We will mail a copy postpaid direct to his address upon receipt of price. **Stamps accepted.**

How to Run a Lathe

How to erect, care for and operate a Screw Cutting Engine Lathe

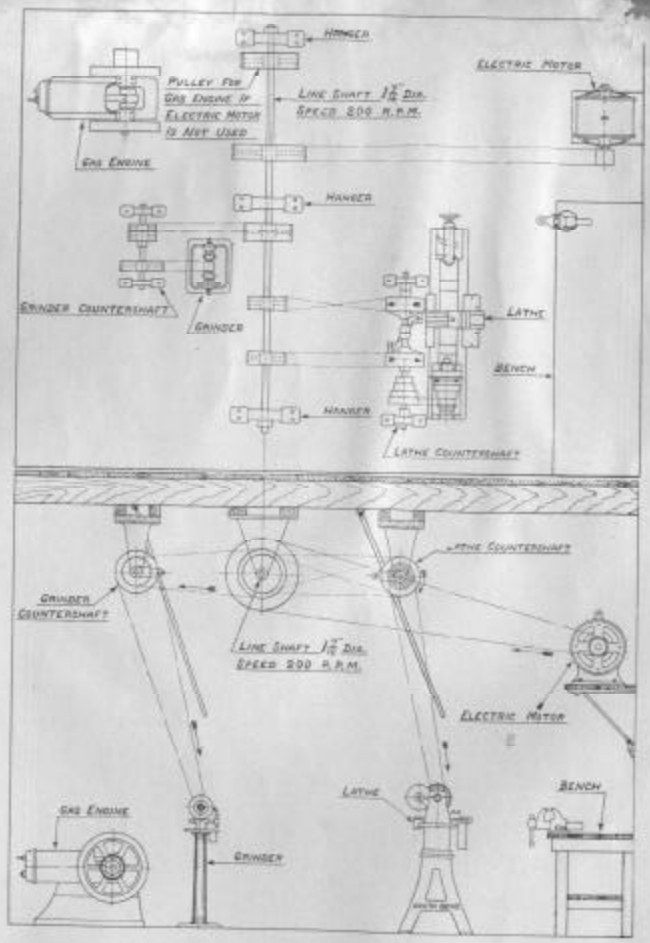
REVISED EDITION

No. 3

SOUTH BEND LATHE WORKS
South Bend, Indiana, U. S. A.
423-425-427 E. Madison St.

Manufacturers of

SOUTH BEND LATHES



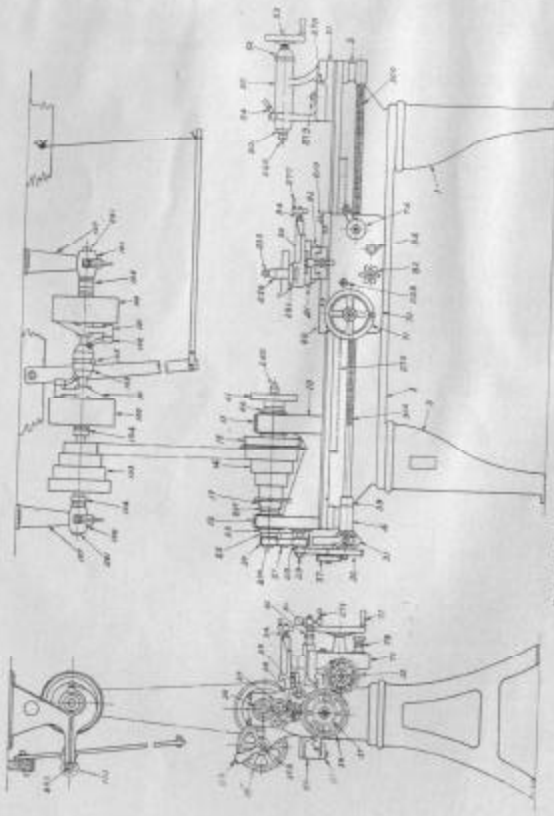
PRACTICAL LAYOUT FOR A SMALL MACHINE SHOP

The drawing on the opposite page illustrates a practical layout for a small machine shop. The line shaft is attached to the joists parallel to the side wall, and leveled perfectly so that the shaft will run free and easy. A line shaft 1 7/16 inch in diameter, having a speed of 200 revolutions per minute, is recommended for the small shop.

An electric motor is mounted on a bracket attached to either side wall, high enough so that the belt will not interfere with the workmen passing underneath. If a gas engine is used instead of an electric motor, the engine may be located conveniently in the corner, as shown.

Countershaft for lathe is attached to the joists about 6 ft. distant from the line shaft. The countershaft should be leveled carefully, the axis being parallel to that of the line shaft. The countershaft belt at head end of lathe is straight; the reverse belt is crossed. Arrows show the direction in which the belts run. The two pulleys on line shaft for driving countershaft are of the same diameter. Some prefer the pulley driving the reverse belt to be 1 inch larger in diameter, so that for thread cutting the carriage may be reversed at high speed. Wood split pulleys crown face are recommended for the line shaft.

A three-horse power motor has ample power to drive the equipment shown in drawing, assuming that the lathe is not larger than 16 inch.



Cut of Lathe showing principal parts numbered

ORDERING REPAIR PARTS

In ordering **repair parts** for lathe, order by number of part and give **size of lathe** that the part is to be used on, because the part numbers apply to all size South Bend lathes from 11 to 18 inch swing inclusive.

NUMBER AND NAME OF LATHE PARTS ON DRAWING

No.
1 Bed.
2 Power Legs.
4 Lead Screw Bracket F.
5 Lead Screw Bracket R.
10 Head Stock.
11 Head Stock Cap, Large.
12 Head Stock Cap, Small.
13 Head Stock Clamp Plate.
14 Spindle Cone.
15 Bull Gear.
16 Bull Gear Clamp.
17 Cone Pinion.
18 Quill Gear.
19 Quill Sleeve.
20 Quill Sleeve Pinion.
21 Ecc. Shaft Bushing.
22 Bronze Box, Large.
23 Bronze Box, Small.
24 Back Gear Lever.
25 Spindle Take up Nut.
26 Reverse Bracket.
27 Reverse Twin Gears (2).
28 Reverse Gear.
29 Stud Gear.
30 Spindle Reverse Gear.
31 Change Gear Bracket.
32 Change Gears and Turning Gear.
33 Change Gear Idler.
34 Change Gear Idler Bushing.
35 Change Gear Collar on L. S.
36 Idler Gear 2 to 1 Large.
37 Idler Gear 2 to 1 Small.
38 Idler Gear Bushing 2 to 1.
39 Thrust Collar on Lead Screw.
40 Large Face Plate.
41 Small Face Plate.
50 Tail Stock Top.
51 Tail Stock Base.
52 Tail Stock Nut.
53 Tail Stock Hand Wheel.
54 Tail Stock Binding Lever.

No.
55 Tail Stock Wrench.
56 Tail Stock Clamp Plate.
60 Saddle.
61 Saddle Gib.
62 Saddle Lock.
63 Cross Feed Bushing.
64 Cross Feed Grs. Collar.
65 Cross Feed Nut.
66 Plain Rest.
67 Thread Cutting Stop.
70 Apron.
71 Apron Hand Wheel.
72 Lead Screw Half Nut.
73 Lead Screw Half Nut Gib (2).
74 Nut Cam.
75 Nut Cam Washer.
76 Rack Pinion Gear.
77 Auto. Apron Worm Wheel.
78 Auto. Apron Clutch Sleeve Bushing.
79 Auto. Apron Worm Bracket.
80 Auto. Apron Clutch Sleeve.
81 Auto. Apron Clutch.
82 Auto. Apron C. F. Star Knob.
83 Auto. Apron C. F. Lever.
84 Auto. Apron C. F. Lever Knob.
85 Auto. Apron C. F. Gear.
86 Auto. Apron Idler Gear.
87 Auto. Apron Idler Gear Pinion.
90 Compound Rest Top.
91 Compound Rest Swivel.
92 Compound Rest Bottom.
93 Compound Rest End Cap.
94 Compound Rest Bushing.
95 Compound Rest Nut.
96 Compound Rest Chip Guard.

Countershaft

100 C. S. Friction Pulleys (2).
101 C. S. Friction Spiders (2).
102 C. S. Friction Fingers (2).

No.
102 C. S. Cone.
104 C. S. Collars (4).
105 C. S. Yoke Lever.
106 C. S. Boxes (2).
107 C. S. Hangers (2).
108 C. S. Shipper Nut.
109 C. S. Yoke Cone.
200 Head Stock Spindle.
201 Tail Stock Spindle.
202 Back Gear Eccentric Shaft.
203 Apron Worm.
204 Apron Rack Pinion.
205 Spindle Sleeve.
207 Spindle Thrust Collar.
208 Apron Worm Collar.
209 Tool Post Block.
210 Carriage Lock Collar Screw.
211 Compound Rest Swivel Bolts.
212 C. G. Bracket Collar Screw.
213 Reverse Collar Screw.
214 Ball Gear Clamp Collar Screw.
215 Apron Worm Clutch Sleeve Hexagon Nut.
216 Compound Rest Swivel Stud.
217 Steady Rest Lock Bolt.
218 Auto Cross Feed Lever Stud.
219 Reverse Steel Collar.
220 Apron Clutch Sleeve Pinion.
221 Compound Rest Gibs (2).
222 Plain Rest Gib.
223 Auto Apron Clutch Screw.
224 Cross Feed Screw.

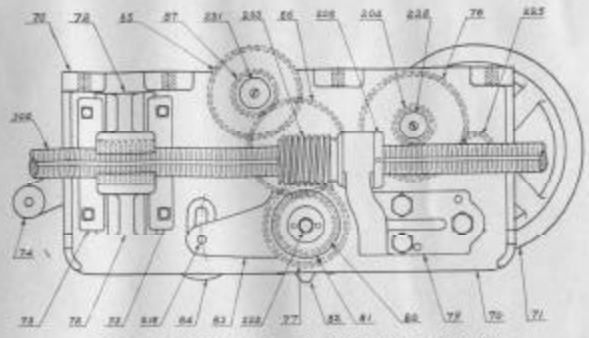
No.
225 Apron Hand Wheel Pinion.
226 Tail Stock Screw.
227 Reverse Shaft.
228 Apron Rack Pinion Stud.
229 Reverse Shoulder Screws (2).
230 Compound Rest Screw.
231 Auto Cross Feed Stud.
232 Apron Half Nut Stud (2).
233 Tool Post Screw.
234 Apron Idler Gear Stud.
235 Cam Cap Screw.
238 Apron Worm Washer.
239 Comp. Rest Steel Wedge.
240 Gap Bridge Pins (2).
241 Reverse Stud Gear Washer.
242 Change Gear Spindle Knob.
250 Tool Post.
251 Tool Post Ring.
252 Tool Post Wedge.
253 Tool Post Wrench.
254 Compound Rest Wrench.
260 Centers (2).
261 C. S. Shaft.
262 C. S. Shipper Rod.
263 C. S. Expansion Wedges.
275 Rack.
276 Cross Feed Ball Crank.
277 Compound Rest Handle.
278 Tail Stock Set Over Screws (2).
279 Tail Stock Clamping Bolt, Nut and Washer.
300 Lead Screw.

HORSE POWER

The horse power required to drive a South Bend lathe to its full capacity under a maximum load is as follows:

11-inch lathe	½	horse power
12-inch "	½	" "
13-inch "	¾	" "
15-inch "	1	" "
16-inch "	2	" "
18-inch "	2½	" "

We have seen a 13-inch lathe driven by a half horse motor and the power seemed amply sufficient for a medium load.



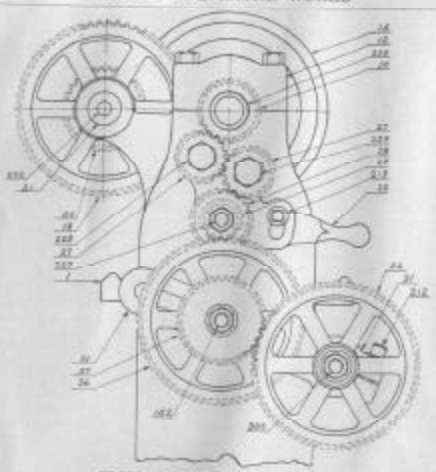
INSIDE VIEW OF AUTOMATIC APRON

Drawing shows detail of the inside view of the automatic apron on South Bend Lathes. Note that the lead screw is splined for driving worm which operates both the power cross feed and the automatic longitudinal feed. This arrangement allows the **thread** of the lead screw to be used for **screw cutting** only, because in screw cutting we use only the half nuts No. 72. This is the reason a splined lead screw on a lathe should last a lifetime.

Another important feature in this automatic apron is that the cross feed and the longitudinal feed can be operated **only one at a time**, so it is impossible when one feed is in operation for the other feed to drop in. This feature will be appreciated by the operator.

No.
70 Apron.
71 Apron Hand Wheel.
72 Lead Screw Half Nut.
73 Lead Screw Half Nut Gibs (2).
74 Nut Cam.
78 Rack Pinion Gear.
77 Auto Apron Worm Wheel.
79 Auto Apron Worm Bracket.
80 Auto Apron Clutch Sleeve.
81 Auto Apron Clutch.
82 Auto Apron C. F. Star Knob.
83 Auto Apron C. F. Lever
84 Auto Apron C. F. Lever Knob.

No.
85 Auto Apron C. F. Gear.
86 Auto Apron Idler Gear.
87 Auto Apron Idler Gear Pinion.
203 Auto Apron Worm.
204 Auto Apron Rack Pinion.
208 Auto Apron Worm Collar.
218 Auto Apron C. F. Lever Stud.
223 Auto Apron Clutch Screw.
225 Auto Apron Hand Wheel Pinion.
228 Auto Apron Rack Pinion Stud.
231 Auto Apron Cross Feed Stud.
300 Lead Screw.



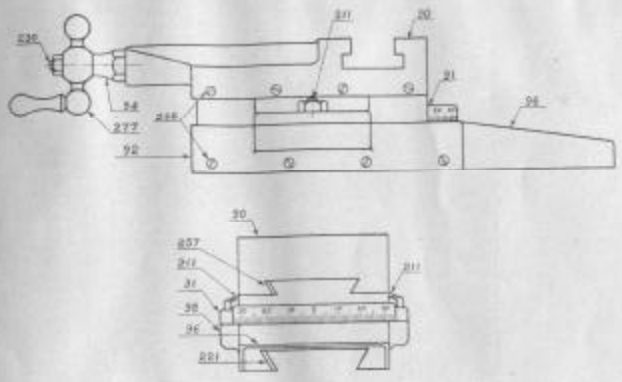
IMPROVED REVERSE

The above drawing shows detail of the Improved Reverse placed on the head of the South Bend Lathe within easy reach of the operator at all times. The Reverse changes the direction of the lead screw. For example, cutting threads right or left, driving the automatic feed right or left, and operating the cross feed in or out.

The Reverse can be shifted instantly without changing gear, or it may be left in a neutral position when spindle is to be run at high speed for such work as filing, polishing, etc.

No.
1 Bed.
13 Head Stock Cap, Small.
14 Spindle Cone.
18 Quill Gear.
20 Quill Sleeve Pinion.
21 Ecc. Shaft Bushing.
26 Reverse Bracket.
27 Reverse Twin Gears. (2)
28 Reverse Gear.
29 Stud Gear
30 Spindle Reverse Gear.
31 Change Gear Bracket.

No.
32 Change Gears.
36 Idler Gear 2 to 1 large.
37 Idler Gear 2 to 1 small.
142 Idler Gear Bolt.
200 Head Stock Spindle.
202 Eccentric Shaft.
212 C. G. Bracket Collar Screw.
218 Reverse Collar Screw.
227 Reverse Shaft.
228 Reverse Shoulder Screws (2).
300 Lead Screw.



GRADUATED COMPOUND REST

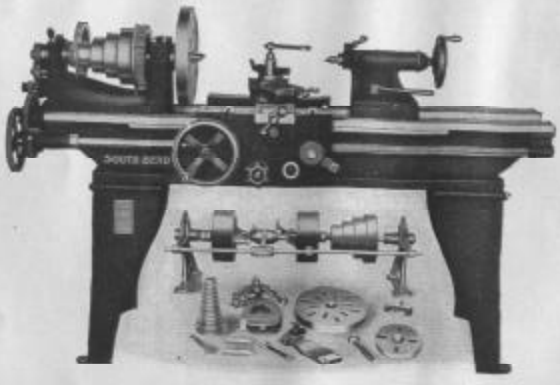
The above drawings show side elevation and end view from the rear of a practical Compound Rest. The Compound Rest Top swivels in a complete circle fastened by two T bolts. It is graduated in degrees so that various angles may be obtained.

Compound Rest Base is fitted with a chip guard No. 96, which prevents chips falling on the cross feed screw.

Compound rest is always recommended on a Lathe used for general all-around work in the Machine Shop.

No.
90 Compound Rest Top.
91 Compound Rest Swivel.
92 Compound Rest Bottom.
94 Compound Rest Bushing.
96 Compound Rest Chip Guard.
211 Compound Rest Swivel Bolts (2).

No.
221 Compound Rest Bottom Gib.
230 Compound Rest Screw.
257 Compound Rest Top Gib.
258 Compound Rest Cone Point Gib Screws.
277 Compound Rest Handle.



16-INCH LATHE AND REGULAR EQUIPMENT

The regular equipment illustrated under Lathe is included in the price and consists of—

Large Face Plate
Small Face Plate
2 Steel Centers
Center Rest
Follower Rest
Change Gears
Adjustable stop for Screw Cutting
Necessary Wrenches
Double Friction Countershaft

All securely crated and packed f. o. b. cars, Factory.

THE NEW LATHE

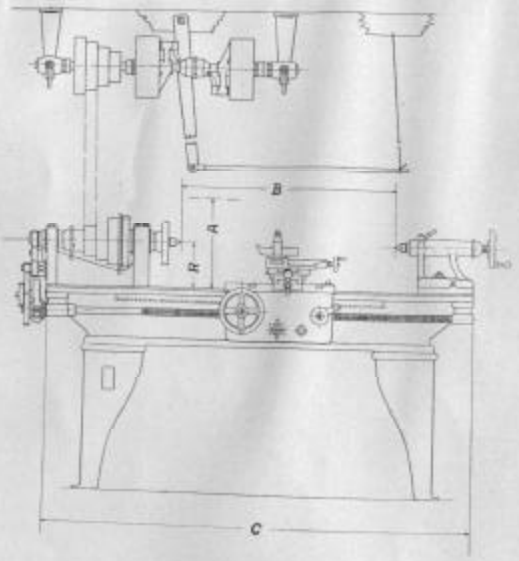
On the arrival of the new lathe remove crating and unpack the parts found in box. See that nothing is overlooked in the wrappings or excelsior. The regular equipment that is included in the price of lathe is illustrated and described on the opposite page. Check up the various parts with this list.

The bright parts of the lathe are covered with grease in order to prevent rusting. Remove this grease with a rag that has been dipped in coal oil or kerosene, then wipe dry. Clean all gears thoroughly, including back gears and change gears. Clean each tooth separately, because sawdust and dirt may have lodged there while the lathe was in transit.

Select the most desirable location in your shop for the lathe. There are several conditions that will govern this spot, such as the position of line shaft, direction of the light, etc. The best results are obtained when the operator working at the lathe has the light coming from a point over his right shoulder.

Study drawings and descriptions of "Practical Layout For Small Shop" on pages 2 and 3.

The floor on which the lathe rests should be solid so that the lathe stands on a firm foundation. If there is any shake the floor should be braced from underneath. There should be a space free all around the lathe as the operator may have an occasional job where it will be necessary that he work from all sides of the machine.



SIZE OF LATHE

The size of an Engine Lathe is determined by the **swing** and **length of bed.** See above drawing.

R represents the radius, one-half the swing.

A represents the swing.

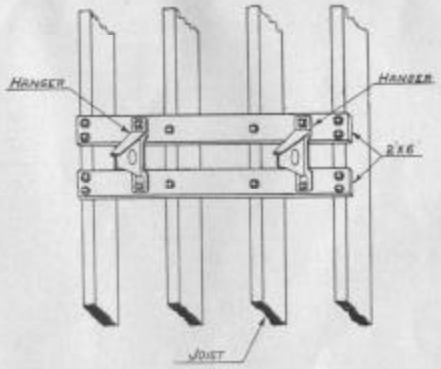
B represents the distance between centers.

C represents the length of bed.

The drawing on opposite page shows the front erection view of lathe and countershaft. The height of the counteshaft should be at least 5 feet from spindle in order to give proper belt distance. Seven feet high would give better results.

The countershaft may be set on either side of the line shaft, being governed by the position of the lathe. See pages 2 and 3. The hangers of countershaft must be set in position so that the extension on hanger through which the shipper rod passes will point toward the line shaft, in order that the shipper rod may guide the belts.

When the location of the lathe is settled, attach the countershaft to the ceiling. A good plan for attaching is to arrange as per drawing herewith. Assemble the countershaft complete, bolt the hangers to the 2 x 6's, in order to get the proper distance beteween hangers. Now remove the countershaft from the hangers, and fasten the 2 x 6's (with hangers) to the ceiling. Secure with several lag screws. Then place the countershaft back in the hangers, level it up properly, adjusting so that the axis of the countershaft is parallel to that of the line shaft.



Plan of Attaching Countershaft to Joists

SETTING THE LATHE IN POSITION

Countershaft fastened in position, adjust the lathe so that the belt will track between spindle cone and countershaft cone. It is necessary that the axis of the lathe spindle is parallel to that of the countershaft. It is not necessary that the lathe spindle be directly underneath the countershaft, (looking at the lathe from the end) as the lathe may be from 6 to 12" either one side or the other of a vertical line dropped from countershaft. See drawing page. 2.

LEVELING LATHE

The **accuracy** of a lathe depends a great deal upon the manner in which it is **erected** and **leveled**. Place level across the ways near the head stock. Repeat this operation at several points the entire length of the bed leveling carefully in every direction. Shim underneath the legs with shingles until the lathe is perfectly level, then, when countershaft and spindle cones are in their relative position so that belts will track properly, fasten lathe firmly to the floor using lag bolts.

BELTING

Leather belt is always recommended. In belting line shaft to countershaft two belts are used. The belt nearest the head end of lathe is usually straight, the other is the reverse or cross belt. See drawing page 2. The countershaft belts should be so arranged that when the shipper rod is thrown over in the direction of the lathe head the spindle of the lathe should revolve so that the top spindle cone runs toward the operator when he is in front of the lathe.

RULES FOR CALCULATING THE SPEED AND SIZE OF PULLEYS

The driving wheel is called the driver, and the driven wheel the driven or follower.

The R. P. M. is the number of revolutions per minute.

Problem 1.

The revolutions of driver and driven, and the diameter of the driven, being given, required the diameter of the driver.

RULE.—Multiply the diameter of the driven by its number of revolutions, and divide by the number of revolutions of the driver.

Problem 2.

The diameter and revolutions of the driver being given, required the diameter of the driven to make a given number of revolutions in the same time.

RULE.—Multiply the diameter of the driver by its number of revolutions, and divide the product by the required number of revolutions.

Problem 3.

The diameter and number of revolutions of the driver, with the diameter of the driven, being given, required the revolutions of the driven.

RULE.—Multiply the diameter of the driver by its number of revolutions, and divide by the diameter of the driven.

Problem 4.

The diameter of driver and driven, and the number of revolutions of the driven, being given, required the number of revolutions of the driver.

RULE.—Multiply the diameter of the driven by its number of revolutions, and divide by the diameter of the driver.

SPEED OF LATHE COUNTERSHAFT

Size of Lathe	Size of Friction Pulley	Speed of Countershaft
11 in.	7 x 2 in.	250 R. P. M.
12, 13 in.	8 x 2 5/8 in.	225 R. P. M.
15 in.	10 x 3 in.	200 R. P. M.
16, 18 in.	10 x 4 in.	180 R. P. M.

OILING LATHE

Frequent oiling is necessary for a lathe or any other machine. A good grade of machine oil gives best results. After lathe is located and fastened to the floor and countershaft attached to the ceiling the next step is oiling the revolving parts of the lathe. Every oil hole should be located and a generous supply of machine oil used flushing each revolving part, not only to give it the necessary oil, but also to make sure that any dust or dirt that may have located in the bearings be washed out.

In oiling the head stock spindle, the mechanism in the apron and the lead screw bearings, all should receive special attention, so that the parts will run free and easy. The same attention should be given to the countershaft before it is attached to the ceiling and after it is set in position.

Oil the spindle cone bearings by removing two small headless set screws which will be found on the large and small steps of the cone. Give each a generous supply of oil, then replace the screws as they prevent dirt reaching the spindle.

Oil the back gear quill through two small oil holes for that purpose. Be sure to use plenty of oil on the lead screw and half nuts before cutting a thread.

Oil the head spindle bearings frequently. It is a very good plan to go over the lathe at least once a day to see that every revolving part has received sufficient oil.

STARTING LATHE

Lathe is now ready to start. See that the shipper rod is properly adjusted. Arrange spindle cone for open belt by throwing out the back gear lever which releases the back gears, then fasten bull gear clamp to spindle cone. Now the lathe is arranged for open belt. If the spindle runs freely on open belt stop lathe, loosen bull gear clamp, slip clamp down as far as it will go, then fasten. Now throw in back gear lever connecting back gears. Lathe is now running back geared.

Never throw in back gears while lathe spindle is running.

Never throw out back gears while lathe spindle is running.

Next, connect reverse gear with spindle gear. Fasten the collar on reverse lever, locking lever in position.

Never throw in reverse gear while lathe is running.

Never throw out reverse gear while lathe is running.

Connect gears on change gear bracket with gear on spindle reverse stud.

In this connection there should be a slight play or shake between the teeth of the two connecting gears. **This point is important.** In connecting any two gears there should always be a little clearance between the top of the teeth of one gear and the bottom of the teeth of the opposite. When two or more gears are in mesh in this manner they will operate with very little friction and give best results.

When the change gears are connected to the reverse spindle gear lock the change gear bracket in position by fastening the collar screw in front, then start lathe, all gears being in mesh.

Never connect, or disconnect, change gear bracket gears with reverse spindle gears when lathe is running.

CARRIAGE

The saddle and apron combined is called the carriage of the lathe. Oil the ways and V's of the lathe bed thoroughly, running the carriage back and forth over the oiled surface, so that the oil is distributed properly. Oil the rear saddle gib by placing some oil on your finger and spreading this oil under the rear way of the lathe where the saddle gib slides.

FACE PLATE

Before mounting a face plate on the nose of spindle all dirt should be removed from the thread of spindle and also from the threaded hole in the face plate. A few drops of oil on the spindle nose will allow the plate to screw on much easier. If the face plate screws on tightly there must be dirt in the threads. Unscrew the plate, remove the dirt, try again. The back of the face plate should go tight up against the shoulder of spindle. The same attention should be given in attaching a lathe chuck to spindle nose.

LATHE CENTERS

Lathe centers are made of tool steel. The head center is always soft because it revolves with the work, and should be trued up occasionally, especially when one is to do an accurate job between centers. For truing a center, remove the face plate, use a flat-nosed tool in tool post and take a light chip off the center, being sure to keep the angle 60 degrees as shown in cut herewith.

Testing angle of center, by center gauge

The tail spindle center is always hardened, because when a shaft is being machined on centers it revolves on the tail center so that there is considerable wear. The tail center should be trued up occasionally. In each case it should be annealed, placed in the head spindle and machined true, and hardened.

The shank of a lathe center conforms to a standard taper, usually Morse standard. Each time the center is placed in spindle care should be taken to see that both spindle hole and center is free from dirt.

Never put your finger in the spindle hole to remove dirt while the lathe is running. Always use a stick with a piece of rag attached.

Always remove center from head spindle when using a lathe chuck on the spindle.

Special Drilling Chuck

Screw Center

Drill Pad

Spur Center

Crotch Center

Cup Center

LATHE ACCESSORIES

The above cuts show a number of accessories that are very useful for various classes of lathe work.

The special drilling chuck screws on to the spindle nose of the Lathe. The centers, drill pad, etc., are machined taper, so that they fit both head and tail spindles of the various size lathes.

With these accessories one is enabled to do a great deal of general work in a lathe, such as drilling of every description on metal, also wood turning and pattern making, etc.

CENTERING

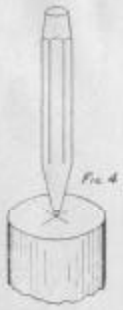


Fig. 4

To turn or machine a shaft on centers in the lathe it is necessary that the shaft be centered.

There are many way of centering. The simplest is to chalk the end of the shaft to be centered. Scratch two lines at right angles to each other, and where these lines intersect will be the approximate center of the shaft. See Fig. 4.

Drive center punch on the intersection of lines on both ends of the shaft. Place the shaft thus punched on the centers of the lathe, revolve by hand; if it does not run true, hold a piece of chalk to the shaft while revolving and it will mark the high spots. Place shaft in the vise once more, drive the center in the direction necessary to have the shaft run true.

Drill and countersink each end of the shaft until a depth is reached sufficient to support the shaft on the centers while it is being turned. A good method of countersinking is shown in Fig. 5.

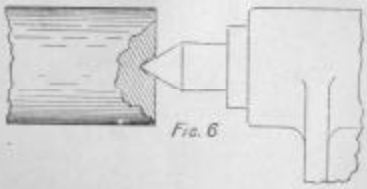
Long shafts may be centered with a breast drill or brace and bit. The regular countersinks may be used in the same manner.

COUNTERSINKING A SHAFT

A drill chuck is fitted to the head spindle of lathe holding a combined drill and countersink. (see Fig. 5-B). The shaft has already been center punched. Place one end of shaft on tail center and feed by turning the wheel of tail stock. Allow the countersink to enter the proper depth, countersink the other end in the same manner. The shaft is now ready to be machined.

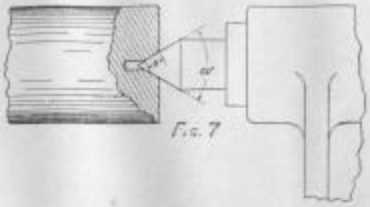
DRILL AND COUNTERSINK

The depth of the countersink depends upon the diameter of the shaft to be machined, and somewhat upon the depth of the cut to be taken. It is important that the countersink have the same taper as the lathe center, 60 degrees.



IMPROPER CENTERING

Fig. 6 shows a shaft countersunk in such a way that it does not fit on the lathe center, but rests on the point only. This very soon destroys the lathe center and will also ruin the shaft.



PROPER COUNTERSINK

Fig. 7 shows the style of countersink which gives best results. A small hole is first drilled beyond the depths of the point of the lathe center; it is then countersunk on an angle of 60 degrees to fit the lathe center.

DRILL AND COUNTERSINK COMBINED

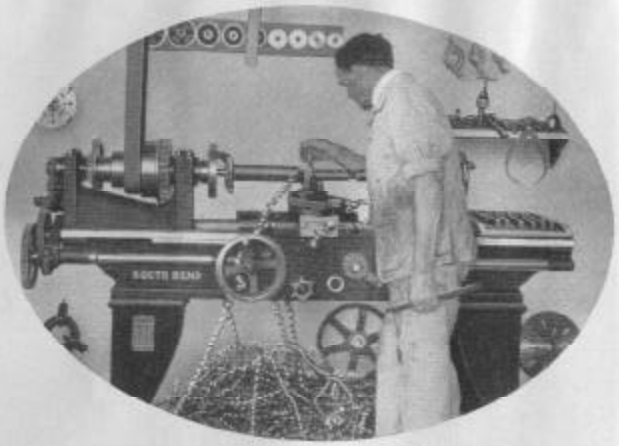
Fig. 5B is a combined drill and countersink, which is both the center drill and countersink. Centering may also be done by a small twist drill for the center hole and a larger twist drill ground 60 degrees following as a countersink.

Fig. 5B

Fig. 8

Fig. 9

Figs. 8 and 9 show two style countersinks that are used to follow the small center drill for countersinking.



TURNING A STEEL SHAFT

The illustration above shows a steel shaft being machined on a lathe between centers. The shaft is driven by a common lathe dog, the tail of which enters the slot in the face plate. It will be noted that a heavy chip is taken, which requires considerable power, so the lathe is running with back gears in mesh.

The lathe is a universal machine for the shop. With various attachments it may be equipped to do the work of a drill press and to some extent of a milling machine, a shaper and a planer.

In addition to the common lathe dog, a clamp lathe dog is used for holding rectangular pieces that are being driven in the lathe. (See illustration). Sometimes a shaft is driven by holding one end in the lathe chuck, the other end being supported by a steady rest. See Fig. 18, page 38.

Clamp Lathe Dog

Common Lathe Dog

FACING END OF SHAFT

When a shaft is being machined on centers, if accurate work is to be done, the end of the shaft must be faced so that it will ride on the centers evenly. A side tool is usually used to do the facing. See Fig. 11.

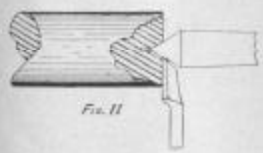


Fig. 11

In facing with a side tool it may be necessary to face into the countersink hole. On reaching the edge of the countersink tail center may be withdrawn slightly. This enables the side tool to face the end clean.

When shaft is faced ready for general machining place a drop of oil on the tail stock center, also a drop in the counter-

sunk hole of shaft. Adjust the tail stock center so that the shaft has a slight play on the centers (it must not turn hard on the centers), then fasten the tail stock spindle by the binding clamp.

POSITION OF TOOL

The position of the turning tool is quite important in machining metal. In most work we find that a little above the center is the proper height. See Fig. 12.

Care should be taken that the tool does not extend too far from the tool post, especially on heavy cuts. The tool should be ground so that it will have plenty of clearance and make a sharp clean cut.

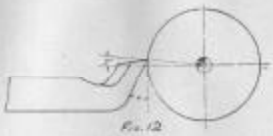
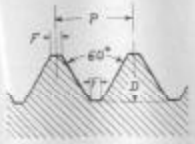


Fig. 12

STANDARD SCREW THREADS

There are several different standards for the various screw threads, but general practice in the United States favors the Sharp V and the U. S. Standard. We show drawings of both herewith. Of the two Standards the U. S. is perhaps the most popular, but there are still a great many mechanics of the old school who prefer the Sharp V thread. In replacing a bolt or a screw it would be well to note whether it is the U. S. Standard or the Sharp V.

The American Licensed Automobile Manufacturers have adopted the Standard for screw threads which we show herewith.



FORMULA

$P = \text{PITCH} = \frac{1}{\text{No. THREADS PER INCH}}$

$D = \text{DEPTH} = P \times .64952$

$F = \text{FLAT} = \frac{P}{8}$

UNITED STATES STANDARD SCREW THREADS

FORMULA

$P = \text{PITCH} = \frac{1}{\text{No. THREADS PER INCH}}$

$D = \text{DEPTH} = P \times .86603$

SHARP V STANDARD SCREW THREADS

TABLE SHOWING PITCH OF THREAD and Sizes of Tap Drills for Standard Thread

Diam. Tap in Ins.	Thds. per inch	Size of Drill	Diam. Tap in Ins.	Thds. per Inch	Size of Drill Ins.	Diam. Tap in Ins.	Thds. per Inch	Size of Drill Ins.
1/4	20	5/16 in.	1 5/16	11	17/64	1 1/4	7	1 5/64
5/16	18	1/4 in.	1 1/4	10	5/8	1 3/8	6	1 11/64
3/8	16	5/16 in.	1 11/16	10	11/16	1 1/2	6	1 19/64
7/16	14	3/8 in.	1 3/8	9	47/64			
1/2	13	11/32 in.	1 5/16	9	51/64			
9/16	12	13/32 in.	1	8	27/32			
5/8	12	29/64 in.	1 1/8	7	61/64			
3/4	11	35/64 in.						

A. L. A. M. Standard Thread and Drill Sizes for Taps

Diam. in.	Pitch	Tap Drill
1/4	28	No. 4
5/16	24	17/64 in.
3/8	24	21/64
7/16	20	25/64
1/2	20	7/16 in.
9/16	18	1/2
5/8	18	9/16
11/16	16	29/64
3/4	16	33/64
7/8	14, 18	51/64, 13/16
1	14	59/64

THREAD CUTTING

In **cutting screw threads** on the lathe the carriage is **always driven** by clamping the half nuts on the **lead screw,** therefore, the friction feed should never be used when thread cutting. See that the feed knob is not tight, but loose or neutral so that neither the power cross feed nor the longitudinal feed can possibly get into action while cutting threads.

Pitch and lead do not always mean the same thing. The pitch of a thread is the distance from the center of one thread to the center of the next. The lead of a screw is the distance the nut will advance in one revolution of the screw. Where a screw is single thread the pitch and lead are the same. But when a screw has a double, triple, or multiple thread, the lead is as many times the pitch as there are multiple threads in the screw.

MEASURING SCREW THREADS

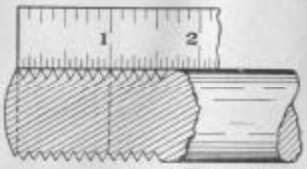


FIG. 70

The above illustration shows the method of finding the pitch of a screw when a thread guage is not convenient.

Place a scale on the screw so that the end of the scale is opposite the first thread or any thread of the screw. In the drawing the dotted lines drawn down from the top of the first and ninth threads opposite the inch mark divides the first and the ninth threads in the middle, but on the lower side of the screw it divides them at the bottom of the thread. Counting the complete number of threads between these marks on the bottom of the screw you will find eight complete threads. There are, therefore, only eight threads per inch on this screw and the pitch is $\frac{1}{8}$".

In counting the threads on the top side where the scale is never include the last thread.

CHANGE GEARS FOR THREAD CUTTING

An index plate, as per illustration, is always attached to a lathe, showing the necessary gears to cut the desired thread. The headings of the three columns shown in plate are as follows:

Thread, means the number of threads to the inch that the operator wishes to cut.

Spindle, means the reverse spindle stud, which in this case revolves the same speed as the lathe spindle.

Screw, means lead screw, which drives the carriage of the lathe.

For example, we wish to cut a screw having a 16 thread. The index plate in cut shows that we should have a 32-tooth gear on the spindle and a 64-tooth gear on the screw. In order to connect these two gears we use what is called an Idler gear. This Idler may be any size that will conveniently connect the two gears.

Drawing, Fig. 13, shows the arrangement of gears for cutting the 16 thread as per example above. This arrangement is called "simple gearing."

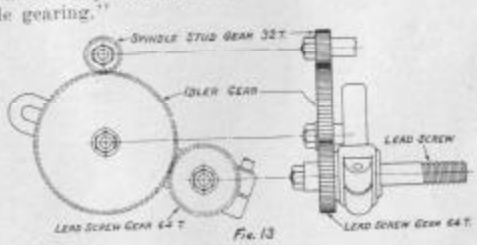


FIG. 13

Simple Gearing

COMPOUND GEARING

The compounding of gears for thread cutting is necessary when the pitch of the thread to be cut requires gears with a great number of teeth, and to avoid having large gears or a great number of small gears we resort to compounding.

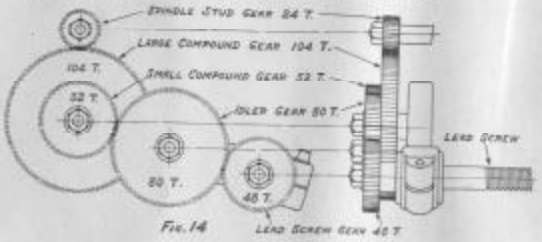
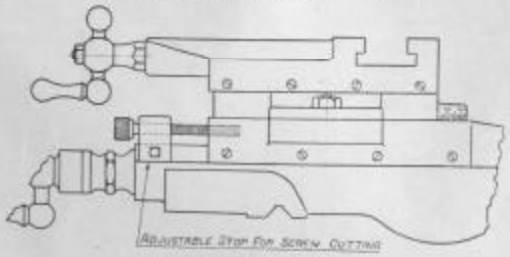


FIG. 14 LEAD SCREW GEAR 48 T.

COMPOUND GEARS

Fig. 14 shows the arrangement of compound gears for cutting a 32 thread on a Lathe. The compound gears are 104 teeth and 52 teeth. It will be noted that these gears are two for one.

The index plate on the lathe, for the above compounding, calls for a 24-tooth gear on the spindle stud, and a 48-tooth gear on the lead screw. The Idler gear is necessary to connect the Compound gear with the screw gear. Any gear may be used as an Idler that will conveniently connect the two.



Thread Cutting Stop

In cutting a thread it is necessary that a number of chips be taken. An adjustable stop for screw cutting, as illustrated in drawing above, is a very convenient arrangement for getting the depth of the chip. After bringing the tool up to the work, fasten the stop in position so that the head of the adjusting screw is close up to the stop. When ready to take the first cut turn this screw about ¼ of a turn. This limits the depth of the cut. Repeat this operation on each cut until the screw is finished.

SETTING OF THREAD TOOL

The cutting edge of thread tool should be ground to an angle of 60 degrees. The height of the tool should be set even with the lathe center. A thread or center gauge is used for the setting of the thread tool in order to give the proper angle on the thread. See Fig. 15.

FIG. 15

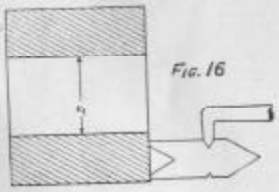


FIG. 16

Adjust the tool so that the edge of the thread guage is parallel with the shaft or piece to be threaded. This thread guage is also used as a templet for grinding the thread tool.

A similar method for setting the thread tool for cutting internal threads is shown in Fig. 16.

The thread tool being set and the change gears arranged to give the desired pitch we are now ready for cutting the thread. If the material to be machined is mild steel plenty of oil should be used on the tool. The adjustable stop will regulate the depth of cut. The beginner should take very light chips. A little experience will teach him the proper depth.

THE FIRST CHIP

Before taking the first chip see that the dog on the shaft to be threaded is tight. See that there is oil on the tail center where it enters the shaft. See that your thread tool is fastened firmly in the tool post and that the automatic feed in the apron is not in action. See that the half nuts in apron are oiled thoroughly and that there is also oil on the lead screw.

Bring the point of the tool to the end of the shaft, clamp the half nuts firmly on the lead screw, and start the lathe. For the first cut let the tool enter only far enough to make a slight scratch as far as you wish the thread to extend. When you reach the end of the cut draw the tool out by turning the cross feed screw. Reverse the shipper rod. This reverses the direction of the lathe spindle and allows the carriage to travel back automatically. Usually two complete turns of the cross feed screw will withdraw the thread tool far enough to clear the thread, so that the tool will not destroy the thread on the return of the carriage. Continue this operation until thread is finished.

Piece being threaded should revolve slowly. On soft machine steel we would recommend a cutting speed of 25 feet per minute for the beginner. For example, cutting an 8-thread on 1½-inch soft steel shaft. The belt should be on the second slowest speed with back gear in.

When cutting threads on soft steel or iron use plenty of oil on the point of the cutting tool. If one has many threads to cut lard oil is recommended.

In cutting threads on cast iron, brass, aluminum, etc., oil is never used. The exception is, when threads are being cut by a die.

A lathe is even geared when the revolutions of the spindle and the revolutions of the spindle stud are the same.

On a lathe that is even geared, when cutting a screw having the number of its threads per inch exactly divisible by the number of threads per inch in the lead screw, it is not necessary to reverse,—the lathe may run in one direction all the time. When the tool has fed to the end of the cut draw it out as before, open the split nut, and reverse the carriage by hand. Throw in the split nut again, take another chip, and repeat this operation until the screw is finished. For example, if your lead screw is 8-thread and the screw that you wish to cut is divisible by eight, such as 8, 16, 24, 32, 40, etc., the above rule may be followed.

Never remove the driving dog from the screw that you are cutting until the thread is finished. Always put the tail of the dog into the same slot of face plate after testing the screw for size.

GRINDING TOOL AFTER THREAD HAS BEEN STARTED

After the thread has been started, if it is necessary to remove the tool for grinding before thread cutting is finished, take the tool out and grind it. After grinding adjust the thread tool as before, setting it opposite the thread groove. Turn the spindle forward by hand by pulling on the belt, and again test to see if the point of the tool is exactly opposite the thread in the work. If it is not opposite drop the reverse gear, turn the spindle forward by hand until the tool is exactly opposite the groove. Then connect the reverse gear as before. This throws in the feed, and you may proceed with the cutting.

In turning the spindle by hand ALWAYS TURN IT FORWARD. If you turn it backward there will be a back lash and it will not show the true position of the tool.

TURNING TAPER

To turn taper on a lathe, the tail stock is set off center a sufficient distance to give the desired taper.

Fig. 22 illustrates an automobile axle being tapered in a 16" South Bend Lathe.

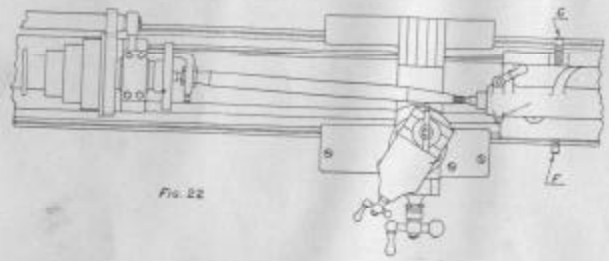


FIG. 22

TURNING TAPER ON AN AUTOMOBILE AXLE

To set over tail stock for turning taper, loosen tail stock clamp, unscrew set screw F to the distance you think necessary, and screw in set screw G the same distance, or until it runs up against the tail stock hub. This will set over the top of the tail stock. Then clamp tail stock to bed and take a chip. Occasionally test the piece, being machined to see if the taper is correct.

In testing the taper of a piece that is being machined (a lathe center shank for example), take several chips off the blank, when the tapered end is small enough, insert it in the taper hole in which it is to fit. Carefully shake with thumb and finger. If there is a shake it will show whether the taper is too great or not great enough. Adjust the tail stock to the lathe accordingly. Take a light chip, make another test. For a final test, make three chalk marks along the elements or side of the taper, place the tapered piece in the hole again and turn carefully by hand. If there is a high spot, it will show on the chalk mark. If it is a perfect fit, it will show along the entire length of the taper.

When extreme tapers are to be turned on a lathe, or where a number of similar parts are to be machined taper, such as in manufacturing, a taper attachment is recommended. We herewith show an illustration of the taper attachment used on South Bend Lathe. This attachment may also be used for boring taper holes, etc.

TAPER ATTACHMENT

The illustration shows a simple, but efficient taper attachment for lathe. This attachment is fitted to the rear V of the lathe by two clamps. These clamps may be adjusted along the entire length of the bed, so that the operator may turn taper in any poistion the whole length of the lathe.

DRILLING IN THE LATHE

Fig. 17 shows a lathe chuck mounted on the head spindle of the lathe and the drill chuck attached to the tail spindle. In this manner a great deal of drilling of duplicate pieces may be done quickly.

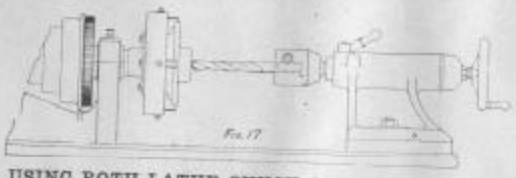
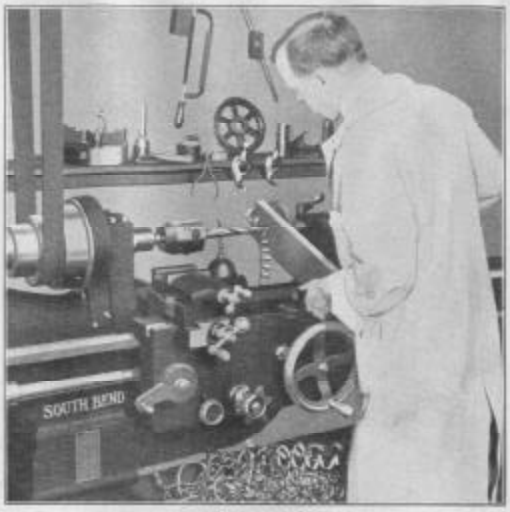


FIG. 17

USING BOTH LATHE CHUCK AND DRILL CHUCK

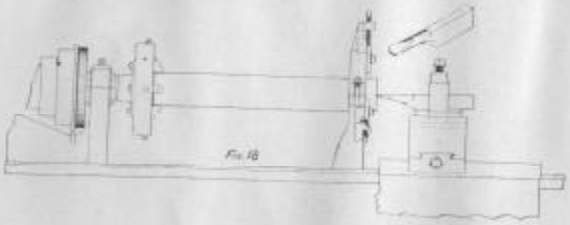
In Fig. 5, page 22, the drill chuck is attached to the head spindle of lathe. Thus it may be seen that a chuck fitted to the tail spindle of the lathe, may be also used in the head spindle, as the taper in both spindles are the same. This feature will be found convenient for a great variety of work.



USING THE LATHE AS A DRILL PRESS

The illustration shows a drilling job being done on the lathe. The drill is 1-inch diameter, the piece to be drilled is steel 1-inch thick. The cutting feed is operated by the hand wheel of tail stock. Drilling of almost any nature can be done in a lathe to advantage. The size of hole may range all the way from 1-16" to 1½" in diameter.

In the drilling operation above the back gears are in mesh on the lathe, so that the power delivered at the point of the drill is equal to the power of a 24" back geared drill press. Practically any drilling job that can be done on the drill press may also be done on the lathe, because the lathe is a universal machine for the general machine shop.



A SHAFT IN THE CENTER REST

Fig. 18 shows a shaft supported by the center rest and being driven by the lathe chuck. This shaft is 3" in diameter and 12" long. A ¾" hole is to be drilled its entire length, so it is necessary to center the shaft so that the drill will start true. Cut shows the centering tool held in the tool post. The point of this tool is ground exactly like the point of an ordinary flat drill. To center the shaft, start the lathe, adjust the tool in so that it is approximately at the center of the shaft. Move the tool rest, so that when the tool begins entting it will show the exact center, and will machine a countersunk hole.

When this countersunk hole is about ⅛" deep remove the centering tool, attach your drill to tail spindle, as shown in Fig. 17, and proceed with the drilling, using the hand-wheel of tail stock for feeding.

MILLING AND KEY-WAY CUTTING ATTACHMENT FOR LATHES

Milling in the Lathe

The illustration above shows a milling and key-way cutting attachment fitted to a South Bend Lathe. A piece of cast iron is held in the vise and an angle milling cutter, which also acts as a face mill, is fitted to the spindle of the lathe. The length of the cut is controlled by the cross feed screw, the depth by the adjustment of lathe carriage, and the vertical adjustment governed by the vertical screw.

The attachment is fitted on the top of the Compound Rest base, located by a center pin projecting from base. The fixture is fastened to the Compound Rest base with two bolts, in the same manner as the Compound Rest top is fastened. This attachment can be used only on a lathe fitted with a Compound Rest.

A milling attachment for a lathe is practical in the shop because it equips the lathe for doing a great deal of work that could be done only on a shaper or a milling machine. An attachment of this kind can take care of a variety of jobs, as it swivels all the way around on a horizontal plane and is graduated in degrees. It swivels 180 degrees on a vertical plane and is graduated. The vertical adjusting screw has a graduated collar reading in one-thousandth of an inch.

KEYSEATING A STEEL SHAFT

Fig. B shows No. 3 attachment cutting a key-way ½-inch wide and 3-16-inch deep in a 2-inch steel shaft. The work is being done on a 13-inch lathe.

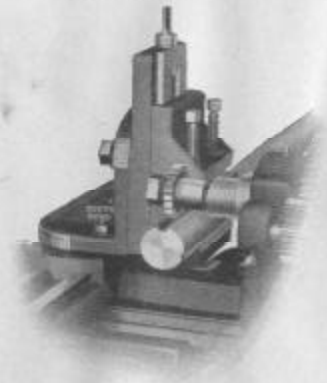


Fig. B

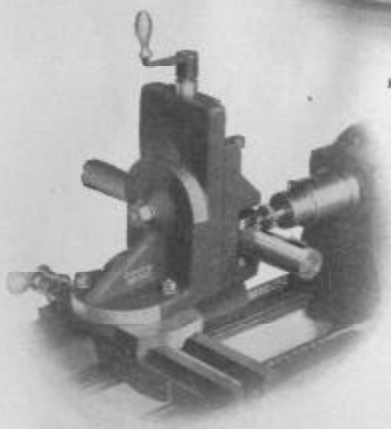


Fig. D
Key Seating Woodruff System

In Fig. D the illustration is taken from the back of lathe, and shows the attachment holding an inch and a half steel shaft which has been key-seated for the Woodruff system of key. A special chuck is fitted to the spindle lathe for holding the cutter.

Fig. C
Squaring a Steel Shaft

Fig. C shows a No. 3 milling attachment fitted to a 13-inch lathe squaring an inch and a half steel shaft. The shaft is held by V blocks in the vise. The same method may be used for sawing off shafting or tubing by using a saw on the arbor.

The shaft in cut may also be squared by turning the attachment at right angles. That is, to let the shaft approach the cutter from the end.

The four illustrations above show the milling attachment doing four different jobs. This is the same size attachment in each case.

Fig. E

SOUTH BEND SPECIAL MILLING ATTACHMENT

The illustration shows our special milling attachment for lathe equipped with a milling machine vise. This attachment is used only for special work.

SIDE MILLING CUTTERS FOR MILLING AND KEYWAY CUTTING ATTACHMENT

These cutters have teeth upon both sides and face and may be used for a variety of jobs. For example in cutting a keyway a half-inch wide, a quarter-inch cutter may be used by taking two chips for the width of the keyway, or a half-inch cutter may be used taking full width of cut in one chip. See cut Fig. B.

Fig. F

No.	Diameter	Width of Face	Hole
16	2½	¼	⅞
17	2½	5/16	⅞
18	2½	⅜	⅞
19	2½	7/16	⅞
20	2½	½	⅞
21	2¾	¼	⅞
22	2¾	5/16	⅞
23	2¾	⅜	⅞
24	2¾	7/16	⅞
25	2¾	½	⅞
26	3	¼	1
27	3	5/16	1
28	3	⅜	1
29	3	7/16	1
30	3	½	1

MILLING ARBOR FOR LATHE

Fig. G

The illustration shows arbor to be used with the South Bend milling and keyway cutting attachment. This arbor fits into the head spindle of lathe. For holding cutters see cut Fig. B.

The arbor is made in three sizes, ¾", ⅞", and 1" diameter. The 1-inch arbor is the most practical.

FORGED STEEL LATHE TOOLS

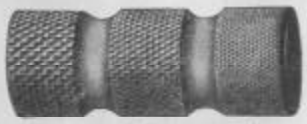
The twelve lathe tools below have been selected as the most practical set of forged tools for general all-round work on the lathe. These tools are made both in carbon and the high speed steels. The size of the tools vary to suit the different size lathes.

1 Left-hand Side Tool.
2 Right-hand Side Tool.
3 Right-hand Bent Tool.
4 Right-hand Diamond Point.
5 Left-hand Diamond Point.
6 Round Nose Tool.
7 Cutting-off Tool.
8 Threading Tool.
9 Bent Threading Tool.
10 Roughing Tool.
11 Boring Tool.
12 Inside Threading Tool.

KNURLING IN THE LATHE

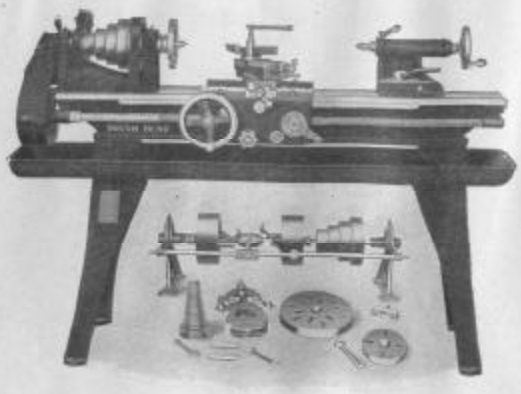
The cut herewith shows a piece of steel with three different grades of knurling. The knurling tool for doing this work is also shown. This tool is held in the tool post of lathe; piece to be knurled is driven slowly on centers or in a chuck; tool is forced slowly into the work as it revolves, and this in turn revolves the knurl wheels, thus the impression is produced. The knurl wheels are hardened. Plenty of oil is used during the operation.

SAMPLE OF KNURLING



Coarse Medium Fine

Knurling Tool

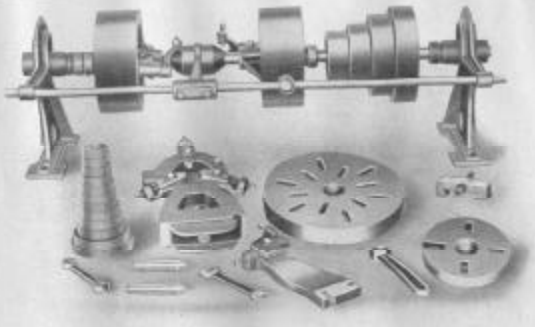


No. 35 — 13-INCH TOOL ROOM LATHE WITH GEAR GUARDS AND OIL PAN

The lathe illustrated above is equipped with gear guards which completely cover all exposed gears. There is a hinged gear guard on the end that covers the reverse and change gears. When the operator wishes to change a gear all that is necessary is to swing back the hinge guard, make the necessary gear changes, and bring the guard back into position.

The oil pan shown in cut is principally used in tool room work and light manufacturing. Sometimes an oil pump is used on a lathe of this kind pouring a constant stream of oil on the work. This pan collects both the oil and chips.

It will be noted that the lathe bed is equipped with two short bench legs which set upon the pan. This No. 35 lathe is often used as a bench lathe, the oil pan and long legs being omitted.



COUNTERSHAFT AND REGULAR EQUIPMENT WITH 15-INCH LATHE

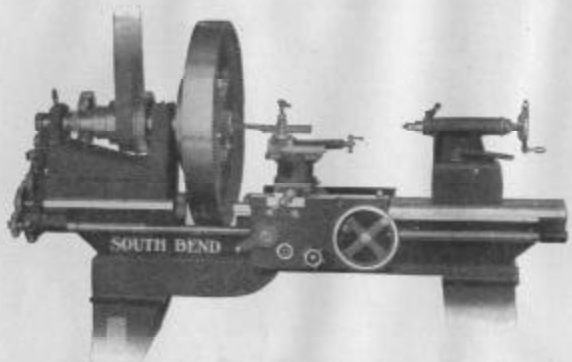
All Included in the Price of Lathe

The equipment illustrated above is for a 16" Lathe and includes, as shown:

One Small Face Plate.
One Large Face Plate.
One Center Rest.
Two Steel Centers.
One Follower Rest.
One Adjustable Stop for Screw Cutting.
One Set of Change Gears for Screw Cutting.
Necessary Wrenches for Lathe.
One Double Friction Countershaft Complete.

The countershaft is one of the very important attachments of a lathe because it is always on duty when the lathe is in operation and attached to the ceiling it is not easily accessible.

The countershaft is simple, practical, and efficient, and will give excellent results year after year. The only attention it needs is about five minutes a week for oiling.



16-INCH LATHE BORING A 30-INCH FLY WHEEL

Gap Bed Lathe equipped with Raising Blocks

The practical application of the gap bed and raising blocks to the lathe may be seen in the above case where the operator was able to do a job on a 16-inch lathe that otherwise would require a 30-inch lathe.

The gap bed lathe with bridge is a very practical tool for the general machine and repair shop that is called upon to do a great variety of work. If a job of large diameter comes in it is a simple matter to remove the bridge, machine the job, replace the bridge, so the lathe may be used as regular straight bed lathe for ordinary work.

HOW TO TEMPER A LATHE TOOL

A lathe tool is made of crucible or tool steel. Care should be used in heating the tool while forging. It should be heated slowly and evenly. After the tool is forged then file or grind into shape. To harden and temper the tool heat slowly for a distance of about 1½ inches from cutting point. When it comes to a cherry red, immerse the tool in cold water about one inch. This leaves some heat in the shank which will assist in drawing the temper. After the point has become cool, remove the tool, polish the hardened surface with a piece of emery cloth, then wipe this polished surface with an oily rag. The heat in the shank of the tool will now drive the temper toward the cutting edge. When this edge becomes a brown straw color immerse the entire tool in cold water.

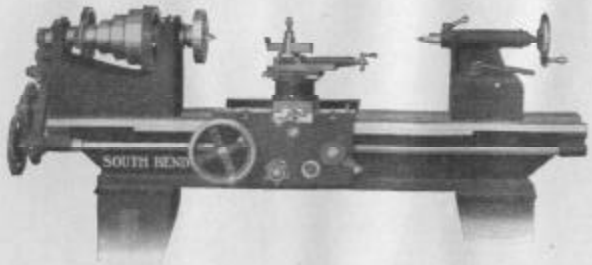
After the tool is hardened and tempered, grind on a fine wheel, being careful not to get the tool heated so as to draw the temper.

When you want a cutting tool exceptionally accurate and durable, such as for thread cutting, rub the cutting edge by hand with a small oil stone. This will increase the effieiency and the wearing qualities.

HOW TO ANNEAL A PIECE OF TOOL STEEL

Heat the steel slowly and evenly to a dark red. Then place in box of lime or ashes, cover completely and let remain over night. In the morning the piece will be annealed ready for machining.

To water-anneal a piece of tool steel, heat slowly and evenly until a dark red. Then hold in the tongs in a shaded corner until all color has left. Place a small pine stick against the steel. When the steel is cool enough so that it will not smoke the pine stick then immerse the steel quickly into cold water and it is ready for machining.



RAISING BLOCKS

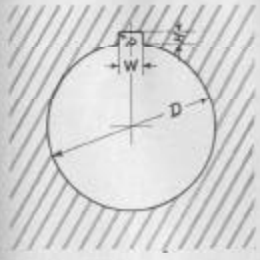
A 15-inch Lathe Blocked to Swing 20 Inches

The above cut illustrates a 15-inch lathe equipped with raising blocks to swing 20 inches over the bed. The raising block equipment includes blocks for head stock, tail stock, tool rest, center rest, also the necessary bolts and screws for attaching blocks to lathe.

The advantage of raising blocks for a lathe for the general all-round shop is appreciated when one has a job of large diameter to be machined. He can attach his blocks, practically making a 20-inch lathe out of a 15-inch lathe at a very slight cost. When the job of large diameter is finished simply remove the blocks and save them until the next large job comes along.

WOODRUFF SYSTEM KEYSEAT

The drawing herewith shows a shaft that has been milled for a Woodruff key, with key inserted. "A" equals the thickness of key. The key should project above the shaft one-half its thickness.



STANDARD KEY-WAYS FOR PULLEYS AND SHAFTS

This diagram shows the recognized standard for the depth and width of key-way in pulleys. The same formula of course may be used for the depth and width of key-way in shaft.

Here we give a list of the standard sizes both for pulleys and shaft.

Diameter (D) of Hole	Width (W) of Keyway	Depth (H) of Keyway	Radius (R)
3-8" to 9-16"	3-32"	3-64"	
9-8 to 7-8	1-8	1-16	.020
15-16 to 1 1-8	5-32	5-64	.025
1 1-16 to 1 3-8	3-16	3-32	.040
1 7-16 to 1 3-4"	1-4	1-8	.050
1 13-16 to 2"	5-16	5-32	.060
2 1-16 to 2 1-2	3-8	3-16	.060
2 9-16 to 3	7-16	3-16	.060

THE SIZING AND CUTTING OF GEAR WHEELS

Diameter, when applied to gears, is always understood to mean the pitch diameter.

Diametral Pitch is the number of teeth to each inch of the pitch diameter.

Example. If a gear has 40 teeth and the pitch diameter is 4 inches, there are 10 teeth to each inch of the pitch diameter and the diametral pitch is 10, or in other words, the gear is 10 diametral pitch.

Diametral Pitch required, circular pitch given. Divide 3.1416 by the circular pitch.

Example. If the circular pitch is 2 inches, divide 3.1416 by 2 and the quotient, 1.5708, is the diametral pitch.

Diametral Pitch required, number of teeth and outside diameter given. Add 2 to the number of teeth and divide by the outside diameter.

Example. If the number of teeth is 40, the diameter of the blank is 10½ inches; add 2 to the number of teeth, making 42, and divide by 10½; the quotient, 4, is the diametral pitch.

Circular Pitch is the distance from the center of one tooth to the center of the next, measured along the pitch line.

Example. If the distance from the center of one tooth to the center of the next tooth, measured along the pitch circle, is ½ inch, the gear is ½ inch circular pitch.

Circular Pitch required, diametral pitch given. Divide 3.1416 by the diametral pitch.

Example. If the diametral pitch is 4, divide 3.1416 by 4 and the quotient, .7854 inch, is the circular pitch.

Number of Teeth required, pitch diameter and diametral pitch given. Multiply the pitch diameter by the diametral pitch.

Example. If the diameter of the pitch circle is 10 inches and the diametral pitch is 4, multiply 10 by 4 and the product, 40, will be the number of teeth in the gear.

Number of Teeth required, outside diameter and diametral pitch given. Multiply the outside diameter by the diametral pitch and subtract 2.

Example. If the whole diameter is 10½ and the diametral pitch is 4, multiply 10½ by 4 and the product, 42, less 2, or 40, is the number of teeth.

Pitch Diameter required, number of teeth and diametral pitch given. Divide the number of teeth by the diametral pitch.

Example. If the number of teeth is 40 and the diametral pitch is 4, divide 40 by 4 and the quotient, 10, is the pitch diameter.

Outside Diameter or size of gear blank required, number of teeth and diametral pitch given. Add 2 to the number of teeth and divide by the diametral pitch.

Example. If the number of teeth is 40 and the diametral pitch is 4, add 2 to the 40, making 42, and divide by 4; the quotient, 10½, is the whole diameter of the gear or blank.

Thickness of Tooth at Pitch Line required. Divide the circular pitch by 2, or 1.57 by the diametral pitch.

Example. If the circular pitch is 1.047 inch, or the diametral pitch is 3, divide 1.047 by 2, or 1.57 by 3, and the quotient, .523 inch, is the thickness of tooth.

Whole Depth of Tooth required. Divide 2.157 by the diametral pitch.

Example. If the diametral pitch of a gear is 6, the whole depth is 2.157 divided by 6, which equals .3595.

Whole Depth of Tooth is about 11-16 or exactly .6866 of the circular pitch.*

Example. If the circular pitch is 2, the whole depth of tooth is about 11-16 of 2 inches or 1⅜ inches nearly.

Distance Between Centers of two gears required. Add the number of teeth together and divide one-half the sum by the diametral pitch.

Example. If the two gears have 50 and 30 teeth, respectively, and are 5 pitch, add 50 and 30, making 80, divide by 2, and then divide the quotient, 40, by the diametral pitch, 5, and the result, 8 inches, is the center distance.

INDEPENDENT LATHE CHUCK

With Four Independent Reversible Jaws

Independent Lathe Chucks

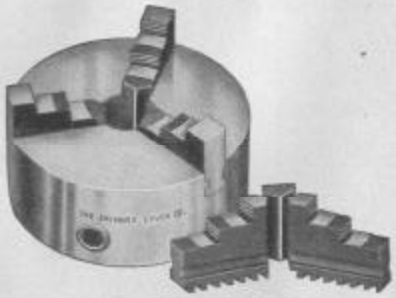
The chuck illustrated above is a 12" independent lathe chuck. The jaws are operated independently of each other and are reversible.

The independent chuck is used for holding heavy pieces and pieces of irregular shape, and is the most practical chuck for the lathe on general work.

UNIVERSAL GEARED SCROLL CHUCK

With Two Sets of Jaws

Illustration shows a 6", 3 jaw universal geared scroll chuck with two sets of jaws. The number 1 jaws are shown in the chuck, and the number 2 jaws are shown along side.

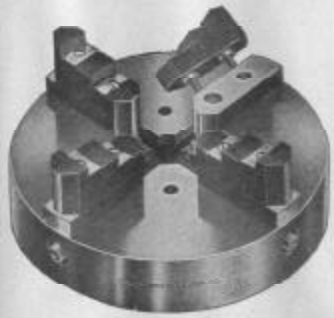


Universal Geared Scroll Chuck

This style chuck is used for holding round pieces. The jaws are moved simultaneously by a scroll threaded disc which is operated by a wrench.

COMBINATION CHUCK, GEARED SCREW

With Patent Reversible Jaws



A Combination Chuck is a combination of a Universal and an Independent Chuck. The jaws work universally in and from the center, but by shifting a stud on the back of chuck, throwing gears out of mesh, the jaws work independently.

Rear View of Lathe Chuck

Fig. 30 shows the rear view of a lathe chuck. It will be noted that there is a recess machined in the back of the chuck. This recess allows the chuck plate to be fitted for attaching chuck to lathe.

Fig. 30

Fig. 31

A SEMI-MACHINED CHUCK PLATE

Fig. 31 shows a Cast Iron Semi-Machined Chuck Plate. It is called "semi-machined" because it has been bored, faced, and threaded to fit the spindle nose of the lathe it is intended for.

To fit a lathe chuck to the spindle, select a semi-machined chuck plate with the flange large enough so that it may be turned to fit the recess in the chuck it is intended for. Screw this chuck plate on the spindle nose so that the hub of the plate fits up against the shoulder of spindle. Machine the chuck plate all over and turn the diameter of the flange to fit the recess of chuck, as shown in Fig. 30. The fit should be accurate,—not tight nor loose, but just right. Remove the chuck plate from the spindle, drill the necessary holes in plate, 1-16" larger than screw, attach it to the chuck with proper screws. Chuck is fitted ready for use.

When ordering a lathe and you wish a chuck included, always specify that the chuck be fitted to the lathe complete with chuck plate before the lathe leaves factory. The lathe manufacturer has suitable equipment for machining and fitting lathe chucks to lathes of their own make, charging approximately the actual cost of the labor and material; their object being that when the lathe and chuck reaches the customer it will fit accurately and give no trouble whatever.

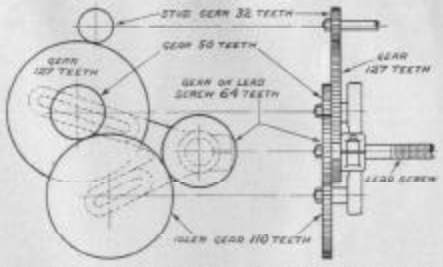
SIZE OF LATHE CHUCKS FOR A LATHE

We show herewith a list giving the size of lathe chuck most suitable for the various size lathes. Of course it may be necessary to depart from this list for special work but for general all-around work in the Machine shop these sizes will be found practical.

11-inch Lathe	4"	to 6"	inclusive
12-inch Lathe	4"	to 8"	inclusive
13-inch Lathe	5"	to 9"	inclusive
15-inch Lathe	6"	to 10"	inclusive
16-inch Lathe	6"	to 12"	inclusive
18-inch Lathe	8"	to 14"	inclusive

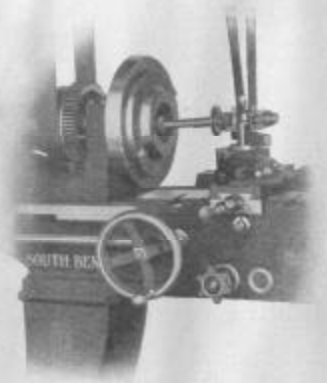
METRIC THREADS ON AN ENGLISH LEAD SCREW

To cut Metric Threads on a South Bend Lathe using a regular standard English lead screw, use the Compound Idler or connecting gears 50 and 127, the No. 127 Gear to mesh with spindle stud. Use an idler to connect the 50-tooth Gear with Gear on Lead Screw.



Arrangement of Gearing to Cut 16 Thread per Centimeter on a No. 34 South Bend Lathe.

When Metric Threads are to be cut as above the regular Index Chart of lathe may be used in selecting gears for the different pitches. Read the chart as so many threads per centimeter, instead of so many threads per inch.

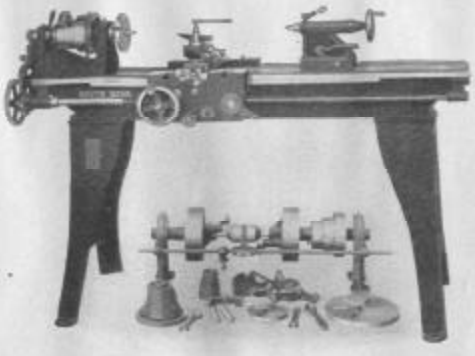


Grinding a Blanking Die on Lathe

GRINDING ATTACHMENT FOR LATHE

The above illustration shows the practical application of a grinding attachment fitted to the lathe. The operation shows a round blanking die being ground for clearance. The grinding attachment is held in the tool post, the emery wheel being driven by an overhead drum that is usually about 10 to 14 inches in diameter. This drum is in turn driven from the lathe countershaft. The length of the drum depends upon the work to be ground. For example, when grinding a printer's roll that is 4-feet long on the lathe the overhead drum should at least be 6-feet 4-inches in length.

A great many different jobs may be ground on a lathe to good advantage. It is a very simple matter for the operator to build his own attachment, for he can then meet the exact conditions required for his work.



Regular equipment, as illustrated under lathe, is included in price

No. 29 — 11-INCH SOUTH BEND LATHE

Fitted with Automatic Longitudinal and Power Cross Feeds

The No. 29 11" South Bend Lathe is used extensively in the laboratory, the tool room and the manufacturing plant, where light accurate work is required.

This Lathe may be furnished with bench legs if desired. A great many of these small Lathes are used on a bench instead of being equipped with long legs.

A practical tool equipment for this Lathe is as follows:

6" 4-Jaw Independent Lathe Chuck.
⅜" Drill Chuck.
Set of 12 Forged Steel Lathe Tools.
Set of 4 Lathe Dogs from ⅜" to 1" inclusive.

THE CUTTING SPEED FOR DIFFERENT METALS

The following cutting speed is recommended where high speed cutting tools are used:

Cast Iron	55 feet per minute
Machine Steel	35 " " "
Wrought Iron	40 " " "
Tool Steel, Annealed	25 " " "
Brass	100 " " "
Bronze	70 " " "
Grey or Red Fiber	50 " " "

HOW TO CALCULATE CHANGE GEARS FOR THREAD CUTTING ON AN ENGINE LATHE

The following rule shows how to calculate gearing to cut any thread on a Screw Cutting Engine Lathe, viz:

Multiply both the number of threads in the lead screw and the number of threads in the bolt to be cut, by any number. This will give you the number of teeth in the gears that can be used in cutting the thread. For example:

Threads to be cut, 12 per inch. Lead Screw on Lathe 6 threads per inch. Multiply both by any number, say 4:

$12 \times 4 = 48$ $\quad$ $6 \times 4 = 24$

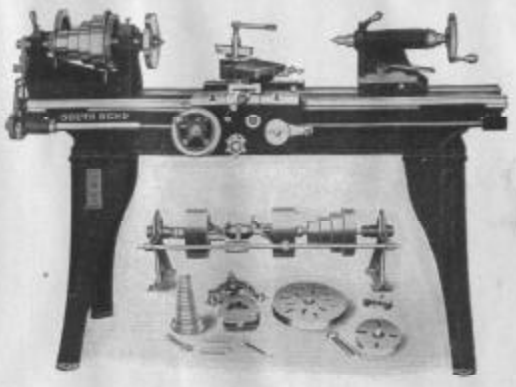
48 and 24 are the gears to use.

If you have not the 48 and 24 gears, try multiplying by 5:

$12 \times 5 = 60$ $\quad$ $6 \times 5 = 30$

If the Thread to be cut is finer than the Thread in the Lead Screw, the smaller gear goes on spindle—while the larger gear goes on the Lead Screw.

Always measure the thread when you have taken the first chip to be sure that you have made no mistake.



Regular equipment as illustrated under Lathe is included in the price

No. 34 — 13-INCH SWING SOUTH BEND SCREW LATHE

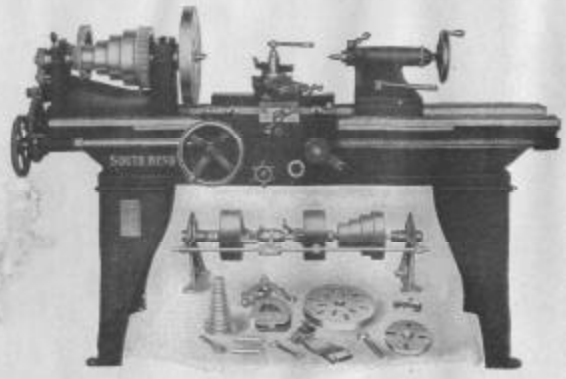
Fitted with Automatic Longitudinal Feed and Power Cross Feed

The No. 34 Lathe illustrated above is surpassed by none for general all-around work in the Machine Shop and general repair shop. It has a great many practical features that makes it valuable in manufacturing and which enables it to take care of the various jobs that come up.

A practical equipment for the above lathe for general machine shop use is as follows:

9" 4-Jaw Independent Lathe Chuck.
½" Drill Chuck.
Set of (12) Forged Steel Lathe Tools.
Set of (6) Lathe Dogs ½" to 1½" inclusive.

For details write for South Bend Lathe Catalog.



Regular equipment, as illustrated under lathe, is included in price

No. 37 — 15-INCH SOUTH BEND LATHE

Fitted with Automatic Longitudinal and Power Cross Feeds

The No. 37 Lathe illustrated above is a practical tool for manufacturing, for the Machine Shop and general repair shop. It is intermediate in size and weight between the 13" and 16" Lathes. This 15" Lathe in an 8' bed is capable of taking care of a great variety of work.

A practical equipment for the above lathe for general shop use is as follows:

10" 4-Jaw Independent Lathe Chuck.
¾" Drill Chuck.
Set of (12) Forged Steel Lathe Tools.
Set of (12) Lathe Dogs ½" to 4" inclusive.

For details write for South Bend Lathe Catalog.

DON'TS FOR MACHINISTS

From "Machinery"

Don't run a Lathe with the belt too loose.

Don't run the point of your lathe tool into the mandrel.

Don't rap the chips out of your file on the lathe shears.

Don't set a lathe tool below the center for external work.

Don't start up a lathe without seeing that the tailstock spindle is locked.

Don't put an arbor or shaft on lathe centers without lubricant on them.

Don't leave too much stock on a piece of work to take off with the finishing cut.

Don't try a steel gage or an expensive caliper on a shaft while it is running.

Don't put a mandrel into a newly bored hole without a lubricant of some kind on it.

Don't put a piece of work on centers unless you know that the internal centers are clean.

Don't try to straighten a shaft on lathe centers, and expect that the centers will run true afterwards.

Don't put a piece of work on lathe centers unless you know that all your centers are at the same angles.

Don't set the cutting point of a lathe or planer tool any farther out from the toolrest than is absolutely necessary.

Don't take a lathe center out of its socket without having a witness mark on it, and put it back again according to the mark.

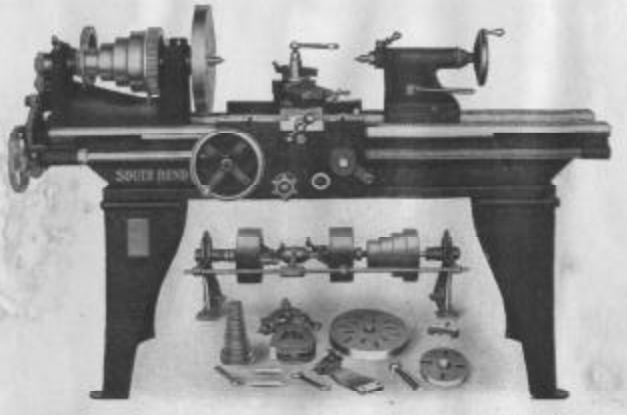
Don't start polishing a shaft on lathe centers without having it loose enough to allow for the expansion by heat from the polishing process.

Don't run your lathe tool into the faceplate.

Don't try to knurl a piece of work without oiling it.

Don't run a lathe an instant after the center begins to squeal.

Don't forget to oil your machine every morning; it works better.



Regular equipment, as illustrated under lathe, is included in price

No. 40 — 16-INCH SOUTH BEND LATHE

Fitted with Automatic Longitudinal and Power Cross Feeds

The No. 40 Lathe is used in general manufacturing, also in the Machine Shop and the practical all-around repair shop where the work is heavy, requiring a lathe of considerable stiffness and strength. This 16" Lathe in 8 or 10' bed will give excellent results for general work because it is capable of taking care of practically any job that comes up.

A practical equipment for the above lathe for general shop use is as follows:

12" 4-Jaw Independent Lathe Chuck.
1" Drill Chuck.
Set of (12) forged steel lathe tools.
Set of (12) Lathe Dogs ½" to 4" inclusive.

For details write for South Bend Lathe Catalog.

DON'TS FOR MACHINISTS

From "Machinery"

Don't forget that a fairly good center-punch may be made from a piece of round file.

Don't forget that a surface, polished with oil will keep clean much longer than one polished dry.

Don't forget that the closer you can get your toolrest to the fork, the better it is.

Don't start to turn up a job on lathe centers unless you know that the centers are both in line with the ways.

Don't cross your belt laces on the side next to the pulley, for that makes them cut themselves in two.

Don't try to cut threads on steel or wrought iron dry; use lard oil or a cutting compound.

Don't run a chuck or faceplate up to the shoulder suddenly; it strains the spindle and threads and makes removal difficult.

Don't screw a tool post screw any tighter than is absolutely necessary; many mechanics have a false idea as to how tight a lathe tool should be to do its work.

Don't leave a wrench in a chuck; always remove it.

When using the automatic cross or longitudinal feed on a lathe be sure that the **split nut is not closed** on the lead screw.

To drive the center out of head spindle use a rod and drive through the hole in spindle.

When putting a lathe chuck on the head spindle, always remove the center, because many times in drilling a piece on the chuck the operator forgets that the center is in and drills right through the job destroying the center.

When the center is removed from the head spindle of the lathe, always put a piece of rag in spindle hole to prevent any dirt from collecting.

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