# GISHOLT
# TURRET LATHE GUIDE
## CARE AND TOOLING

# GISHOLT TURRET LATHE GUIDE

for

## CARE AND TOOLING

### GISHOLT TOOLS

TURRET LATHES
AUTOMATIC TURRET LATHES
VERTICAL BORING MILLS
UNIVERSAL TOOL GRINDERS
HORIZONTAL BORING AND DRILLING MACHINES
DOUBLE EMERY GRINDERS

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TOOL POST TOOL HOLDERS
REAMERS (SOLID ADJUSTABLE)
Shell, Hand, Chucking
BORING BARS (ADJUSTABLE CUTTER)
CHUCKS

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SPECIAL TOOLS, JIGS AND FIXTURES

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PERIODOGRAPH
Workman's Time on Job Recorder

**Gisholt Machine Company**

General Offices

MADISON, WIS., U. S. A.

BRANCH OFFICES
50 Church St., New York City
208 S. LaSalle St., Chicago Ill.

WORKS
Madison, Wisconsin
Warren, Pennsylvania

S—2

# Preface.

This book has been compiled for the use of operators and those who are in touch with Gisholt Turret Lathe work.

Our intention has been to arrange the suggestions in a way most beneficial to all those interested in the operation and care of Gisholt Turret Lathes and tools.

Tooling, which is an almost inexhaustible subject, is treated quite thoroly; there are illustrations of standard and special tools for rough and finish turning, facing, boring and reaming, giving proper allowances between rough and finish cuts so as best to maintain uniformity of sizes and quality of finish.

All of the articles illustrated have been successfully worked out in practice and many of them are being used today.

Possibly very few of the tools shown will exactly fill your requirements without some modification; therefore, the book must be accepted as a *guide* only, and we hope it will prove a satisfactory reference in selecting tool equipment for Gisholt Turret Lathes.

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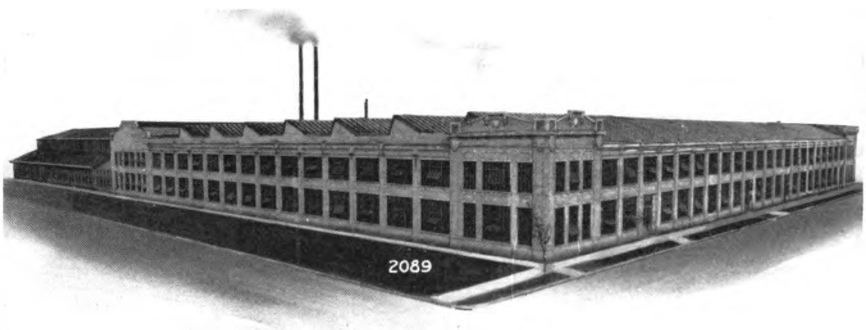
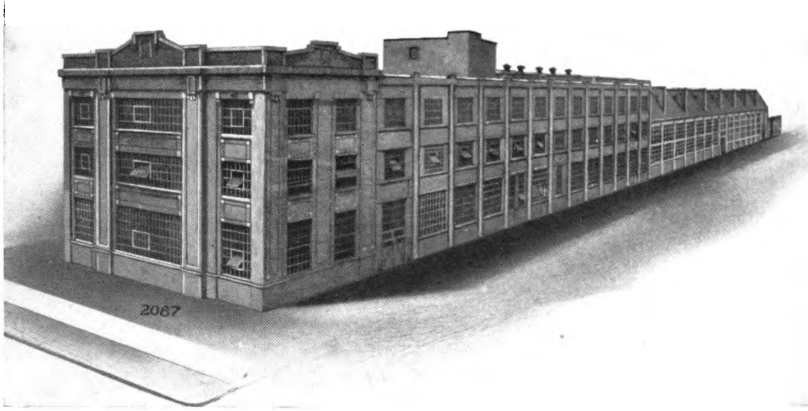
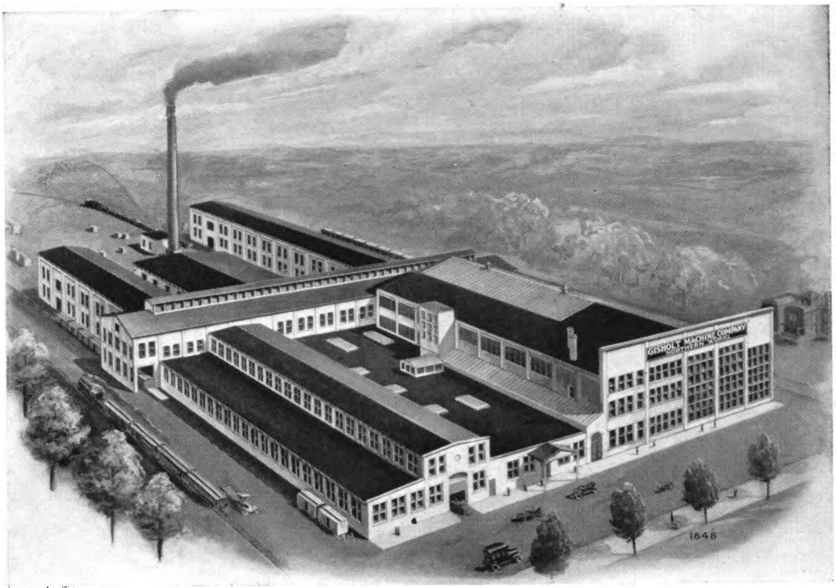
We want to co-operate with you in getting the very best results from our lathes and ask you to feel free at all times to confer with us personally or by mail.




Gisholt Main Works, Madison, Wis.

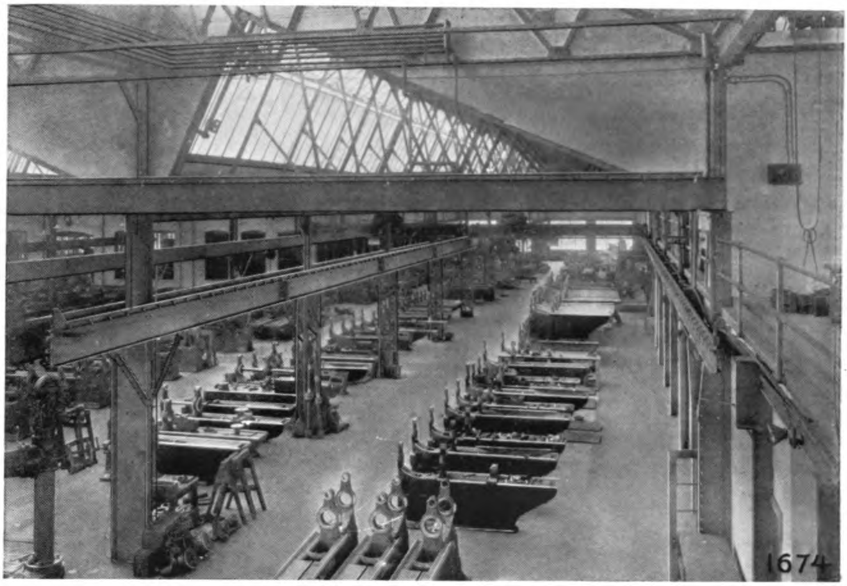



Pattern Shop and Foundry, Madison, Wis.

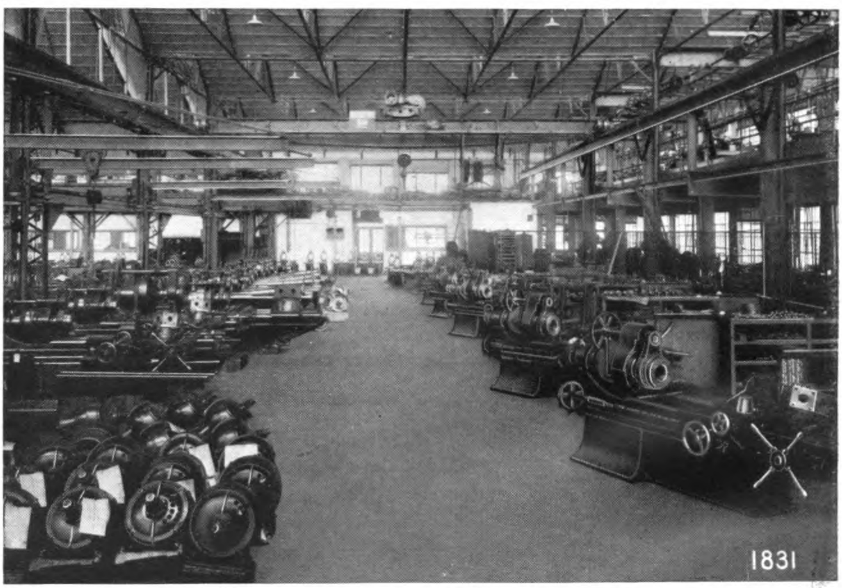



Gisholt Northern Works, Madison, Wis.


Gisholt Warren Works, Warren, Pa.

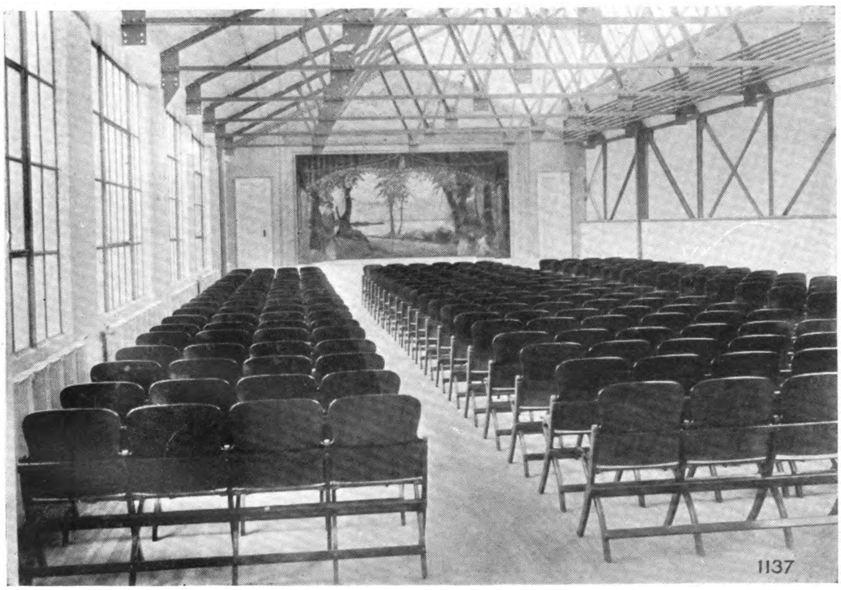


Interior View—Main Works

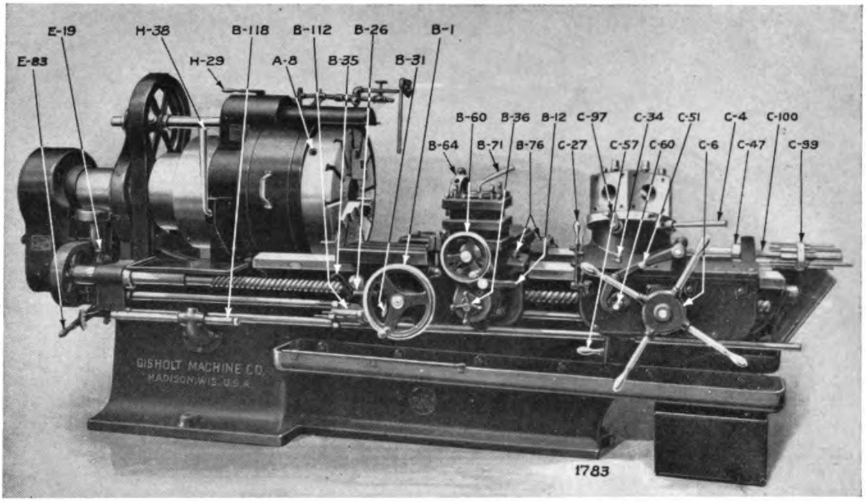


Interior View—Main Works


Locker Room




Gisholt Club Room




A8. Chuck Scroll Pinions.
B1. Carriage Apron Hand Wheel.
B12. Cross Feed Tumbler Lever.
B26. Carriage Apron Feed, Friction Dog Handle.
B31. Carriage Apron, Thread Cutting Pull Pin Lever.
B35. Carriage Apron Feed Trip Lever.
B36. Cross Feed Friction Star Nut.
B60. Cross Feed Screw Hand Wheel.
B64. Drill Support.
B71. Tool Post Elevating Handle.
B76. Carriage Right Front Gib Clamping Screw.
B112. Carriage Stop Bar Stop Carrier.
B118. Carrage Stop Bar on Bed.
C4. Turret Clamp Ring Bracket Handle.
C6. Turret Apron Pilot Wheel.
C27. Rapid Traverse Friction Operating Lever.
C34. Turret Slide Front Gib Clamp Screw (Left).
C47. Turret Stop Bar Positive Stop Adjusting Nut.
C51. Turret Apron, Feed Trip Link.
C57. Turret Apron, Feed Change Lever.
C60. Turret Apron, Feed Friction Dog Handle.
C97. Turret Locating Pin Pinion Tappet.
C99. Turret Stop Bar Stop Screw Carrier.
C100. Turret Stop Bar.
E19. Feed Reverse Lever.
E83. Feed Change Lever.
H29. Back Gear Shaft Lever.
H38. Headstock Friction Lever.

# The Gisholt Turret Lathe.

## USES AND ADVANTAGES.

The tool post carriage has a four sided turret tool post, drill support, and taper attachment. The turret slide carries a hexagonal or six sided turret head.

This construction permits the use of multiple tools and doing any combination of the three operations, boring, turning, and facing at the same time.

Bearing this in mind, the necessity of securely chucking the work is easily appreciated. Many methods of chucking, using specially fitted jaws, bonnets and face plate fixtures are shown in the chapter on chuck equipment.

The four sided tool post and six sided turret head facilitate the carrying of a number of tools at a positive setting, which insures uniformity in the work done. This eliminates the necessity of constantly calipering and measuring to get the sizes wanted.

In the four sides of the tool post, may be clamped tools to properly break the scale and remove enough stock to prepare the casting or forging for the finishing tools. When the conditions warrant, finishing tools also may be carried in the tool post.

With the aid of the carriage stops and the graduated dial on the cross feed screw, an accurate degree of uniformity may be maintained in boring, turning and facing.

On the six sides of the turret head, may be mounted drills, boring bars, reamers, tap and dies: Also facing heads, which, when properly supported, may be arranged with arms and cutters for boring, turning and facing various diameters and shapes. A screw adjustment in these arms makes it possible to obtain very accurate settings.

Automatic adjustable stops are provided for each face of the turret. By the use of these stops and those provided for the tool post, *the mental strain on the operator is reduced to a minimum*, because the care and attention necessary is so much less than that required when single tools are used, and changed to obtain each accurate dimension.

When the machines are arranged in groups or batteries, a tool setter can take care of a number of machines, the exact number being governed by the frequency of changing of jobs. After setting the machines up, men of absolutely no experience may be taught in a reasonable length of time to operate and do just as much, and as good work as the tool setter.

In summing up the uses of the turret lathe, the foremost considerations would be to securely chuck the work, properly break the scale with suitable roughing cutters and tools, and afford ample support for all tools, especially boring bars and facing heads.

# Care and Operation of Machines.

## INSTALLATION.

The floor on which the lathe is placed should be firm enough so that it will not vibrate excessively. This will insure the machine running more smoothly and working more satisfactorily, especially when doing extra heavy duty or running at a high speed.

The lathe should be set perfectly level, and, when belt driven, parallel with the countershaft.

When installing a group or battery of lathes, sufficient room should be allowed between the machines for the operator and for placing rough and finished work. Sometimes this is over-looked until it is too late, and results in a crowded department, also, unquestionably, it lowers production.

Before putting the belts on a new machine, all the grease or rust preventive should be removed from all surfaces with kerosene and the working parts well oiled.

## OILING.

Proper oiling of machinery is *Most Essential.*

It is always a good thing to remember that wherever there is a revolving, sliding or moving bearing of any kind, provision for lubrication of some kind should be made; and these bearings are more readily found by one familiar with the machine.

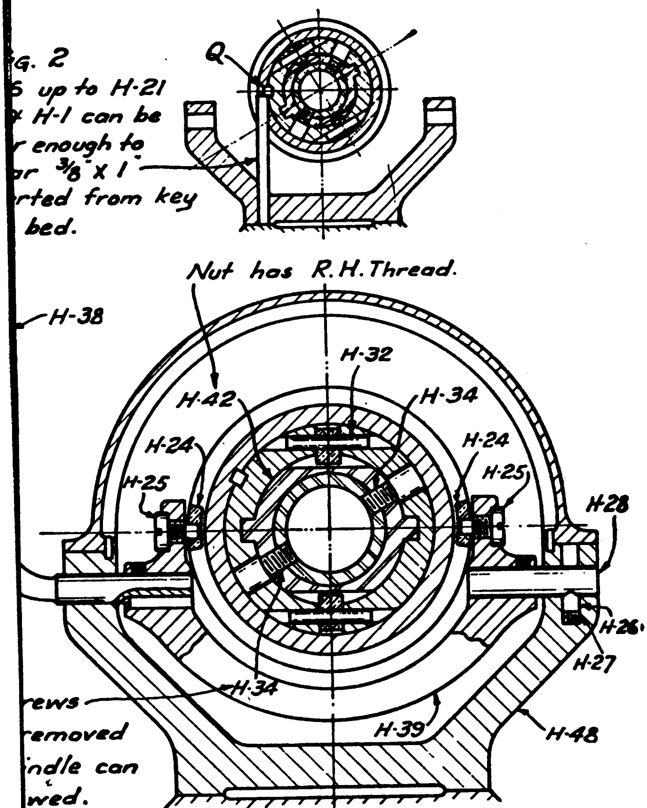
When the demonstrator is called upon to "break in" or instruct a new operator, usually he will begin by showing the operator where to find the oil holes and how to reach them. This is done without thinking how much previous experience the operator may have had on other machinery. Some resentment may be shown occasionally but this should not be, as the sole intention of the demonstrator is to assist.

The oiling of the machine always should be given the most careful attention of the operator. It is unnecessary to flood a bearing with so much oil that it will run down over the outside of the machine and onto the floor, but the oiling should be done at regular intervals. Always bear in mind that oil is cheaper than repairs.

The time lost during the repairing of a machine is very often of more consequence than the cost of new parts or the repairing of the old ones.

When oiling turret, the oil hole in top of the turret head should be towards front of machine or the operator's position. When oiled in this position, the oil runs down to turret spindle, lubricating it.

Moral: *Good care of machinery saves money, time and trouble.*




SECTION OF HEADSTOCK
FOR GISHOLT TURRET LATHE
GISHOLT MACHINE Co.
MADISON, WIS
SHEET No. 10250A SKETCH No. 16

## ADJUSTMENT.

When a machine is shipped from the factory, it is properly adjusted for running, but, as many uncalled for and unforeseen things may happen between the time it leaves the factory and its installation in the customers plant, it is always advisable to try all adjustments before starting the machine.

## HEADSTOCK.

The spindle bearings should be adjusted differently for various classes of work; for instance, if small work is being done or work that requires high speed, the bearings should be loose enough so as not to become hot to the touch of the hand.

An ideal adjustment is to have the bearings slightly warm and still have the spindle revolve freely. If the bearings run a little warm and maintain an even temperature it is an indication that the bearings are properly adjusted.

Then, when heavy, large diameter work is being done, the bearings should be pulled up a little tighter, as less clearance is required at the slower speed. By careful attention along this line, the bearings will wear a great deal longer and produce much better work.

The adjustments of headstock friction clutches are made as follows:

By turning H7 adjusting nut (right hand thread) toward the cone, the high speed friction clutch is tightened, and turning H46 adjusting nut towards gear will tighten intermediate speed friction clutch.

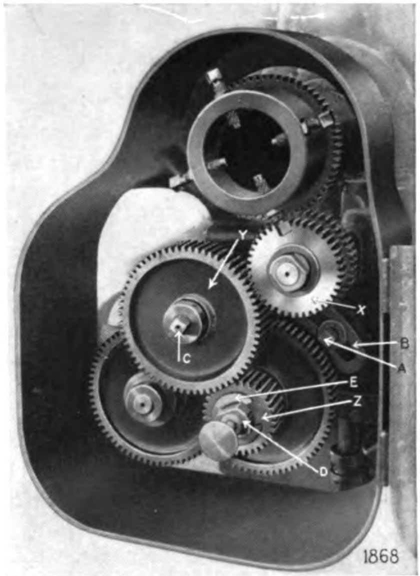
For adjusting headstock bearings and clutches see sketch No. 16, page 12A.

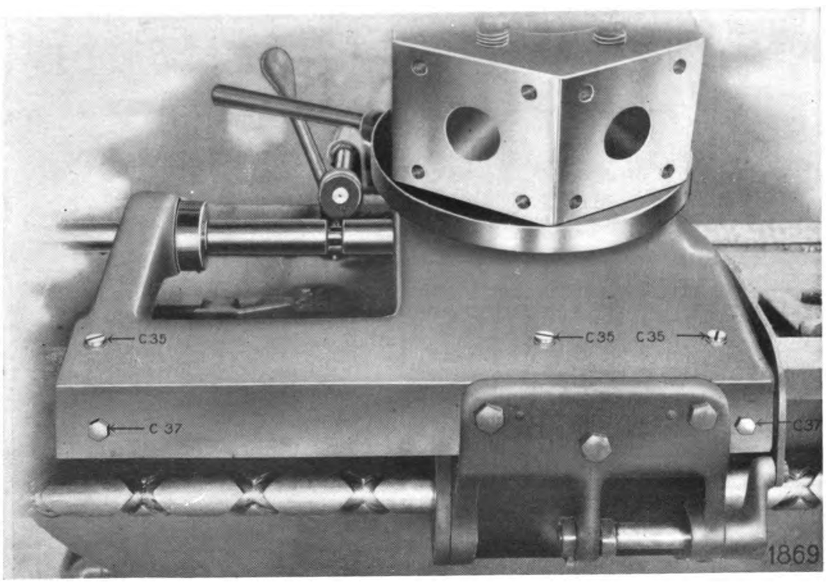
## FEED BOX.

The change gears in feed box, as shown in figure 1868, page 14, should be thoroly cleaned and readjusted.

To change the gears in feed box proceed as follows: First loosen stud "A" and swing quadrant "B" back as far as it will go thus throwing gears "X" and "Y" out of mesh. Second loosen stud "C" and raise gear "Y" up as far as it will go and slightly tighten stud "C". Third loosen nut "D" and remove open washer "E". The change gear "Z" may now be removed and the one selected put in its place. After which replace washer and nut and tighten. Next properly mesh gears "Y" and "Z" and tighten stud "C". Next swing quadrant up until gears "X" and "Y" mesh properly and securely tighten stud "A". The changes are always made with the gear "Z" to get the threads and feeds as shown on the chart. The gear "X" may be changed for special pitch threads not shown on chart.

The use of the change gears and threading is further explained under head of "Thread Cutting and Feed Changes", page 176.

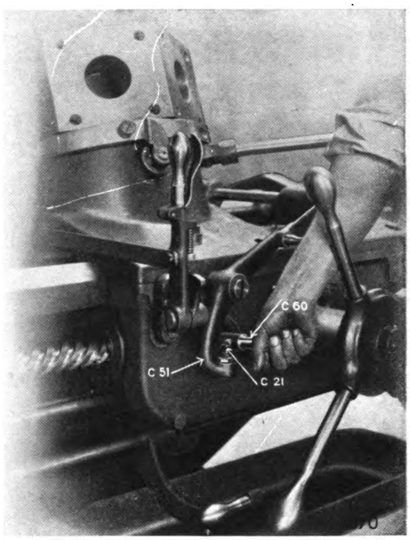

Y
X
B
A
C
E
Z
D
1868


C35
C35
C35
C 37
C37
1869

## TURRET.

See figure 1869, page 14. C89 turret slide gib (rear) can be properly adjusted by pulling up all the adjusting screws C35, until the turret slide is tight, then loosening up the adjusting screws, a little at a time until slide works freely. The clamp screws C37, on the back of the slide should then be tightened, in order to hold the adjustment.

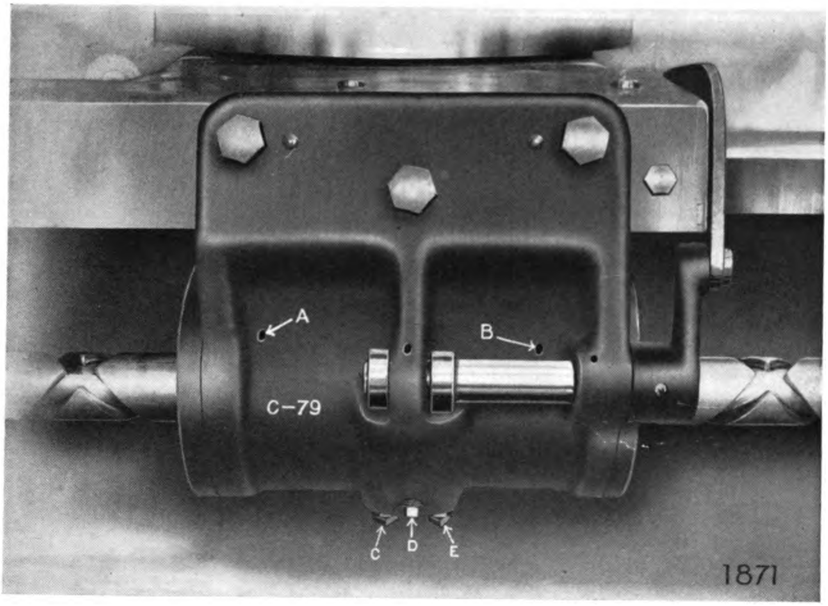
The turret feed friction adjustment is made with C21 catch screw in C51 trip link. (See figure 1870, page 15.)

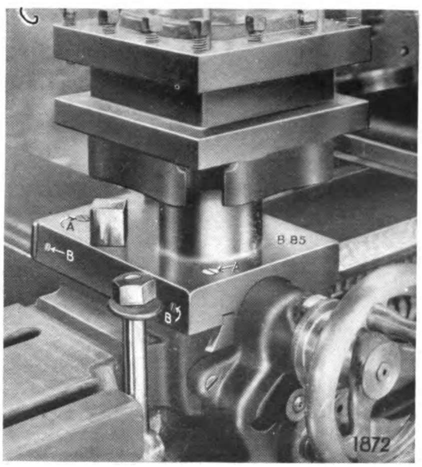


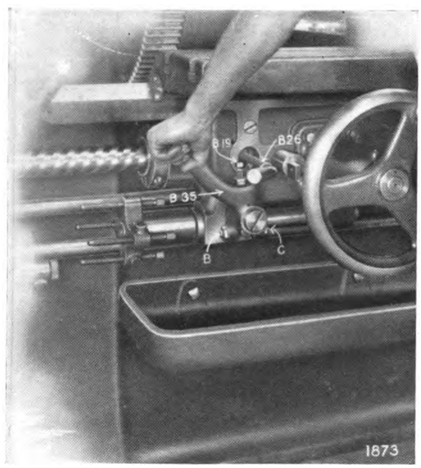

## POWER TRAVERSE

The type of power traverse as shown in view 1266 contains two nuts, one right and one left hand—C70 and C71, which run on F1 rapid traverse screw (Shown in view 1280), page 225. The clutches on these nuts are simple split ring frictions and are adjusted by set screws on the underside of C79 rapid traverse friction housing. (See figure 1871, page 16.)

The screw, indicated by "C", will adjust the clutch which drives the turret back from the chuck and the one indicated by "E" drives forward. This is the order in which the power traverse is assembled but as these traverse nuts are interchangeable it is possible to get them assembled wrong if the housing "C79" is dismantled at any time. This would reverse the movement of the turret slide when the traverse clutches are engaged.


A
B
C-79
C
D
E
1871


A
B
B 85
B
1872


B 19
B26
B 35
B
C
1873

Care should be taken to get the proper adjustment. These clutches should not be set up too tight.

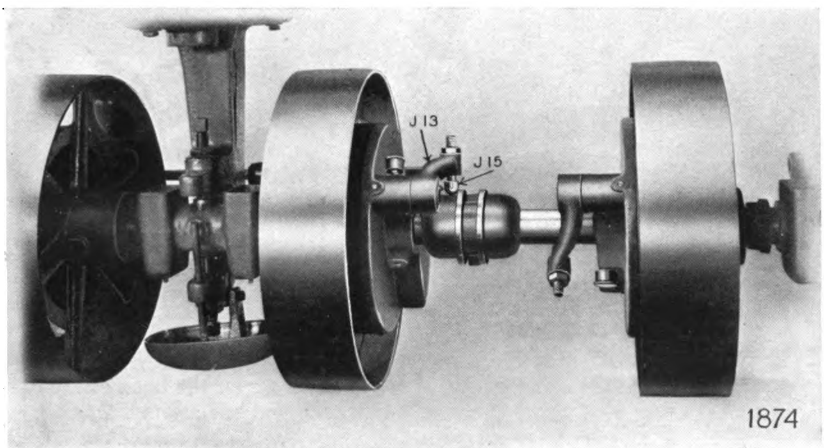
## TOOL POST CARRIAGE.

B86 carriage gib (rear) should be adjusted the same as the turret slide gib, as described in a preceding paragraph, under "turret adjustments."

B84 cross slide gib can be adjusted by pulling the adjusting screws "A" up until B85 cross slide works hard. Then they should be released until the proper adjustment is obtained. Tighten adjusting lock screws "B". (See figure 1872, page 16.)

The carriage feed friction adjustment is similar to that of the turret feed friction, the adjustment being made with B79 lever catch, in 835 trip lever. (See figure 1873, page 16.)

By adjusting screws "B" and "C" in yoke of B35 carriage feed trip lever (See figure 1873, page 16) the power feed on tool post carriage can be automatically tripped at various distances from the positive stop.



1874

## COUNTERSHAFT.

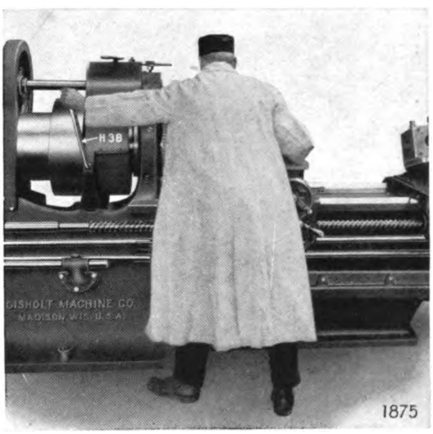
The countershaft clutches are adjusted by the set screw J15 in J13 friction ring expanding pin dog. (See figure 1874, page 17.)

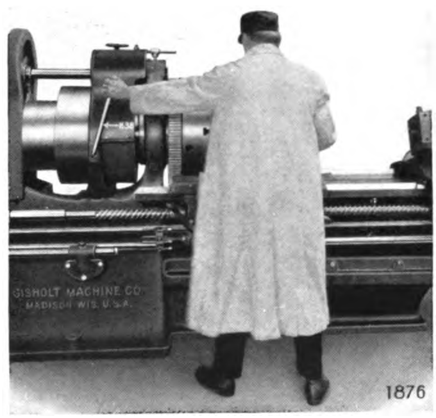
## OPERATING.

Figure 1783, page 10, is a cut of a standard Gisholt Turret Lathe. The operating levers are indicated by arrows which are numbered; the names will be found at bottom of picture.

Three spindle speeds may be obtained without shifting the belt or changing the motor speed. They are called, high speed, intermediate speed, and slow speed.

At the high speed, the spindle is driven thru a friction clutch in the cone. This clutch is engaged by moving the operating lever H38 to the left as is shown in figure 1875, page 18.



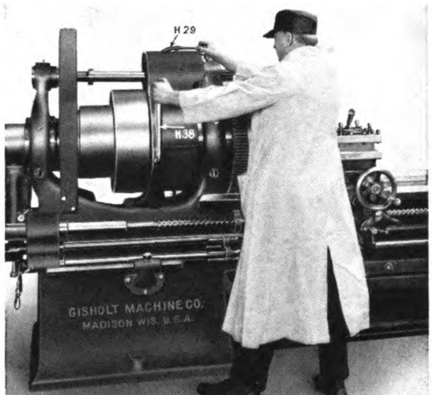

At the intermediate speed, the spindle is driven thru a friction clutch in the clutch gear at the large end of the cone. This speed is obtained by moving the operating lever H38 to the right as is shown in figure 1876, page 18.

At the slow speed the spindle is driven by a ring gear on the back of the chuck. This speed is obtained by sliding the back gear shaft, (which has pinion cut on the end) to the right, with the lever H29. The other lever H38 being in a neutral, which is a vertical, position as is shown in figure 1877, page 19. The pinion on the back gear shaft will mesh more freely with ring gear on back of chuck, if the spindle is revolving slowly. For this reason it is advisable to start the spindle at the intermediate speed, returning the operating lever to a neutral position before attempting to engage the slow speed.

*The operator should never leave the machine for any length of time while it is running. Nor should he leave the machine with the chuck wrench in the chuck.*

Carriage feed is engaged by raising the handle B26 up until the set screw in the trip lever B35 catches under the catch pin in the B26 handle, as shown in figure 1878, page 20.

Both the carriage and turret feeds may be released by hand as well as automatically.



1877

The carriage feed may be released by hand by moving B35 trip lever to the left, allowing the B26 handle to drop as shown in figure 1873, page 16. The tool post cross feed is engaged by turning the star nut B36 to the right, and disengaged by turning it to the left. Star nut B36 is shown in figure 1880, page 20. Between the cross feed hand wheel and this star nut, is located a tumbler lever B12 by which the cross feed is reversed. There also is a neutral position for this lever.

The turret feed is engaged by lifting up handle C60 until the screw in trip link C51 catches under the catch pin in the C60 handle, as shown in figure 1870, page 15.

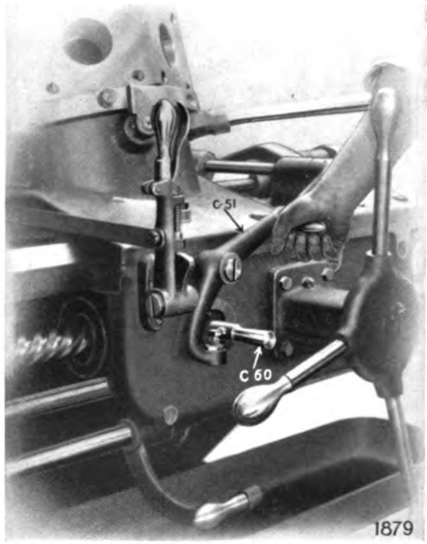
The turret feed may be released by hand by pressing down on trip link C51 until the handle C60 drops, as shown in figure 1879, page 20.

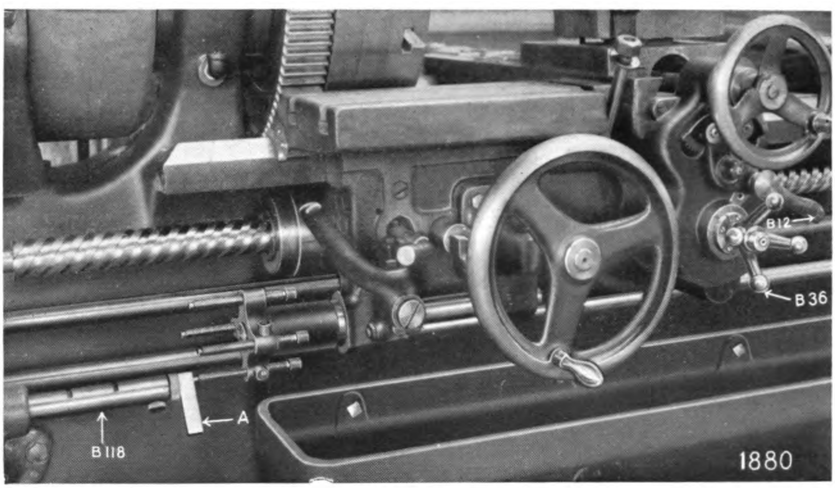
## TOOL POST CARRIAGE AND TURRET STOPS.

The question of stops is most vital as the turret lathe loses much of its effectiveness and usefulness in duplicate production, if adequate stops for the tools are not provided and used.

The stops provided on the Gisholt lathe are easily set, in fact it takes very little more time to set a stop than to scale or caliper a dimension. Time will be


B-26
B-35
1878


C-51
C 60
1879


B12
B 36
A
B 118
1880

saved (if the stops are used) if there are so few as six pieces in a lot to be machined.

Sometimes the castings or forgings to be machined cannot be chucked and located by any definite point, making it impossible to use the same stops for the carriage and turret on piece after piece. To take care of this condition, an adjusting screw with a knurled head is put in the end of carriage stop bar B118 (See figure 1880) page 20. By the use of this adjustment, it is possible to set all four carriage stop screws for the tool post tools, and move them all forward or back as required without changing their relations.

When this adjustment is being used, the regulation of the turret stops can be taken care of by a rod "A" (shown in figure 1881) page 22, bolted to the carriage and running back under the turret, serving as a turret stop. In figure 1881 it is clearly shown how this plan works out. Before this rod is made, it is best to get the tools for the job partly set up in order to get the correct length.

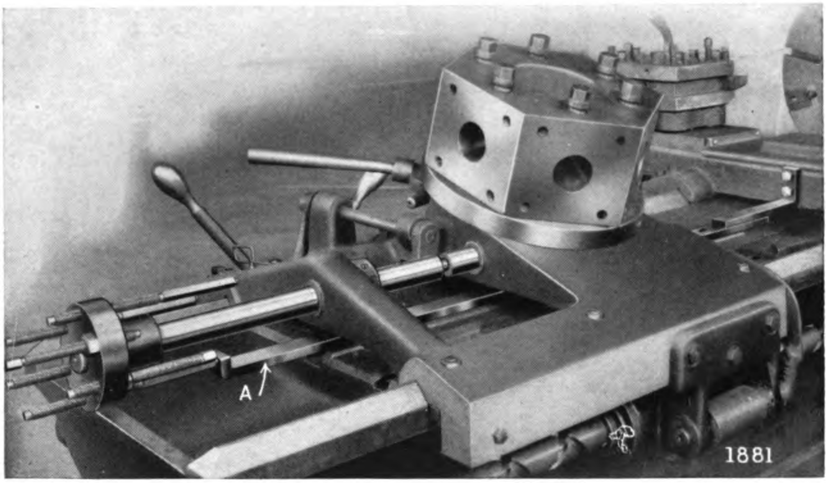
When this arrangement is used, it is necessary, of course, to use one carriage stop to adjust carriage to proper position in order to have the turret stops the same for each piece.

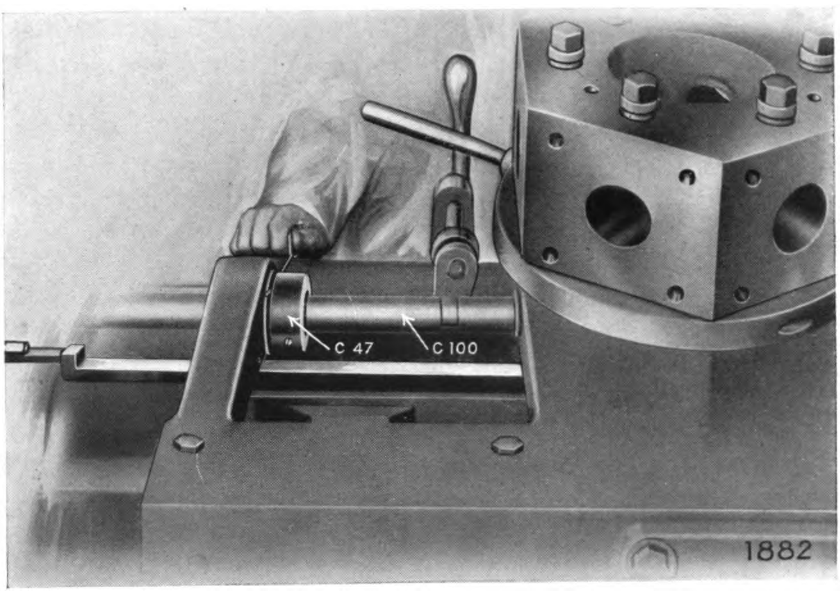
On jobs requiring considerable power to feed the turret tools into the work, it has at times been found easier to get the proper depth if a feeler is used in connection with the turret stops. The feeler is used between the turret stop adjusting nut C47 on stop bar C100, and the bridge on the turret slide. The positive stop is of course very reliable, but chances for error (which always exist everywhere) are reduced to a minimum if a feeler is used as shown in figures 1881 and 1882, page 22.

This is a very sensitive feeler and is put on our latest machines. You can easily make one of either cold rolled steel or drill rod and quickly apply to any machine.

All the stops for the turret may be changed without altering their relative positions one to another, simply by screwing the knurled nut "C47" forward or back, and being careful to allow enough space between the nut and the turret slide for the feed to trip automatically.

Occasionally you may want to use more than four stops for the tool post tools, especially if you have a job with several different surfaces to be faced. Suppose for example two faces are to be machined, one 3/4" nearer the face of chuck than the other, with only one stop available. Set the stop for the face nearest the chuck and then make a gage 3/4" thick and use between the stop screw and the stop bar. In figure 1880 is shown a gage at "A" illustrating the principle of this idea. You can also judge from this illustration how easy it would be to work out and use many combinations of these gages.


A
1881


C 47
C 100
1882

# Meaning of the Terms "Cutting Speed" and "Feed"

Cutting speed is expressed usually in feet per minute and is the speed at which the material passes the point of the cutting tool. To find cutting speed multiply the diameter of the work in inches by 3.1416. This gives the circumference, which should be multiplied by the revolutions per minute and the product divided by 12 giving the result in feet per minute. For example, if the piece being turned is 18 inches in diameter and the spindle speed is 9 revolutions per minute $18 \times 3.1416 \times 9 \div 12 =$ feet per minute, as is shown in left hand margin.

```
     3.1416
         18 inches
   ---------------
    251328
    31416
   ----------
   56.5488 circumference
           9 revolutions per minute
12 | 508.9392 | 42.41 feet per minute
    48
    --
     28
    24
    --
     49
     48
     --
      13
      12
      --
       1
```

A very easy way to obtain the approximate cutting speed is to leave off the fraction of 3.1416 and simply multiply the diameter in inches by $3 \times$ R. P. M. divided by 12. It is understood that this only gives an approximate cutting speed, but it is very easily figured.

The feed of the tools is the rate at which the tool advances in the work per revolution, and is expressed as .008″ or 1/32″, or 1/8″ (or any amount) per revolution.

The proper feeds and speeds on any class of work can be determined by observing the life of the tool.

Roughing tools, generally speaking, when used anywhere near the limit, should be ground about twice a day, especially where it is necessary that they be set to stops. If they are ground more than two or three times a day, a great amount of time will be lost in grinding and resetting. On the other hand, if it is not necessary to grind at least once or twice a day, they are not being used at the proper feeds and speeds and are not working up to their capacity.

The variations in feed will be governed by the following:

1st. The design of the piece being machined.

2nd. The chucking hold on the piece.

3rd. The amount of stock to be removed.

4th. The amount of scale on the casting or forging and the kind of material.

If too heavy a feed is used on castings or forgings of frail construction, the work will spring away from the tool causing a variation in size. An example of this is in the turning and boring of piston rings from a pot casting made long enough for several rings.

The chucking hold on the piece also has a great deal to do with the amount of feed used. A piece chucked in a way such that it is impossible to move it, makes it possible to use a feed limited only by the strength of the tool.

The cutting speed also helps to determine the amount of feed; furthermore, the amount of feed helps to determine the cutting speed.

If the tool is working near its capacity and the speed is increased, it will be found necessary to reduce the feed or grind the tools more often. If the cutting speed is decreased, the feed may be increased within reasonable limits the best results being obtained with heaviest feeds possible and cutting speed to suit so that it will not be necessary to grind the roughing tools more than two or three times a day.

# Tooling

## STANDARD TOOL EQUIPMENT.

Tooling is one of the most important factors in turret lathe practice. In fact, the success of turret lathes depends almost entirely on the proper tooling of the machines to meet the exacting requirements for duplicating parts and maintaining the required accuracy under actual working shop conditions.

For your convenience and assistance in selecting or designing tools for your Gisholt Turret Lathes, we have gone thru our drawing files and selected typical fixtures and tools (covering a large variety of work) that have been successfully used. Any modifications necessary to suit your particular work will undoubtedly suggest themselves to you.

The tools have been grouped together and arranged in the order in which they should be considered in making up an equipment for any piece to be machined.

First is shown a standard equipment which is recommended for chuck work, and second a standard equipment for work from bar stock. These tools will cover a large variety of work which does not require special tools and fixtures.

Then in order come:

Special chuck jaws, and chucking fixtures.

Tool post tools, tool holders, etc.

Special drill supports.

Drills, drill holders, etc.

Boring bars, standard and special; end bars; taper and radius boring bars; boring bar cutters and cutter heads.

Reamers, and reamer arbors, standard and special.

Facing heads with standard and special arms.

Facing head cutters and special heads.

Taps and dies with holders.

## TIME AND TOOL ESTIMATES.

To accurately make time and tool estimates for turret lathe work, a certain amount of information is necessary that is not usually shown on the drawings.

The points most necessary, relative to this information, are taken up in the following questions and are fully illustrated in figure 30ZZ, page 26, particularly questions 1, 2 and 3.

When sending prints for time and tool estimates kindly follow these suggestions:

If possible make notes on the prints, with red or yellow pencil, outlining where each piece is to be machined. See example of guidance, page 26.

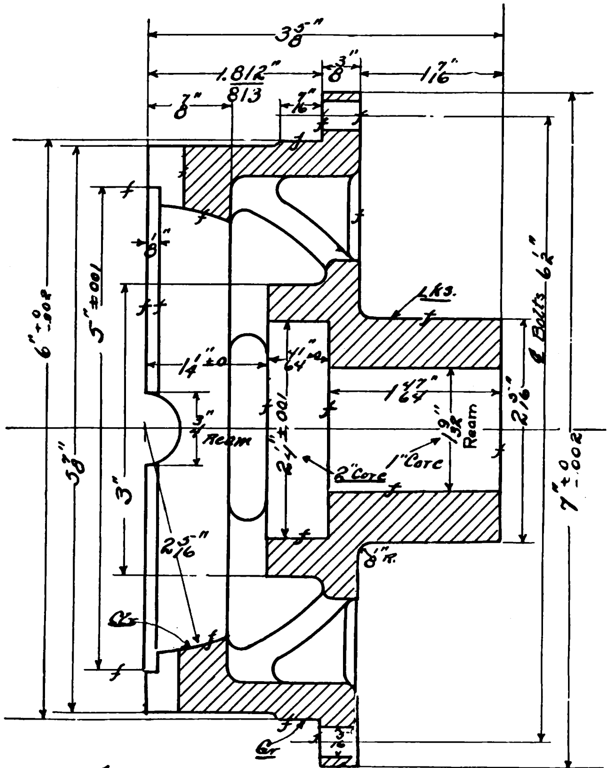
1. Question: How many pieces are to be made per lot per year?

Example: If there are 100 pieces to be made per year and 10 pieces per lot, show as a fraction 10/100, the numerator denoting the number of pieces per lot and the denominator, the number of pieces per year. This should be put on the drawing, and the pieces indicated by an arrow.

2. Question: What kind of material and how much stock is to be removed?

Note: Sometimes the material is not shown on the print.

Example for Guidance



$\frac{10}{100}$ Material, Cast Steel.
1/8″ Stock to Remove.
40 to 50 Ft. p. M., Cutting Speed.

(30ZZ)

3. Question: What is the possible cutting speed, (in feet per minute) removing 1/8″ stock without grinding the roughing tools?

Note: The roughing tools in good turret lathe practice should not be ground oftener than three times a day.

4. Question: Are the holes solid or cored? If cored, give diameter of rough hole.

Note: The size of the core should be given, and about how much it runs out, so that it will be possible for the chief tool designer to determine whether or not it is necessary to use a core drill and to know the size of the boring bar pilot required.

5. Question: What limit either way from a given dimension will be allowed? Also, within what limits must the piece run?

Note: Sometimes the drawings do not have the limits shown.

6. Question: Are any surfaces finished before coming to the Gisholt? If so, indicate them by F. P.

7. Question: Is there any surface or point from which the customer wishes to locate? If so, indicate by "Loc."

8. Question: Are your taps standard thread, "V" thread or special size?

9. Question: Are pieces machined or ground to finished size?

10. Question: Is customer willing to make change in patterns for ease of chucking?

Note: For surfaces to be machined use the following symbols:

For "Finished Previously" use "F. P.", referring to question 6.

For "Locate" use "Loc."

For "Looks" use "Lks.", meaning 2 cuts but no size.

For "Balance" use "Bal.", meaning 1 cut but no size.

For "Fit" use "Fit", meaning 3 cuts .001 to .002 limit.

For "Polish" use "Pol.", meaning 2 cuts and polish.

For "File" use "File", meaning 2 cuts and file.

For "Clearance" use "Clr.", meaning 1 cut.

For "Grinding" use "Gr.", meaning 2 cuts with .006 to .01 limit.

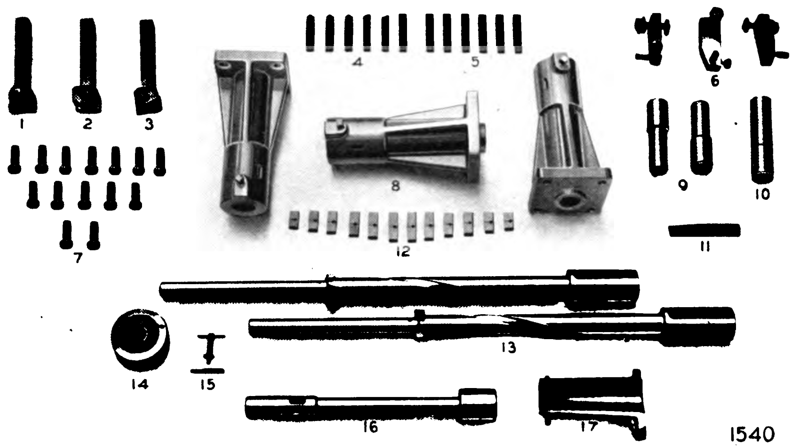
Note: If cross-pin holes on pistons are to be bored on Gisholt, state whether bored before or afer grinding.

## STANDARD BORING AND TURNING TOOLS FOR GISHOLT LATHES.

Figure 1540, page 28, shows the standard set of tools for boring and turning plain, circular or cylindrical pieces such as gear blanks, sleeves or collars, and for general work within the range of the machine. When the variety of work requires it, this standard set forms an excellent basis for an outfit of special tools. The addition of a few cutters and reamers will adapt this set to a large range of special work. Reamers are not included in the set as a great many sizes would be required to provide any considerable range. The boring bar cutters furnished provide for ample variation in standard sizes.

The Gisholt Solid Adjustable Reamers are fully described beginning on page 148 and the Gisholt Boring Bars with adjustable and solid cutters are described beginning on page 124.

## STANDARD BORING AND TURNING TOOLS FOR GISHOLT LATHES (continued)




### TOOLS IN SET.

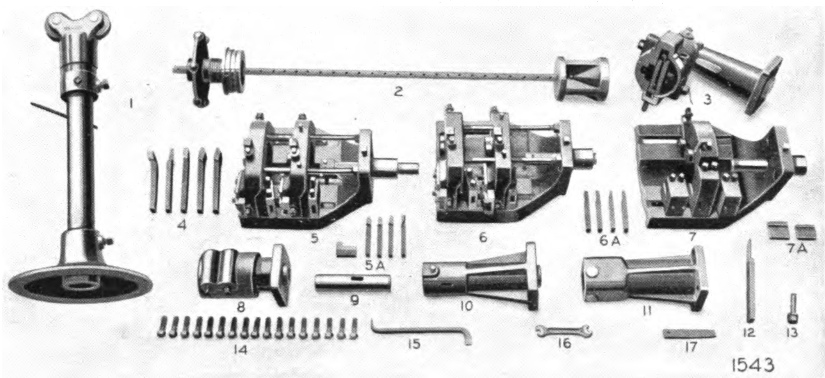
(Figures refer to Cut Numbers.)

1–2–3—Three Tool Post Tool Holders.
4—One Set 6 Tool Bits Formed and Ground.
5—One Set 6 Tool Bits Blank.
6—One Set 3 Universal Chuck Jacks.
7—One Set Hex Head Turret Screws.
8—One Set 3 Drill Holders.
9—Two Drill Sockets No. 4 Morse Taper.
10—One Drill Socket No. 5 Morse Taper.
11—One Drift.
12—Seven Pairs Expansion Boring Bar Cutters.
13—One Pair No. 4 Boring Bars.
14—One Lubricating Chuck Bushing.
16—One Reamer Arbor No. 4 Morse Taper.
17—One Reamer Arbor Support.

Boring Bar Cutters furnished in the set give the following range of holes for the various sizes of lathes:

13″ Lathe ---------- $1\frac{9}{16}$″—$3\frac{1}{16}$″ 28″ Lathe---------- $2\frac{3}{8}$″—$4\frac{1}{2}$″
21″ and 24″ Lathes----- 2″—$3\frac{3}{4}$″ 34″ and 41″ Lathes--- $2\frac{7}{8}$″—$5\frac{1}{2}$″

## BAR TOOLS FOR GISHOLT LATHES




This illustration shows the Standard Set of Tools for Bar Work on Gisholt Lathes. This set is the result of our study of the requirements of many customers covering a large variety of work. Consequently it is so designed as to be easily adjustable and of great range.

### TOOLS IN SET.

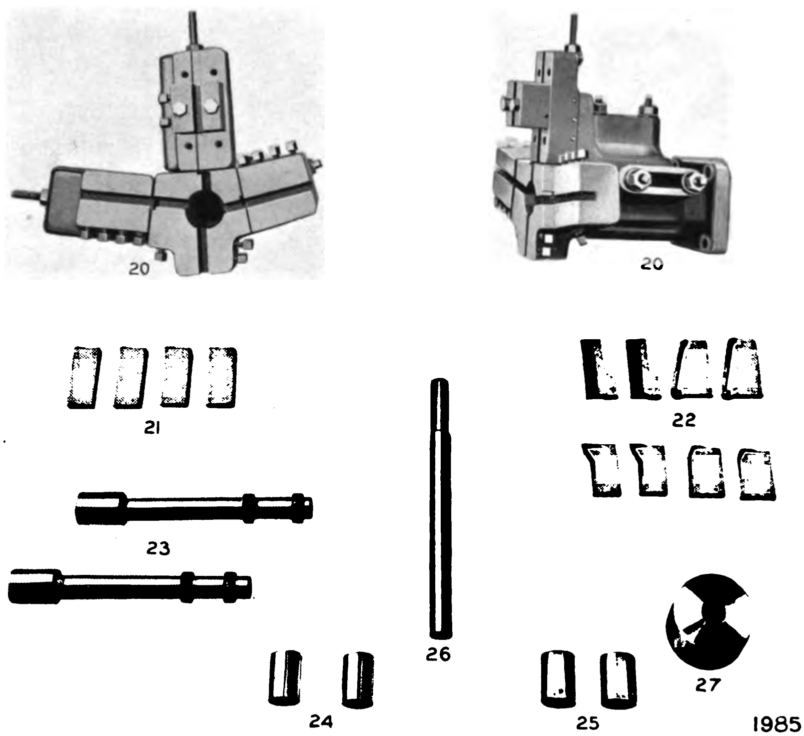
(Figures refer to Cut Numbers.)

1—One Rod Stand.
2—One Centering Sleeve.
3—One Bar Stock Feeder.
4—Five Tool Post Tools.
5—One Roughing Box Tool with Cutters.
6—One Finishing Box Tool with Cutters.
7—One Taper Forming Box Tool with Cutters.
8—One Die Head Holder.
9—One Drill Socket No. 5 Morse Taper.
10—One Drill Holder.
11—One Tap Holder.
12—One Cut Off Tool.
13—One Cut Off Tool Support.

Box Tools will take work as follows: (outside diameters)

| | |
|---|---|
| 21″—3½″ Lathe ------3⅜″ x 13″ | 24″—6¼″ Lathe -----5⅞″ x 16″ |
| 24″—4¼″ Lathe ------4⅛″ x 15″ | 28″—6¼″ Lathe -----5⅞″ x 17″ |

## FACING HEADS AND ACCESSORIES




This illustration shows the Gisholt Universal Facing Heads and Accessories that may be used on a great variety of work, and serve as an aid in maintaining standard diameters, etc., on the work being finished.

### TOOLS IN SET.

(Figures refer to cut numbers.)

20—Facing Heads located on the turret by a pilot and held by screws. All three arms have adjustment for length while the top and back arms have screw adjustments for setting diameters and top arm also has a removable tool block which may be set in different positions.

21—Cutters—one set of four blank facing head cutters.

22—Cutters—one set of four roughers, and four finishers. The shapes shown are those frequently used in facing heads and may be made from blank cutters.

23—Supporting arbors with bushing retaining collars, used for supporting facing heads, the best results being obtained when bushing and arbor bear directly in bore of work.

24—Supporting bushings held on supporting arbor by retaining collars, the outside made a slip fit in the bore of work.

26—Face plate arbor occasionally used; is held in chuck and is sometimes used to center work which cannot be conveniently chucked with jaws. Arbor runs in bushing held in facing head.

25—Taper bushings are used in facing heads to support face plate arbor.

27—Chuck bushing used in chuck to hold face plate arbors.

## SETTING UP THE TOOLS ON THE MACHINE.

No matter how simple or how intricate may be the sequence of operations on any turret lathe job, the following plan will reduce to a minimum the chance for error as well as the labor.

To begin with, ascertain the number of pieces to be machined at a time, also the estimated total number. This will govern the outlay to be made for special equipment. Some work can be done better and more quickly with a few special tools in addition to the standard tools; consequently, special tools are desirable when a large number of the same piece is required. But when the standard tools will do the work and, the number of pieces is rather small, it is not advisable to make special tools as their cost would probably over-balance the saving in time of machining.

The chucking equipment is considered first, because, before cutting can be done, the piece must be chucked. We furnish with the machine a regular standard jaw shown on page 42 but frequently jaws especially fitted to the work will give the most satisfactory results. The standard jaw was adopted as it proved more applicable, generally, than any other shape. By referring to Chuck Equipment chapter, wherein are shown numerous types of jaws and several face plate fixtures, practical ideas may be formed as to how best to hold any particular piece. We want to impress on your mind very clearly the necessity of securely holding the work as this particular phase of tooling must be considered as an absolutely necessary foundation for every tool equipment. Points along this line which must not be overlooked, are the required size limits, and the points against which the piece must be located when chucked. As, when the size limits are close, the work must not be distorted by the pressure of the chuck jaws if true work is expected. Very often an inexpensive change in the pattern, which does not materially change the design of the piece, will greatly simplify the chucking.

After definitely deciding on the chucking method, the roughing tools for turning and facing must be considered. These are almost always held in the tool post. Tools for rough boring diameters too large to be bored with boring bar heads are also held in the tool post. A number of these tools of various shapes are shown.

When planning the turret tools, drills are the first in order, and to decide about this, one must know if the hole in the work is cast or forged solid or if it is cored. If solid, a two lip twist drill or something that will do the same work, is necessary. But if cored, a suitable core drill should be used, supported in the regular drill support. The core drill, however, is only needed for cored holes that are too small to allow a fairly rigid boring bar pilot to enter. The question of proper grinding of drills is discussed in "Drill" chapter, and a few special drills are shown in "Drill Support" chapter.

Next in order come boring bars. The nature of the work and quantity of pieces required will determine whether or not special bars are needed. In either case, we would, if possible, use the type shown in Boring Bar chapter. A few special bars are illustrated in this chapter from which ideas may be formed as to the bars best suited for the work. If the size limits of the hole are close, a roughing and finishing bar should be used with correct allowance between the roughing and finishing cutters. Allowances are noted in "Boring Bar" chapter.

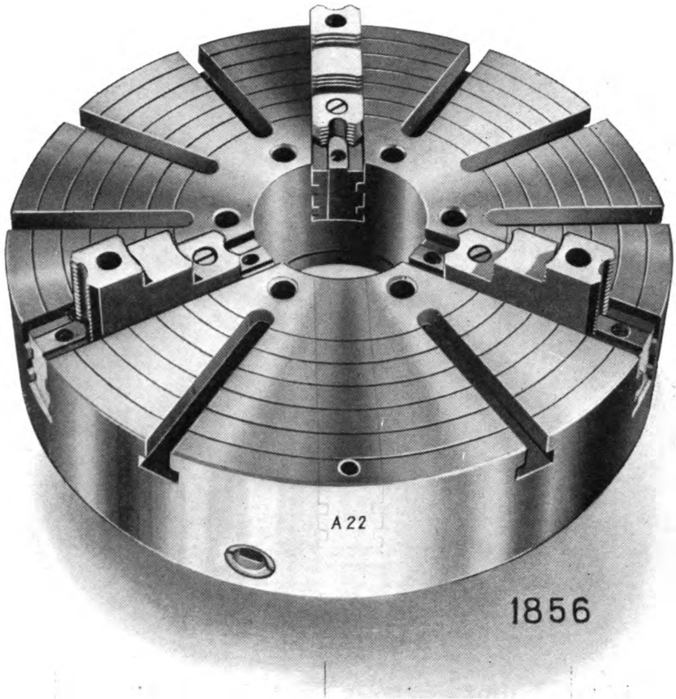
Reamers are an important part of the turret tool equipment and should follow the finishing bars in holes requiring accurate dimensions. This subject is thoroly discussed in "Reamer" chapter, several special reamers being shown.

The facing heads are generally used in pairs, especially if the size limits are close. One, used to true the surfaces roughed with tool post tools and the other, for sizing the most accurate dimensions, and, if necessary, three can be used, altho often times only one is necessary to properly finish the work when a liberal tolerance in size is allowed. At all times they should be rigidly supported and set up as described in "Facing Head" chapter.

A very convenient way of setting the tools in the facing head when setting up a job, is to have a sample piece correctly finished, which will fit over the supporting arbor in the head, and serve as a gauge for setting the tools. In this way the tools may be set so only a minimum of adjustment will be necessary to obtain the sizes wanted.

This sample piece may sometimes be a help in other ways. For instance it may be put in the jaws and used as a gauge for setting stops, both for the turret and tool post tools, near enough so that very little adjustment is required for final setting.

# Chucking




THREE JAW UNIVERSAL GEARED SCROLL CHUCK.

This chuck is very rigidly constructed and is used on nearly all Gisholt Turret Lathes. Changes have been made from time to time which have added to its life, rigidity and adaptability.

It may be used as a two jaw chuck by removing false jaw A22 and inserting either the number one or number three jaw bases.

Special shaped jaws may be made for irregular work which cannot be held in three jaws.

Various types of these jaws are shown in figures 86Z page 44, 88Z page 48, and 136Z page 52.

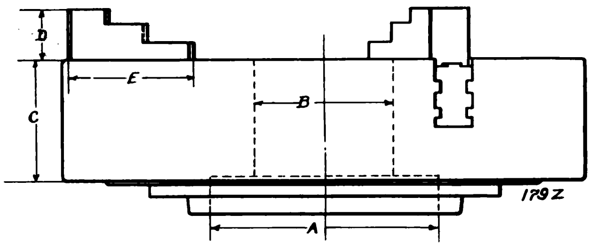
You will note (see figure 1856, page 33) the jaw base which we call the "dust proof jaw base" almost completely fills the slots in the body. At each end is a small felt block which fills the opening necessary to start the rack teeth of the jaw base in the scroll.

The bases are provided with cross slots and corresponding screw holes so that the top jaws may be set at different diameters. With this arrangement it is only necessary to move the bases a short distance in or out, thus keeping a majority of the base rack teeth in mesh with the scroll teeth at all times, and undoubtedly greatly increasing the life and strength of the whole chuck.

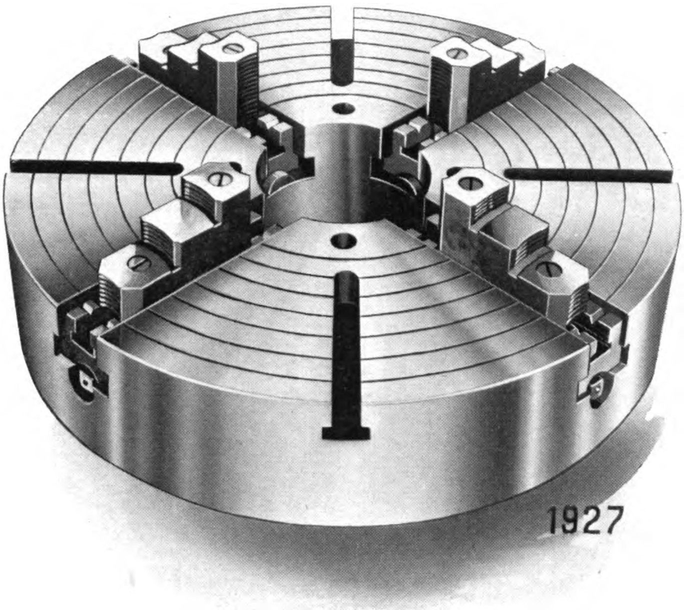
As the rack teeth and scroll are never exposed, chips cannot work in and cause the trouble which we know follows when foreign substance works into running bearings.

The regular equipment of these chucks includes one set each of standard reversible hard and soft top jaws, with the necessary wrench and screw driver.

## DIMENSIONS AND WEIGHTS




| Diameter Inches | Weight Pounds | "A" Inches | "B" Inches | "C" Inches | "D" Inches | "E" Inches |
|---|---|---|---|---|---|---|
| $13\frac{1}{2}$ | 150 | 7 | 3 | $4\frac{1}{4}$ | $1\frac{15}{16}$ | $4\frac{1}{16}$ |
| 18 | 315 | 9 | $4\frac{3}{8}$ | $5\frac{3}{8}$ | $2\frac{3}{8}$ | $5\frac{15}{16}$ |
| 24 | 570 | $10\frac{1}{2}$ | 5 | $5\frac{11}{16}$ | $2\frac{3}{8}$ | $5\frac{15}{16}$ |
| 24 | 565 | $12\frac{1}{4}$ | $6\frac{3}{8}$ | $5\frac{11}{16}$ | $2\frac{3}{8}$ | $5\frac{15}{16}$ |
| 28 | 815 | $10\frac{1}{2}$ | 5 | $6\frac{1}{2}$ | $2\frac{15}{16}$ | 7 |
| 28 | 810 | $12\frac{1}{4}$ | $6\frac{3}{8}$ | $6\frac{1}{2}$ | $2\frac{15}{16}$ | 7 |
| 32 | 1180 | $13\frac{1}{2}$ | 6 | $6\frac{9}{16}$ | $2\frac{15}{16}$ | 7 |



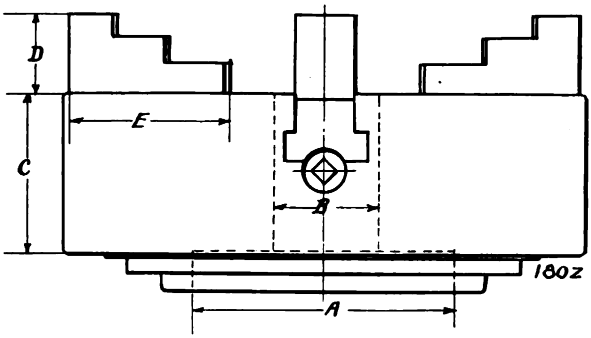

FOUR JAW INDEPENDENT CHUCK.

This chuck is of very heavy, rigid construction, and is sometimes used in connection with the Gisholt turret lathe, but should only be used when the work cannot be handled with the regular three jaw chuck.

Its design embodies the "dust proof" feature same as is found in the three jaw scroll chuck. The jaw base practically fills the slot in the chuck and the top jaw may be adjusted to different positions, necessitating only a small movement of the jaw base.

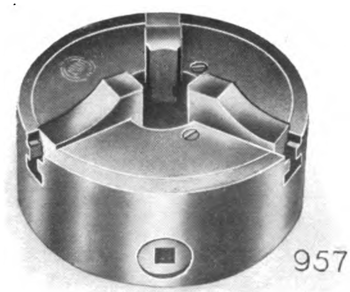
Hard top jaws are almost always used with this chuck altho soft ones could be applied if necessary, and could be fitted readily to the work.

## DIMENSIONS AND WEIGHTS




| Diameter Inches | Weight Pounds | "A" Inches | "B" Inches | "C" Inches | "D" Inches | "E" Inches |
|---|---|---|---|---|---|---|
| 13½ | 150 | 7 | 3 | 4⅝ | 1⅞ | 3⅞ |
| 18 | 310 | 9 | 3⅝ | 5½ | 2⅝ | 5½ |
| 24 | 490 | 10½ | 5 | 5½ | 2⅝ | 5½ |
| 24 | 485 | 12¼ | 6⅜ | 5½ | 2⅝ | 5½ |
| 28 | 720 | 10½ | 5 | 5¾ | 3⅜ | 7 |
| 28 | 715 | 12¼ | 6⅜ | 5¾ | 3⅜ | 7 |
| 32 | 900 | 13½ | 6 | 6 | 3⅜ | 7 |

## DRILL SUPPORT CHUCK.




The chuck shown above is 6″ outside diameter and has a 2″ hole thru the center.

It is a three jaw, universal, scroll type, very rigidly constructed, and is generally used in the drill support, on the Gisholt Turret Lathe.

The jaw equipment usually consists of plain steel jaws, hardened and ground, altho soft jaws of any desirable shape may be used.

## BORING AND FITTING JAWS.

The first subject to consider in selecting or designing an equipment of tools is that of chucking, and it is just as necessary to start at this point when planning subsequent operations of machining a casting or forging as it is necessary to lay a foundation when erecting a large building.

Very often the piece to be machined is of frail construction and must be held in a way to prevent distortion and insure a good true job after piece has been removed from chuck. To accomplish this result in some cases it is necessary to add a chucking ring to the casting and bore the jaws especially to fit. Again, the chucking problem is quickly solved by providing in the casting three holes of proper dimension in which to insert the jaws.

In connection with the chucking problem comes the order of operations, which sometimes influences the method of chucking. Some castings, if properly chucked, may be finished at one setting, while others will require as many as three or four chuckings before the piece can be finished, especially when the size limits are very close.

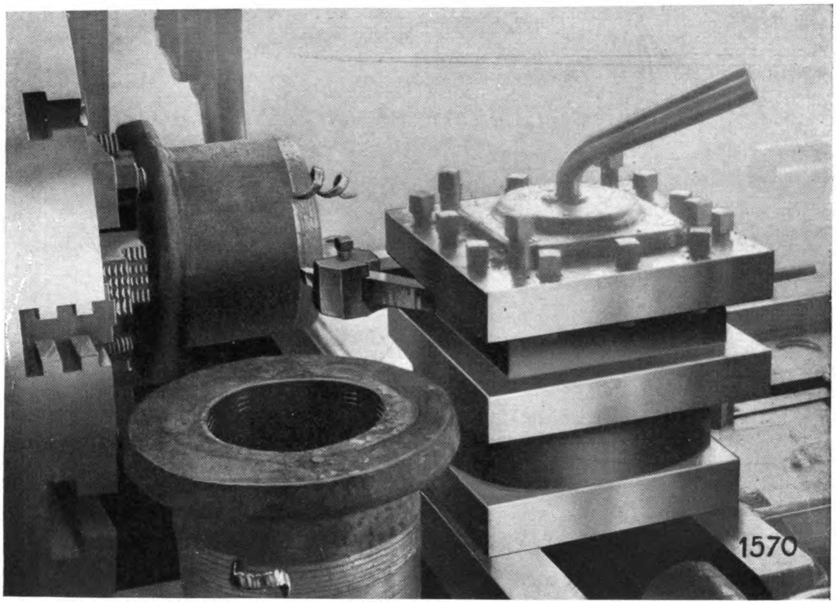
The first and most important point is to hold the work securely, and to accomplish this end, special jaws are often absolutely necessary.

Surfaces on which the jaws bear are usually tapered, caused by the draft on the pattern or in the forging dies, and this makes chucking difficult with the ordinary standard chuck jaw. However, by boring or turning the jaws to conform to this taper, the work may be held for very heavy cuts.

Jaws for rough castings and forgings should be corrugated and hardened, making what might be called the teeth, from $1/32''$ to $3/64''$ wide on top and from $1/8''$ to $3/16''$ wide at the bottom, and from $1/16''$ to $3/32''$ high. This type is almost always made of machine steel, carbonized and hardened, altho tool steel may be used with equally good results if properly hardened and drawn.

The teeth of the corrugated jaw sink into the work, and for this reason should not be used on finished work, altho it will hold a great deal better than a smooth one. An illustration of how the teeth leave their impression in the work is shown in figure 1570, page 38. This piece is about 7″ long and a little less than 5″ bore where chucked.

When this type of jaw is used under extra heavy duty, the pressure of the tool will cause the teeth to sink far enough into the work to loosen it slightly, necessitating a second tightening, altho the jaws may have been as tight as possible, at the start. In order to set the chuck jaws as tightly as possible, the wrench should be applied to all three pinions successively. Do not overlook this point. The standard wrench furnished should not be changed in any way.

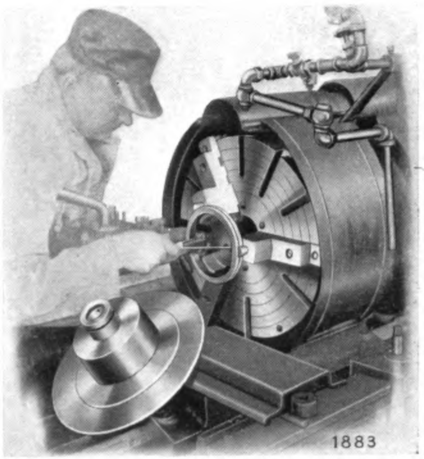



The main object in boring or turning jaws is to have them conform to shape of the surface on which they are to bear. There are no doubt several ways in which this may be done satisfactorily. We shall, however, describe the method which has proved most practical and produced the best results.

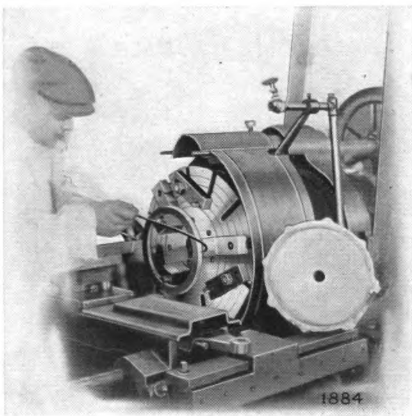
An object of some kind should be gripped in the jaws as near as possible to the point where the jaws will take their bearings on the piece to be machined. As a standard equipment for this work we call your attention to figure 1883. Here we have a set of three studs and a steel ring. The studs are placed in the counterbored holes, one in each jaw, as shown, and the ring chucked in them. This sets the jaws in the proper position for boring. They should be tightened up on the ring with about the same pressure as will be used when chucking the work.

A greater accuracy is necessary when preparing jaws for chucking on finished work especially when it is desirable to have the chucked surface run true. The jaws should not be bored the exact diameter of the piece to be chucked but an allowance made for spring. This allowance will approximate .0015″ to each inch of diameter on the chucking circle for finished surfaces and the allowance should be doubled for rough castings. For example, suppose the piece to be chucked is 4″ diameter, the jaws should be left about .006″ small when boring and .006″ large when turning. If the jaws are being prepared for a rough casting, the allowance should be about .012″ or $^1/_{64}$″.

When the jaws are bored or turned on a large circle, the measuring must, of course, be done from the tool to the jaw, as is shown in figures No. 1883 and No. 1884.



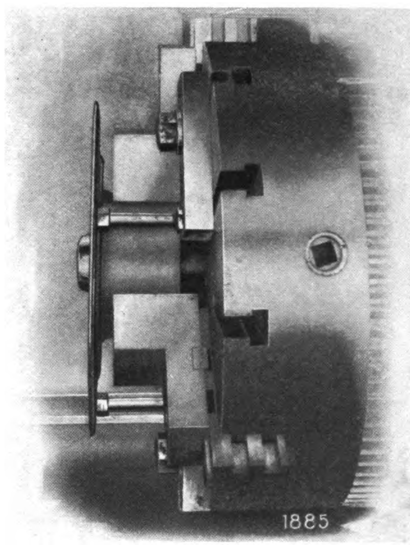

It must be understood that these allowances are only approximate and cannot be depended on absolutely. To be sure of good results, the chuck pinion used to tighten the jaws should be marked when in the tightened position. And when




the jaws are tightened on the work the pinion should be in exactly the same position as when boring. If not, the jaws should be rebored or turned as the case may be and more or less stock left to take up the spring as required.

For chucking on finished surfaces, or second operation work, the same pinion should always be used to tighten the jaws on the work as was used to tighten them on the ring when they were bored or turned. This will bring the scroll to the same position on the rack of the jaw base and the work will run true within .001″, providing this method is carefully followed and the chucked surface is round and uniform in size. It may be necessary occasionally to rebore the jaws if large numbers of pieces are being machined at a time.

Figure 1884, page 39, shows the operator calipering the size of the jaws he is turning for the piece shown. Note the ring and stud plan is used for turning as well as boring, only the ring is chucked *on* the studs which is just the reverse of the boring operation. If a ring cannot be found suitable for the job, heavy, soft wire may be used to hold tension on the jaws.



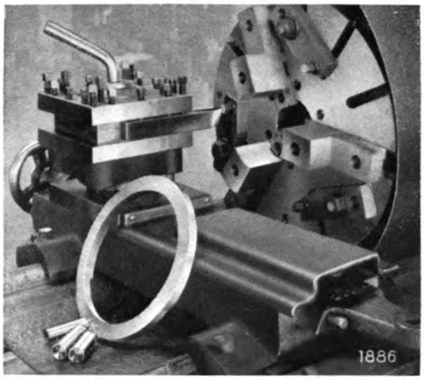

When it is necessary to resort to the wire the jaws should be run in a half an inch or so from the circle on which they will be turned and the wire wound around and securely fastened. Then return the jaws to proper position being sure wire is tight and proceed to turn to proper size.

If jaws are taper bored or turned, use taper attachment. (See "Taper Attachment" Chapter, page 115.)

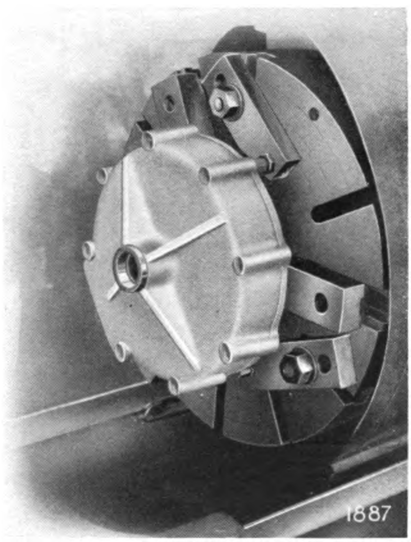
## CHUCK JACKS.

We have found the use of chuck jacks very valuable on a large variety of chucked work. Figure 1885 shows a flanged hub chucked with soft jaws and with the flange supported by standard chuck jacks. These not only help support the flange against the tool pressure but serve to true the flange when chucking.

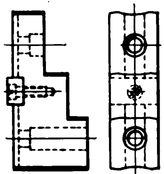
Figure No. 1887, page 41, shows a piece chucked internally and located by standard chuck jacks. The screws in the jacks are soft steel and are faced off true and square as is shown in figure No. 1886. The ring and studs which were used in boring the jaws are also shown in this figure.

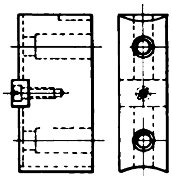


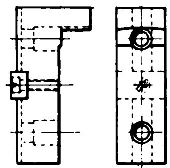

In figure No. 90Z, page 58, at CK52a is shown a spring chuck jack stud. When only three chuck jacks are required the solid ones serve the purpose very well, but sometimes it is advantageous to use more than three. The spring studs are indispensable for this work as they automatically adjust themselves.

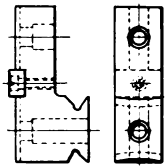


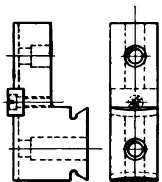

For example suppose we wanted to use 6 chuck jacks on the piece shown chucked in figure No. 1885, page 40. We would use 3 solid screw studs, which would remain stationary and three spring studs which would adjust themselves against the work and be tightened in place.

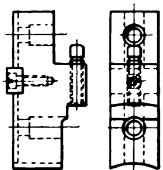

CK 1

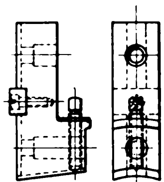

CK 2


CK 3


CK 4


CK 5


CK 6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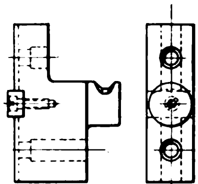
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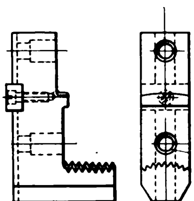
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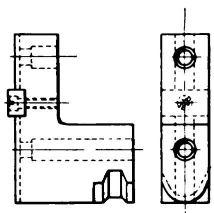
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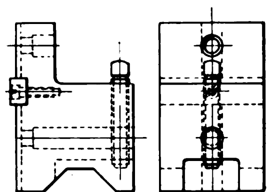
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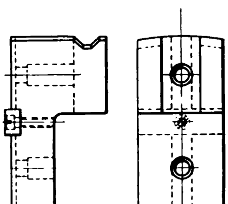
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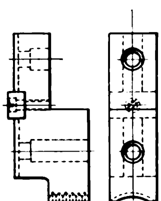
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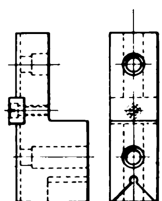
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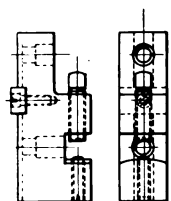
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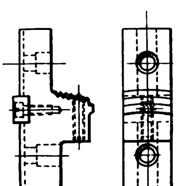
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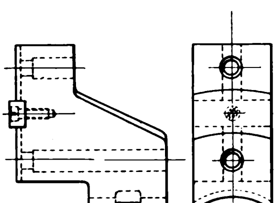
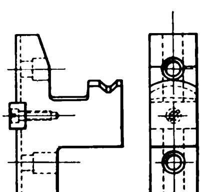

CK 17

85 Z


CK 18

*Symbol and number refer to figures on page 42.*

CK1. Standard hard jaw furnished with machine.

CK2. Soft jaw, one end bored thru, the other end bored to a shoulder.

CK3. Jaw for large diameter work, used either hard or soft.

CK4. Jaw for bevel gears, large and small, used either hard or soft.

CK5. Jaw for work having chucking flange, such as piston ring pots, etc., large and small. Used either hard or soft.

CK6. Hard jaw for chucking two diameters, set screw bears on larger diameter.

CK7. Hard jaw used on taper surface, pointed set screw shown helps to hold work in jaws.

CK8. Hard jaw for chucking in holes in web of gear or fly wheel.

CK9. Hard jaw for chucking inside work and supporting flange.

CK10. Hard jaw for chucking on hub between spokes.

CK11. Hard jaw used in pairs for holding "T" shaped pieces.

CK12. Hard jaw for chucking inside rim. One jaw of the set made wide to straddle spoke.

CK13. Hard jaw with heel cut out to clear flange on work or for work that is to be back faced thru spindle.

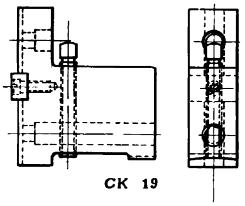
CK14. Hard jaw used in pairs for holding square work.

CK15. Hard jaw for thin pieces, work is centered with jaws and clamped with set screws, preventing distortion.

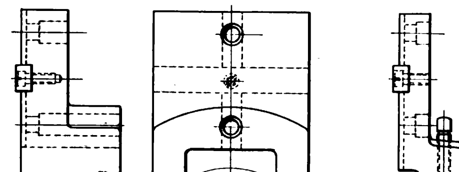
CK16. Hard jaw for inside taper surface.

CK17. Hard jaw for long work.

CK18. Hard jaw for holding inside of rim, setting work far enough away from chuck to back face rim with tool post.



CK 19



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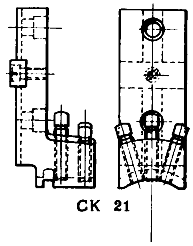

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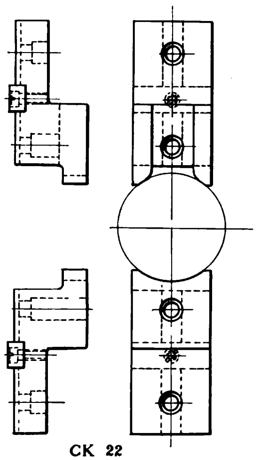

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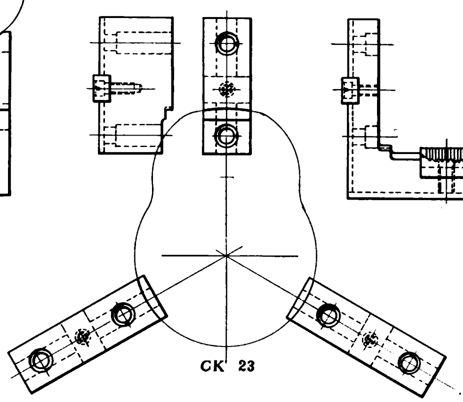

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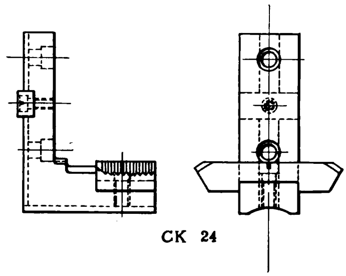

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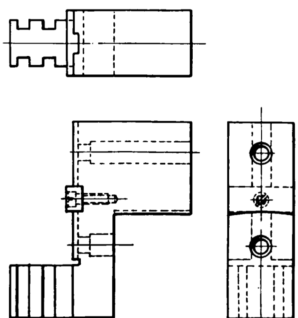

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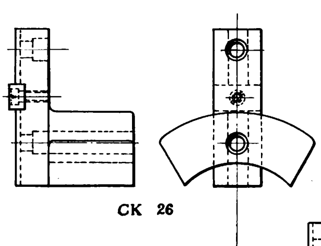

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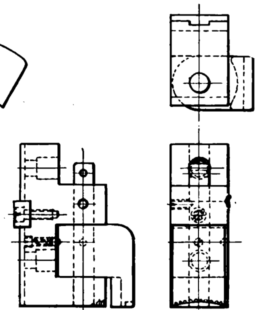


CK 27

*Symbol and number refer to figures on page 44.*

CK19. Hard jaw for long work, set screw used to center end next to chuck.

CK20. Hard jaw for holding on flange. One jaw extra wide to straddle boss on flange.

CK21. Hard jaw for holding gas engine cylinder with flanged end.

CK22. Hard jaw used in pairs for holding irregular pieces with projection on one side.

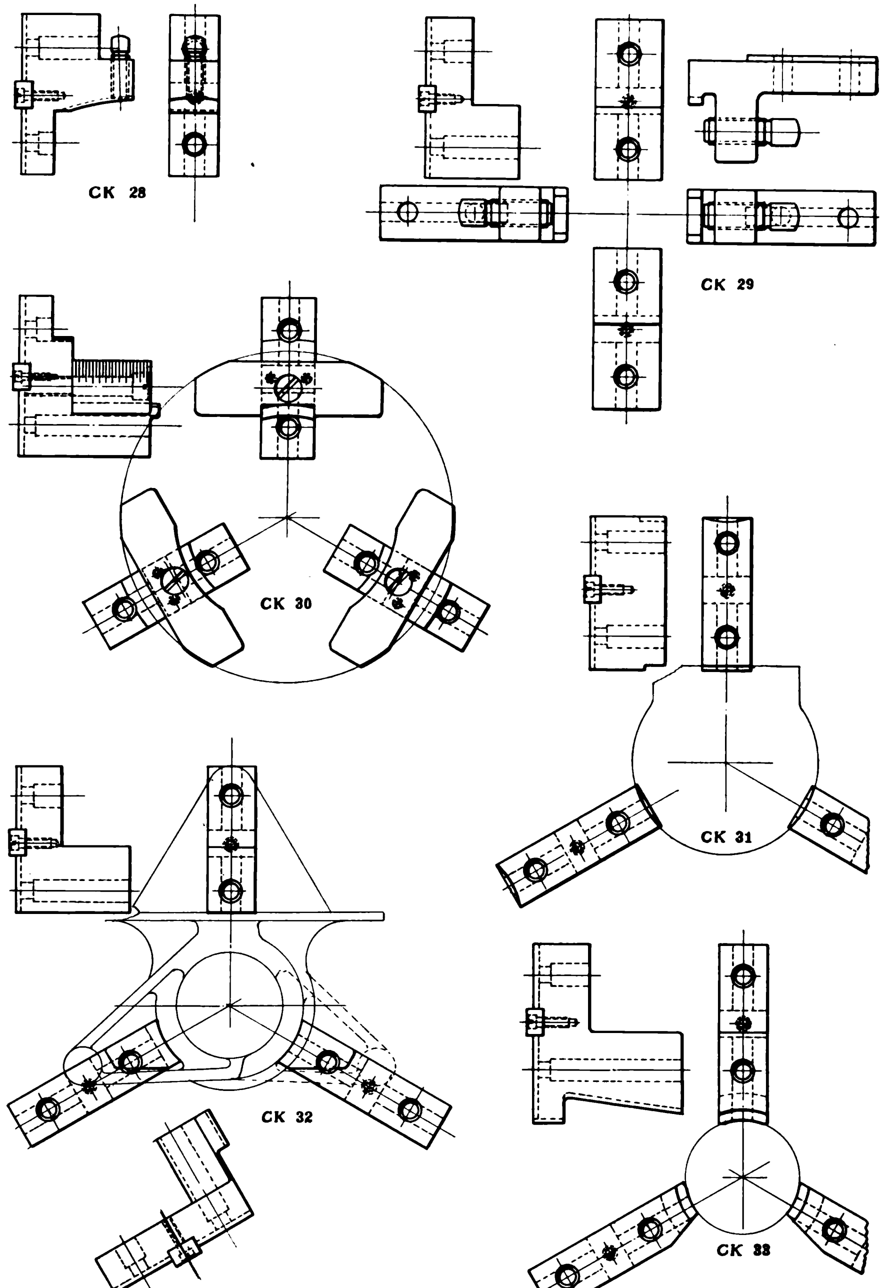
CK23. Hard jaws for gas engine bearing plate of irregular shape.

CK24. Hard jaw for inside of pipe couplings, making six point bearing.

CK25. Hard jaw for heavy chucking, gives better bearing in chuck slot when using old style short jaw base.

CK26. Soft jaw for chucking on outside of thin work. A set of these jaws almost encircles piece.

CK27. Hard and soft jaw combined, used when one set up of tools will do both operations, by reversing work in jaws.




87Z

*Symbol and number refer to figures on page 46.*

CK28. Hard jaw for holding spherical shapes.

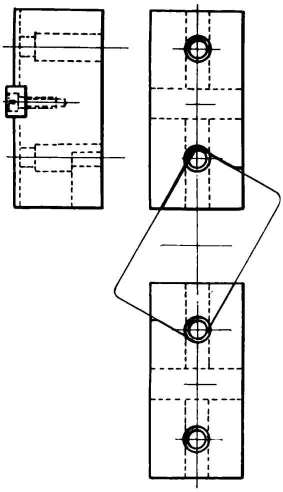
CK29. Pair of jaws and blocks for rectangular work. The two jaw arrangement is used, giving universal movement to jaws. Screws in blocks are then adjusted to suit.

CK30. Hard jaws for holding inside, large diameters. Two of cross blocks oscillate on the jaw and adjust themselves to work, while the third is solid and serves as driver.

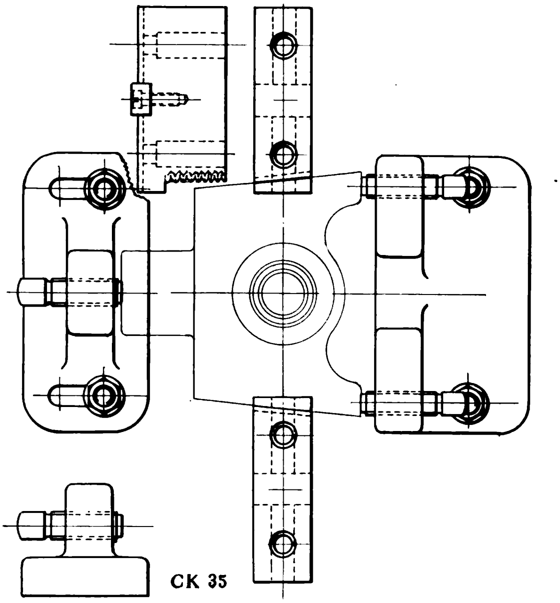
CK31. Hard jaws for irregular shape.

CK32. Hard jaws for irregular shape.

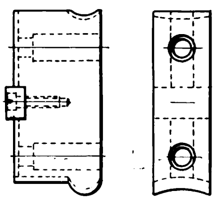
CK33. Hard jaws for taper surfaces. Two jaws cut away for clearance.



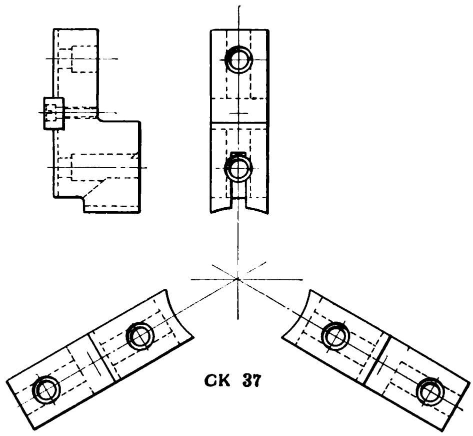
CK 34



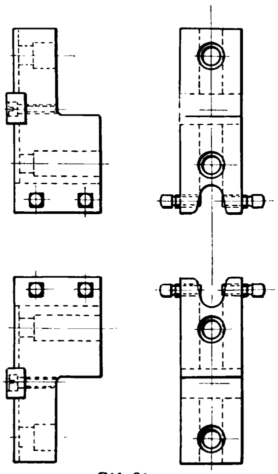
CK 35



CK 36



CK 37



CK 38

88 Z

*Symbol and number refer to figures on page 48.*

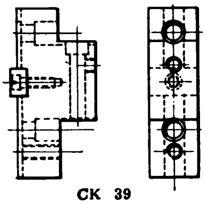
CK34. Hard jaws used in pairs for rectangular shapes.

CK35. Pair of hard jaws and blocks for holding cross-heads.

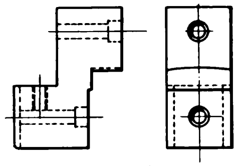
CK36. Jaws either hard or soft, one end bored for handwheels, the other for wormwheels.

CK37. Hard jaws for chucking on hub, one split to straddle rib.

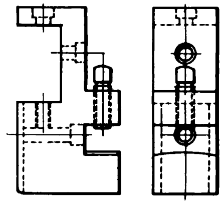
CK38. Pair of jaws slotted to straddle rib and arranged with set screws to hold on rib.



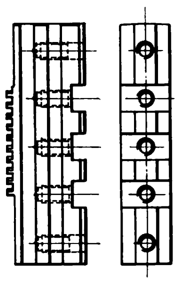
CK 39

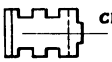


CK 40



CK 41





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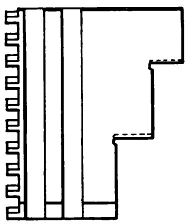

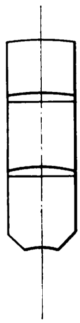

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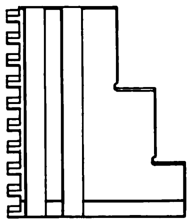
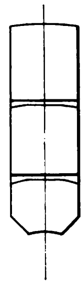
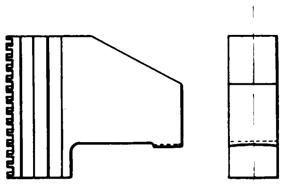




CK 44



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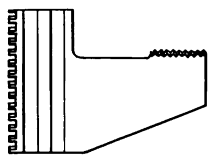
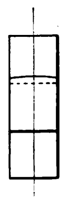
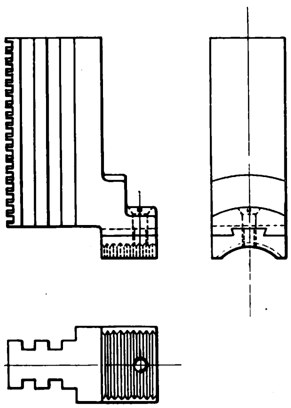
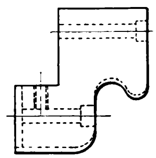
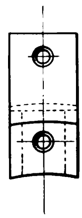




CK 46







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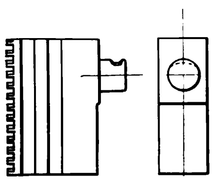
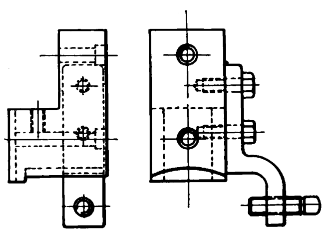


CK 49

CK 47

89z



CK 50

*Symbol and number refer to figures on page 50.*

CK39. Reversible top jaw on which may be used the small slip jaws that were furnished with the solid type of jaw.

CK40. Small slip jaw, used either hard or soft.

CK41. Small slip jaw for holding thin work.

CK42. Dust proof jaw base.

CK43. Solid type jaw for chucking on outside diameter.

CK44. Solid type jaw for chucking on inside diameter.

CK45. Solid type jaw for long work, outside holding.

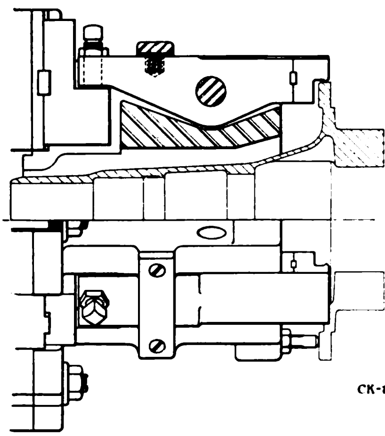
CK46. Solid type jaw for long work, inside holding.

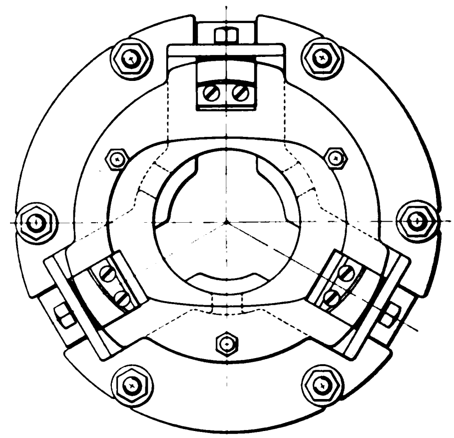
CK47. Solid type jaw with hardened steel shoe for small diameter work.

CK48. Small slip jaw for bevel gears, either hard or soft.

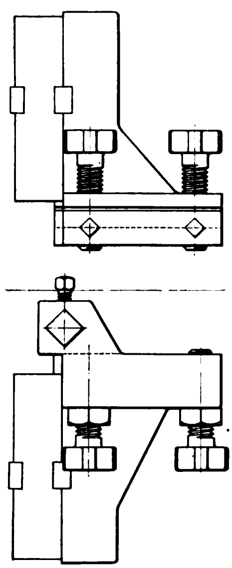
CK49. Solid type jaw for holding in holes in gear web.

CK50. Small slip jaw with driver.

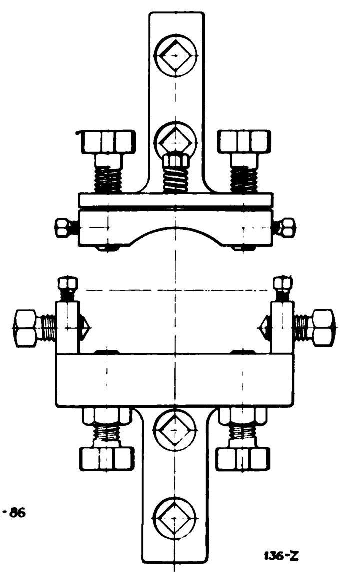




CK-85



CK-86



136-Z

In figure CK85 is shown an auxiliary jaw held in a bonnet which is bolted to the face of the chuck.

The jaw oscillates on a cross pin in the bonnet and is actuated by the regular jaw as shown. A spring is used to keep the auxiliary against the standard jaw.

This equipment was made to hold a rear axle differential carrier. The flange on which the piece is chucked is approximately fourteen inches from the face of the chuck; the hub end is centered by a cone centering sleeve in the bore of the chuck.

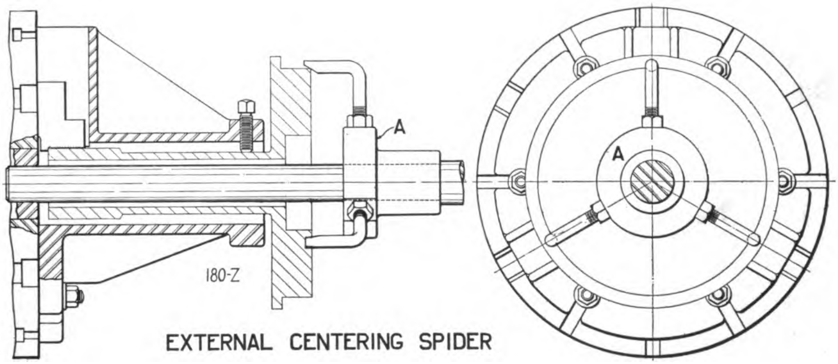
It would be impossible to hold this piece securely in this manner with a standard jaw, as it would necessarily extend fourteen inches from the chuck, which would interfere with the free sliding action the jaw bases should have.

Figure CK86 shows a special set of two jaws used to hold a very irregular shaped automobile brake band support, held against very heavy cuts, and with the aid of a centering spider, the work was properly located for boring.

## CENTERING SPIDERS.

The centering spider is a wonderful help in rapid chucking of a great many parts.

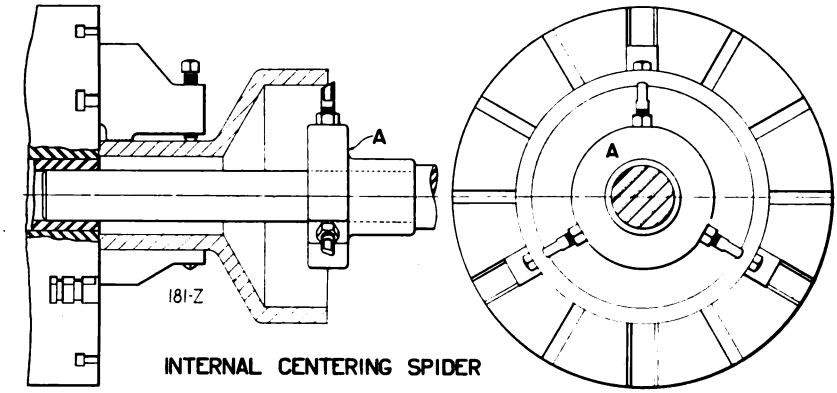
An irregularly shaped piece or extremely long work is more quickly and accurately chucked if a spider is used.



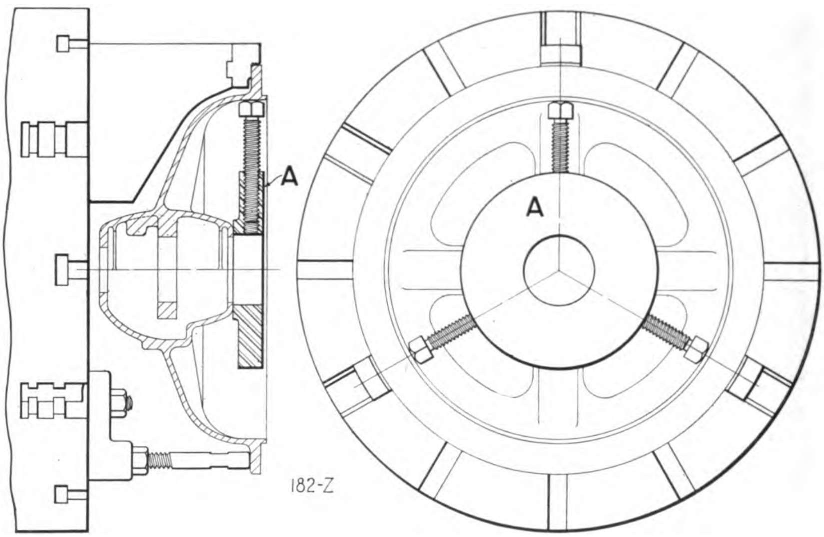
EXTERNAL CENTERING SPIDER

Figure Z—180 shows a long piece which is held at one end with jaws that are practically standard and at the other with set screws in a supporting bonnet bolted to the face of chuck. An external centering spider is used to center the outer end before setting the screws. Centering spider shown at "A".

First, the piece is put into the jaws, which are closed up to just touch the work. Second, the spider, which should be a snug fit, on the boring bar pilot is slipped into place and centered around the work as shown. Third, the screws in bonnet are set up tight with an even pressure on each screw. Of course, to do this, all




INTERNAL CENTERING SPIDER




SUPPORTING SPIDER

three screws must be set lightly against the work before any of them are pulled tight. Fourth, pull jaws up as tight as may be necessary to hold work.

Figure Z—181 is a very good illustration of how the same plan is used on the inside instead of outside. The nature of the work at hand will determine which way would work to the best advantage.

## SUPPORTING SPIDERS.

Occasionally work is brought to the Gisholt lathe which is not only very irregular in shape but fragile in nature, so much so that when chucked, the jaws spring the work out of shape resulting in an untrue piece of work when finished.

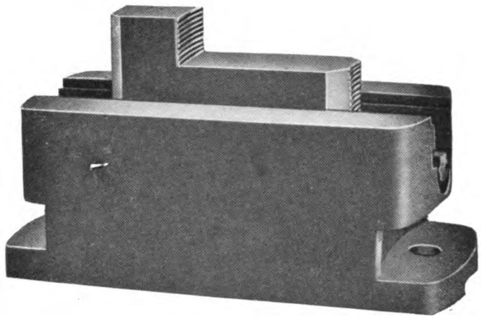
Figure 182Z illustrates a casting such as mentioned. A supporting spider is shown at A which makes possible the rigid chucking necessary to hold this piece successfully, so as to prevent distortion.

Before the piece is put in the jaws it is laid on the floor or bench and the spider placed on the hub.

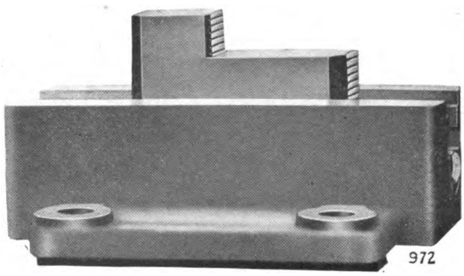
The three screws are tightened just enough to hold the spider in place.

Then the work is chucked with one screw of the spider under each jaw.

# FACE PLATE JAWS.




SINGLE TONGUE TYPE



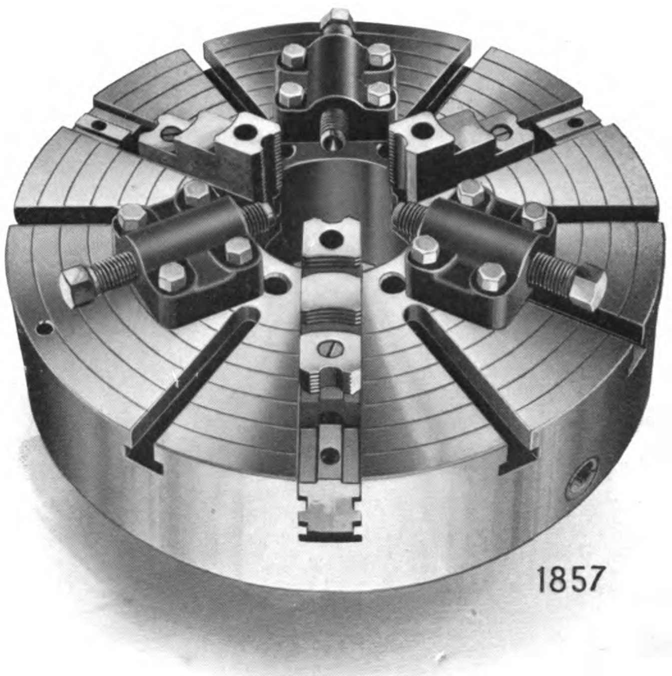

DOUBLE TONGUE TYPE

The face plate jaws shown above are most commonly used in connection with vertical boring mills and with face plate work on large engine lathes. Occasionally, however, they work in very nicely with the larger scroll chucks when the "two jaw" arrangement is used, thus forming a four jaw chuck, two jaws being controlled and operated by the scroll and the two independent jaws, each operated by its own screw.

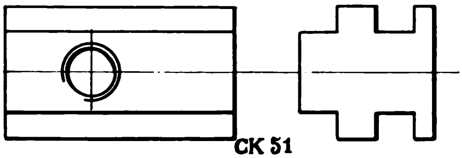
The two shown are popular types from which ideas may be gathered in designing jaws to meet any particular requirement.

## AUXILIARY JAWS.

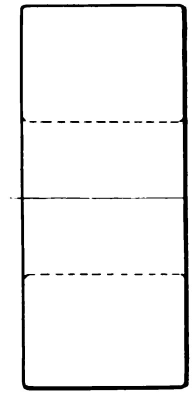
We have found that heavy bar work requires more driving power than can be had from a scroll chuck. In recognition of this fact auxiliary jaws, shown in cut 1857, are often used with excellent results. The work is chucked and centered in the regular way by the standard jaws and then further clamped by tightening the screws in the auxiliary jaws.



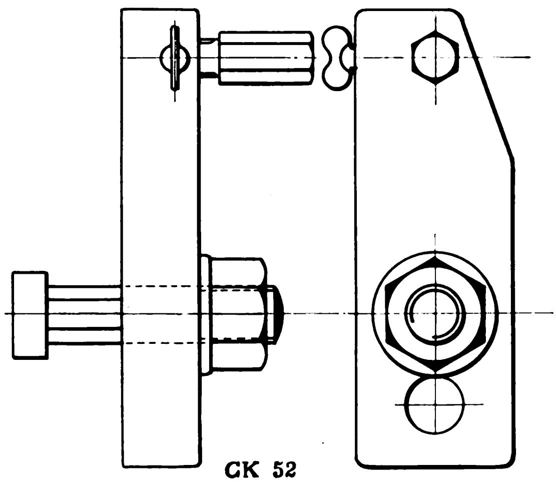
1857



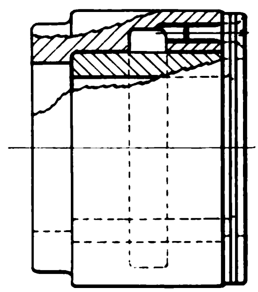
CK 51



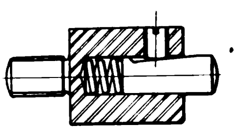
CK 53



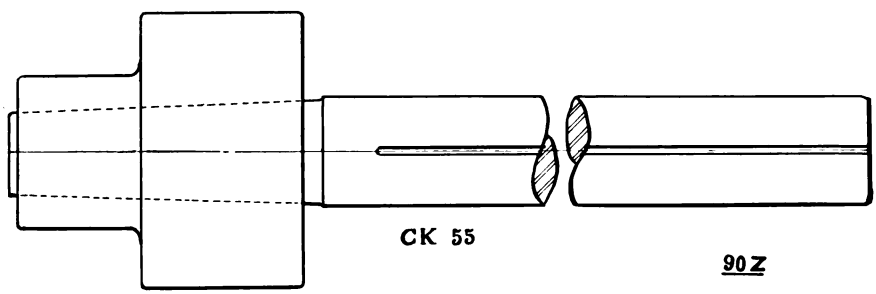
CK 52



CK 54



CK 52A



CK 55

90 Z

*Symbol and number refer to figures on page 58.*

CK51. Block used in jaw slot for bolting fixtures to chuck face.

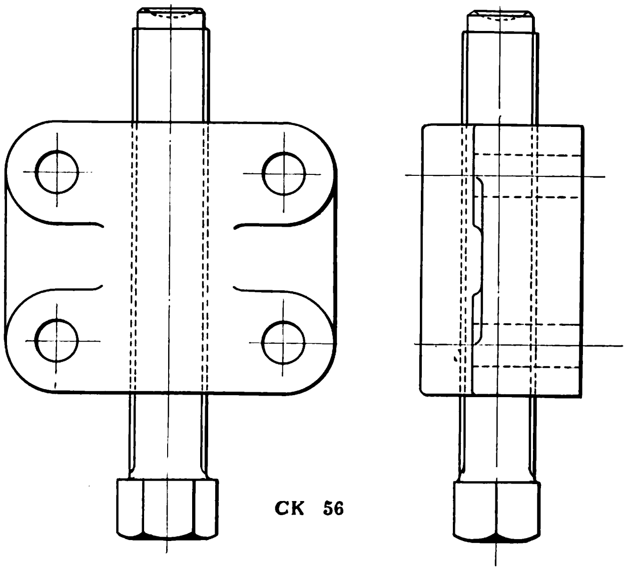
CK52. Chuck jacks used to locate and support work between jaws.

CK52A. Spring chuck jack stud, see page 40 for description.

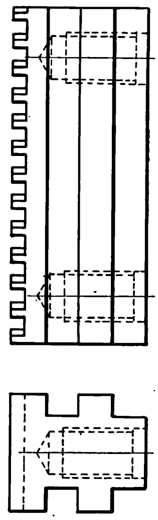
CK53. Solid chuck bushing.

CK54. Lubricated chuck bushing.

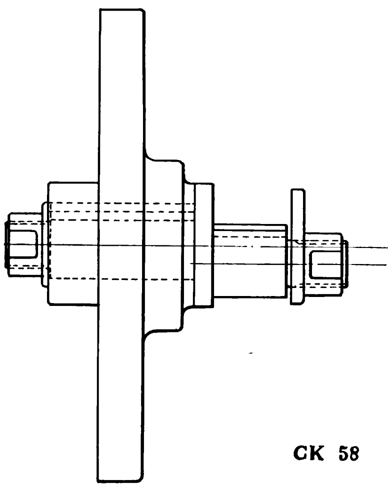
CK55. Face plate arbor and bushing.



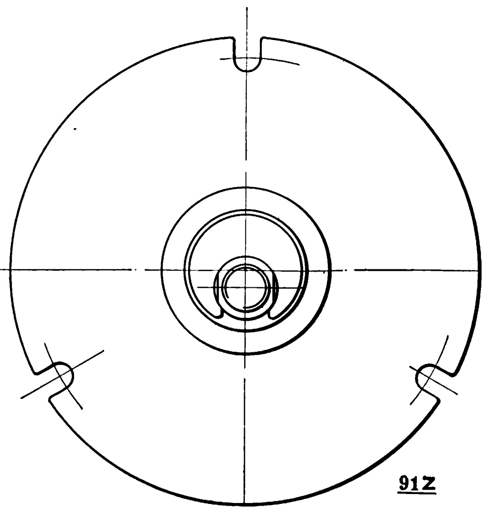
CK 56



CK 57



CK 58



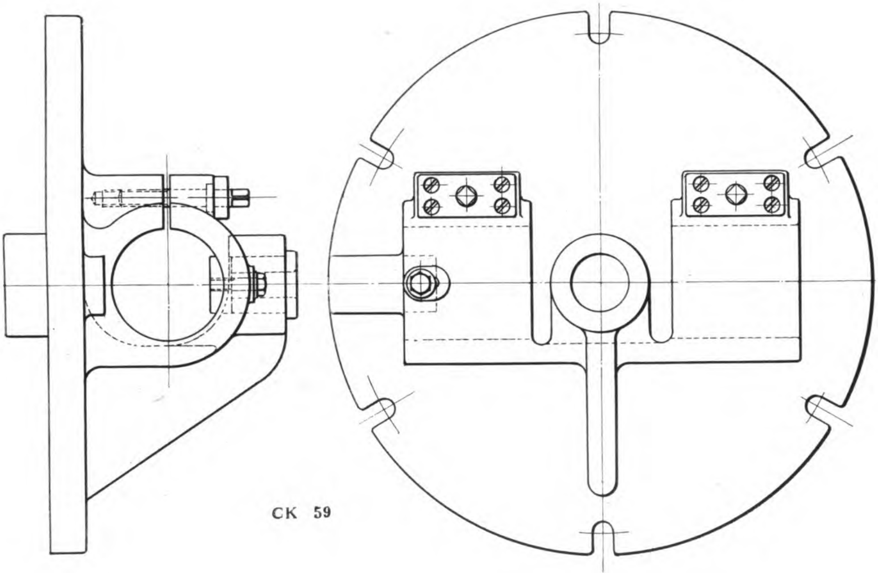
91Z

*Symbol and number refer to figures on page 60.*

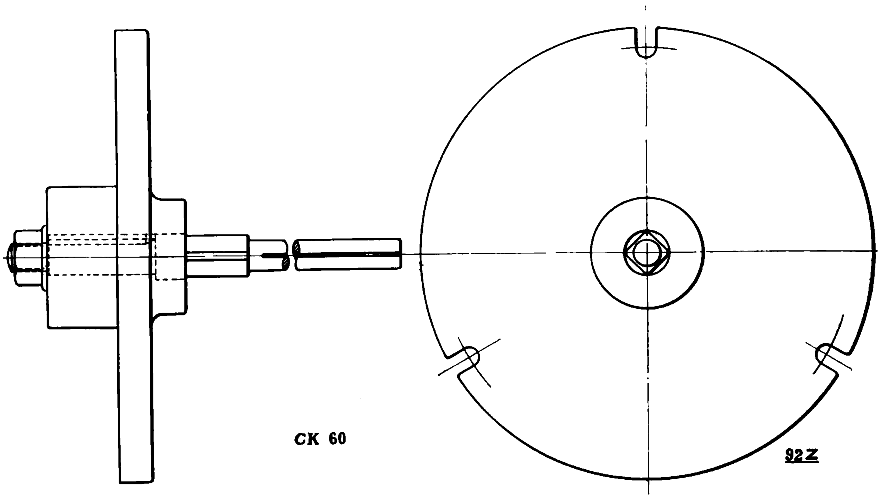
CK56. Face plate blocks, used in bar work to assist jaws in holding bar.

CK57. Scroll block, used with angle plate on chuck to adjust for center distance.

CK58. Chuck plate and arbor for turning eccentric work after it has been bored.



CK 59



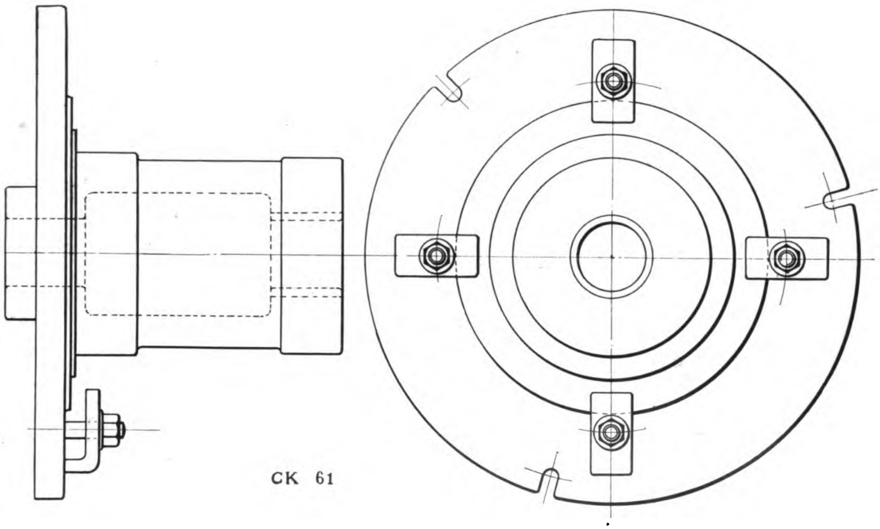
CK 60

92 Z

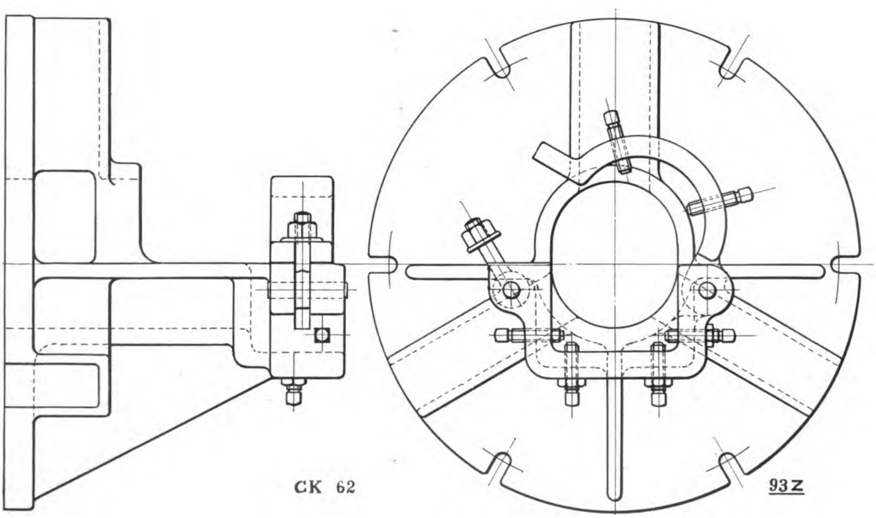
*Symbol and number refer to figures on page 62.*

CK59. Chuck fixture for boring cross pin holes in pistons.

CK60. Chuck plate with square arbor.



CK 61



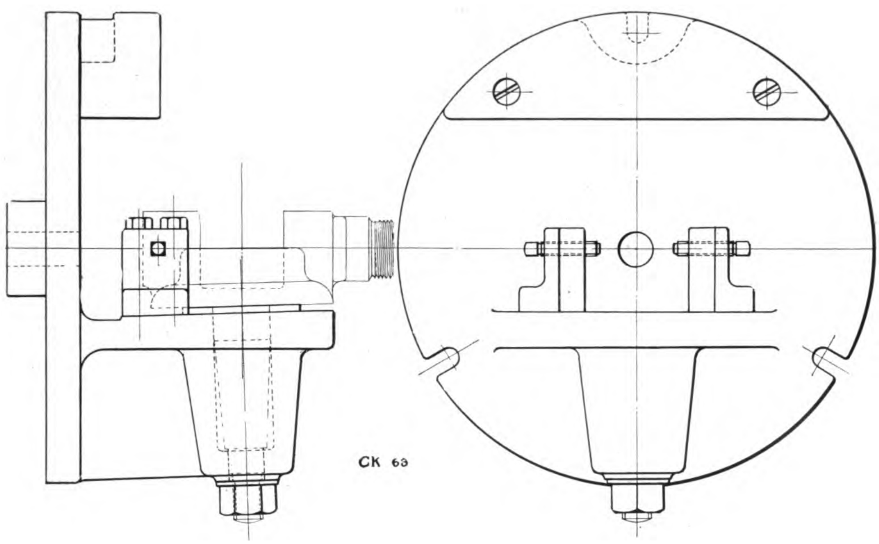
CK 62

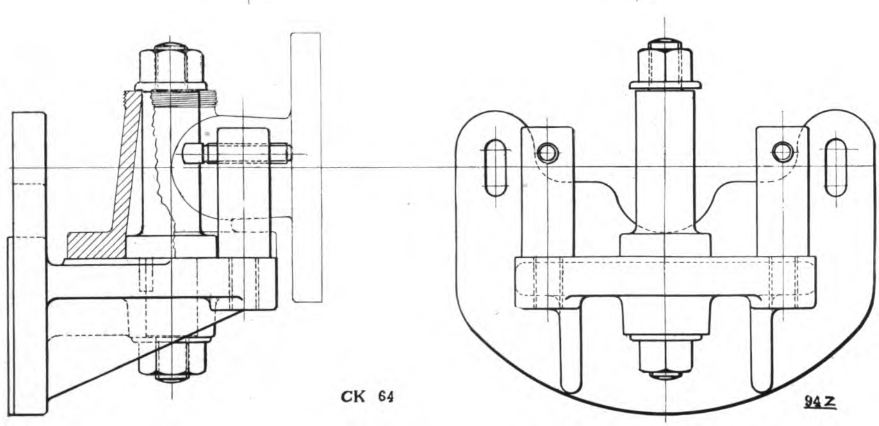
93Z

*Symbol and number refer to figures on page 64.*

CK61. Chuck plate and clamps for holding long work for second operation.

CK62. Open chuck bonnet for long, irregular shaped work.

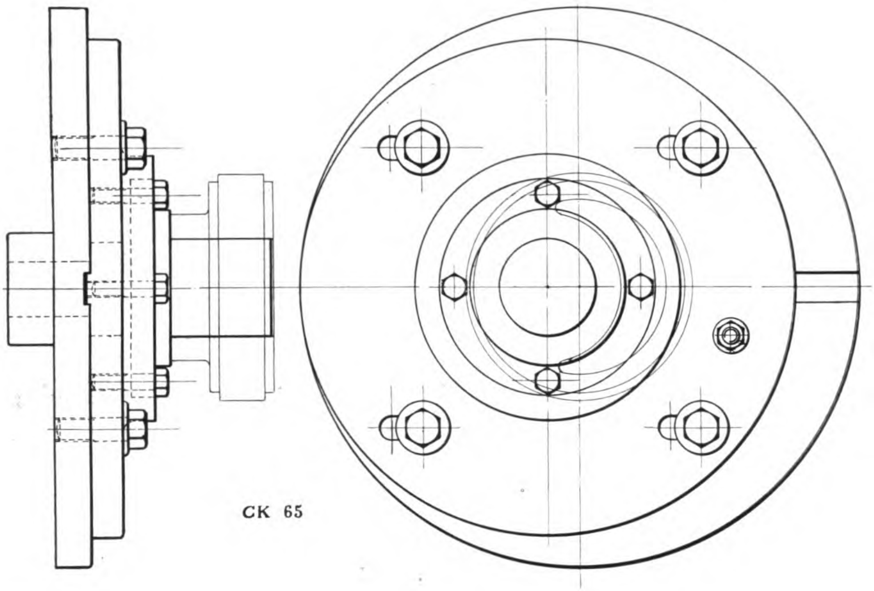

CK 63


CK 64
94 Z

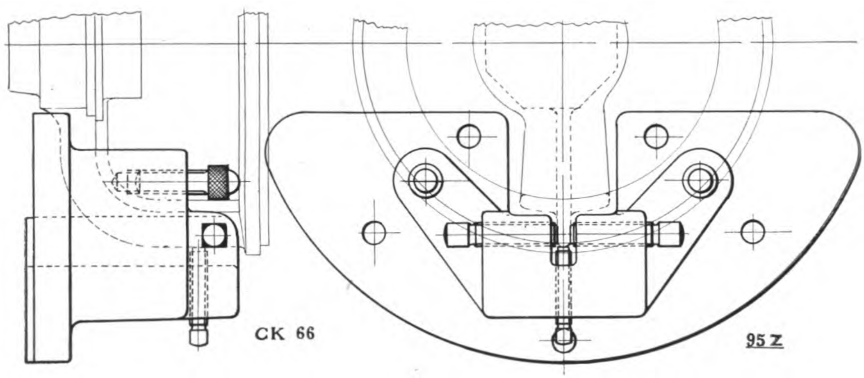
*Symbol and number refer to figures on page 66.*

CK63. Angle plate with counterweight for finishing automobile steering knuckles.

CK64. Angle plate for flanges.



CK 65



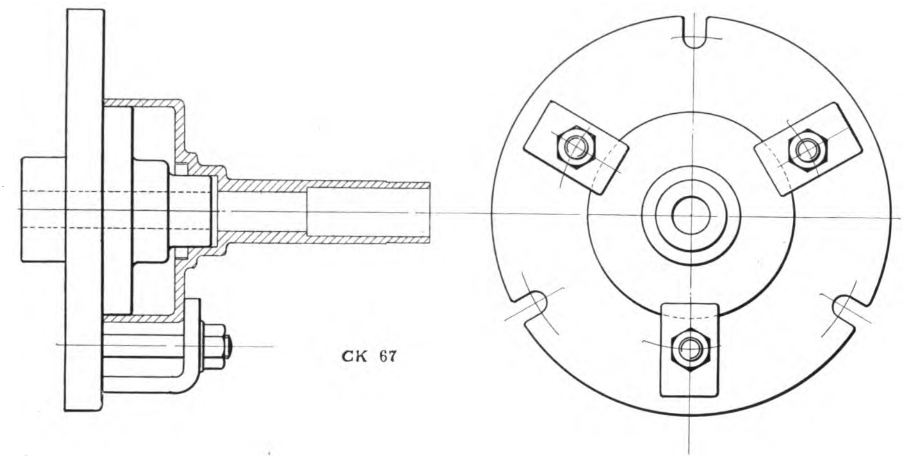
CK 66

95 Z

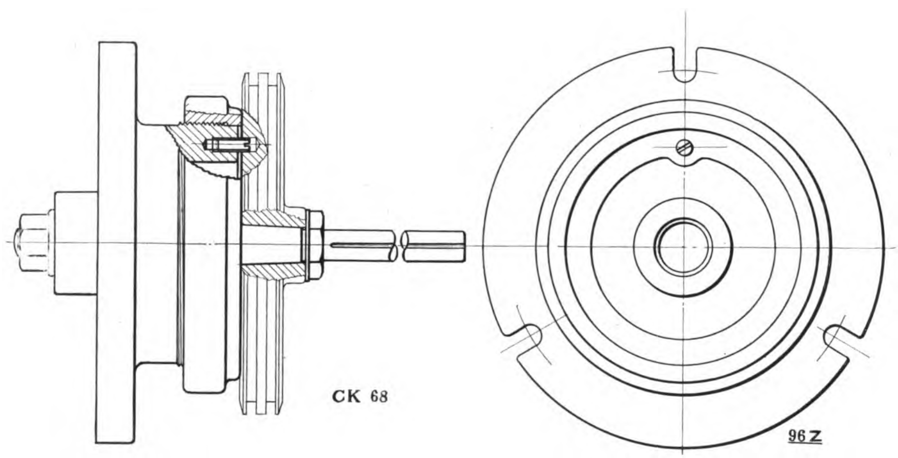
*Symbol and number refer to figures on page 68.*

CK65. Chuck plate for turning engine eccentrics.

CK66. Fixtures, used in pairs for holding motor bonnets.



CK 67

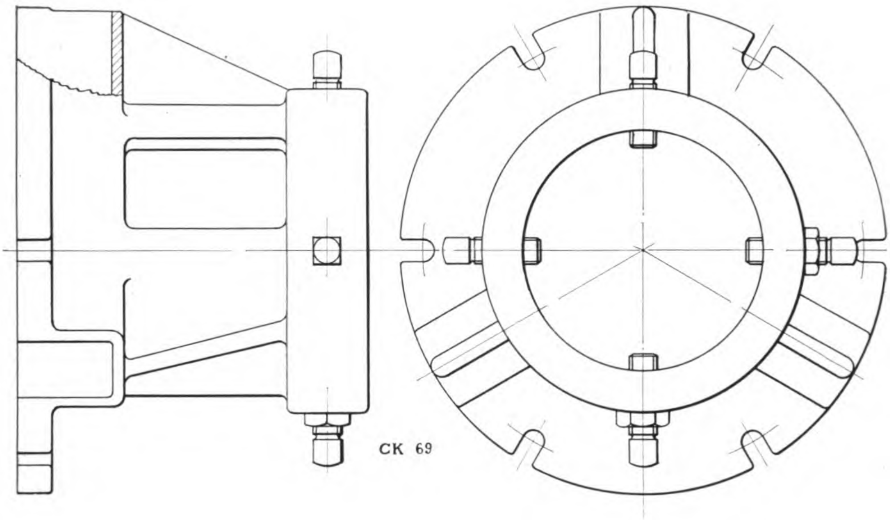



CK 68

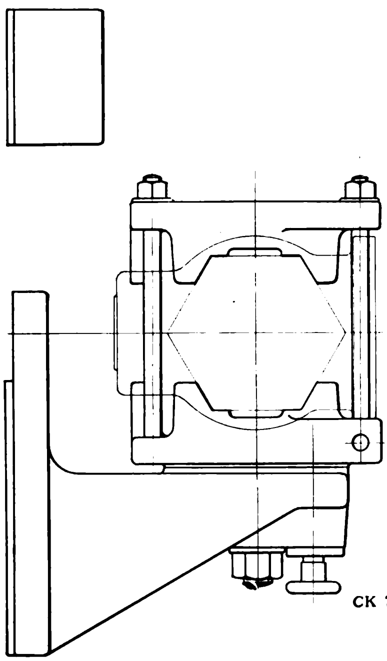
*Symbol and number refer to figures on page 70.*

CK67. Chuck plate, arbor, and clamps for holding differential housings, brake drums, etc.

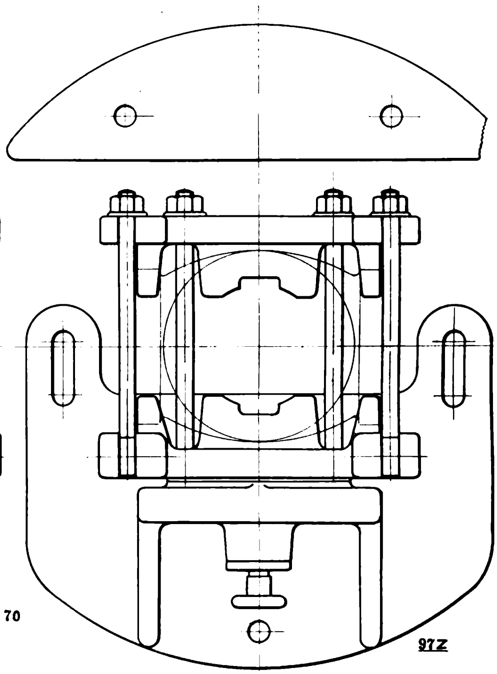
CK68. Chuck plate and taper arbor for steam pistons.



CK 69



CK 70

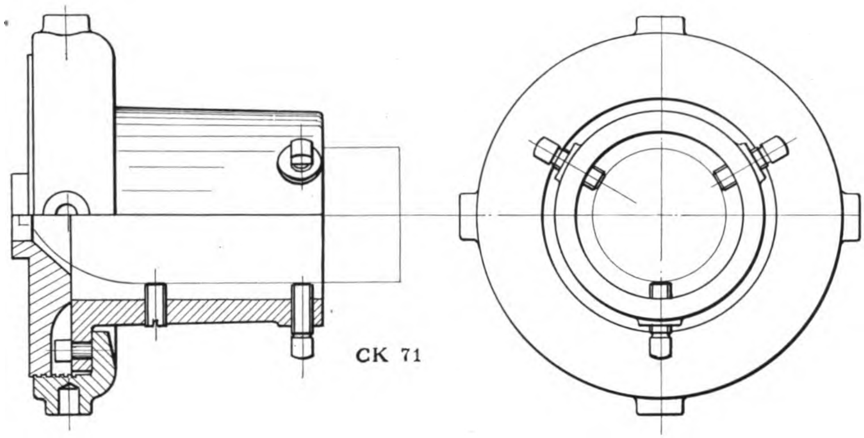


97Z

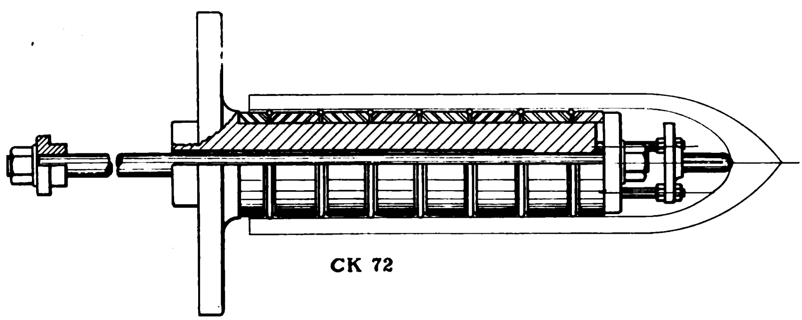
*Symbol and number refer to figures on page 72.*

CK69. Closed chuck bonnet for long work.

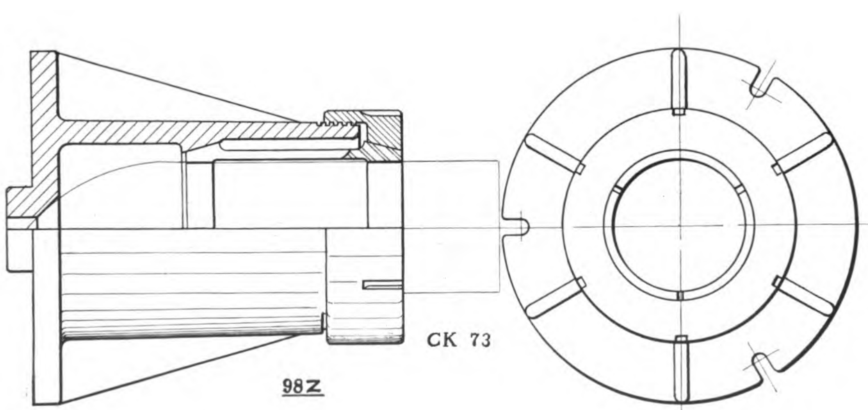
CK70. Angle plate and cradle for finishing valve bodies at one chucking.



CK 71



CK 72



CK 73

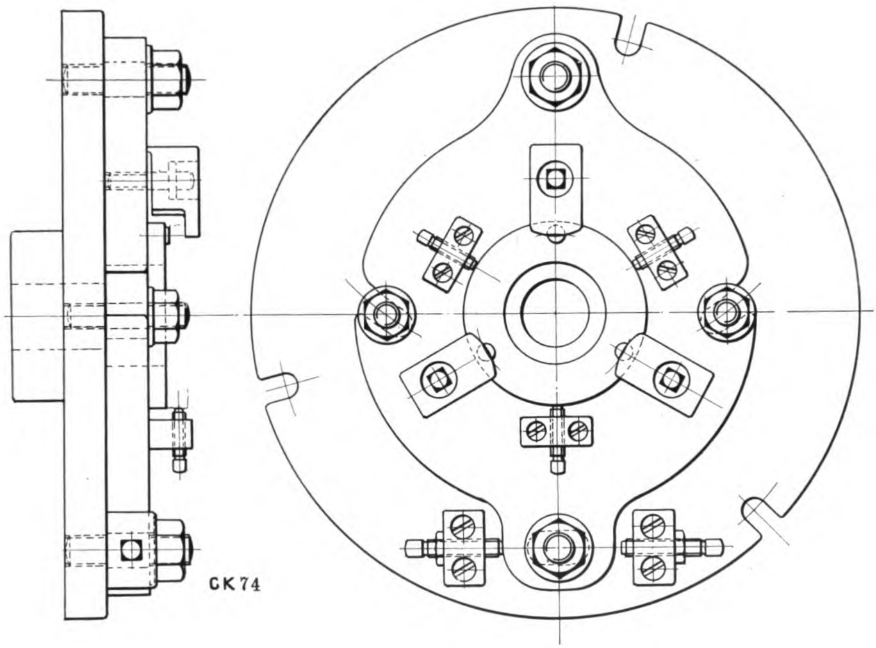
98Z

*Symbol and number refer to figures on page 74.*

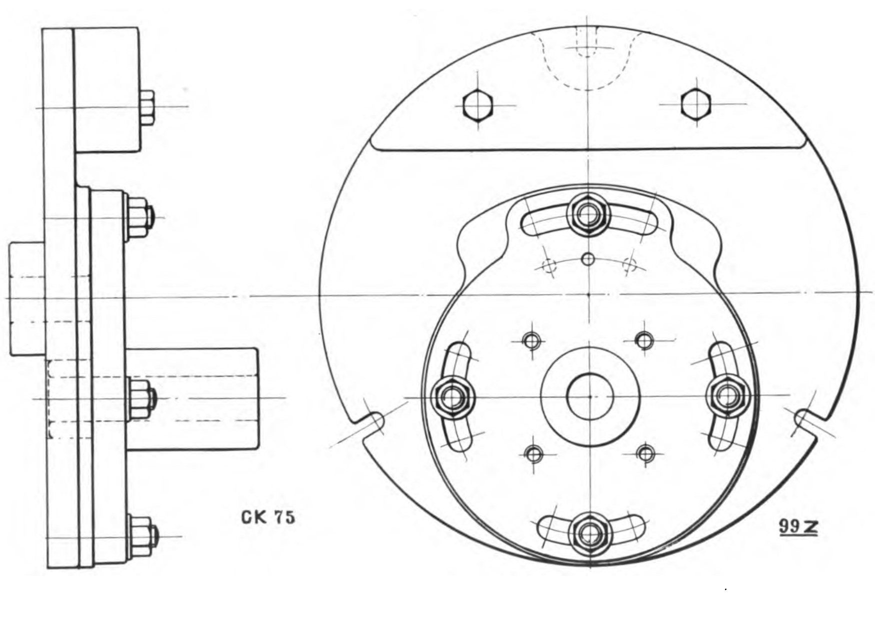
CK71. Floating chucking fixture for holding rough shells while finishing inside.

CK72. Internal chucking fixture or expanding mandrel for shells.

CK73. Collet chuck for shells.



CK74



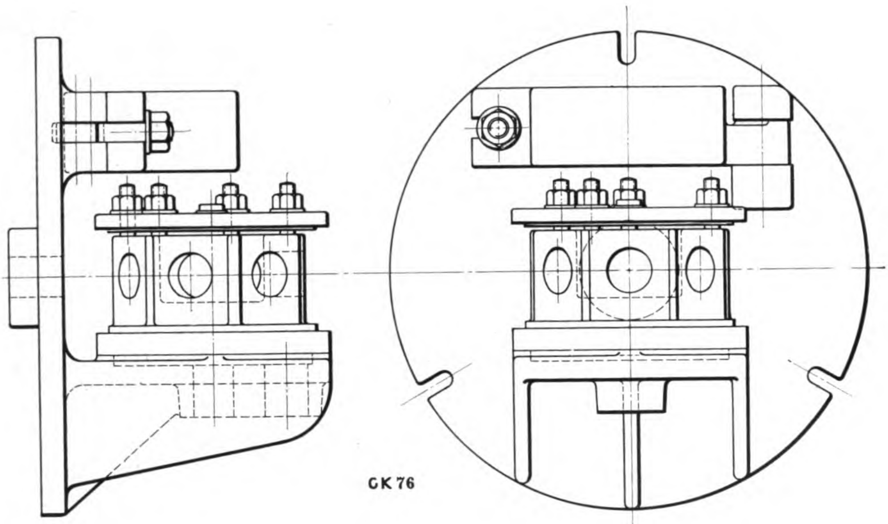
CK 75

99 Z

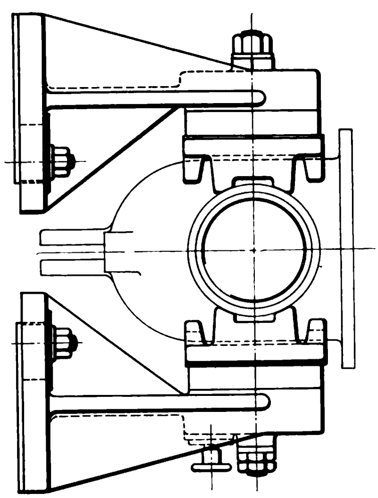
*Symbol and number refer to figures on page 76.*

CK74. Swivel chuck plate for finishing eccentric piston rings. Plate is held in one position while pot is turned then swiveled to eccentric position and pot is bored and rings cut off. Stops for proper throw or eccentricity provided.

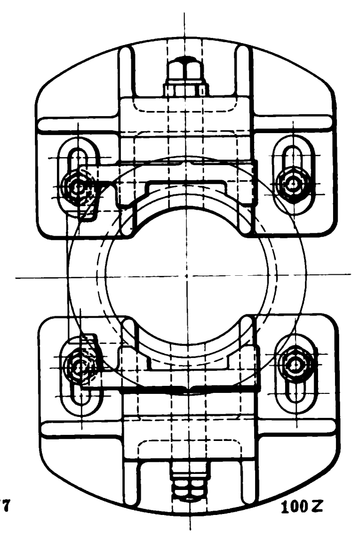
CK75. Swivel chuck plate for boring valve seats in gas engine cylinder.



CK 76



CK 77

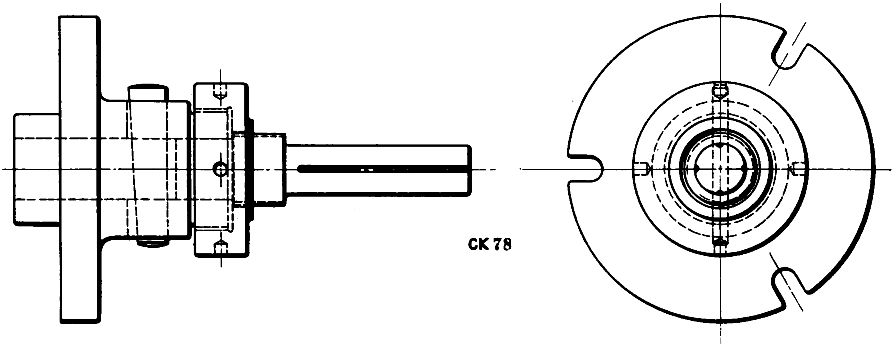


100 Z

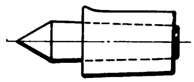
*Symbol and number refer to figures on page 78.*

CK76. Angle plate for boring 7 sided aeroplane crank cases.

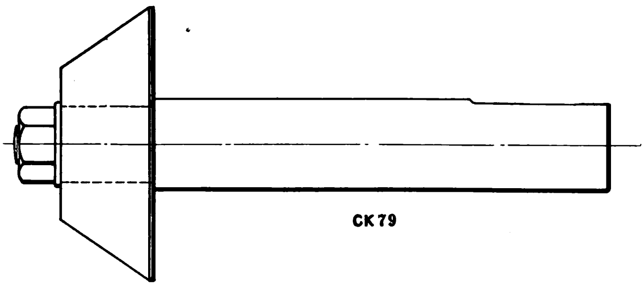
CK77. Valve chuck.



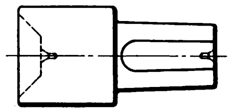
CK 78



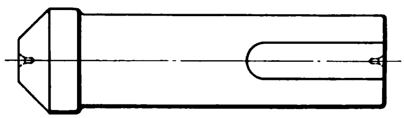
CK 80



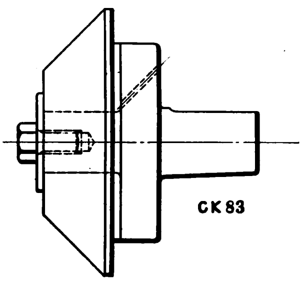
CK 79



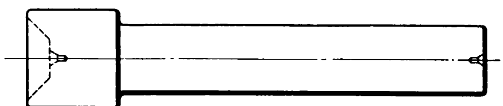
CK 81



CK 82



CK 83



CK 84 101 Z

*Symbol and number refer to figures on page 80.*

CK78. Chuck plate with threaded arbor. After piece is screwed to proper position it is tightened by means of taper cross key.

CK79. Revolving male cone center used in turret.

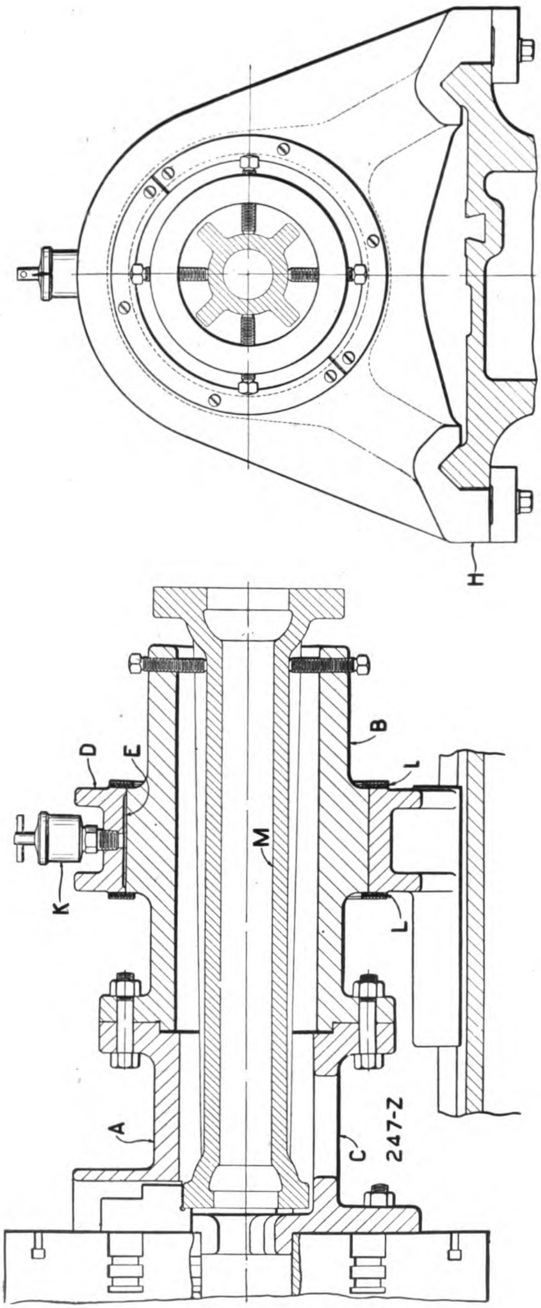
CK80. Cone center used in drill holder.

CK81. Female center used in drill holder.

CK82. Male center used for centering outer end of work while chucking.

CK83. Revolving male center used in drill holder.

CK84. Female center used in turret.



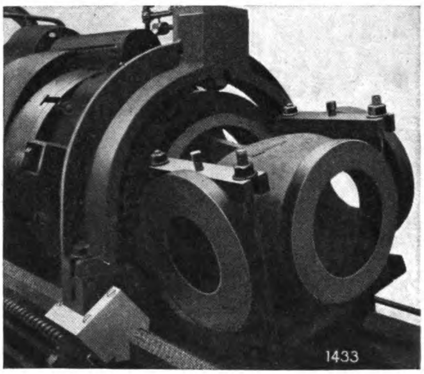

STEADY REST

# Steady Rests.

When chuck fixtures are made for extremely long pieces, it is generally advisable to provide a suitable steady rest to support the outer ends of the pieces.

Figure 247Z shows a substantial steady rest, made to support a long bonnet bolted to face of chuck. The part to be machined is shown at "M" and is approximately 36″ long.

The work for which the bonnet was made, varied considerably in length and the bonnet was made in two pieces. Piece "A" is bolted to the chuck and remains fixed while piece "B" is made in different lengths to accommodate the length of the work. Piece "A" has three hand holes "C" equally spaced, thru which a rod may be inserted to lift the piece into the jaws.




The steady rest "D" supports on the outer end of the bonnet at "E"; the length of the bearing is approximately 6″. This bearing of course could be changed to suit the requirements. The steady rest is bolted to the V's as shown at "H" and is moved back and forth according to the length of the work.

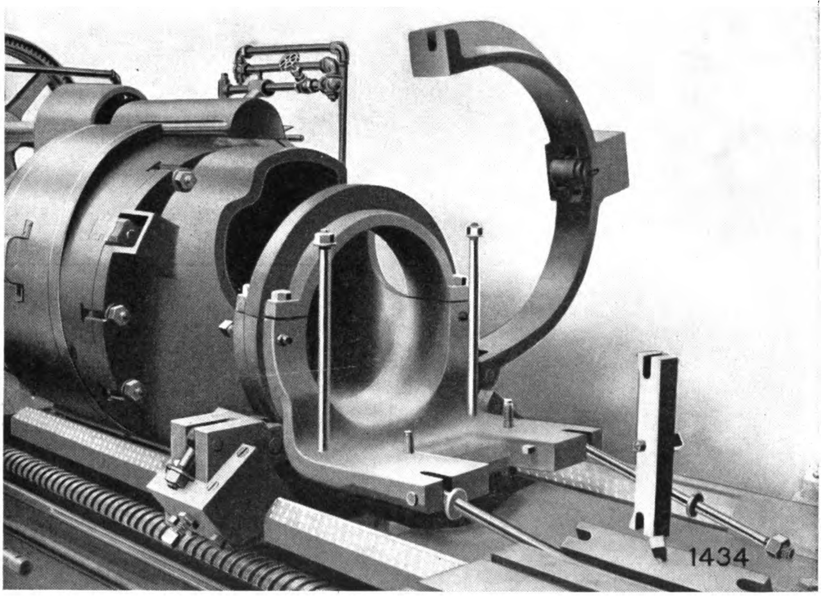
The bonnet and steady rest are made of cast iron and the bearing lubricated with grease thru the force feed grease cup shown at "K".

A felt washer is used at "L" to prevent dust working into the bearing and is held in place by a split steel washer.

This type steady rest has proved superior to all others we have used or seen used.

Figure 1433 shows a chucking fixture for a large valve approximately 30″ long and a steady rest with a valve in place.

Figure 1434 shows the fixture with a clearer view of the steady rest. The rest is arranged with three rollers with sight feed oilers for lubrication.




On extremely heavy work we have found better results may be obtained if the rollers are omitted and a steady rest with a full circular bearing used, as previously shown in cut 247Z page 82 and described on page 83.

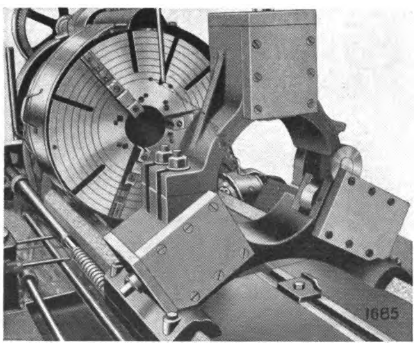
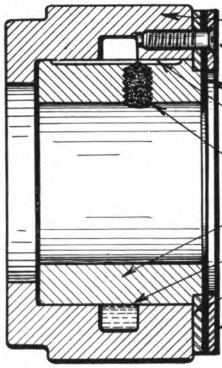



Figure 1685 shows still another steady rest used in practically the same way. The rollers are about four inches in diameter and run on pins two inches in diameter and are also lubricated with sight feed oilers.

## SELF-LUBRICATING CHUCK BUSHINGS.




53-Z

Prior to the development of the self-lubricating chuck bushing as shown in detailed cross section above, pilot bushings were a never ending source of annoyance.

The outside diameter of the Master Bushing which is of cast iron is ground to fit the bore of the chuck. The Master Bushing is bored to receive interchangeable *Pilot Bushings* as the boring bars have pilots of different sizes.

The *Pilot Bushing* which is usually made of cast iron is ground to a snug sliding fit on pilot of boring bar and remains practically stationary with the boring bar, while the Master Bushing revolves around it. An oil chamber in the Master Bushing keeps the bearing properly lubricated.

A felt plug in pilot bushing feeds the oil from reservoir in Master Bushing to pilot of boring bar.

A retaining washer is used to keep the *Pilot Bushing* in place. When *lubrication* is *not used* on the work a Leather Washer is supplied to remove chips or grit from the bar before it enters the bushing.

The self-lubricating chuck bushing is superior to the old style in several ways.

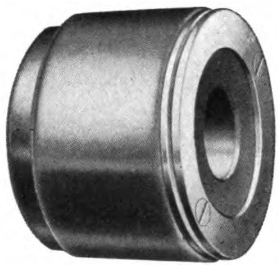
If the old style bushing is used, a full size bushing is required for each size of boring bar pilot. The bushings must be driven in and out the chuck when changing from one size to another.

With the self-lubricating type this change is more easily and quickly made. Simply remove retainer plate, change the pilot bushings and replace plate.

The constant wear on the boring bar pilot by the old style bushing soon causes a loose fit, resulting in a variance in the size of the work. This trouble is overcome by the self-lubricating type as the bearing is not on the bar, but between the outside diameter of Pilot Bushing and the bore of Master Bushing which is a well protected, well lubricated bearing.

The wear in the old style chuck bushing is often due to lack of proper lubrication, while, with a reasonable amount of attention, the Oil Chamber in the Master Bushing of the self-lubricating type will dispense with the troublesome question of oiling. The chamber may be filled readily without removing *Pilot Bushing* simply by removing either one of the Retaining Washer Screws.

The first cost of the self-lubricating style is more than that of the old style bushing, but as no oil is wasted in the self-lubricating type, the saving in oil alone will very soon pay for the extra initial cost.



**Self-Lubricated Bushing**

| | Inches | Inches | Inches | Inches | Inches | Inches |
|---|---|---|---|---|---|---|
| Size Master Bushing, outside diameter* .......... | 3⅜+ | 3⅝+ | 4⅜+ | 5+ | 6+ | 6⅜+ |
| Outside diameter of Pilot Bushing .................. | 2¼ | 2½ | 3⅛ | 3¾ | 4½ | 4¾ |
| Maximum size bore of Pilot Bushing .................. | 1⅞ | 2⅛ | 2⅜ | 3⅜ | 4 | 4¼ |

We are prepared to furnish the old style solid type chuck bushings as shown below. Some of these have a hardened steel core bushing pressed into the cast iron body. The others are plain cast iron bushings ground to size.

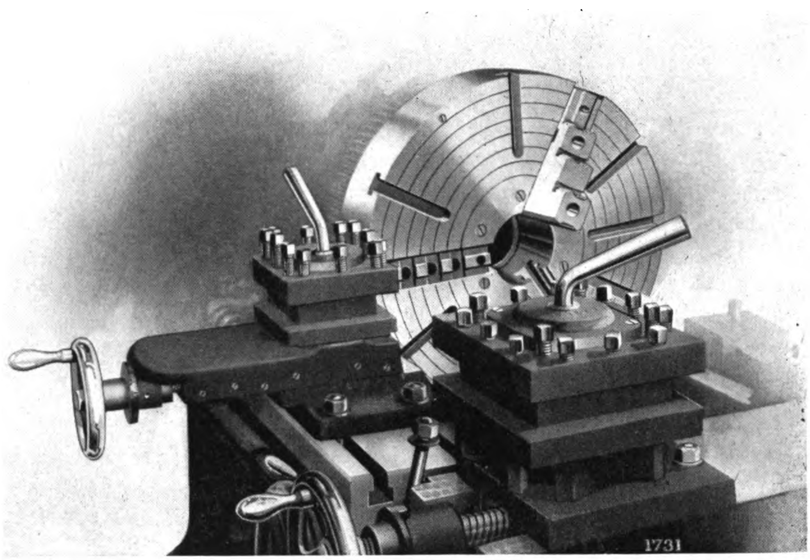
**Regular C. I. Bushing**

**Hardened Steel Core**

| | Inches | Inches | Inches | Inches | Inches | Inches | Inches |
|---|---|---|---|---|---|---|---|
| Size Bushing, outside diam.** .... | 3+ | 3⅜+ | 3⅝+ | 4⅜+ | 5+ | 6+ | 6⅜+ |

* ** The outside diameters given are approximate only. When ordering, care should be used to specify the EXACT diameter of the hole or bore in the chuck and the bushing will be ground to suit.

# Tool Post and Tool Post Tools.



## THE WING REST.

Occasionally it is necessary to turn a piece of work so large in diameter that an auxiliary tool post, placed on the front side of the tool post carriage proves advantageous as it affords a support for the cutting tool, very close to the work.

The wing rest equipment includes a four sided, turret tool post similar in appearance to the regular cross slide tool post. See figure 1731.

As this arrangement was made primarily for turning large diameters, no power cross feed is furnished. The regular cross slide tool post is used for the general run of facing work, altho the wing rest tool post may be used for facing in short distances from the outside.

Turning tools for large diameters may be set a little above or below center without affecting their cutting qualities in the least. Therefore, no adjustment for height of tools is provided in the wing rest tool post.

## CROSS SLIDE TOOL POST.

The regular cross slide tool post has an independent adjustment for height for each side as, on turning, boring and facing small diameters, it is quite essential that the tools be set to the correct height.

The tool post is used primarily to carry tools for rough turning and facing, and for boring diameters too large to be bored with boring bar cutters and cutter heads. It is also often used for finish turning, boring, facing, and forming various diameters and shapes.

## TOOLS.

(For use in Cross Slide Tool Post.)

Some work will require that more than four tool post tools be used in the tool post. To meet this condition properly, the following suggestions are offered:

If specially shaped short tools can be used, as many as seven or eight may be held adequately. However, if the nature of the tool will not permit of its being shortened, it is necessary to change the tools in the tool post. In this case it is better, if possible, to confine the changing to one side only.

This idea may be carried out with any number of tools and still use the tool post carriage stops and index dial on the cross feed screw.

Tool post tools should be ground so that, when they are pressed against the back of the tool post slot, they will be in correct cutting position. An adjusting screw should be put in the butt end of each tool for locating the tool for length. The adjusting screw bears against a block set in the corner of the tool post or against another tool. See figure B45b, page 187.

Great care should be exercised in setting these tools so that they will not over-hang their supports more than is absolutely necessary.

An over-hang of more than 1½ times the height of the tool will cause undue strain.

When tools, such as cut off tools, extend far from the tool post, a suitable support should be provided. In figure 139Z, page 105 is shown an ideal support for cut off tools, and with slight modification this would serve very well for other over-hanging tools.

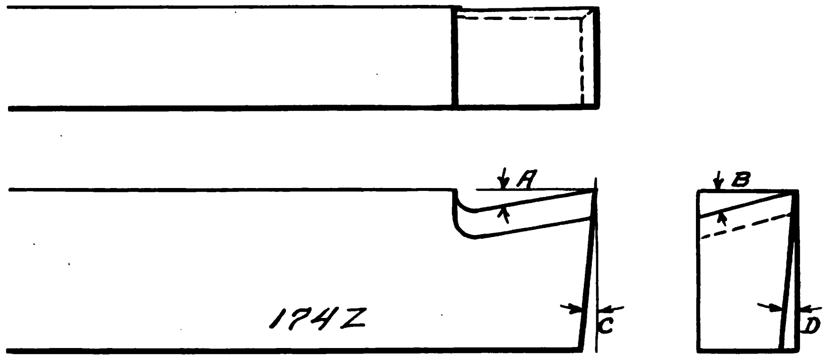
The clearance and top rake angles (see figure 174Z, page 89) have quite a bearing on the life of these tools. Valuable tables have been compiled by practical men, giving what might be called standard angles of clearance and top rake for different kinds of material, but many times the prevailing conditions make it necessary to deviate from these rules to get the best results.

## FEEDS, SPEEDS AND GRINDING.

Feeds and speeds, are governed by the depth of cut, the amount of scale, the kind and hardness of material and the angles of clearance and top rake on the cutting tool. As all these conditions must be considered, the best place to obtain the correct cutting speed and feed is "right on the job."

For cutting cast iron, soft or medium steel, or aluminum, the cutting point of the tool should always be the highest, the top of the tool sloping down in both directions from this point. The exact angles depend on the kind and hardness of material; also the depth of cut and the feed used.

For examples of ideal cutting tools for cast iron, we shall start with the very hardest iron which is commercially used, and can be worked at a cutting speed of about twenty to twenty-five feet per minute. These tools should have from 5° to 10° side and end clearance (shown at "C" and "D" in figure 174Z) with a top rake of 2° to 5°.




A—Back Slope or Rake.
B—Side Slope or Rake.
C—End Clearance.
D—Side Clearance.

On some of the harder irons, the tool will work longer between grindings if used perfectly flat on top, but more power is required to feed this shaped tool into the work.

The angles of top slope or rake should increase as the hardness of the cast iron decreases. Tools with a top rake of 15° or 20° are often used with very good results on the softer grades of iron.

The clearance angles on tools for steel cutting are practically the same as for cast iron, while the top rake varies a great deal more.

Cutting tools for very hard steel should have little or no top rake. And in some cases, when turning extremely hard steel, the cutting point of the tools is ground lower than the back. This shape is called a negative rake and is never resorted to except for extremely hard material and brass, bronze and other metals of this nature.

As the steel decreases in hardness the top rake should be increased the same as with the cast iron cutting tools. A top rake of as much as 30° is often used on tools for cutting very soft steel.

By watching the location of the little pit which the chip forms on the top of the tool, the correct rake angle may be determined.

As soon as, or very shortly after, this pit wears thru to the cutting edge the tool will break down. The pit should start 1/16" or 1/8" back from the cutting edge. If it starts nearer than this, reduce the rake angle or round the point to a larger radius, which will throw the contact point of the chip farther back on the tool and the tool will wear much longer between grindings.

Metal cutting tools should not be used with square corners unless absolutely necessary; this condition is seldom, if ever, necessary in a roughing tool.

The relation between the side and back slope of the top rake is governed to some extent by the depth of cut and the feed used.

For instance, if a cut 1/2" deep were taken in cast iron or steel, the feed per revolution would be comparatively less than the depth of cut. A tool that would cut freely under these conditions would have more side slope (shown at "B" figure 174Z, page 89) than back slope (see "A" figure 174Z), and would allow the chip to roll away with less friction on the tool.

If a reversed condition is found, that is, a cut of only a few thousandths deep and the feed a great deal more, the best results would be obtained by using a tool with a greater back slope and very little or no side slope.

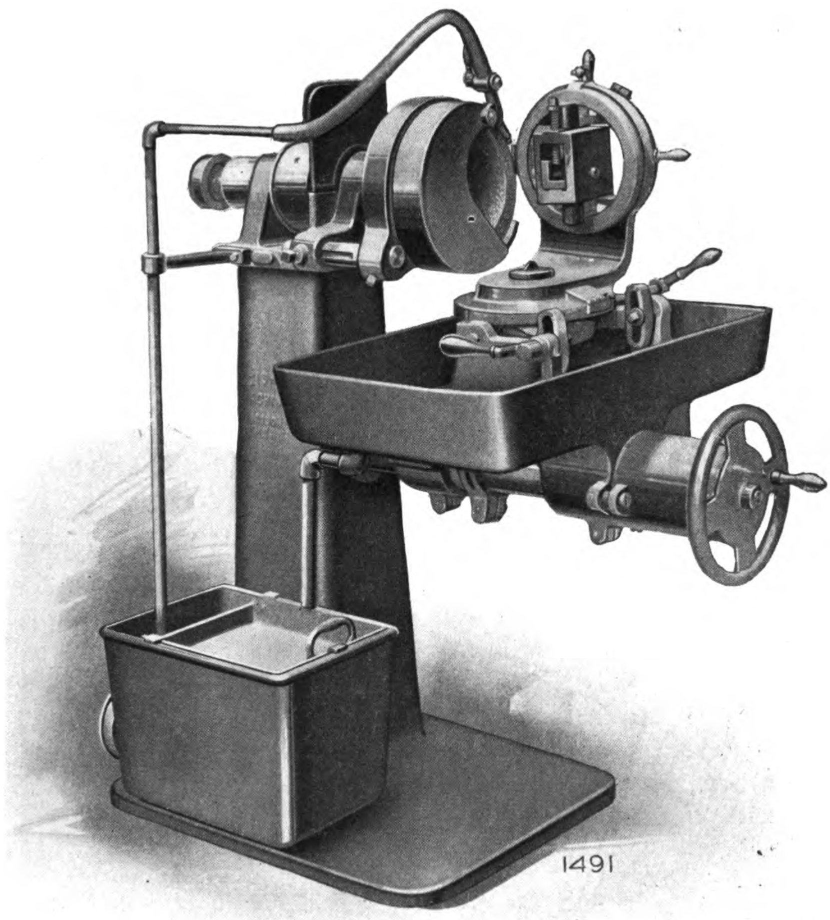
The back and side slope should be about the same when the depth of cut and the feed per revolution are the same.

The grinding of all tool post tools should be done accurately, and it should also be done quickly. The combination of these two essentials almost eliminates the use of the old style emery wheel.

You may know just the angle of the clearance and top rake the tool should have and, with the use of a bevel protractor or degree gauge, you may do this grinding by hand. Grinding tool post tools by hand is a time consuming operation and, when you have finished, you are not absolutely sure each face is just right or each cutting edge as straight as you would like to have it.

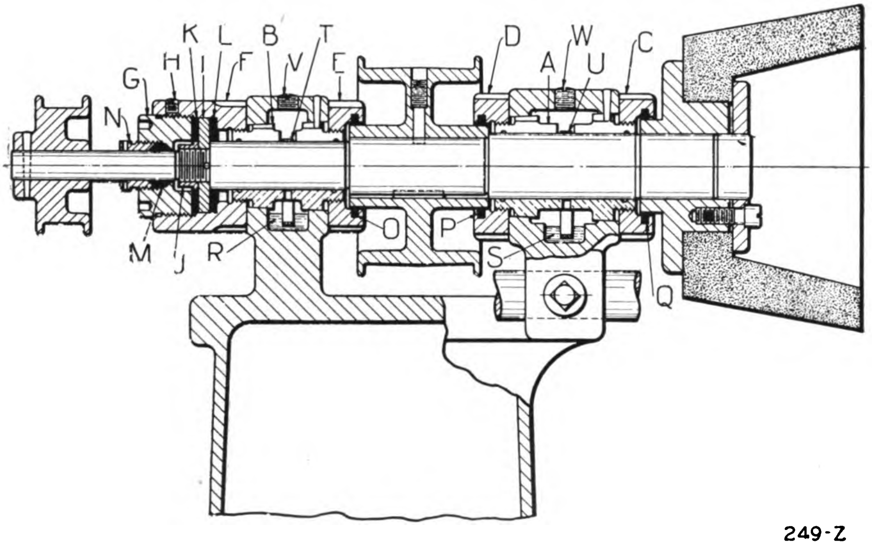
The Gisholt Universal Tool Grinder was designed especially for grinding tools to proper cutting angles, quickly and accurately.

# Gisholt Universal Tool Grinder.




**Belt Driven Gisholt Universal Tool Grinder**

# SPINDLE ADJUSTMENT OF UNIVERSAL TOOL GRINDER.




The spindle boxes "A" and "B" are tapered on the outside to permit adjustment.

To adjust front spindle box "A," release adjusting nut "C" and tighten adjusting nut "D," both of which have right-hand thread.

To adjust rear spindle box "B," release adjusting nut "E" and tighten adjusting nut "F," both of which have right-hand thread.

The end thrust adjustment is made with adjusting nut "G," (right-hand thread), and when proper adjustment is obtained, retaining screw "H" should be securely tightened. The end thrust is contained in the adjusting nut "F" and adjustment of spindle boxes can be made without interfering with the end thrust adjustment.

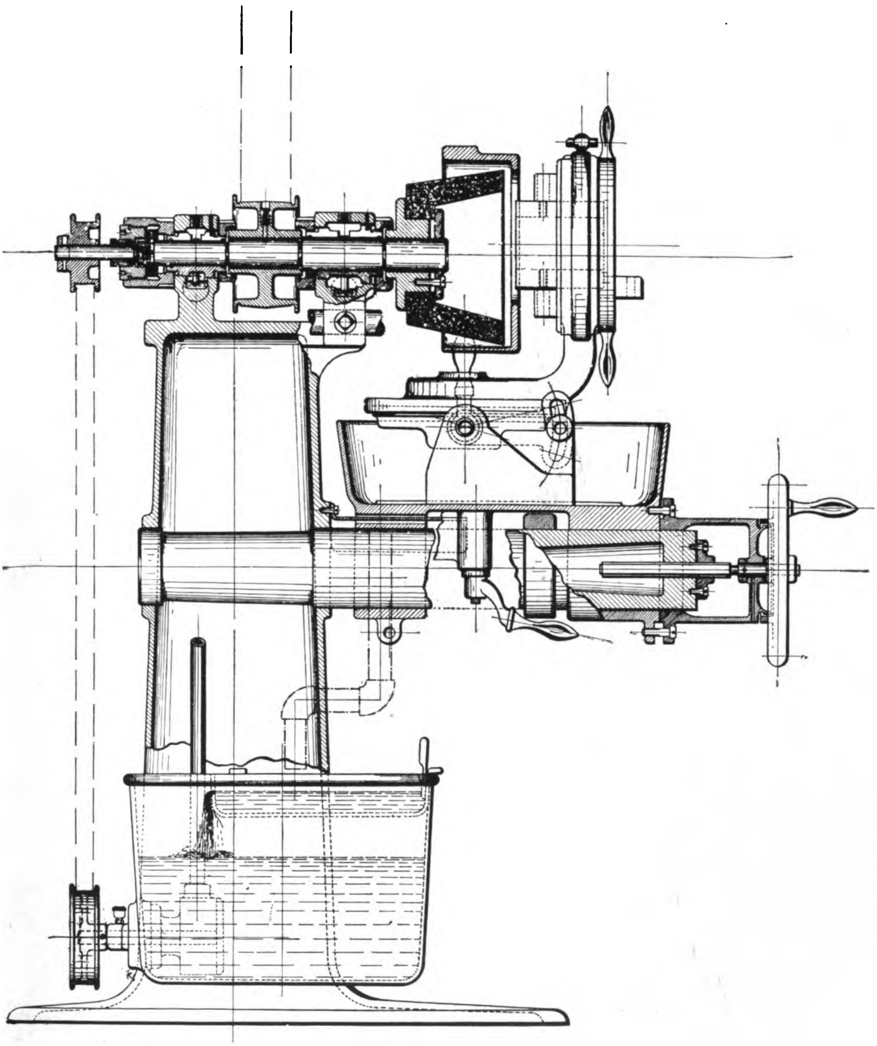
The steel collar shown at "I" is keyed to the spindle and clamped against a shoulder on the spindle by retaining nut "J." On each side of steel collar "I" is fitted a fibre collar shown at "K" and "L" serving as an end thrust washer.

The packing shown at "M" is held in place by packing nut "N" (left-hand thread). The object of this packing is to prevent oil leakage, as well as make the bearing dust proof.

Felt washers shown at "O," "P" and "Q" serve to keep dust and grit from entering the main spindle bearings.

Care should be taken to see that the oil reservoirs "R" and "S" are kept full enough, so that the oil rings "T" and "U" always run in oil.

The oil rings "T" and "U" should always be in position on the spindle, so that they are revolving with the spindle and lift the oil for lubricating these bearings. The action of these oil rings may be observed if the screw plugs "V" and "W" are removed.



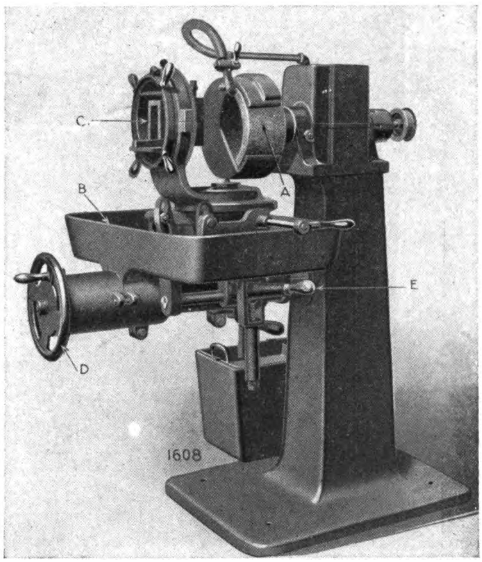
132 Z

**Cross section showing Construction Details of Belt Driven Machine**

## TOOL GRINDING BY THE GISHOLT METHOD

In the first place we have a cup emery wheel (A) mounted directly on the spindle of the machine.

Just below this is a large pan (B). Mounted in the pan is a Universal adjustable tool holder (C) in which the tool-post tool to be ground is clamped the same as it would be in the lathe. This pan has two movements—one to and from the main column of the machine and actuated by a hand wheel (D)—the other, an




**Rear View of Tool Grinder**

oscillating motion of the pan about the axis of the hand wheel, for traversing the tool across the face of the wheel. This motion is obtained by an up and down movement of the handle shown to the right of the pan at (E).

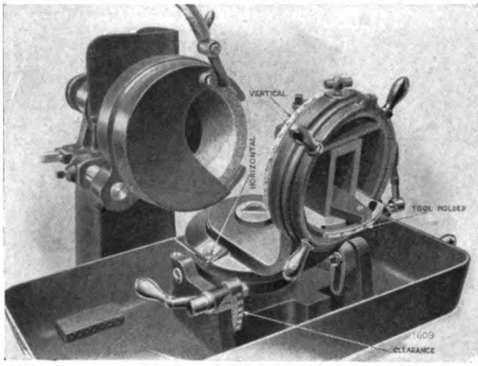
Suppose we grind a tool—the one known as number thirteen on the chart—an ordinary square nose lathe tool, just to show the simplicity of grinding by the Gisholt Method.

We shall grind in the order of faces A, B, C and D, as shown on the chart.

The tool is held in the Universal Head shown in the cut opposite. This Universal Head has four graduated circles by means of which the tool may be set in any desired position for grinding. The chart gives the setting for each circle.

Under the heading "Tool Holder" we have the setting for the circle shown in cut at top of page 95. By it the tool may be swiveled through an angle of 30° on each side of center graduation, (stamped 30°).

Under the heading "Vertical" we have the setting for the circle by means of which the tool may be turned through 360°. This circle moves around a horizontal axis. The setting indicated denotes the angle through which the tool is turned around its horizontal axis, showing 2° clearance.




**Showing Graduations on Grinder**

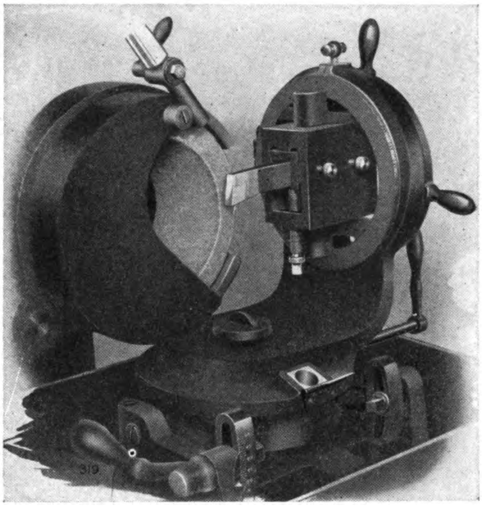
Under the heading "Horizontal" we have the circle by means of which the tool may be turned through 150° in a horizontal plane. This circle moves around a vertical axis, and serves for grinding the faces and sides, also round nose tools. The settings show that the opposite sides of the tool are parallel.

| KIND OF TOOL | Nº OF TOOL | FACE | ANGLES: TOOL HOLDER | VERTICAL | HORIZONTAL | CLEARANCE |
|---|---|---|---|---|---|---|
|  C, A, D, B | 10 CAST IRON | SIDE A | 30 | 182 | 0 | 15 |
| | | SIDE B | 30 | 358 | 0 | 15 |
| | | END C | 30 | 90 | 100 | 15 |
| | | TOP D | 30 | 90 | 350 | 15 |
| | 13 STEEL | SIDE A | 30 | 182 | 0 | 15 |
| | | SIDE B | 30 | 358 | 0 | 15 |
| | | END C | 30 | 90 | 100 | 15 |
| STRAIGHT FINISH | | TOP D | 30 | 85 | 348 | 15 |

Under the heading "Clearance" we have the setting of the circle that has a horizontal axis parallel to the face of the wheel. By means of this circle, the Universal Head may be swiveled in the base around a horizontal axis (always at right angles to the spindle) through an angle of 15° on either side of the horizontal plane (stamped 15°). This setting is for the purpose of obtaining clearance on thread tools without distorting the angle of the point, making it unnecessary to calculate fractional settings.

We shall now clamp the tool in the holder, and proceed to grind side A.

First, we set the Tool Holder at 30, as called for on chart. Second, we

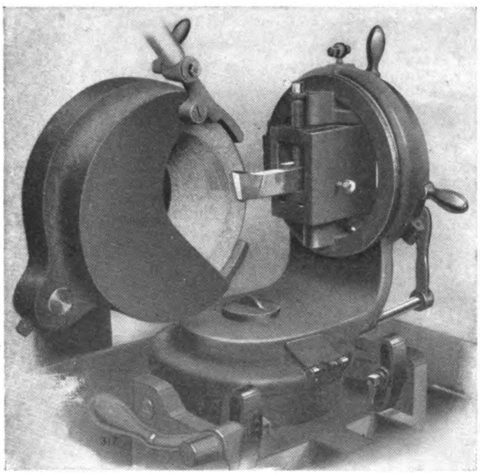


First Operation—Side A

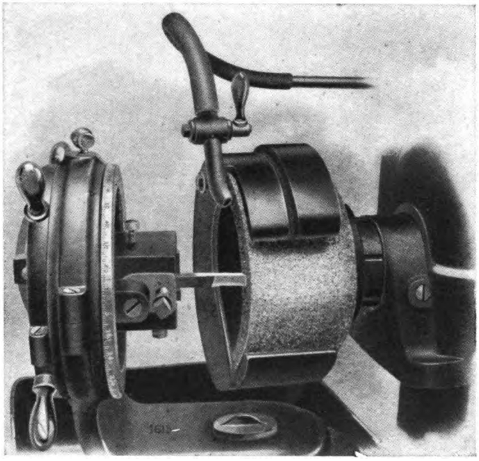
set the Vertical at 182, to get the side clearance. Third, the Horizontal, we leave at Zero and fourth, we get the proper Clearance by setting clearance circle at 15.

This sets the machine for grinding side "A" of the tool.

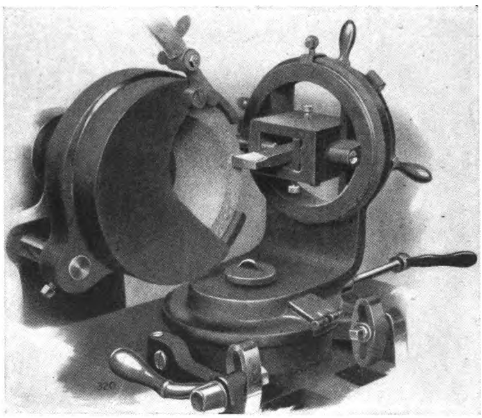
Next we take hold of the hand wheel with the left hand, and traverse the tool holder up to the wheel. As we grind, the tool is traversed across the face of the wheel by means of the lever operated by the right hand.



Second Operation—Side B



Third Operation—End C



Fourth Operation—Top D

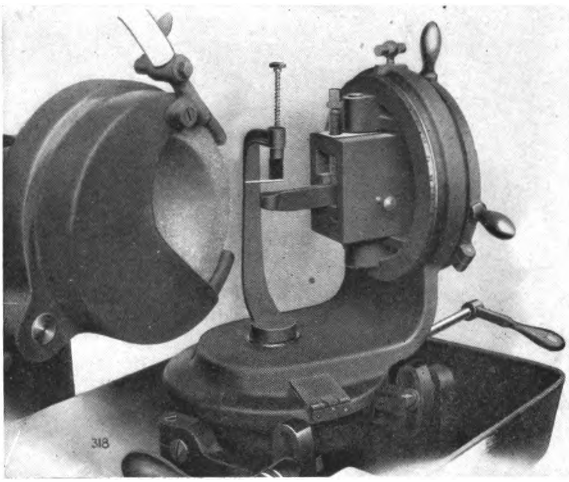
Faces B, C and D are then ground in similar manner. The tool is not removed from the holder until all faces are ground. Both the setting and grinding of the tools are very simple operations.

The tools are always clamped in the same way.

Sometimes there is a number of tools of the same kind to be ground at the same time. In such cases it will be found advantageous first to grind the same side of each tool of the lot; then set the Grinder for second side, grinding all on that side and so on.

## BENT TOOLS.

When grinding a bent tool, you simply move the tool holder either side of the 30° center line to bring the face to be ground parallel to the face of the wheel. This is the only change required for bent tools. They are then ground at the same settings as the straight tools, the tool being moved the same amount as it is bent.



**Grinding Round Nose Tools**

## ROUND NOSE TOOLS.

Grind top D first on tools Nos. 16, 17, 18, 19, 21, 59, 60, 64 and 66; then center by the use of centering device shown by the illustration on this page, the adjustment being made by turning Tool Holder circle. The tool is then ground by swinging on a vertical axis. In this way a uniform clearance is produced on the end of the face of the tool. The matter of correct angles has been worked out by us to cover quite a variety of tools. Take, for instance, those shown by the chart on page 99. This sample set of 27 correctly ground tools is sent with each Grinder if desired.

The chart shows exactly how to reproduce the angles in the tools and will be of much assistance to the operator in setting up his machine and also to the smith in forging new tools. Chart has been revised and now gives angles best adapted for lathe tools made of high speed steel for working steel or cast iron. Full size chart, of miniature shown on page 99, will be mailed free to users of our Grinder.

| Kind of Tool | No. of Tool | Face | Tool Holder | Vertical | Horizontal | Clearance |
|---|---|---|---|---|---|---|
| Right hand finisher | 1 Lathe | Side A | 30 | 190 | 0 | 15 |
| | | End C | 30 | 0 | 55 | 18 |
| | | Top D | 30 | 78 | 0 | 15 |
| | 55 Planer | Side A | 30 | 184 | 0 | 15 |
| | | End C | 30 | 0 | 55 | 19 |
| | | Top D | 30 | 80 | 0 | 15 |
| 30° Right hand side finisher | 2 Lathe | Side A | 60 | 190 | 0 | 15 |
| | | End C | 30 | 0 | 25 | 18 |
| | | Top D | 60 | 78 | 0 | 15 |
| Left hand finisher | 4 Lathe | Side A | 30 | 350 | 0 | 15 |
| | | End C | 30 | 180 | 55 | 12 |
| | | Top D | 30 | 102 | 0 | 15 |
| | 56 Planer | Side A | 30 | 356 | 0 | 15 |
| | | End C | 30 | 180 | 55 | 11 |
| | | Top D | 30 | 100 | 0 | 15 |
| 30° Left hand side finisher | 5 Lathe | Side A | 0 | 350 | 0 | 15 |
| | | End C | 0 | 180 | 55 | 12 |
| | | Top D | 0 | 102 | 0 | 15 |
| Straight cutting off | 7 Cast iron | Side A | 30 | 182 | 0 | 15 |
| | | Side B | 30 | 358 | 0 | 15 |
| | | End C | 30 | 90 | 100 | 15 |
| | | Top D | 30 | 90 | 0 | 15 |
| 30° Right hand cutting off | 8 Cast iron | Side A | 60 | 182 | 0 | 15 |
| | | Side B | 60 | 358 | 0 | 15 |
| | | End C | 60 | 90 | 100 | 15 |
| | | Top D | 60 | 90 | 0 | 15 |
| 30° Left hand cutting off | 9 Cast iron | Side A | 0 | 182 | 0 | 15 |
| | | Side B | 0 | 358 | 0 | 15 |
| | | End C | 0 | 90 | 100 | 15 |
| | | Top D | 0 | 90 | 0 | 15 |
| Straight finisher | 10 Cast iron | Side A | 30 | 182 | 0 | 15 |
| | | Side B | 30 | 358 | 0 | 15 |
| | | End C | 30 | 90 | 100 | 15 |
| | | Top D | 30 | 90 | 350 | 15 |
| | 13 Steel | Side A | 30 | 182 | 0 | 15 |
| | | Side B | 30 | 358 | 0 | 15 |
| | | End C | 30 | 90 | 100 | 15 |
| | | Top D | 30 | 85 | 348 | 15 |
| 30° Right hand finisher | 11 Cast iron | Side A | 60 | 182 | 0 | 15 |
| | | Side B | 60 | 358 | 0 | 15 |
| | | End C | 60 | 90 | 100 | 15 |
| | | Top D | 60 | 90 | 350 | 15 |
| | 14 Steel | Side A | 60 | 182 | 0 | 15 |
| | | Side B | 60 | 358 | 0 | 15 |
| | | End C | 60 | 0 | 90 | 15 |
| | | Top D | 60 | 85 | 348 | 15 |
| 30° Left hand finisher | 12 Cast iron | Side A | 0 | 182 | 0 | 15 |
| | | Side B | 0 | 358 | 0 | 15 |
| | | End C | 0 | 90 | 100 | 15 |
| | | Top D | 0 | 90 | 350 | 15 |
| | 15 Steel | Side A | 0 | 182 | 0 | 15 |
| | | Side B | 0 | 358 | 0 | 15 |
| | | End C | 0 | 90 | 100 | 15 |
| | | Top D | 0 | 95 | 348 | 15 |
| 30° Left hand rougher | 16 Lathe | Side A | * | 0 | — | 27 |
| | | Grind top D first | | | | |
| | | End C | 0 | 90 | 100 | 15 |
| | | Top D | 30 | 100 | 340 | 15 |
| | 60 Planer | Side A | * | 0 | — | 19 |
| | | Grind top D first | | | | |
| | | End C | 0 | 90 | 100 | 15 |
| | | Top D | 30 | 105 | 350 | 15 |
| 30° Right hand rougher | 17 Lathe | Side A | * | 180 | — | 3 |
| | | Grind top D first | | | | |
| | | End C | 60 | 90 | 100 | 15 |
| | | Top D | 30 | 80 | 340 | 15 |
| | 59 Planer | Side A | * | 80 | — | 11 |
| | | Grind top D first | | | | |
| | | End C | 60 | 90 | 100 | 15 |
| | | Top D | 30 | 75 | 350 | 15 |
| Circular | 18 Lathe | Side A | * | 180 | — | 8 |
| | | Side B | * | 0 | — | 22 |
| | | Grind top D first | | | | |
| | | Top D | 30 | 90 | 0 | 15 |
| Right hand side rougher | 19 Lathe | Side A | * | 180 | — | 5 |
| | | Grind top D first | | | | |
| | | End C | | | 95 | |
| | | Top D | 30 | 87 | 350 | 15 |
| | 64 Planer | Side A | * | 180 | — | 11 |
| | | Grind top D first | | | | |
| | | End C | | | 95 | |
| | | Top D | 30 | 89 | 350 | 15 |
| Left hand side rougher | 21 Lathe | Side A | * | 0 | — | 25 |
| | | Grind top D first | | | | |
| | | End C | | | 95 | |
| | | Top D | 30 | 93 | 350 | 15 |
| | 66 Planer | Side A | * | 0 | — | 19 |
| | | Grind top D first | | | | |
| | | End C | | | 95 | |
| | | Top D | 30 | 91 | 350 | 15 |
| Brass | 23 | Side A | 30 | 190 | 20 | 15 |
| | | Side B | 30 | 350 | 20 | 15 |
| | | End C | 30 | 90 | 100 | 15 |
| | | Top D | 30 | 90 | 0 | 15 |
| 30° Brass | 24 | Side A | 60 | 190 | 20 | 15 |
| | | Side B | 60 | 350 | 20 | 15 |
| | | End C | 60 | 90 | 100 | 15 |
| | | Top D | 60 | 90 | 0 | 15 |
| U. S. Std. Thread | 28 Right hand | Side A | 30 | 180 | 30 | 5 |
| | | Side B | 30 | 0 | 30 | 20 |
| | | End C | 30 | 0 | 90 | 30 |
| | | Top D | 30 | 90 | 0 | 15 |
| | 30 Left hand | Side A | 30 | 180 | 30 | 10 |
| | | Side B | 30 | 0 | 30 | 25 |
| | | End C | 30 | 0 | 90 | 30 |
| | | Top D | 30 | 90 | 0 | 15 |
| 30° U. S. Std. Thread | 29 Right hand | Side A | 60 | 180 | 30 | 5 |
| | | Side B | 60 | 0 | 30 | 20 |
| | | End C | 60 | 0 | 90 | 30 |
| | | Top D | 60 | 90 | 0 | 15 |
| | 31 Left hand | Side A | 60 | 180 | 30 | 10 |
| | | Side B | 60 | 0 | 30 | 25 |
| | | End C | 60 | 0 | 90 | 30 |
| | | Top D | 60 | 90 | 0 | 15 |
| Square thread | 32 Right hand | Side A | 30 | 190 | 0 | 15 |
| | | Side B | 30 | 355 | 0 | 15 |
| | | End C | 30 | 90 | 100 | 15 |
| | | Top D | 30 | 90 | 0 | 15 |
| | 34 Left hand | Side A | 30 | 185 | 0 | 15 |
| | | Side B | 30 | 350 | 0 | 15 |
| | | End C | 30 | 90 | 100 | 15 |
| | | Top D | 30 | 90 | 0 | 15 |
| 30° Square thread | 33 Right hand | Side A | 60 | 190 | 0 | 15 |
| | | Side B | 60 | 355 | 0 | 15 |
| | | End C | 60 | 90 | 100 | 15 |
| | | Top D | 60 | 90 | 0 | 15 |
| | 35 Left hand | Side A | 60 | 185 | 0 | 15 |
| | | Side B | 60 | 350 | 0 | 15 |
| | | End C | 60 | 90 | 100 | 15 |
| | | Top D | 60 | 90 | 0 | 15 |
| Worm & Acme thread | 36 Right hand | Side A | 30 | 180 | 14½ | 0 |
| | | Side B | 30 | 0 | 14½ | 20 |
| | | End C | 30 | 90 | 100 | 15 |
| | | Top D | 30 | 90 | 0 | 15 |
| | 38 Left hand | Side A | 30 | 180 | 14½ | 10 |
| | | Side B | 30 | 0 | 14½ | 30 |
| | | End C | 30 | 90 | 100 | 15 |
| | | Top D | 30 | 90 | 0 | 15 |
| 30° Worm & Acme thread | 37 Right hand | Side A | 60 | 180 | 14½ | 0 |
| | | Side B | 60 | 0 | 14½ | 20 |
| | | End C | 60 | 90 | 100 | 15 |
| | | Top D | 60 | 90 | 0 | 15 |
| | 39 Left hand | Side A | 60 | 180 | 14½ | 10 |
| | | Side B | 60 | 0 | 14½ | 30 |
| | | End C | 60 | 90 | 100 | 15 |
| | | Top D | 60 | 90 | 0 | 15 |
| Inside rougher | 40 Lathe | Side A | 30 | 0 | — | 25 |
| | | Side B | 30 | 180 | — | 5 |
| | | Grind side A with holder and top D without holder | | | | |
| | | Top D | 30 | 90 | 350 | 5 |
| Inside finisher | 41 | Side A | 30 | 0 | 90 | 25 |
| | | Holder not used | | | | |
| | | End C | 30 | 202 | 0 | 15 |
| | | Top D | 30 | 80 | 0 | 15 |
| Use holder except for top D. Inside U. S. Std. Thread | 42 Right hand | Side A | 30 | 0 | 30 | 30 |
| | | Side B | 30 | 180 | 30 | 2 |
| | | End C | 30 | 180 | 90 | 0 |
| | | Top D | 30 | 90 | 0 | 15 |
| | 43 Left hand | Side A | 30 | 0 | 30 | 28 |
| | | Side B | 30 | 180 | 30 | 0 |
| | | End C | 30 | 180 | 90 | 0 |
| | | Top D | 30 | 90 | 0 | 15 |
| Use holder except for top D. Inside square thread | 44 Right hand | Side A | 30 | 350 | 0 | 15 |
| | | Side B | 30 | 185 | 0 | 15 |
| | | End C | 30 | 180 | 90 | 5 |
| | | Top D | 30 | 90 | 0 | 15 |
| | 45 Left hand | Side A | 30 | 355 | 0 | 15 |
| | | Side B | 30 | 190 | 0 | 15 |
| | | End C | 30 | 180 | 90 | 5 |
| | | Top D | 30 | 90 | 0 | 15 |

**GISHOLT MACHINE CO.**
MADISON, WIS., U. S. A.

**TOOL GRINDING CHART**

THE DASH (—) MEANS TO SWING VERTICAL CIRCLE STAND ON HORIZONTAL CIRCLE

THE STAR (*) MEANS TO GRIND D FIRST, THEN SET RADIUS TO GAUGE AND CLAMP TOOL HOLDER

Z-251

**A larger size of Chart is furnished with each Gisholt Grinder, showing the correct setting of the Universal head for grinding these tools**

The chart gives grinding angles for 44 tools, but only 27 tools are necessary, as samples for forging, for some of the tools vary only slightly in grinding angles.

## GRINDING HIGH SPEED AND SELF HARDENING STEELS ON GISHOLT GRINDER.

If users of Gisholt Tool Grinders have trouble with the cracking or checking of High Speed Steel Tools, it is invariably because the operator undertakes to keep the tools cool by using water while taking the *heavy roughing cuts.* This can be obviated as follows:

Have tools rough forged to approximate shape.

Grind tool slowly at first, until tool becomes warmed through, then grinding can be forced without injury to the tool, but *do not use water on a roughing cut*, as the water will not overcome the heat and will check the steel. Getting the tool hot will not hurt it if kept dry.

After rough grinding, return tool to blacksmith and have it tempered. Then return tool to Grinder for finish grinding and *use plenty of water*, as with these light cuts, water will keep it amply cool. As tool becomes dull, regrind, using water. When necessary to re-forge, proceed *from forging* as before.

If the above be followed, no trouble should be encountered from the checking or cracking of High Speed Steel.

## GISHOLT TOOL GRINDER—EMERY WHEEL.

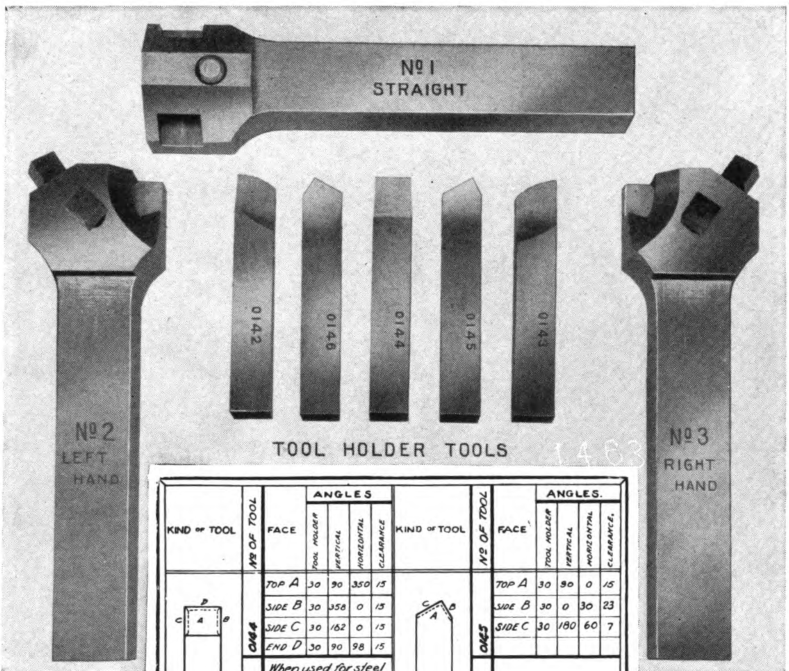
To secure satisfactory results from a Grinding Machine, one of the most important features is to have a satisfactory wheel. Primary features are the Grain and Hardness.

### GRAIN.

We recommend nothing finer than a No. 20 grain emery, although a mixture of No. 20 and No. 30 gives satisfactory results in some cases. There is a tendency to specify a finer grain by some users, but it is undesirable on this machine. The standard emery wheel furnished with the machine is No. 24 grain, grade L.

### HARDNESS.

The wheel should be as soft as possible, yet not so soft as to crumble. A hard wheel will fill or clog up, then cut slowly and produce undue heating unless dressed very frequently. Most emery wheel manufacturers have their individual grading standards, varying with the different makes. We have experimented considerably with different makes, grades, etc., and are prepared to fill orders with a wheel we can thoroughly recommend.




| No. of Tool | Face | Tool Holder | Vertical | Horizontal | Clearance |
|---|---|---|---|---|---|
| 0144 | Top A | 30 | 90 | 350 | 15 |
| | Side B | 30 | 358 | 0 | 15 |
| | Side C | 30 | 162 | 0 | 15 |
| | End D | 30 | 90 | 98 | 15 |
| | When used for steel horizontal circle is set at 350 while grinding top (A) | | | | |
| 0142 | Top A | 30 | 80 | 0 | 15 |
| | Side B | 30 | 188 | 0 | 15 |
| | End C | * | 0 | - | 23 |
| | When used for steel horizontal circle is set at 350 while grinding top (A) | | | | |
| 0143 | Top A | 30 | 100 | 0 | 15 |
| | Side B | 30 | 352 | 0 | 15 |
| | End C | * | 180 | – | 7 |
| | When used for steel horizontal circle is set at 350 while grinding top (A) 129-Z | | | | |
| 0145 | Top A | 30 | 90 | 0 | 15 |
| | Side B | 30 | 0 | 30 | 23 |
| | Side C | 30 | 180 | 60 | 7 |
| 0146 | Top A | 30 | 90 | 0 | 15 |
| | Side B | 30 | 180 | 30 | 7 |
| | Side C | 30 | 0 | 60 | 23 |

**GISHOLT MACH. CO**
MADISON WIS U.S.A.
GRINDING CHART FOR TOOL HOLDER BITS.
THE DASH (–) Means to swing vertical circle stand on horizontal circle.
THE STAR (*) Means to grind (D) first: Then set radius to gauge and clamp tool holder.

The Gisholt Tool Post Tool Holders shown above were developed to meet a demand for a heavy tool holder that would give the maximum support to the cutting tool. The inserted cutters for these holders can be ground on the Gisholt Universal Tool Grinder as well as any solid forged tools. Six cutters are included in this set, (2 of No. 0142). Inserted cutters for other type of tool holders can also be ground.

## CORRECT FORGING—USE OF FORMER BLOCK

The matter of correct forging of tools is also important. The nearer the tool is forged to the proper shape, the less the grinding required.

In order to assist the smith in getting the correct shapes we furnish with each Grinder a Former Block shown on this page. By the use of these nearly all of the usual shapes of tool-post-tools may be obtained.

Referring to chart on page 99.


**Former Block to Aid in Correct Forging**


Tools numbered 1, 19, 55 and 64 are shaped to the left side of the top of the Former Block.

Tools numbered 4, 21, 56 and 66 are shaped to the right side of the top of the Former Block.

Tools numbered 2, 17, 24, 29, 31, 37, 39 and 59 are shaped to the lower right side of the Former Block.

Tools numbered 5, 16 and 60 are shaped to the lower left side of the Former Block.

Tools numbered 8, 11, 14, 33 and 35 are shaped to the upper right side of the Former Block.

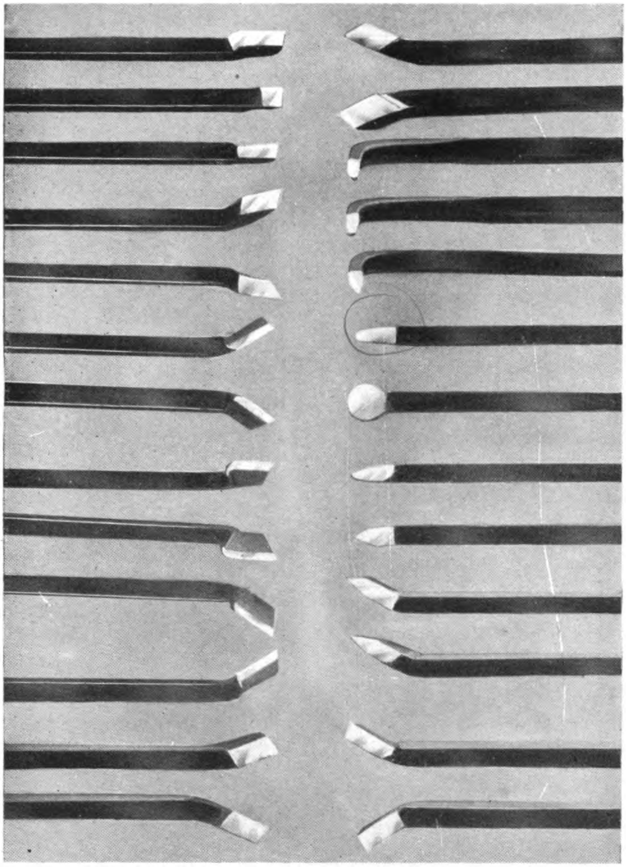
Tools numbered 9, 12 and 15 are shaped to the upper left side of the Former Block.

Tools should be forged with somewhat more clearance than shown in the tables so as to reduce the area to be ground.

Great economy, both in forging and in grinding, results from the use of the

Former Block. We suggest that the set of 27 standard tools be mounted on a board and kept in the smith shop for reference when forging.

When two numbers are stamped on sample tool (for instance 1 and 55), it indicates the sample can be used for forging either number. The tool forged should be stamped with the number shown on chart to which it is ground.



**Sample Tools showing some of the Styles ground on Gisholt Grinder**
**Suggested method of mounting Tools on board for Smith shop**

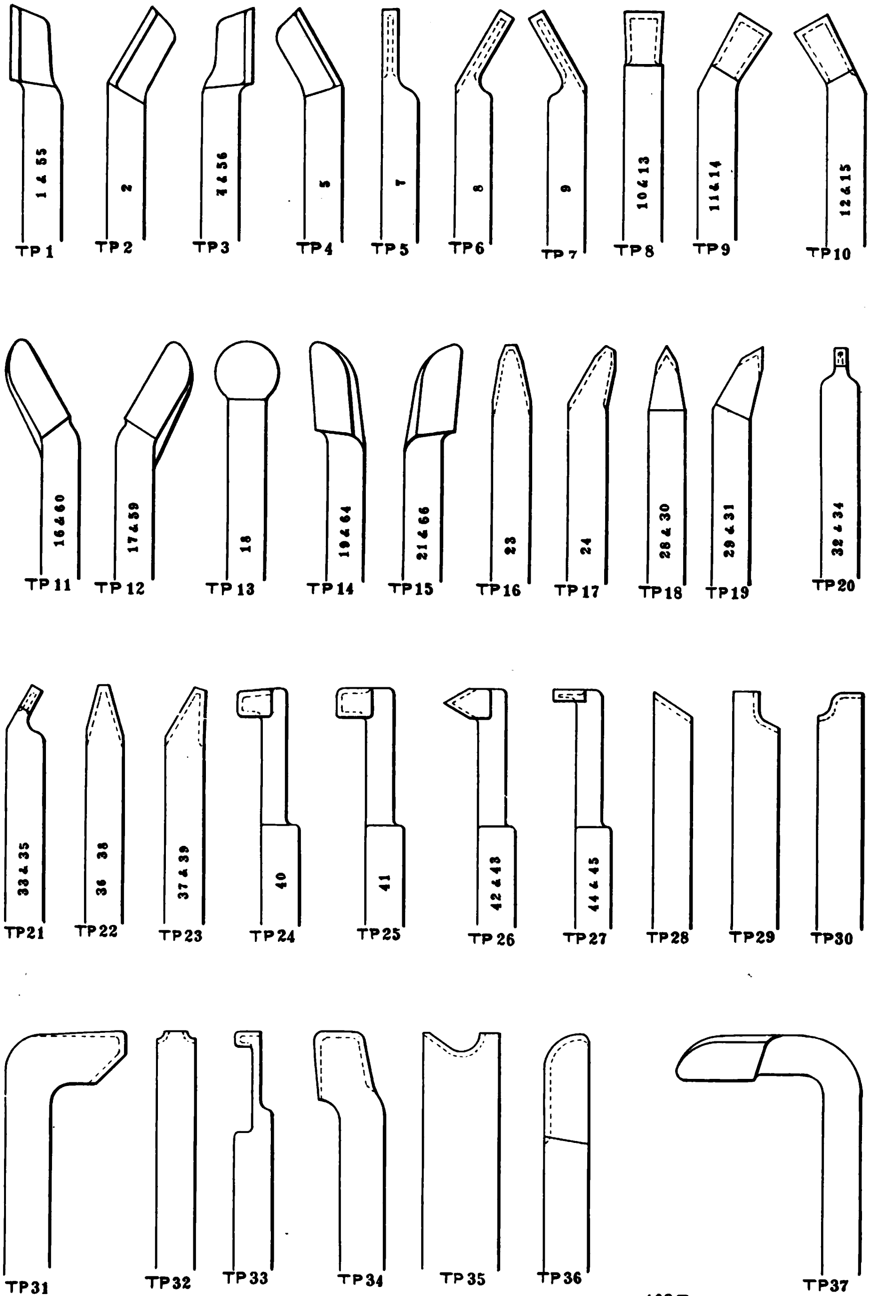
## PRINCIPAL DIMENSIONS

Will grind stock up to 1¾″ or flat stock up to 1¾″x2¾″.

By taking the small tool holder out, stock up to 2″x3½″ may be ground.

A special holder is furnished for grinding small tools used in standard tool holders, such as Gisholt, Armstrong, and a special holder can be furnished for O. K. tools.

Will grind broad cutters up to 3½″ in length, or 7″ by reversing.


1 & 55
TP 1
2
TP 2
4 & 56
TP 3
5
TP 4
7
TP 5
8
TP 6
9
TP 7
10 & 13
TP 8
11 & 14
TP 9
12 & 15
TP 10
16 & 60
TP 11
17 & 59
TP 12
18
TP 13
19 & 64
TP 14
21 & 66
TP 15
23
TP 16
24
TP 17
28 & 30
TP 18
29 & 31
TP 19
32 & 34
TP 20
33 & 35
TP 21
36 38
TP 22
37 & 39
TP 23
40
TP 24
41
TP 25
42 & 43
TP 26
44 & 45
TP 27
TP 28
TP 29
TP 30
TP 31
TP 32
TP 33
TP 34
TP 35
TP 36
TP 37
102 Z

*Symbol and number refer to figures on page 104.*

TP1 toTP27. See grinder chart, page 99.

TP28. Finishing bevel.

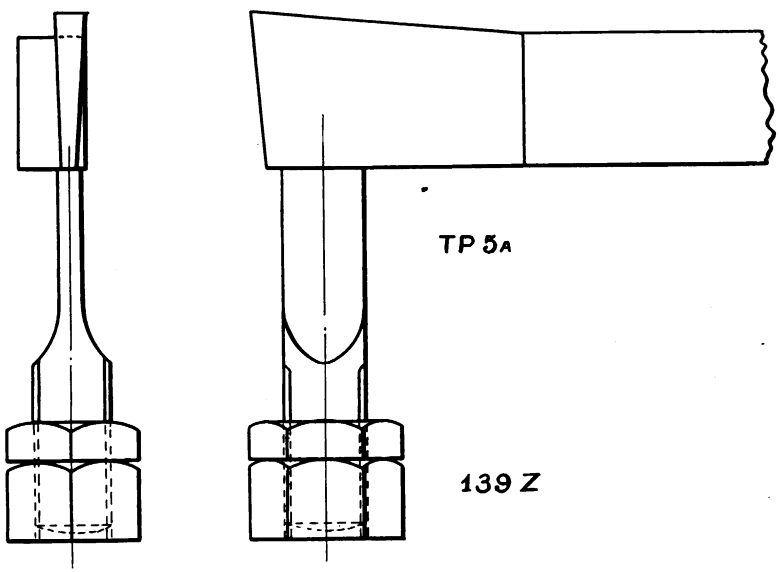
TP29 to TP31. Forming tools.

TP32. Corner rounding tool.

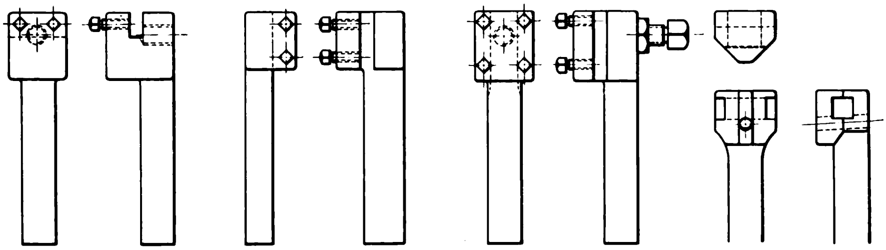
TP33. For cutting out clearance between double gears.

TP34 to TP36. Forming tools.

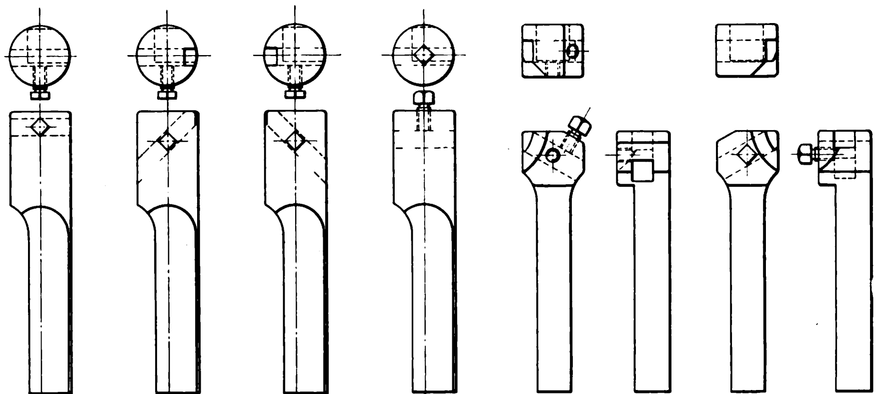
TP37. Bent roughing tool. Used in side of tool post with another tool in regular position for facing or turning.



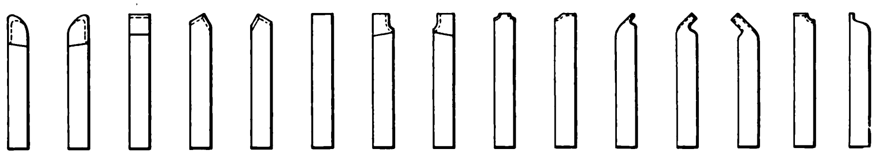

TP5A. Support for cut off tool. This support or one similar may often be used to good advantage with any overhanging tool post tool.



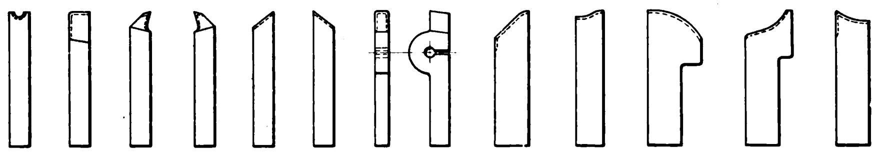
TP38 TP39 TP40 TP41



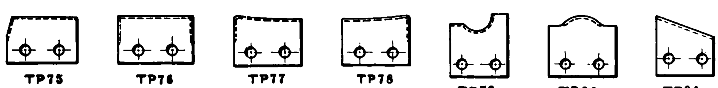
TP44 TP45 TP46 TP47 TP42 TP43



TP48 TP49 TP50 TP51 TP52 TP53 TP54 TP55 TP56 TP57 TP58 TP59 TP60 TP61 TP6'



TP63 TP64 TP65 TP66 TP67 TP68 TP69 TP70 TP71 TP72 TP73 TP74



TP75 TP76 TP77 TP78 TP79 TP80 TP81

103 Z

*Symbol and number refer to figures on page 106.*

TP38, 39. Holders for flat forming cutters. See cutters TP75 to TP81 below.

TP40. Holder for two tools used for straddle facing.

TP41, to TP43. Standard tool holders. See standard tool equipment, pages 28 and 101.

TP44. Holder from round stock, set screw on top of cutter.

TP45. Holder from round stock cutter on angle for turning and facing.

TP46. Holder from round stock cutter on angle for boring and facing.

TP47. Holder from round stock—set screw in end.

TP48, to TP53. Cutters supplied with standard tool equipment, see pages 28 and 101.

TP54, TP55. Cutters for forming sprocket teeth.

TP56. Corner rounding cutter.

TP57. Forming cutter.

TP58. Grooving cutter for angle tool holder.

TP59, TP60. Square thread tools for right and left hand tool holders.

TP61. Tool for finishing, turning or facing and rounding corner.

TP62. Grooving tool for straight tool holder.

TP63. Forming tool for pulley flange.

TP64. Finishing tool.

TP65. Thread tool—outside threading.

TP66. Thread tool—inside threading.

TP67, TP68. Tools for finishing bevel surfaces.

TP69. Spring tool.

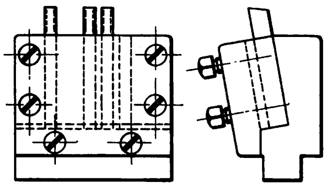
TP70. to TP74. Forming tools.

TP75. to TP78. Flat forming tools for crowned pulleys.

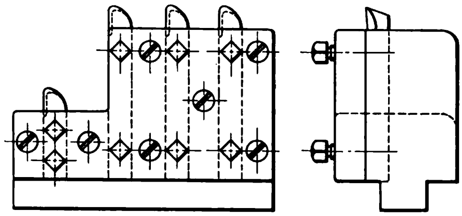
TP79. Flat forming cutter for ball on steering knuckle.

TP80. Flat forming cutter for worm gear.

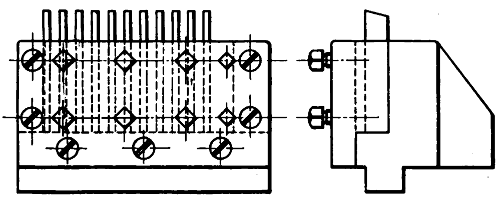
TP81. Flat forming cutter for bevel.



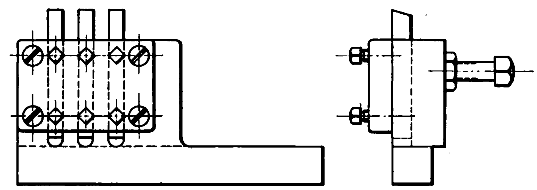
TP 82



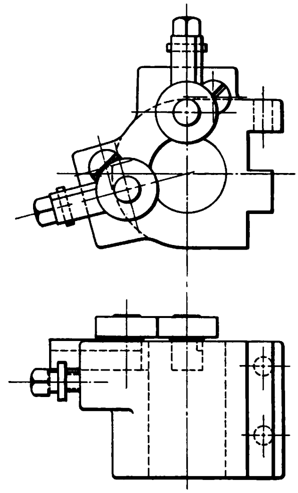
TP 83



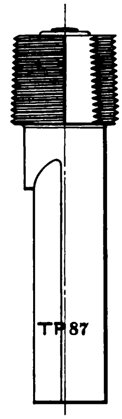
TP 84



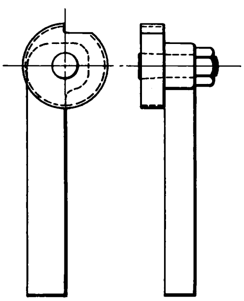
TP 85



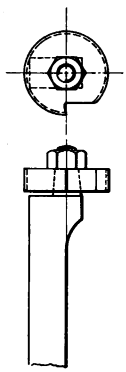
TP 86



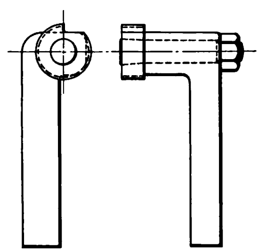
TP 87



TP 88



TP 89



TP 90

104 Z

*Symbol and number refer to figures on page 108.*

TP82. Tool holder for grooving tools.

TP83. Tool holder for gang tools for facing flywheel web and rim.

TP84. Tool holder used in cutting off piston rings.

TP85. Tool holder for piston grooving tools.

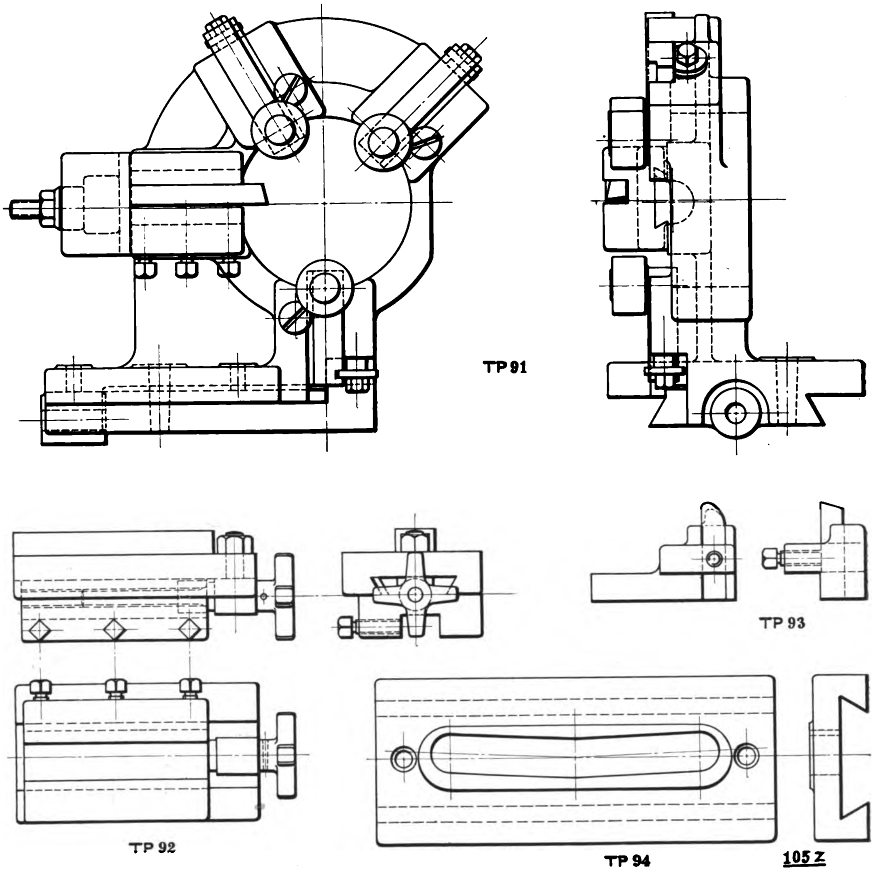
TP86. Roller support on tool post for small bar work.

TP87. Thread chaser for pipe flanges.

TP88. Outside thread chaser.

TP89. Inside thread chaser.

TP90. Special outside thread chaser.

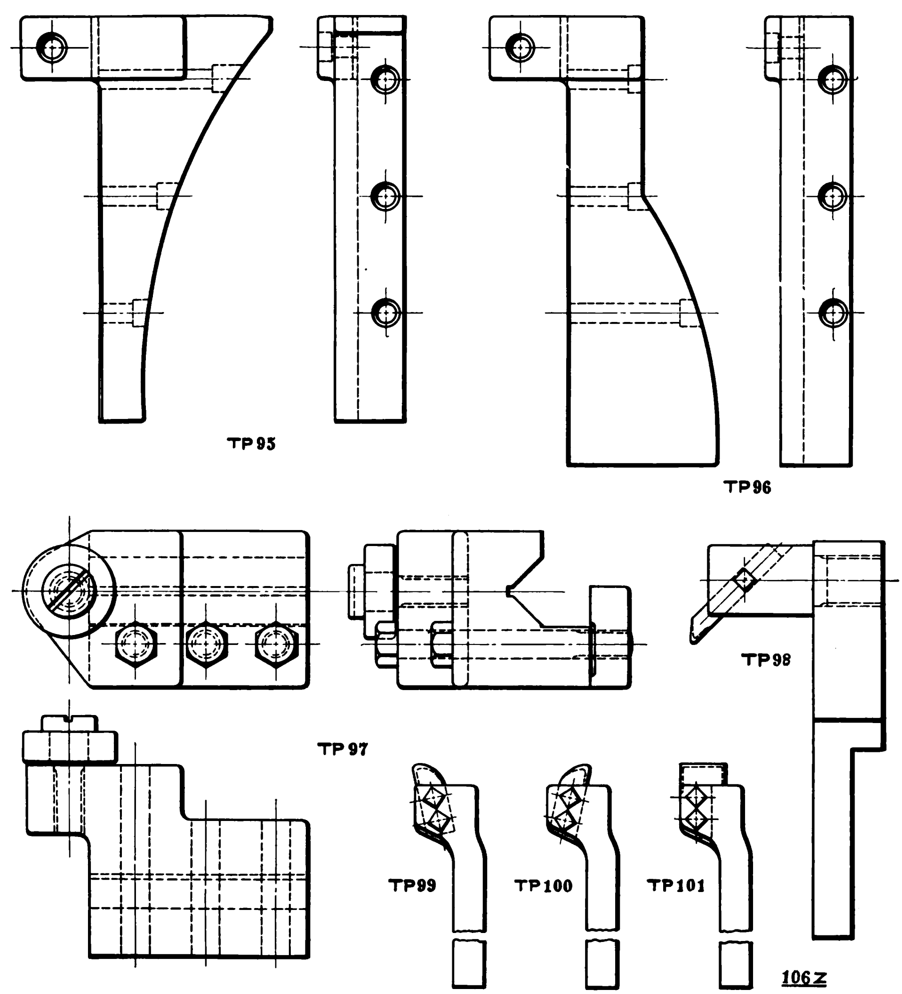



TP91. Steady rest carrying finishing cutter, used on tool post carriage for turning long work. The roughing cut is carried by a tool in the turret tool post and set about 1/8″ ahead of finishing cutter.

TP92. Adjustable tool holder employed when taper attachment is used for bevel facing or turning. See page 115 for further description.

TP93. Tool holder for turning. Used with regular tools in tool post.

TP94. Taper attachment forming block for crown pulleys.




TP95. Forming block on cross slide for facing convex surfaces.

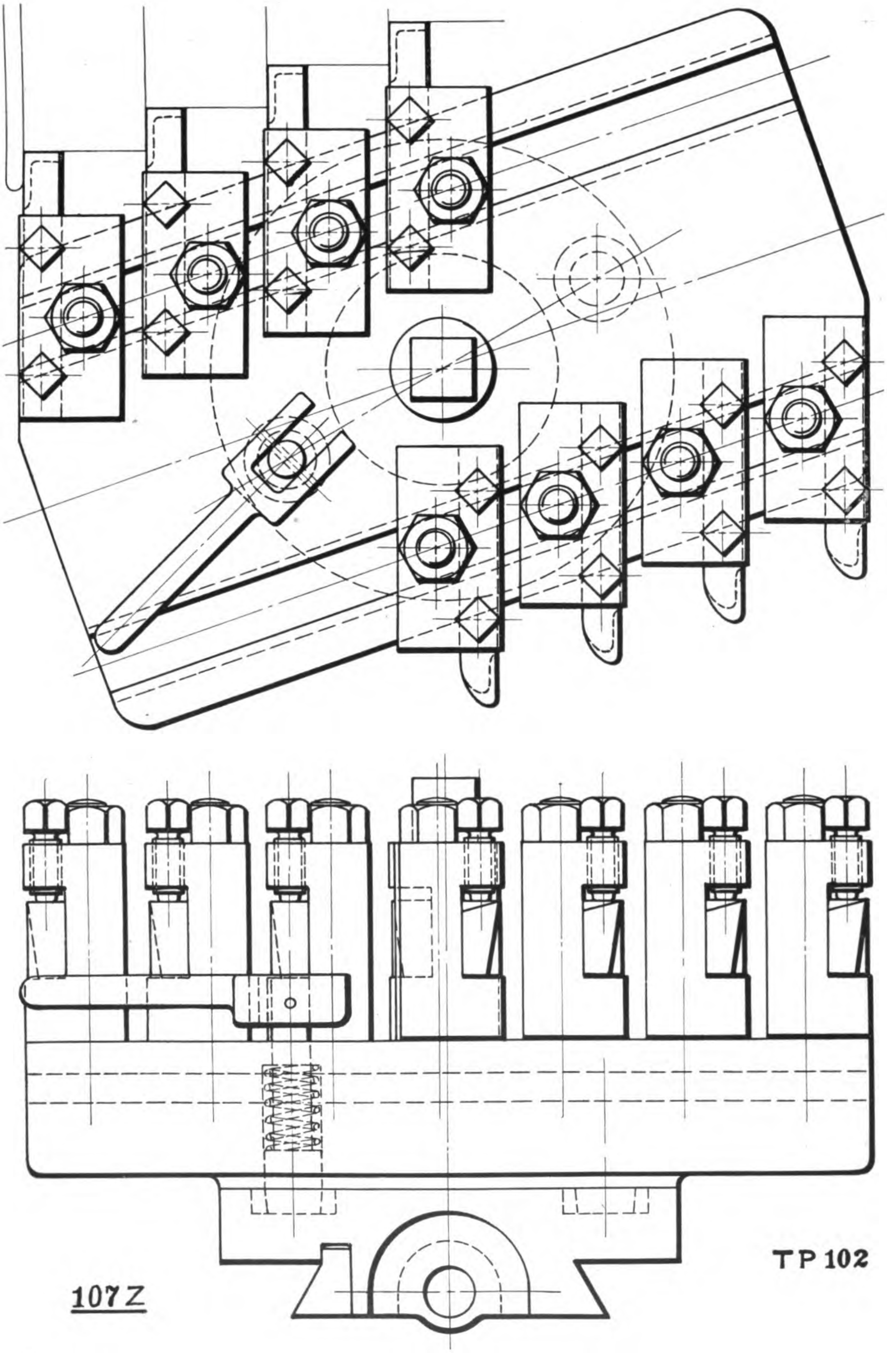
TP96. Forming block for concave surfaces.

TP97. Guide roller on ways. Used with TP95 and TP96.

Note: Forming blocks are bolted securely to cross slide on side toward turret, and the guide roller is clamped tight to front "V" way. The carriage then will follow shape of forming block.

TP98. Special tool holder for boring.

TP99 to TP101. Special tool holders for turning and forming.




107 Z

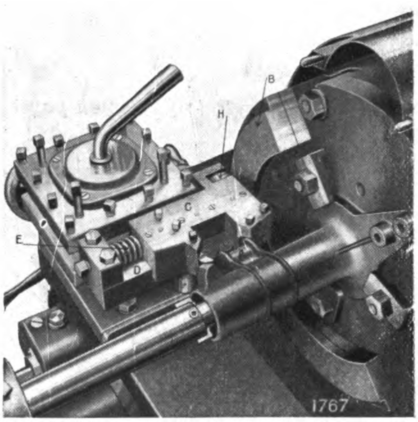
*Symbol and number refer to figures on page 112.*

TP102. Special tool post for rough and finish turning cone pulleys.

Figure 1767 shows a rather unusual job for a turret lathe.

It consists of rough and finish boring and reaming a hole the entire length of piece. Also the boss "A" is faced on both sides while the piece is being bored. The unusual feature of this job lies in the fact that the faces of the boss "A" are at two different angles to the axis of the cylindrical part or the bore.

To obtain these two different angles the cam plate "B" was made and bolted to face of chuck. The plate tapers in, getting thinner toward center of chuck; this gives one angle. Plate is also thinner at one end than at the other, which gives the second angle.



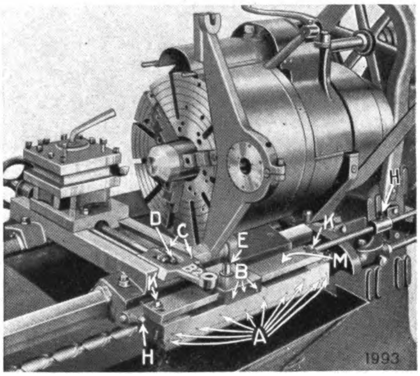

Tool Holder "C" is a sliding fit on the base "D" with a gib for adjustment, and carries two tools which are shown in position for facing both sides of boss "A". In one end of the holder "C" is arranged a hardened steel crowned roller "H", which is held against the cam plate "B" by compression spring "E." As the tools are fed in, the roller follows the shape of the cam, thereby causing the tools to follow the angles required on the face of the boss "A".

This same idea has been used for other work. In some cases the cam plate forms a complete circle, while in others it may be either more or less than the one shown which is approximately a half circle.

# Taper Attachment.

## ADJUSTMENT AND CONNECTION.

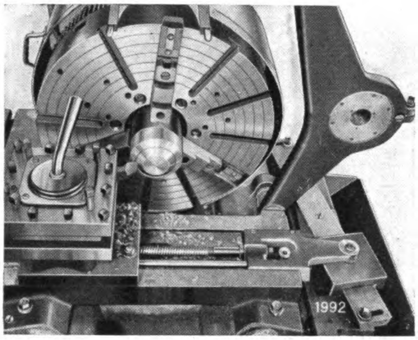
Before attempting to use the taper attachment the gibs should be correctly adjusted and well oiled. This is done by adjusting the gib screws "A" (shown in fig. 1993) in taper attachment slide so that gibs will move with a snug sliding fit, but not be too tight. Then adjust gib screws "B" in the swivel slide to about the same tension. The tail block "B2" should be adjusted to move freely with adjusting screws "C", after removing taper pin "D". Remove taper pin "D", by turning to the right, the hex head nut which is on the end of it.




Having removed the taper pin "D", the tail block "B2" should be lined up and the stud "E" screwed in place.

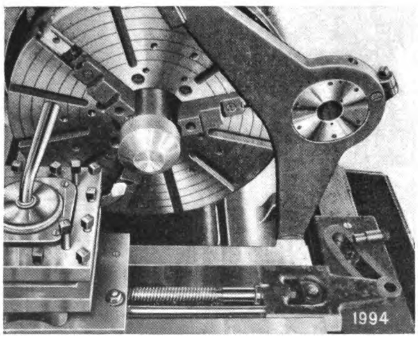
Set the tool post carriage so the cutting tool will be an inch or two from the point where it is to begin cutting and tighten the set screws "H" on the rod. Then loosen the clamp screws "K" and set the swivel "M" as near as possible to the taper desired. Gage taper after first cut and, if not correct, readjust the swivel "M" to suit. Always move tool post carriage back far enough to carry the cutting tool past the starting point. This is to take up any lost motion that may exist in the attachment. This lost motion is found in all taper attachments and is unavoidable.

The cutting tool should be set exactly on center. If height of tool is changed taper will also change, that is, if proper taper is obtained with tool set on center and tool is raised or lowered, the taper will change.




## USE.

The most common use of the taper attachment is that of boring or turning tapers with tool post tools. The taper attachment may be set to turn straight, or taper up to 4¼″ per foot. It is frequently used and proves very convenient for boring or turning jaws.




We have successfully used the taper attachment in facing bevel gears where the angle is near forty-five degrees. This is done by setting the attachment to one side or the other, according to the angle required and engaging both the cross feed and the carriage feed at the same time. Very accurate results may be expected thru this combination if the tool post carriage stops are used, or some other means of accurately locating the carriage, and observing the index dial on the cross feed screw. Both feeds should be engaged with the spindle not in motion.

Figure 1992 is an illustration of bevel facing with the taper attachment. The machine was stopped in the middle of the cut and this view taken.

Angles that do not come within the range of the standard taper attachment may be obtained by making a special guide block as shown in figure 1994, page 116. Almost any desired shape may be had thru the use of special blocks, such as the crowning of pulleys, etc. One of the blocks used for crowning pulleys is shown at TP94, page 110.

Taper turning and boring is further discussed in Facing Head Chapter, pages 172, 174 and 175.

# The Drill Support.

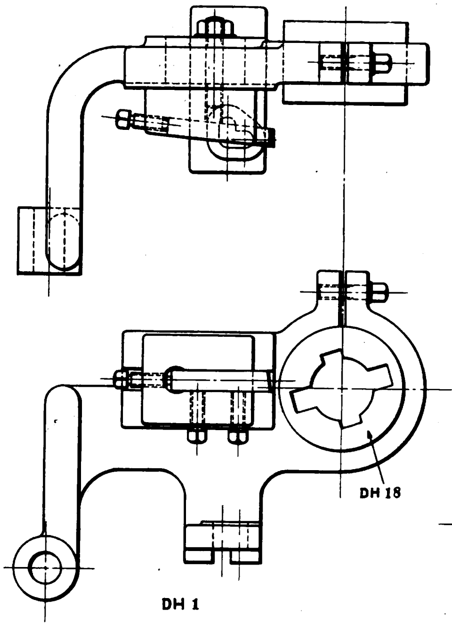
The foremost consideration in the design of the drill support was its adaptability to the general run of turret lathe work.

It is quickly lowered into position and when not in use may be swung back out of the way of other tools and to clear the chuck. A 6″ universal scroll chuck is provided and may be used in a number of ways. One of these is in starting drills true in solid material, such as forgings and work from bar stock. A center drill is sometimes held in the chuck in drill support when a center is required in the work being done.

The drill support affords an ideal support close to the work for three or four lip drills, commonly used for opening up cored and other rough holes. This support is most valuable as usually these holes do not run true, and if not supported, the drill has a tendency to follow the rough hole.

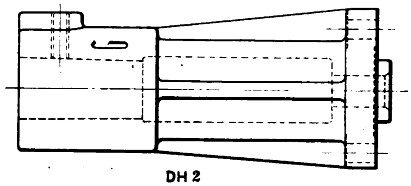
Occasionally work will come to the turret lathe with what is commonly called a "blind hole" or a hole that does not extend all the way thru the piece. This, of course, prohibits the use of the piloted bars which are usually supported in a bushing held in the bore of the chuck. Here we find the drill support almost indispensable as a support for end boring bars used on this class of work. When used in this way, the drill support chuck is replaced with a bushing. The bushing should be a sliding fit on the boring bar. See illustration on sheet 108Z, page 118, also figure 2005 and 2006, page 122.

When the amount of work to be performed warrants doing so, special drill supports may be made that will give an advantage over the standard support. Some of these are made to carry turning and facing tools for sizing and facing the end of the work. See sheets 108Z and 109Z, pages 118 and 120.

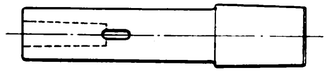


DH 18

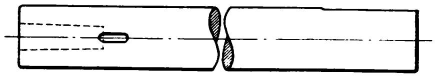
DH 1



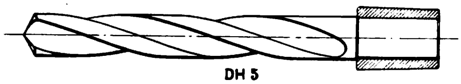
DH 2



DH 3

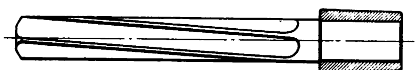


DH 4



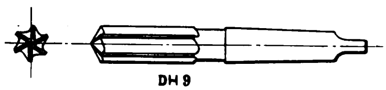
DH 5

DH 6

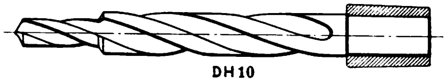


DH 7

DH 8



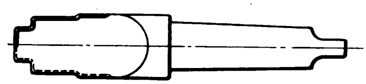
DH 9



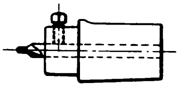
DH 10

DH 11

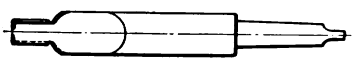
DH 12



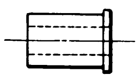
DH 13



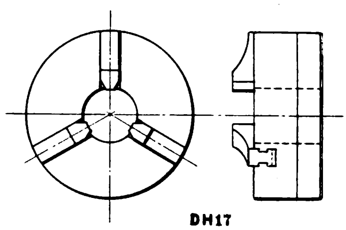
DH 14



DH 15



DH 16



DH 17

108 Z

*Symbol and number refer to figures on page 118.*

DH1. Special drill support carrying a tool to size end of work.

DH2. Standard drill holder.

DH3. Drill socket for using taper shank drills with drill holder.

DH4. Drill socket fitting turret.

DH5. Twist drill, straight shank, with bushing for standard drill holder.

DH6. Twist drill, taper shank.

DH7. 4 lipped drill, straight shank, with bushing for standard drill holder.

DH8. 3 grooved chuck reamer, straight shank, with bushing, etc.

DH9. Special taper shank drill.

DH10. Twist drill, two diameters.

DH11. Oil tube twist drill, straight shank.

DH12. Oil tube twist drill, taper shank.

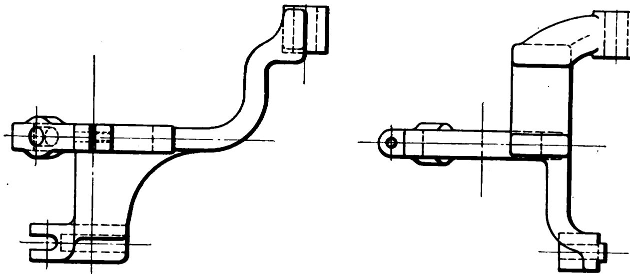
DH13 & DH15. Special drills.

DH14. Center drill.

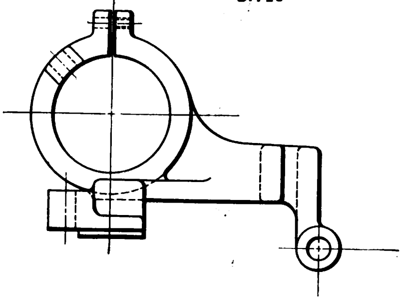
DH16. Bushing for supporting drills in chuck DH17.

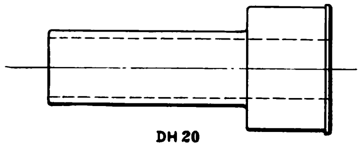
DH17. 6″ chuck used in drill support.

DH18. Bushing in drill support used for supporting end bars larger than can be supported by 6″ chuck DH17.

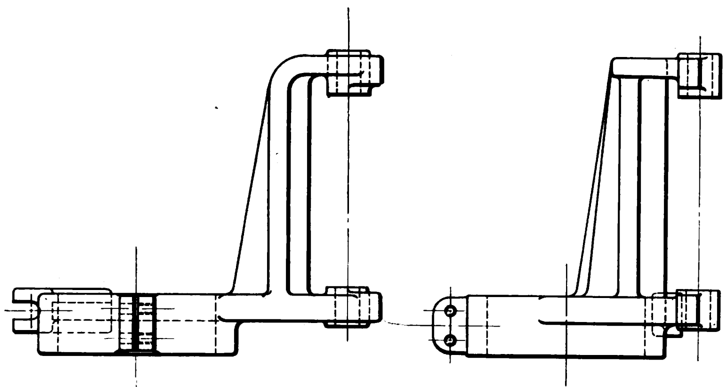


DH 19

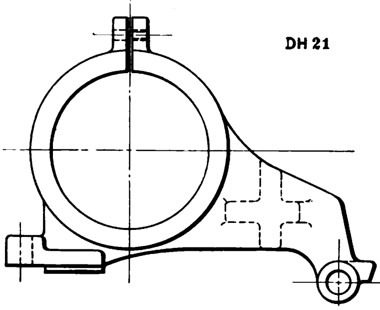




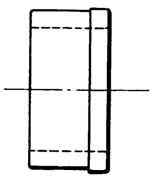
DH 20



DH 21



109Z



DH 22

*Symbol and number refer to figures on page 120.*

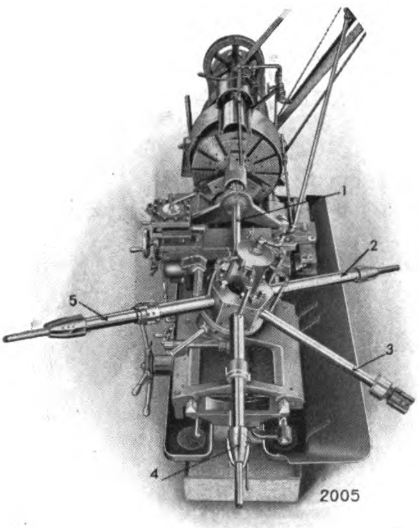
DH19. Special drill support.

DH20. Bushing on end bar for supporting close to the cutter in long work.

DH21. Special drill suport allowing tool post to be used while boring with end bar.

DH22. Flanged bushing for drill support.

An actual application of the standard drill support is shown in figures 2005 and 2006. The tools on the machines in these cuts were used to bore a high explosive shell approximately 20″ deep. The drill support is fitted with a bushing and supports bars No. 1 and No. 3 which bore to a depth of 16″. These bars carry a sliding bushing which is a slip fit in the drill support bushing.



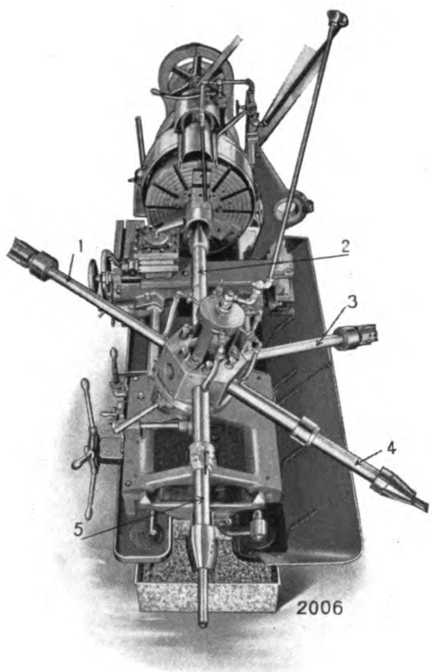




Figure 2005 shows support lowered in place with bar No. 1 ready to begin boring.

Figure 2006 shows support thrown back out of way, with bar No. 2 in position to enter work.

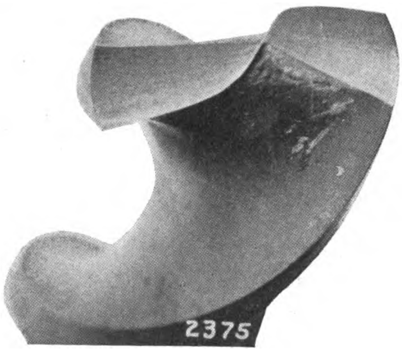
# Turret Tools.

## DRILLS

As drills are often a part of turret lathe tool equipment, we offer a few suggestions in regard to drill grinding.

The twist drill will cut fairly free when new, but, as it is ground and reground, the web or center part becomes heavier or thicker and makes the point wider. This condition requires an excessive amount of power to feed the drill thru the material.

Often-times the attempt to relieve the point results in its being weakened which causes undue breakage, therefore, nothing has been gained.



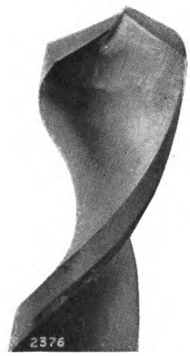



Figure 2430 shows a drill which has been ground only a few times, but has a web of considerable thickness. However, in this case, the cutting edges *do not* extend to the center.

Figures 2375 and 2376 show the same type drill with this web or center part ground to give a cutting edge right in to the center of the drill. Note again the cutting edges of both lips *extend* to the center and have a strong web connecting them. The point is not weakened in the least as the *heel* of the lip is *not* ground away.

Great care, however, must be exercised in grinding, because, if the relief is ground past center into the heel of the opposite lip, a weakness results. In relieving the point, the grinding may be done on almost any emery wheel for tool grinding but the best results will be obtained on a wheel about 4″ in diameter by ½″ thick with square corners.

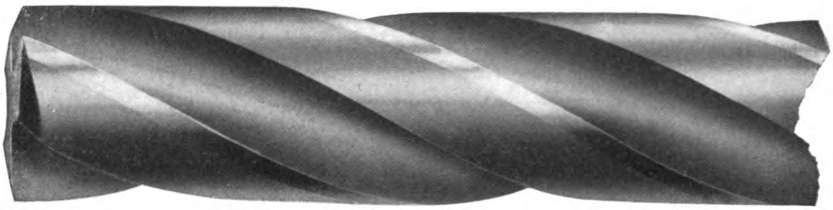
This shape of lip may be ground with equally good results on flat drill bits, which are sometimes used instead of the twist drill.

The regular grinding should, of course, be done on a drill grinder, not by hand.

The three or four lip drill is used to open up cored and other rough holes before using boring cars. For this work the drill should be carefully ground to accomplish the desired result, which is, not only to open up or enlarge the hole, but also to help true it.

It is quite customary to chamfer the ends of the lips, but experience has taught us that a drill ground in this way has a tendency to follow the rough hole.

If the end of the drill is ground square, or better still slightly concave and the corners beveled about $^1/_{16}''$ wide, it will invariably make a truer hole than the chamfered drill and it will cut faster, which means that a heavier feed may be used.



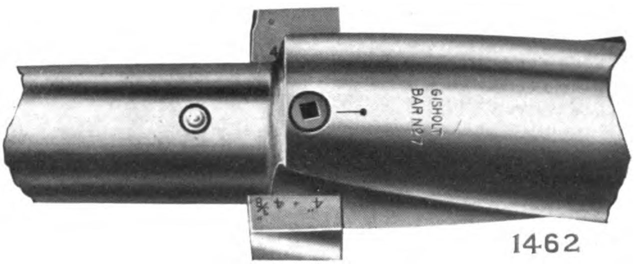
1889

Figure 1889 shows how a three or four lip drill may be ground as we recommend. Grinding should always be done by machine, because the best results are obtained if all lips cut exactly alike.

Cutting speeds and feeds are governed by the work at hand depending on material being drilled, size of drill and amount of stock removed.

A few special drills are shown on sheet 108Z, page 118.

## BORING BARS.



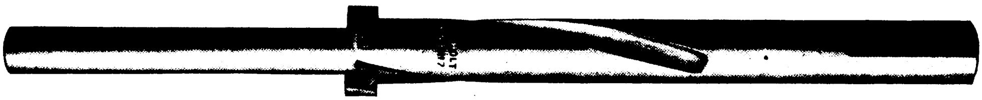

1462

There are in use a great number of differently designed boring bars, some of which are exceedingly well constructed and very serviceable.

Two of the most essential requisites of a boring bar are rigidity and chip clearance. The latter perhaps is of as much, if not more, importance than the former. Cutters are frequently broken by chips clogging between the work, the cutter, and the bar due to insufficient chip clearance.

While the question of chip clearance must not be over-looked, the bar should be made as rigid as possible.

The Gisholt Standard Boring Bar as shown below has been developed to a very high point of efficiency. Note the spiral groove which leads back from each cutting lip of the cutter. The spiral lead is right hand which helps to work the chips out of the hole the same as they work out along the flutes of an ordinary twist drill.



Twelve sizes of this bar form a complete standard set, boring any desired size of hole from 1″ to 9⅛″ diameter. This bar has a long pilot and is supported in a bushing held in the bore of the chuck.

The type shown in figure 1460 is held in the turret head proper by a very snug sliding fit, and clamped with a clamp screw, while the smaller sizes are held in our standard drill holders, which are shown on page 118.

At least two bars should be used to produce a true hole with a close size limit—one for roughing and the second for finishing. The finisher, of course, is usually followed by a reamer as a final finisher and sizer.

There should be very little stock left for the finishing bar, because the less the finishing cutter removes the truer the job will be when finished, providing enough stock is left for the finisher to cut all the way around or "clean up."

The amount usually allowed between the roughing and finishing cutters is from .015″ to .020″ for both cast iron and steel, governed to a great extent by the condition of the work as it comes to the machine. For reaming allowances see page 151.

Sometimes the work may be handled more rapidly if special bars are made. A few special bars are shown on some of the following pages. Note some of these carry cutter heads slotted for cutters. Others are made with steps having cutters in each step for different sized holes in the same piece which may be bored simultaneously.

Always bear in mind that to get the best results and highest production, your boring bars *must be rigidly supported.* End bars which have the cutter in the extreme end and no pilot should be supported in the drill support provided for that purpose. See illustrations in drill support chapter.

Trouble is occasionally experienced thru miscalculating the length of boring bars. The pilot must necessarily be long enough to extend thru the work and enter the supporting bushing in the chuck and the shank of the bar must be long enough to reach over the cross carriage and permit boring and turning at the same time.

Taking all this into consideration, we insert for your convenience the table on page 127, which probably will assist in determining the length of bars, also the location of the cutter slots so as best to take care of the work at hand or under consideration.

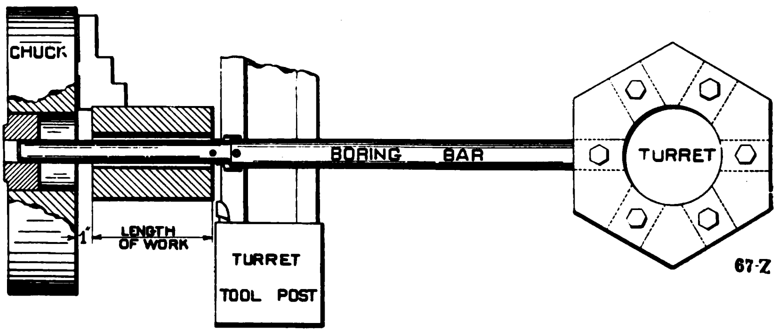
You will note that the table is in two sections; the first, relating to that work which will not swing over the tool post carriage cross slide, the second to that work which will swing over the tool post carriage cross slide.

Whenever a No. 1, No. 2 or No. 3 bar is used with our 21″ or larger Lathe, it is carried in the drill holder on the turret, in a split bushing, and the regular stock 29″ bar will care for any work in length up to 10″, (subject to chucking diagram below) which will cover most requirements.

The "lengths of work" given in table opposite are conservative, and any given size of bar is intended to bore occasional slight extra lengths which exist because of variations in castings.

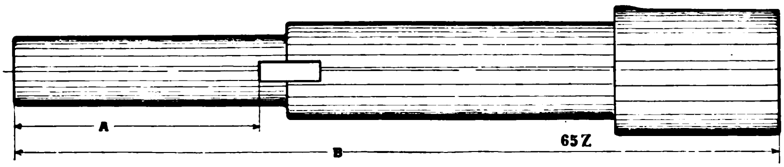
The allowance on the pilot, between the length of work and the "A" dimension, permits the pilot to have not less than a 2″ bearing in the chuck bushing; permits the chuck bushing being set back from $1\frac{1}{2}$″ to 2″ in the bore of the chuck; it also assumes that the work itself will be held 1″ out from the face of the chuck.

In case the work is to be held at a greater distance than 1″ from the face of the chuck, the *additional* distance should be *added* to the length of work.



67-Z

# LENGTH OF BARS FOR USE WITH GISHOLT TURRET LATHES




| GISHOLT TURRET LATHES | NOT OVER CARRIAGE The Boring Bar Dimensions for Chucked Work that will NOT Swing Over the Tool Post Carriage Cross Slide. | | | OVER CARRIAGE The Boring Bar Dimensions for Chucked Work that WILL Swing Over the Tool Post Carriage Cross Slide. | | |
|---|---|---|---|---|---|---|
| Size | Length of Work | "A" | "B" | Length of Work | "A" | "B" |
| | Inches | Inches | Inches | Inches | Inches | Inches |
| "G" or 13½ inch..... | .. | .. | .. | 6 | 10 | 24 |
| | 4 | 8 | 26 | 8 | 12 | 26 |
| | 6 | 10 | 29 | 11 | 15 | 29* |
| "H" or 21 inch....... | 6 | 11 | 34 | 10 | 15 | 34 |
| | 8 | 13 | 38* | 12 | 17 | 36 |
| | 10 | 15 | 42 | 14 | 19 | 40 |
| | 11 | 16 | 44 | 16 | 21 | 44 |
| "I" or 24 inch........ | 8 | 13 | 40 | 14 | 19 | 42 |
| | 10 | 15 | 44* | 16 | 21 | 46 |
| | 12 | 17 | 48 | 18 | 23 | 48 |
| "J" or 28 inch........ | 8 | 13 | 44 | 14 | 19 | 44 |
| | 10 | 15 | 48* | 16 | 21 | 48 |
| | 12 | 17 | 52 | 18 | 23 | 52 |
| | 14 | 19 | 56 | 20 | 25 | 56 |
| | 16 | 21 | 60 | 23 | 28 | 60 |
| "K" and "L"......... 34 in. and 41 in....... | 8 | 14 | 48 | 14 | 20 | 48 |
| | 10 | 16 | 52 | 16 | 22 | 50 |
| | 12 | 18 | 56* | 18 | 24 | 54 |
| | 14 | 20 | 60 | 22 | 28 | 60 |
| | 15 | 21 | 62 | 24 | 30 | 62 |

* Stock Bar usually recommended for ordinary use.

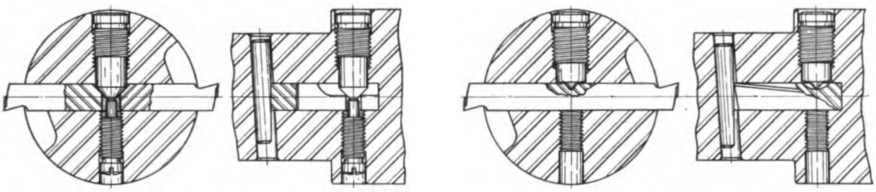
# GISHOLT BORING BARS.

This description of the Gisholt Boring Bar is given to illustrate the importance and superiority of this type of bar.

The bars are made of special steel, heat treated to give toughness and increase the tensile strength and then hardened on the pilot only.

The cutter slot is so located that the cutter leads the large diameter of the bar, which, having spiral grooves for the chips to pass thru, permits boring of diameters only slightly larger than the bar. The cutter key is placed in front of the cutter whose backing is thus the bar itself. The maximum rigidity is insured by this arrangement and the fact that the cutter has the extra support of the larger diameter of the Bar. As the chip groove does not cut thru the bottom of the cutter slot it does not reduce the backing of the cutter.

Jigs are used in machining these bars to secure interchangeability of cutters, and uniformity of bars.



1 134-Z 2

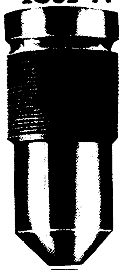
Expansion or Adjustable and Solid Cutters are regularly furnished with these bars. At 1 in figure 134Z is shown the principle of the Adjustable Cutter.

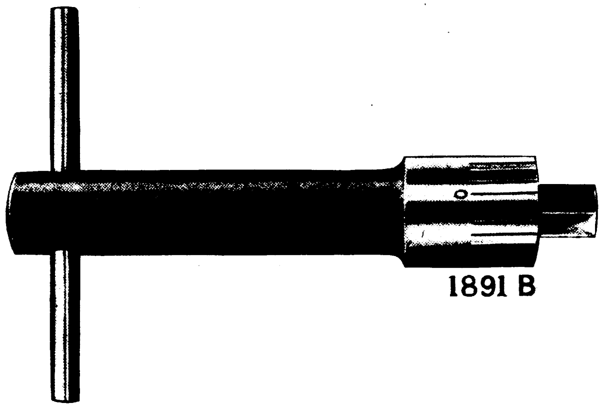
The cutter is made in halves with the inner ends beveled. The adjustment is made with a fine pitch screw which has a 90° point and works against the beveled ends of the cutter, expanding it.

The Adjusting Screw (1891A) is carefully made, hardened and accurately ground. A square hole is broached in the end to receive the Adjusting Wrench (1891B) which is graduated, making possible adjustments in thousandths. An Adjustment Lock Screw (1891C) is used to hold the Adjusting Screw in place when the proper setting has been made.

The front of the cutter blade (see 55Z, page 131) is beveled to a 3½° angle, same being widest at the inner end. A shim is used between the cutter and the cutter Key which we call Expanding Cutter Shim (1891D). It is made of Chrome Nickel Steel, heat treated and is milled with a 4° bevel as shown. The bevel side of the shim is set against the cutter. As the cutter is milled to a $3\frac{1}{2}^\circ$ angle and the shim to $4^\circ$, when the Cutter Key is set up tight, the shim bears heaviest at the ends, locking the cutter so as to prevent shifting under heavy cuts.

1891 A

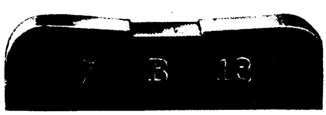




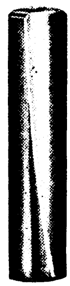
1891 B

1891 C

The Cutter Key (1891E) is made of regular drill rod, heat treated. It is flattened on one side at a $3^\circ$ angle. The key hole in the bar is drilled at this same angle so that the key has a flat bearing against the Cutter Shim, or against



1891 D



1891 E

Adjustment of the expansion cutters finer than .001″ is readily made by dividing the graduations on the Adjusting Wrench.

The correct procedure for obtaining a predetermined diameter of the cutter, when setting it in the Bar, is as follows:

First Be sure to remove any chips and thoroly clean the slot in the bar, the cutter, cutter shim, and adjusting screw.

Second Place cutter in slot and screw adjusting screw down until cutter has no end motion.

Third Put cutter shim in place and tighten cutter key slightly.

Fourth Take measurements and determine how much the cutter must be expanded to reach the required diameter.

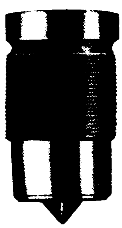
1891 F

Fifth Slightly loosen cutter key using punch (1891F) as shown, (but do not remove it), then expand cutter by running adjusting screw down with adjusting wrench which, being graduated in thousandths, makes possible very accurate adjustments.

Sixth Check measurement and, if not correct, slightly loosen cutter key again; then make any fine adjustment necessary and drive cutter key tight.

Seventh Be sure to tighten the adjusting lock screw when proper setting is made, after which the cutter can be removed for grinding and replaced without removing the adjusting screw or materially changing the size.

Note: Remember when making fine adjustments, cutter key should not be removed, but slightly loosened. This keeps the cutter in place while adjustment is being made.



1891 G

With the solid cutter as shown in figure 2-134Z, page 128, the key fits against the cutter. The cutter is centered by a fine pitch centering screw (1891G) as shown. The head of this screw is similar to that used for the Adjustable Cutter; the same wrench will fit both. These screws are hardened and accurately ground.

An advantage of this type of solid cutter lies in the fact that it may be shifted to one side, thus boring holes over its size. The Centering Screw is not used to hold the cutter, but simply to center it quickly and accurately, the holding of the cutter is done entirely by the key.

Following are a few of the different types of cutters, which may be very successfully used with the Gisholt Boring Bars.

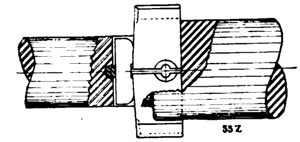



Figure 55Z. Standard Expansion Cutters have adjustment of from $^3/_{16}''$ to $^7/_{16}''$ (depending on size) by .001″ graduations, and finer if graduations are divided.

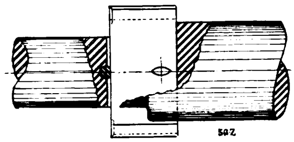
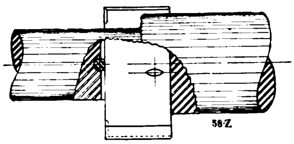



Figure 56Z. Standard Solid Cutters are centered in bar with accurate centering screw and held in place by standard cutter key. In emergency cases they may be set off center, and larger holes bored. See figure 58Z.



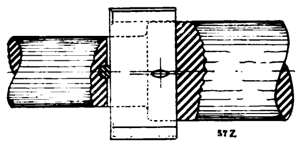




Figure 57Z. Floating Cutter which is sometimes used with favorable results when reamers are not available. Float is obtained by slightly loosening the Centering Screw and Cutter Key, thus allowing the Cutter a slight free movement in the bar.

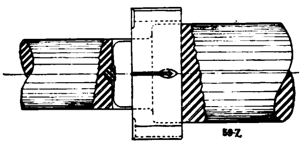



Figure 59Z. Swedge Expansion Cutters of this type permit a slight adjustment, but are not so reliable as the Standard Expansion Cutter.

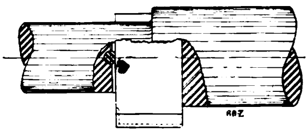



Figure 60Z. Single End Cutters used in emergency. Cutters are quickly and easily made from proper size stock.

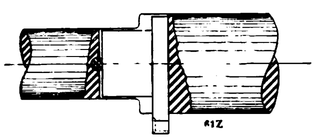



Figure 61Z. Another emergency Cutter, which may be made of square stock when proper size for single end cutters is not available. It may be shimmed by a piece of flat stock.

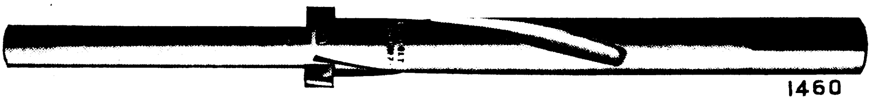
The Gisholt Boring Bars as listed on page 132 cover the ordinary sizes and lengths suitable for use with the various sizes of Gisholt Standard Turret Lathes.

Bars No. 1, No. 2 and No. 3 in the 29″ length as given, when used in combination with a drill holder on the turret, are of suitable length for use with any of our Standard Turret Lathes. A split bushing is used to fit the bars to the holder which permits of adjustment for length and also affords a more rigid support for small diameter bars.

No. 4 and larger bars are carried directly in the Turret. When ordering, the exact size of the hole in the Turret must be given.

All Boring Bars are complete with parts necessary to carry either the Expansion or solid cutters, as may be desired, except the No. 1 and No. 2 bars which do not carry the Expansion Cutter.

The list covers the ordinary stock sizes of Bars only, with the single cutter slot, regular diameters and base lengths. (Continued top of next page.)



1460

## LIST OF GISHOLT STANDARD BORING BARS.

| Bar Number | Range of Bore | Diameter of Pilot | Length of Pilot in Front of Cutter Slot | Diameter of Bar Back of Cutter Slot | Length of Bar Over All |
|---|---|---|---|---|---|
| | Inches | Inches | Inches | Inches | Inches |
| H–1 | 1 to 1 3/4 | 5/8 | 10 | 7/8 | 29 |
| H–2 | 1 3/8 to 2 1/2 | 7/8 | 10 | 1 1/4 | 29 |
| H–3 | 1 9/16 to 3 1/1 | 1 1/8 | 10 | 1 1/2 | 29 |
| H–4 | 2 to 3 3/4 | 1 3/8 | 14 1/4 | 1 7/8 | 38 |
| I–4 | 2 to 3 3/4 | 1 3/8 | 15 | 1 7/8 | 44 |
| J–4 | 2 to 3 3/4 | 1 3/8 | 16 | 1 7/8 | 48 |
| K–4 | 2 to 3 3/4 | 1 3/8 | 18 | 1 7/8 | 56 |
| H–5 | 2 3/8 to 4 9/16 | 1 5/8 | 14 1/8 | 2 1/4 | 38 |
| I–5 | 2 3/8 to 4 9/16 | 1 5/8 | 15 | 2 1/4 | 44 |
| J–5 | 2 3/8 to 4 9/16 | 1 5/8 | 16 | 2 1/4 | 48 |
| K–5 | 2 3/8 to 4 9/16 | 1 5/8 | 18 | 2 1/4 | 56 |
| H–6 | 2 7/8 to 5 1/2 | 1 7/8 | 13 3/4 | 2 3/4 | 38 |
| I–6 | 2 7/8 to 5 1/2 | 1 7/8 | 15 | 2 3/4 | 44 |
| J–6 | 2 7/8 to 5 1/2 | 1 7/8 | 16 | 2 3/4 | 48 |
| K–6 | 2 7/8 to 5 1/2 | 1 7/8 | 18 | 2 3/4 | 56 |
| I–7 | 3 1/4 to 6 1/4 | 2 1/8 | 15 | 3 | 44 |
| J–7 | 3 1/4 to 6 1/4 | 2 1/8 | 16 | 3 | 48 |
| K–7 | 3 1/4 to 6 1/4 | 2 1/8 | 18 | 3 | 56 |
| I–8 | 3 5/8 to 6 5/8 | 2 3/8 | 15 | 3 1/4 | 44 |
| J–8 | 3 5/8 to 6 5/8 | 2 3/8 | 16 | 3 1/4 | 48 |
| K–8 | 3 5/8 to 6 5/8 | 2 3/8 | 18 | 3 1/4 | 56 |
| J–9 | 3 7/8 to 7 3/8 | 2 5/8 | 16 | 3 3/4 | 48 |
| K–9 | 3 7/8 to 7 3/8 | 2 5/8 | 18 | 3 3/4 | 56 |
| K–10 | 4 1/8 to 7 13/16 | 2 1/8 | 18 | 4 | 56 |
| K–11 | 4 5/16 to 8 1/4 | 3 1/8 | 18 | 4 1/4 | 56 |
| K–12 | 4 3/4 to 9 1/8 | 3 3/8 | 18 | 4 1/2 | 56 |

When other than the regular stock bars are required, we would prefer to have drawings of the work submitted to us, so that we may determine the length and size of bars best suited to the work, altho the table given on page 127 may aid you in determining just what you require.

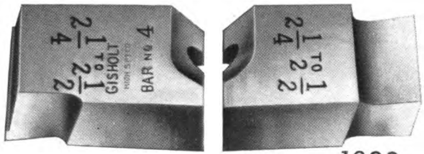
## BORING BAR EXPANSION CUTTERS.

The Expansion Cutters listed below are completely finished and may be interchanged from one bar to another of the same size.

The table in the left hand column gives our cutter number and, when followed by the Bar number in which it is to be used, definitely indicates just what cutter is desired.

If two or more Bar numbers follow a given sized cutter, it indicates that the cutter is interchangeable in any of those bars.

Range of Expansion of any Cutter is readily determined by reference to the column headed "Range of Bore." (Continued next page.)




1890

## LIST OF BORING BAR EXPANSION CUTTERS.

| Cutter Number | For Bar No. 3 | | For Bar No. 4 | | For Bar No. 5 | | For Bar No. 6, 7 and 8 | | For Bar No. 9, 10, 11 and 12 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Range of Bore Inches | Used in Bar No. | Range of Bore Inches | Used in Bar No. | Range of Bore Inches | Used in Bar No. | Range of Bore Inches | Used in Bar No. | Range of Bore Inches | Used in Bar No. |
| 30 | | | 2 to $2\frac{1}{4}$ | 4 | $2\frac{3}{8}$ to $2\frac{11}{16}$ | 5 | $2\frac{7}{8}$ to $3\frac{1}{4}$ | 6 | $3\frac{7}{8}$ to $4\frac{5}{16}$ | 9, 10 |
| 31 | $1\frac{9}{16}$ to $1\frac{3}{4}$ | 3 | $2\frac{1}{4}$ to $2\frac{1}{2}$ | 4 | $2\frac{11}{16}$ to 3 | 5 | $3\frac{1}{4}$ to $3\frac{5}{8}$ | 6 or 7 | $4\frac{5}{16}$ to $4\frac{3}{4}$ | 9, 10, 11 |
| 32 | $1\frac{3}{4}$ to $1\frac{15}{16}$ | 3 | $2\frac{1}{2}$ to $2\frac{3}{4}$ | 4 | 3 to $3\frac{5}{16}$ | 5 | $3\frac{5}{8}$ to 4 | 6, 7 or 8 | $4\frac{3}{4}$ to $5\frac{3}{16}$ | 9, 10, 11, 12 |
| 33 | $1\frac{15}{16}$ to $2\frac{1}{8}$ | 3 | $2\frac{3}{4}$ to 3 | 4 | $3\frac{5}{16}$ to $3\frac{5}{8}$ | 5 | 4 to $4\frac{3}{8}$ | 6, 7 or 8 | $5\frac{3}{16}$ to $5\frac{5}{8}$ | 9, 10, 11, 12 |
| 34 | $2\frac{1}{8}$ to $2\frac{5}{16}$ | 3 | 3 to $3\frac{1}{4}$ | 4 | $3\frac{5}{8}$ to $3\frac{15}{16}$ | 5 | $4\frac{3}{8}$ to $4\frac{3}{4}$ | 6, 7 or 8 | $5\frac{5}{8}$ to $6\frac{1}{16}$ | 9, 10, 11, 12 |
| 35 | $2\frac{5}{16}$ to $2\frac{1}{2}$ | 3 | $3\frac{1}{4}$ to $3\frac{1}{2}$ | 4 | $3\frac{15}{16}$ to $4\frac{1}{4}$ | 5 | $4\frac{3}{4}$ to $5\frac{1}{8}$ | 6, 7 or 8 | $6\frac{1}{16}$ to $6\frac{1}{2}$ | 9, 10, 11, 12 |
| 36 | $2\frac{1}{2}$ to $2\frac{11}{16}$ | 3 | $3\frac{1}{2}$ to $3\frac{3}{4}$ | 4 | $4\frac{1}{4}$ to $4\frac{9}{16}$ | 5 | $5\frac{1}{8}$ to $5\frac{1}{2}$ | 6, 7 or 8 | $6\frac{1}{2}$ to $6\frac{15}{16}$ | 9, 10, 11, 12 |
| 37 | $2\frac{11}{16}$ to $2\frac{7}{8}$ | 3 | | | | | $5\frac{1}{2}$ to $5\frac{7}{8}$ | 7 or 8 | $6\frac{15}{16}$ to $7\frac{3}{8}$ | 9, 10, 11, 12 |
| 38 | $2\frac{7}{8}$ to $3\frac{1}{16}$ | 3 | | | | | $5\frac{7}{8}$ to $6\frac{1}{4}$ | 7 or 8 | $7\frac{3}{8}$ to $7\frac{13}{16}$ | 10, 11, 12 |
| 39 | | | | | | | $6\frac{1}{4}$ to $6\frac{7}{8}$ | 8 | $7\frac{13}{16}$ to $8\frac{1}{4}$ | 11, 12 |
| 40 | | | | | | | | | $8\frac{1}{4}$ to $8\frac{11}{16}$ | 12 |
| 41 | | | | | | | | | $8\frac{11}{16}$ to $9\frac{1}{8}$ | 12 |
| Exp. | $\frac{3}{16}''$ | | $\frac{1}{4}''$ | | $\frac{5}{16}''$ | | $\frac{3}{8}''$ | | $\frac{7}{16}''$ | |

For convenience in ordering, please use our cutter number followed by the number of the Bar in which it is to be used.

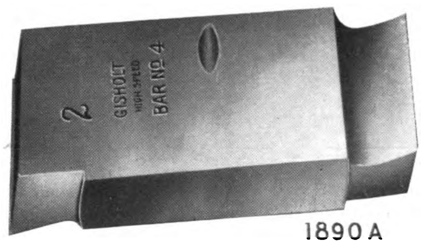
*Example:* One cutter No. 32-3 means one 1¾″ to 1 15/16″ cutter for No. 3 Bar
Two Cutters No. 32-5 means two 3″ to 3 15/16″ cutters for No. 5 Bar
Four Cutters No. 33-7 means four 4″ to 4⅜″ cutters for No. 7 Bar

One cutter is understood to be the two halves or *one complete cutter.* A pair of cutters would be understood to be four halves or two complete cutters, which could be used for roughing and finishing.

## BORING BAR SOLID CUTTERS.

The Solid Cutters listed below are all hardened and finished ready for use, except, perhaps, for grinding to suit local conditions. Each cutter has a central locating spot on the side with which the centering screw engages to center cutters in the bar.

Unless specified, we usually furnish the cutters ground, which, of course, would not interfere with the user regrinding it to meet his particular requirements. A cutter ground standard will usually cut .001″ to .002″ over its size.




1890 A

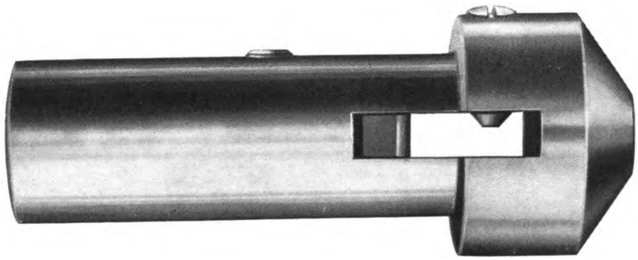
## LIST OF BORING BAR SOLID CUTTERS.

**The Several Sizes of Bars will Carry Cutters for Boring the Following Diameters**

| Bar | Will Bore | Bar | Will Bore |
|---|---|---|---|
| | Inches | | Inches |
| No. 1 | From 1 to 1¾ | No. 7 | From 3⅛ to 6 |
| No. 2 | From 1⅜ to 2½ | No. 8 | From 3⅜ to 6½ |
| No. 3 | From 1⅝ to 3 | No. 9 | From 3⅞ to 7½ |
| No. 4 | From 2 to 3¾ | No. 10 | From 4⅛ to 8 |
| No. 5 | From 2⅜ to 4½ | No. 11 | From 4⅜ to 8½ |
| No. 6 | From 2⅞ to 5½ | No. 12 | From 4⅝ to 9 |

In producing accurate work, as before stated, it is customary to rough bore, finish bore and then ream. In this case the cutters should be ordered in pairs, one Rougher (marked "R") and one Finisher (marked "F").

When these cutters are ordered in pairs, "R" and "F," we will assume that a Reamer is to follow the finishing cutter in the work unless otherwise instructed, and will supply cutters marked accordingly. The rougher would be ground in master bar from .015″ to .020″ undersize, and the Finisher ground from .005″ to .007″ undersize to leave stock for reaming.



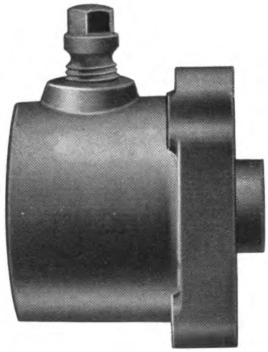
## MASTER GRINDING ARBORS

The grinding and sharpening of cutters can be done in the usual manner in the bars themselves. However, it is inconvenient and also takes the boring bars out of service, oftentimes delaying production.

We can furnish Master Grinding Arbors which, for the purpose intended, are an exact reproduction of a short section of the bar itself. These Arbors will carry either the Expansion or Solid cutters, have hardened tool steel center, and a screw action is substituted for cutter key to avoid any jar while on centers.

These Arbors are a great convenience because of their shorter length, also a great economy, as the grinding and sharpening of cutters can be done at the convenience of the tool room without taking the boring bars out of service.

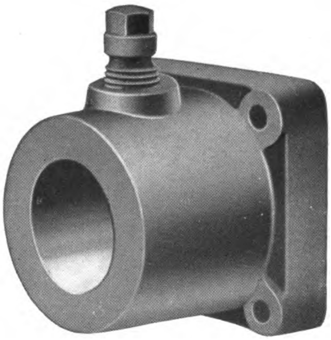
| Master Grinding Arbor | Length of Arbor | Will Carry All Cutters for Boring Bars |
|---|---|---|
| No. 1 | 7 inches | No. 1 |
| No. 2 | 7½ inches | Nos. 2 and 3 |
| No. 4 | 8 inches | No. 4 |
| No. 5 | 8 inches | No. 5 |
| No. 6 | 8 inches | Nos. 6, 7 and 8 |
| No. 9 | 8½ inches | Nos. 9, 10, 11 and 12 |



## TURRET ADAPTERS.

Perhaps your Gisholt Turret Lathe department consists of several sizes of lathes. And frequently you find it necessary, in emergency cases, to shift the tools for some work to a different size of machine than that for which they were made.

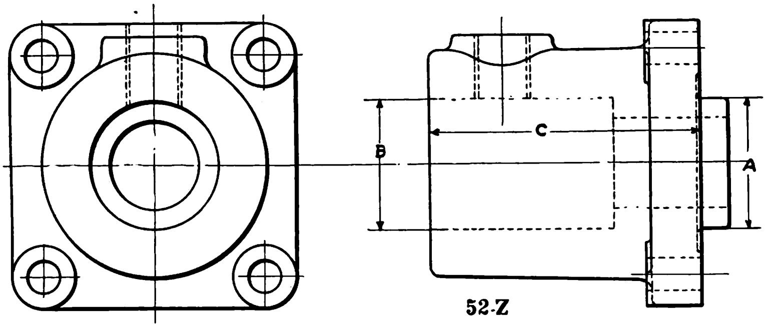
To facilitate this change, the Turret Adapters will prove very satisfactory for the boring bar and reamer equipment. They are made to fit the hole in the turret and bored to fit the boring bar. (See list next page.)



## TURRET EXTENSIONS.

Occasionally a case arises where the regular Boring Bars on hand are not of sufficient length to do some unusually long work. This is sometimes nicely handled by the use of Turret Extensions of proper length.

These Extensions bolt onto the face of the Turret (the bore being the same as that of the holes in the Turret), forming a rigid and substantial support, and, in fact, are preferable to an extremely long Bar. (See list next page.)




## TURRET ADAPTERS

**With Necessary Screws**

| Number | Will Carry Bars for Machine Next Size | A | B | C |
|---|---|---|---|---|
| | | Inches | Inches | Inches |
| G–58 | Larger* | 1½ | 2¼ | 4 |
| H–58 | " | 2¼ | 3 | 5 |
| I–58 | " | 3 | 3½ | 5½ |
| J–58 | " | 3½ | 4 | 6 |
| H–59 | Smaller | 2¼ | 1½ | 5 |
| I–59 | " | 3 | 2¼ | 5½ |
| J–59 | " | 3½ | 3 | 6 |
| K–59 | " | 4 | 3½ | 6 |

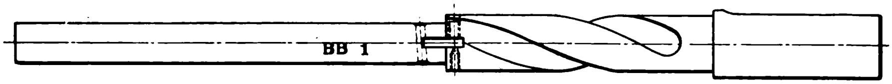
* If planning to use a long bar on machine requiring the use of a Number 58 Adapter, use care in checking the total length to see that it will swing.

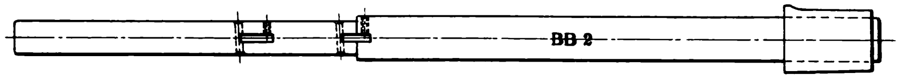
## TURRET EXTENSIONS

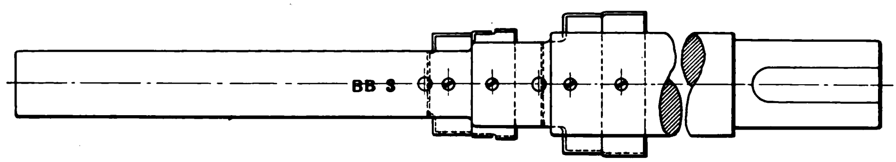
**With Necessary Screws**

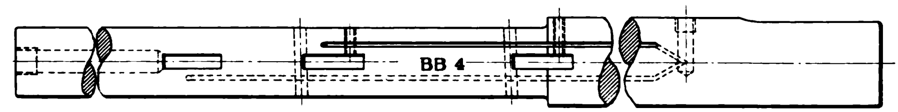
| Number | A | B | C** |
|---|---|---|---|
| | Inches | Inches | Inches |
| G–60 | 1½ | 1½ | 4 |
| H–60 | 2¼ | 2¼ | 5 |
| I–60 | 3 | 3 | 5½ |
| J–60 | 3½ | 3½ | 6 |
| K–60 | 4 | 4 | 6 |

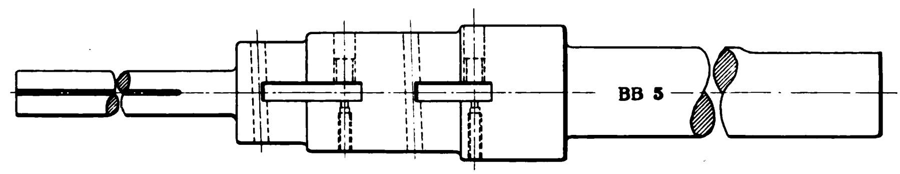
** Any desired length can be supplied.

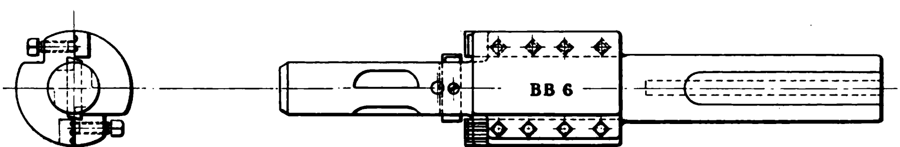


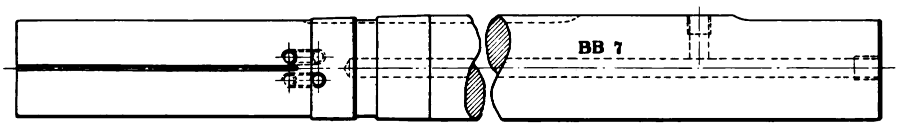



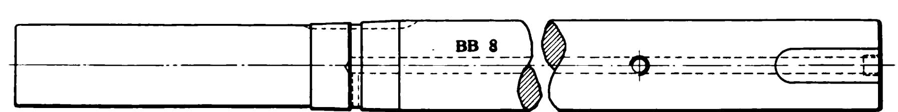




110Z

*Symbol and number refer to figures on page 138.*

BB1. Standard boring bar for adjustable or solid cutters.

BB2. Bar for two solid cutters.

BB3. Bar for a number of different diameters. Two cutters in each slot of bar.

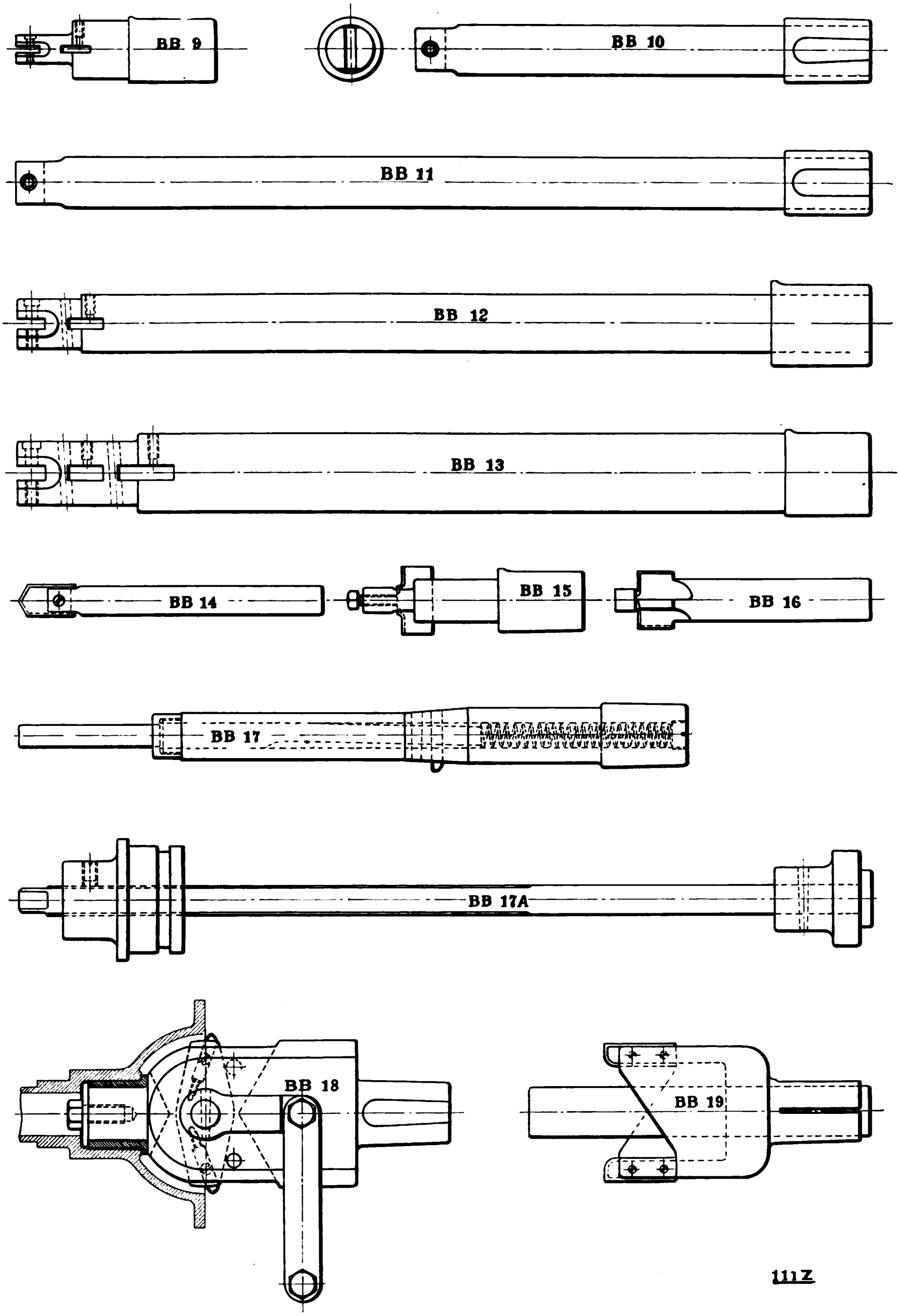
BB4. Bar with oil tubes. The forward slot arranged so cutter may be readily slipped into place for facing.

BB5. Bar with two slots for cutters for boring large diameters where only a small pilot can be used.

BB6. Bar for rough boring hole and roughing counterbore in flywheel.

BB7. Bar for two or more boring heads. Set screws thru bar to adjust cutters in first head.

BB8. Oil tube bar for one boring head.




111 Z

*Symbol and number refer to figures on page 140.*

BB9. Short end bar with extra slot.

BB10. End bar to fit drill holder.

BB11. End bar to fit turret.

BB12. End bar with one extra slot.

BB13. End bar with two extra slots.

BB14. End bar for small holes.

BB15. Counterbore with inserted cutter.

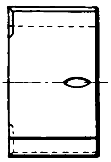
BB16. Counterbore solid.

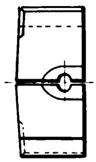
BB17. Bar for boring taper holes.

BB17a. Stop in spindle. Used with No. 17.

BB18. Bar for spherical part of differential gear case.

BB19. Head with supporting arbor for finishing annular groove in face of work, such as ball races.


BB 20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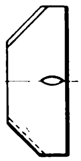
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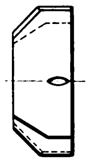
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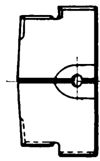
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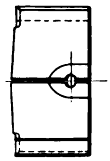
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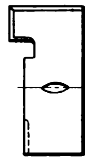
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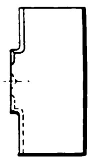
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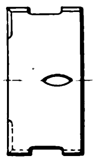
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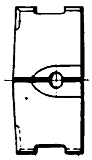
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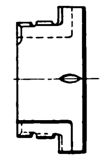
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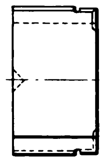
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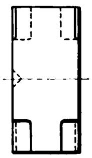
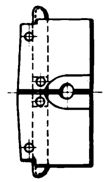
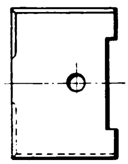

BB 32


BB 33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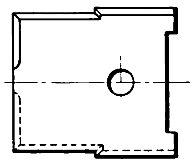
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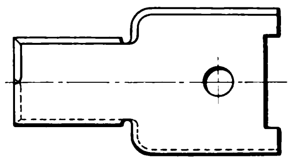
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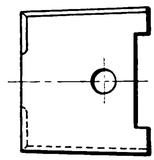
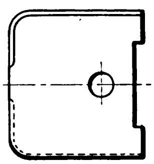

BB 37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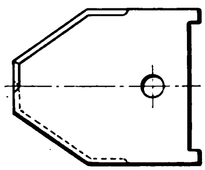
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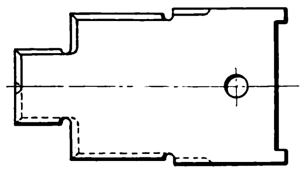
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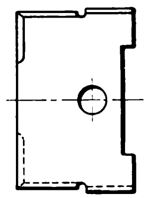
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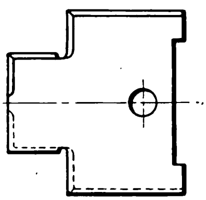
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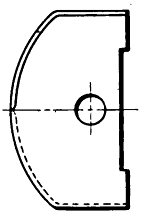
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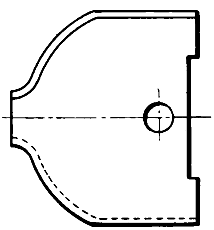
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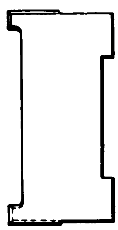
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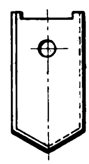

BB 46

112Z

*Symbol and number refer to figures on page 142.*

BB20. Boring bar solid cutter.

BB21. Boring bar expansion cutter.

BB22. Solid cutter for valve seats.

BB23. Solid cutter for boring to size and finishing valve seat.

BB24. Expanding cutter for two different diameters.

BB25. Expanding cutter for boring and facing bottom of hole.

BB26. Single end cutter for boring hole, turning boss, and facing bottom.

BB27. Facing cutter, cutting edge on front only.

BB28. Solid cutter for rough and finish boring with one cutter.

BB29. Expansion cutter same as BB28.

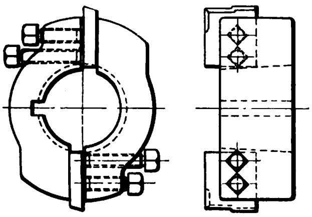
BB30. Solid cutter for boring two diameters and facing end.

BB31. Solid cutter to be inserted in bar next to chuck and bore toward turret. See BB4.

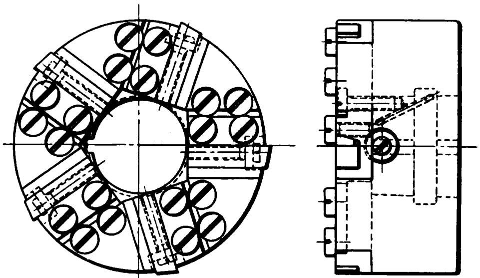
BB32. Facing cutter, cutting edge front and back.

BB33. Expansion cutters with inserted tools.

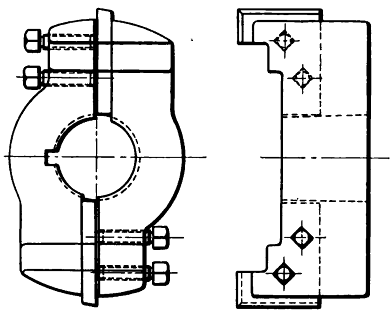
BB34. to BB46. End bar cutters of various shapes.



BB 47



BB 48



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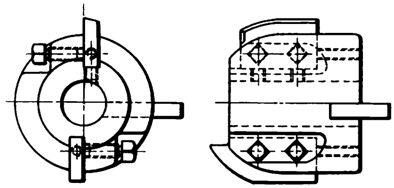
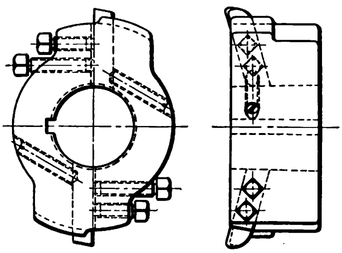


BB 50



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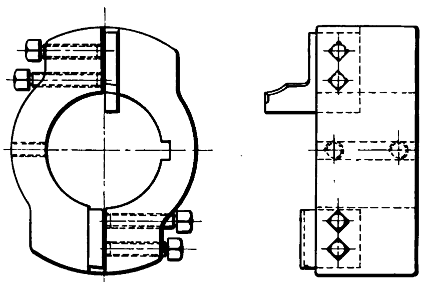

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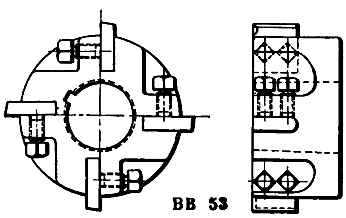
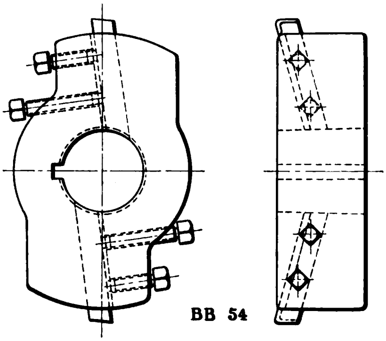


BB 53

113Z



BB 54

*Symbol and number refer to figures on page 144.*

BB47. Boring head with flat cutters.

BB48. Adjustable boring head for motor frames.

BB49. Boring head with flat cutters. Body of head cut away to clear hub.

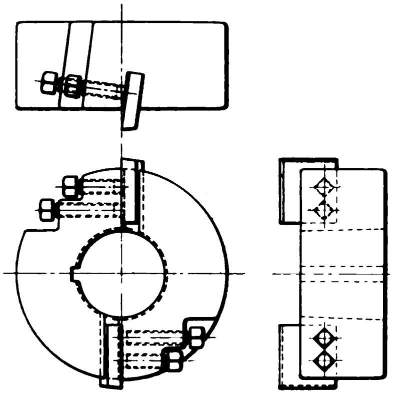
BB50. Head for spherical bores.

BB51. Head with square cutters, adjustable.

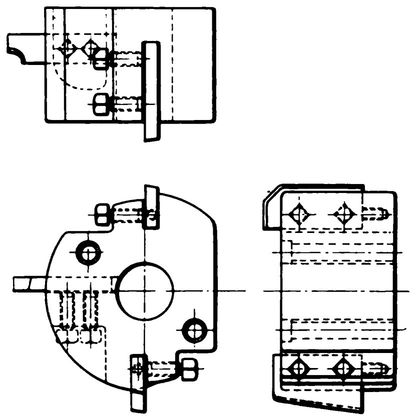
BB52. Head for boring and facing.

BB53. Head with four flat cutters.

BB54. Head with square cutters and oil tube.



BB 55



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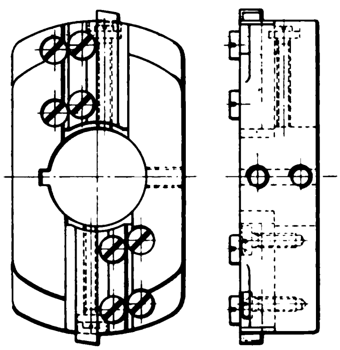

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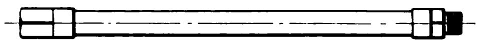

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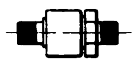

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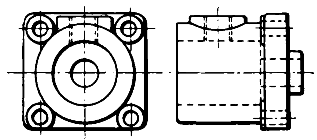

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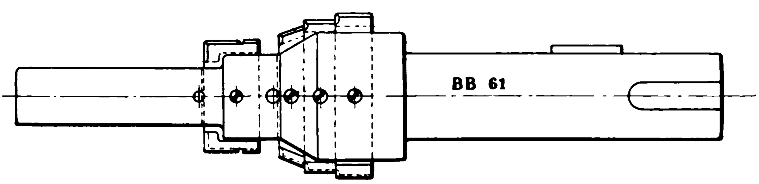
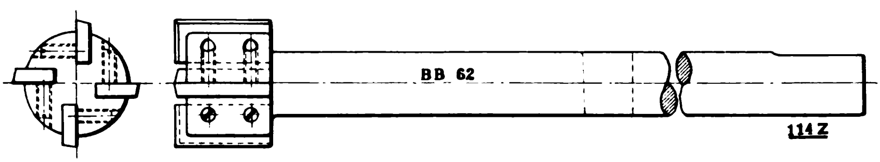


BB 61



BB 62

114 Z

*Symbol and number refer to figures on page 146.*

BB55. Boring head with cutters set on angle to give top rake.

BB56. Head for taper bore with cutter in body of head for chamfering corner.

BB57. Head with adjustable tool slides.

BB58. Flexible steel tube used with oil tube drills and bars.

BB59. Oil pipe connections.

BB60. Boring bar extension (See page 136).

BB61. Boring bar with cutters for automobile hub.

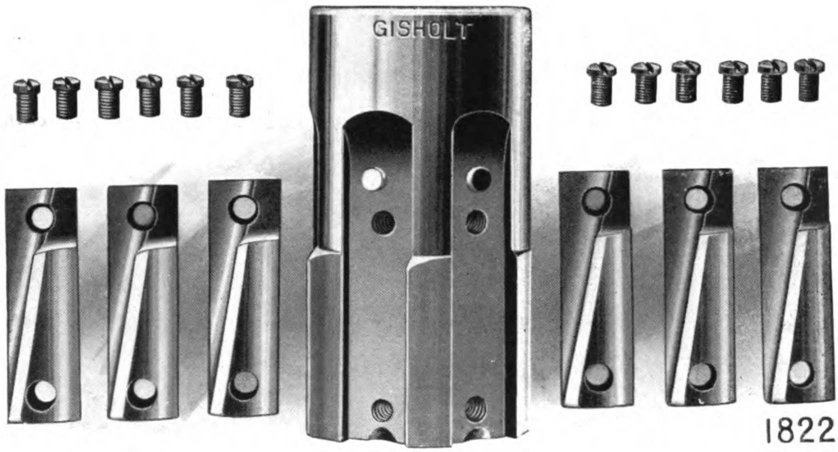
BB62. End bar with four cutters.

# Reamers

The right hand spiral reamer with not too many blades and with ample chip clearance is recommended as the reamer most adaptable for commercial use in cast iron, aluminum and especially steel.

Its advantage over the straight fluted reamer is that the chips will work out along the spiral flute about the same as they do with a twist drill.

If the reamer has an excessive amount of stock to remove or if the steel being reamed is soft and mushy with a tendency to tear, the spiral fluted type will prove far superior to the straight fluted type.




1822

The straight fluted reamer is very satisfactory for cast iron and for short holes in some other materials, when the length of the hole does not exceed the diameter of the reamer.

The blades of the spiral fluted reamer are inserted in a high carbon steel body. The blade slot is straight and the spiral cutting edge is milled on the blade; each blade having only one cutting edge. See figure 1822.

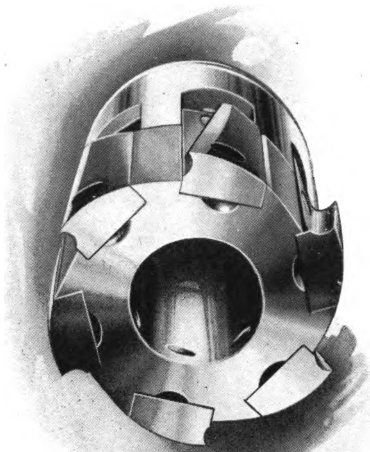
Two types of spiral fluted reamers with arbors are shown on page 155.

The straight shank reamer shown in figure 1828, page 150, is made for holes from 1″ to 2¼″. The shank is hollow and has a small hole leading (from this central cavity) to each blade. This makes it possible to flood the reamer with oil or cutting compound.

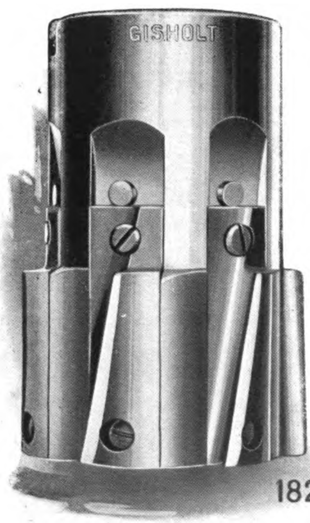
The shell reamer shown on page 149 is made for holes from 2¼″ to 4½″. For sizes larger than 4½″ diameter, the blades are set into a special body as is shown in figure 177Z, page 157.

Reamers are very important tools. If a hole requires reaming, it indicates that an accuracy is required not readily obtained otherwise.

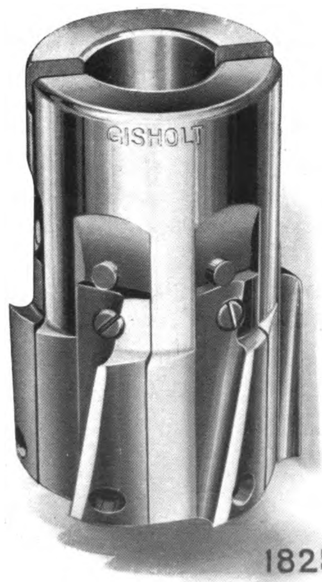
## REAMERS



1824




1823




1825

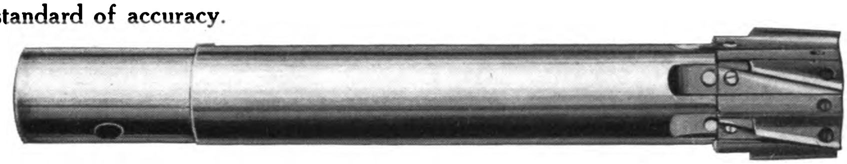
The accuracy of such work is absolutely dependent on the maintenance of accuracy in the tools producing it.

Then the first consideration in selecting reamers should be to secure a style and type which, under practical working conditions, may be held up to a desired standard with the least expense and care.

Experience has taught the dependability of the old solid type reamer. But with the soild type reamer there is no adjustment and, as soon as it has worn down below the low limit of the required size, it is useless.

The solid type high speed steel reamer was unpractical because of the first cost, the hardening difficulties and the absence of adjustment.

Many of the renewable blade or adjustable reamers were too frail in construction to withstand successfully actual working conditions. Some of them were too readily adjusted outside of the tool room to insure the maintenance of the desired standard of accuracy.



1828

The Gisholt reamer was developed by practical men of many years experience and has all the dependable features of the old solid type reamer, the desirable features of the adjustable reamer and has overcome the above mentioned objections.

The blades are of high speed steel and are set into the body as shown in figures 175Z and 176Z, page 151.

The adjustment is made by underlaying the blades with thin paper or tin foil. A hard surfaced insoluble paper about .001″ thick is recommended. The tin foil can be obtained as thin as .0005" and is used for the finer adjustments.

It is only necessary to loosen the screws a turn on two and lift the blade enough to insert the underlay to the first screw, altho the screws and blade may be taken out and the underlay made the full length of the blade.

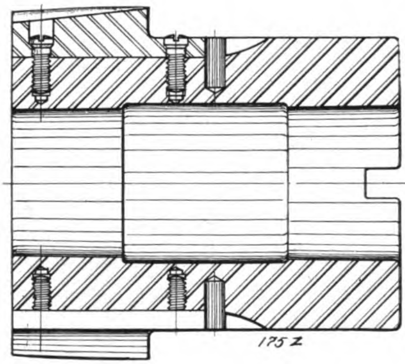
It may only be necessary at times to underlay the blades on one side of the reamer. If so, when the next adjustment is made, underlay the remaining blades.

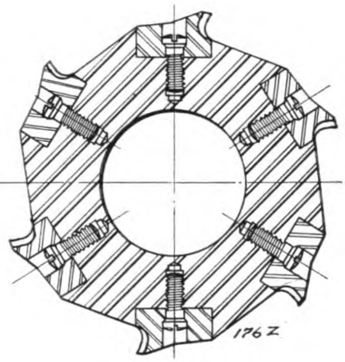
If the reamer does not get dull, underlaying may be repeated more than once; but should the reamer get dull, re-grinding is in order and should be done as follows:

Remove paper or tin foil underlay, and replace with metal underlay thick enough to expand the reamer sufficiently to permit grinding to the desired size.

The underlay strips should be cut $1/16$″ or $1/32$″ narrower than the blade slot with clearance holes for the screw.

The grinding should be done on an absolutely true arbor, between dead centers on a universal grinder to the required diameter plus .0005". This seeming oversize will eliminate undersize results. The reamers should be slightly larger in front, but taper should not exceed .00025" to each inch of length. The heel of the blade should then be backed off with a cup shaped emery wheel leaving a land from .006" to .010" wide. As the blades are spaced unevenly, the one being backed off should be on the locating rest.




Satisfactory clearance results may be obtained by setting the blade rest below dead center for the different sized reamers.

For reamers 1" to $1\,^{7}/_{16}$" diameter; set rest $^{1}/_{16}$" below center.
For reamers $1\frac{1}{2}$" to $2\frac{1}{2}$" diameter; set rest $^{3}/_{32}$" below center.
For reamers $2\,^{9}/_{16}$" to 4" diameter; set rest $\frac{1}{8}$" below center.
For reamers 4" to $6\frac{1}{2}$" diameter; set rest $^{5}/_{32}$" below center.

A reamer is a finishing and sizing tool and must be kept sharp and true to insure first class work.

As the purpose of a reamer is not to remove a bulk of stock (as a boring tool), but to finish and size a hole, as little stock as possible should be left for the reamer to remove.

In general practice, it is found that better results will follow the use of slow cutting speeds and comparatively coarse feeds.

The customary allowance for reaming holes in cast iron, and malleable iron is from .004" to .008". For brass and bronze .003" to .006". The cutting speed should be about one-third to one-half of the highest cutting speed, at which the roughing tools would stand up. For instance, if a grade of iron is being machined that will permit a cutting speed of 40 ft. per minute, the approximate reamer speed would be from 15 to 20 ft. per minute.

In reaming cylinders or work where a high finish is required, it may be necessary to run slower than the speed above mentioned, and the feed under these conditions should be about $\frac{1}{4}$" per revolution.

The allowance for steel ranges from .003″ to .005″; the cutting speed being about one half the highest cutting speed which the roughing tools will stand.

The feed will vary a great deal more in steel reaming than in cast iron, owing to the difference in hardness. Soft mushy steel or the kind commonly used in hot or cold pressed steel work, such as automobile brake drums, etc., will not stand as coarse a feed as steel with a higher carbon content. The feeds vary from $1/_{24}$″ to $1/8$″ per revolution.

For reaming steel the reamer should be flooded with lard oil, or a cutting compound of some kind. The oil is given the preference as it has been found that the reamers will hold to a standard size longer when working in oil.

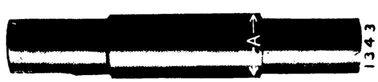
A mixture of one part kerosene to three or four parts lard oil will sometimes add to the quality of finish, as will also a mixture of one part powdered sulphur to about forty parts lard oil.

Trouble is sometimes experienced in a reamer cutting oversize. This may be caused by the turret being out of line or the reamer on an arbor that is bent, or by removing excessive stock.

## REAMER GRINDING MANDRELS.

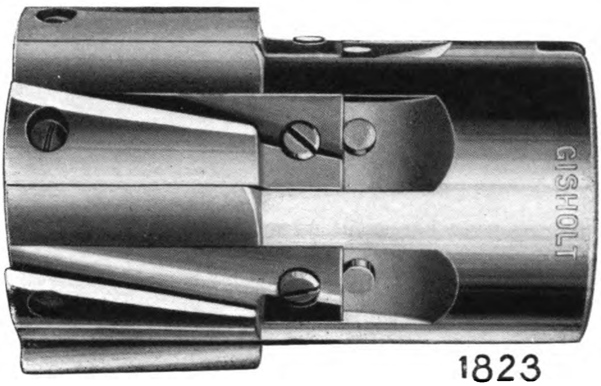
Very often reamers are ground on the arbors on which they are to be used. This is a good plan, but may cause delays which could be avoided, if more than one reamer of proper size were supplied for the job, and these ground on a Reamer Grinding Mandrel. This would not take the arbor out of service. All reamer arbors should be checked up occasionally and straightened if necessary.

We are prepared to furnish Mandrels (as shown below) which are hardened and accurately ground and centered for reamers having standard taper holes, tapering $1/8$ inch to one foot.




## REAMER GRINDING MANDRELS

| Symbol No. | A Large Diameter Inches | Used for Shell Reamers Inches | Length Over All Inches |
|---|---|---|---|
| 3465 | 1 | $2\frac{1}{16}$ to $2\frac{1}{2}$ | $7\frac{1}{8}$ |
| 3466 | $1\frac{1}{4}$ | $2\frac{9}{16}$ to $3\frac{1}{8}$ | $7\frac{7}{8}$ |
| 3467 | $1\frac{1}{2}$ | $3\frac{3}{16}$ to 4 | $8\frac{1}{8}$ |
| 3468 | 2 | $4\frac{1}{16}$ to $6\frac{3}{16}$ | $9\frac{5}{8}$ |
| 3469 | $2\frac{1}{2}$ | $6\frac{1}{4}$ and larger | $10\frac{5}{8}$ |




1823

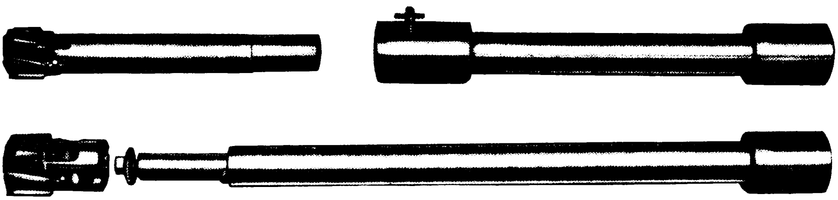
| Diameter Inches | Length Over all Inches | Hole* Inches | Blades | | Number of Blades |
|---|---|---|---|---|---|
| | | | Full Length Inches | Cutter Length Inches | |
| 2¼ | 3½ | 1 | 2 | 1½ | 6 |
| 2 5/16 | 3½ | 1 | 2 | 1½ | 6 |
| 2⅜ | 3½ | 1 | 2 | 1½ | 6 |
| 2 7/16 | 3½ | 1 | 2 | 1½ | 6 |
| 2½ | 3½ | 1 | 2 | 1½ | 6 |
| 2 9/16 | 3¾ | 1¼ | 2 | 1½ | 6 |
| 2⅝ | 3¾ | 1¼ | 2 | 1½ | 6 |
| 2 11/16 | 3¾ | 1¼ | 2 | 1½ | 6 |
| 2¾ | 3¾ | 1¼ | 2 | 1½ | 6 |
| 2 13/16 | 3¾ | 1¼ | 2¼ | 1⅝ | 6 |
| 2⅞ | 3¾ | 1¼ | 2¼ | 1⅝ | 6 |
| 2 15/16 | 3¾ | 1¼ | 2¼ | 1⅝ | 6 |
| 3 | 3¾ | 1¼ | 2¼ | 1⅝ | 6 |
| 3 1/16 | 3¾ | 1¼ | 2¼ | 1⅝ | 6 |
| 3⅛ | 3¾ | 1¼ | 2¼ | 1⅝ | 6 |
| 3 3/16 | 4 | 1½ | 2¼ | 1⅝ | 6 |
| 3¼ | 4 | 1½ | 2½ | 1¾ | 6 |
| 3 5/16 | 4 | 1½ | 2½ | 1¾ | 6 |
| 3⅜ | 4 | 1½ | 2½ | 1¾ | 6 |
| 3 7/16 | 4 | 1½ | 2½ | 1¾ | 6 |
| 3½ | 4 | 1½ | 2½ | 1¾ | 6 |
| 3⅝ | 4 | 1½ | 2½ | 1¾ | 6 |
| 3¾ | 4 | 1½ | 2½ | 1¾ | 6 |
| 3⅞ | 4 | 1½ | 2½ | 1¾ | 6 |
| 4 | 4 | 1½ | 2½ | 1¾ | 6 |
| 4⅛ | 5 | 2 | 2½ | 1¾ | 6 |
| 4¼ | 5 | 2 | 2½ | 1¾ | 6 |
| 4⅜ | 5 | 2 | 2½ | 1¾ | 6 |
| 4½ | 5 | 2 | 2½ | 1¾ | 6 |

* Hole standard taper ⅛" to 12" fitting standard arbors. Straight hole can be supplied when so specified.

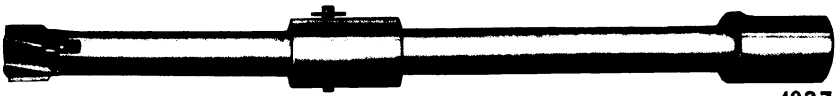
1828

## SPIRAL FLUTED—STRAIGHT SHANK REAMERS.

| Diam. Inches | Length Over All Inches | Blades | | No. of Blades | Straight Shank Size Inches |
|---|---|---|---|---|---|
| | | Full Length Inches | Cutting Length Inches | | |
| 1 | 10½ | 1⅜ | 1 | 4 | 1 × 2½ |
| 1 1/16 | 10½ | 1⅜ | 1 | 4 | 1 × 2½ |
| 1⅛ | 11 | 1⅜ | 1 | 4 | 1 × 2½ |
| 1 3/16 | 11 | 1⅜ | 1 | 4 | 1 × 2½ |
| 1¼ | 11½ | 1⅜ | 1 | 4 | 1 × 2½ |
| 1 5/16 | 11½ | 1⅜ | 1 | 4 | 1 × 2½ |
| 1⅜ | 12 | 1¾ | 1¼ | 4 | 1 × 2½ |
| 1 7/16 | 12 | 1¾ | 1¼ | 4 | 1 × 2½ |
| 1½ | 12½ | 1¾ | 1¼ | 4 | 1 × 2½ |
| 1 9/16 | 12½ | 1¾ | 1¼ | 6 | 1⅜ × 2½ |
| 1⅝ | 13 | 1¾ | 1¼ | 6 | 1⅜ × 2½ |
| 1 11/16 | 13 | 1¾ | 1¼ | 6 | 1⅜ × 2½ |
| 1¾ | 13½ | 1¾ | 1¼ | 6 | 1⅜ × 2½ |
| 1 13/16 | 13½ | 1¾ | 1¼ | 6 | 1⅜ × 2½ |
| 1⅞ | 13½ | 1¾ | 1¼ | 6 | 1⅜ × 2½ |
| 1 15/16 | 14 | 1¾ | 1¼ | 6 | 1⅜ × 2½ |
| 2 | 14 | 1¾ | 1¼ | 6 | 1⅜ × 2½ |
| 2 1/16 | 14 | 2 | 1½ | 6 | 1⅞ × 2½ |
| 2⅛ | 14½ | 2 | 1½ | 6 | 1⅞ × 2½ |
| 2 3/16 | 14½ | 2 | 1½ | 6 | 1⅞ × 2½ |
| 2¼ | 14½ | 2 | 1½ | 6 | 1⅞ × 2½ |

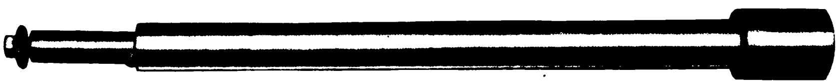


1847



1827

1846



1847 A

## SHELL REAMER ARBORS

**A Floating Arbor, Especially Adapted for Use on Gisholt Turret Lathes**

| Symbol Number | Length Over All | Suitable for Use With Gisholt | For Holding Gisholt Shell Reamers |
|---|---|---|---|
| G-8 | 20″ | $13\frac{1}{2}$″ Lathe | $2\frac{1}{4}$″ to $2\frac{1}{2}$″ |
| H-8 | 26″ | 21″ Lathe | $2\frac{1}{4}$″ to $2\frac{1}{2}$″ |
| H-9 | 30″ | 21″ Lathe | $2\frac{9}{16}$ to $3\frac{1}{8}$″ |
| H-10 | 30″ | 21″ Lathe | $3\frac{3}{16}$″ to 4″ |
| H-12 | 30″ | 21″ Lathe | $4\frac{1}{16}$″ to $6\frac{3}{16}$″ |
| I-8 | 30″ | 24″ Lathe | $2\frac{1}{4}$″ to $2\frac{1}{2}$″ |
| I-9 | 30″ | 24″ Lathe | $2\frac{9}{16}$″ to $3\frac{1}{8}$″ |
| I-10 | 30″ | 24″ Lathe | $3\frac{3}{16}$″ to 4″ |
| I-12 | 30″ | 24″ Lathe | $4\frac{1}{16}$″ to $6\frac{3}{16}$″ |
| I-14 | 30″ | 24″ Lathe | $6\frac{1}{4}$ and larger |
| J-8 | 36″ | 28″ Lathe | $2\frac{1}{4}$″ to $2\frac{1}{2}$″ |
| J-9 | 36″ | 28″ Lathe | $2\frac{9}{16}$″ to $3\frac{1}{8}$″ |
| J-10 | 36″ | 28″ Lathe | $3\frac{3}{16}$″ to 4″ |
| J-12 | 36″ | 28″ Lathe | $4\frac{1}{16}$″ to $6\frac{3}{16}$″ |
| J-14 | 36″ | 28″ Lathe | $6\frac{1}{4}$″ and larger |
| K-8 | 44″ | 32″ Lathe | $2\frac{1}{4}$″ to $2\frac{1}{2}$″ |
| K-9 | 44″ | 32″ Lathe | $2\frac{9}{16}$″ to $3\frac{1}{8}$″ |
| K-10 | 44″ | 32″ Lathe | $3\frac{3}{16}$″ to 4″ |
| K-12 | 44″ | 32″ Lathe | $4\frac{1}{16}$″ to $6\frac{3}{16}$″ |
| K-14 | 44″ | 32″ Lathe | $6\frac{1}{4}$″ and larger |

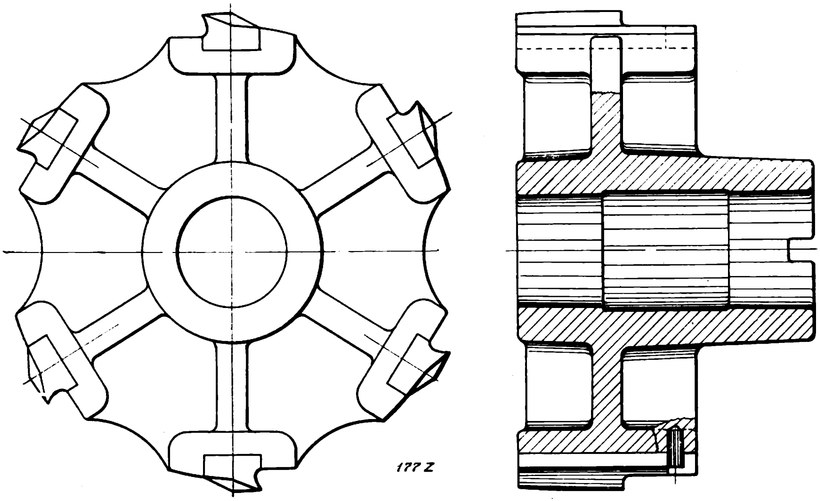
1828 A

## STRAIGHT SHANK REAMER ARBORS

**A Floating Arbor, Especially Adapted for Use on Gisholt Turret Lathes**

| Symbol Number | Length Over All | Socket Bore | Suitable for Use with Gisholt |
|---|---|---|---|
| | Inches | Inches | |
| G–2A | 14 | 1 | 13½ in. Lathe |
| G–3A | 14 | 1⅜ | 13½ in. Lathe |
| G–4A | 14 | 1⅞ | 13½ in. Lathe |
| H–2A | 18 | 1 | 21 in. Lathe |
| H–3A | 18 | 1⅜ | 21 in. Lathe |
| H–4A | 18 | 1⅞ | 21 in. Lathe |
| I–2A | 22 | 1 | 24 in. Lathe |
| I–3A | 22 | 1⅜ | 24 in. Lathe |
| I–4A | 22 | 1⅞ | 24 in. Lathe |
| J–2A | 26 | 1 | 28 in. Lathe |
| J–3A | 26 | 1⅜ | 28 in. Lathe |
| J–4A | 26 | 1⅞ | 28 in. Lathe |
| K–2A | 30 | 1 | 32 in. Lathe |
| K–3A | 30 | 1⅜ | 32 in. Lathe |
| K–4A | 30 | 1⅞ | 32 in. Lathe |

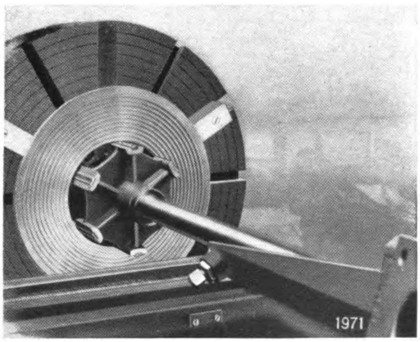
## LARGE SHELL REAMERS.




Large holes (above 6″ diameter) are very often finished with boring tools, resulting in much greater cost and in lower quality (which means variation in size) than can be produced with the proper kind of reamer.

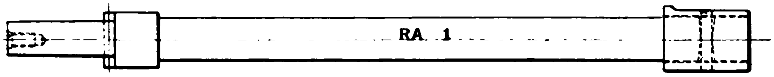
The chief objection to these large reamers seems to be the weight, which objection is removed if the type shown above in figure 177Z is used.

These reamer bodies may be made of cast iron and have been successfully used in diameters as large as 14″.

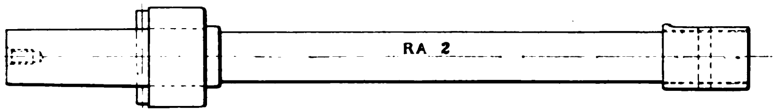



An actual application of a very large reamer is shown in view 1971 above. This reamer is about 10″ diameter. However, as before stated, we have used reamers of this type as large as 14″ with excellent results.

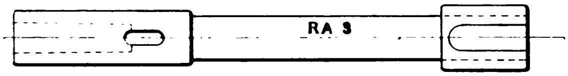
The reamer arbor support, shown under the reamer, holds it up in line to enter the hole and still allows enough "float" to produce satisfactory results.



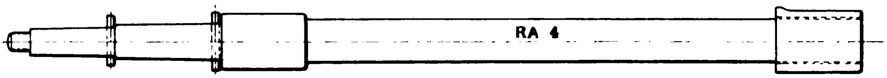
RA 1



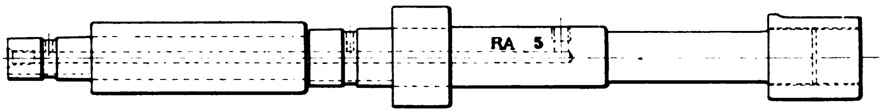
RA 2



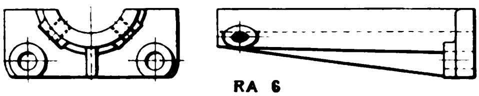
RA 3



RA 4

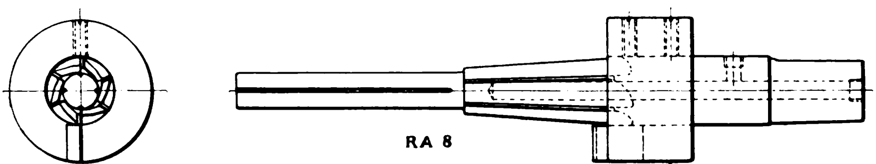


RA 5



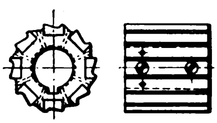
RA 6

RA 7

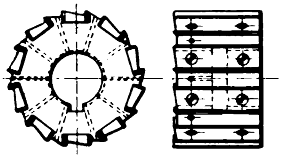


RA 8

RA 12



RA 9



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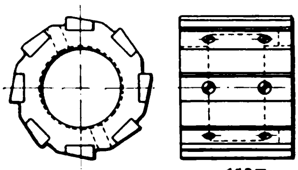


RA 11

119Z

*Symbol and number refer to figures on page 158.*

RA1. Standard shell reamer arbor.

RA2. Shell reamer arbor for large reamers.

RA3. Standard taper shank reamer arbor.

RA4. Shell reamer arbor for two reamers.

RA5. Shell reamer arbor with distance piece between reamers. Arranged with oil chamber for flooding reamers.

RA6. Reamer arbor support.

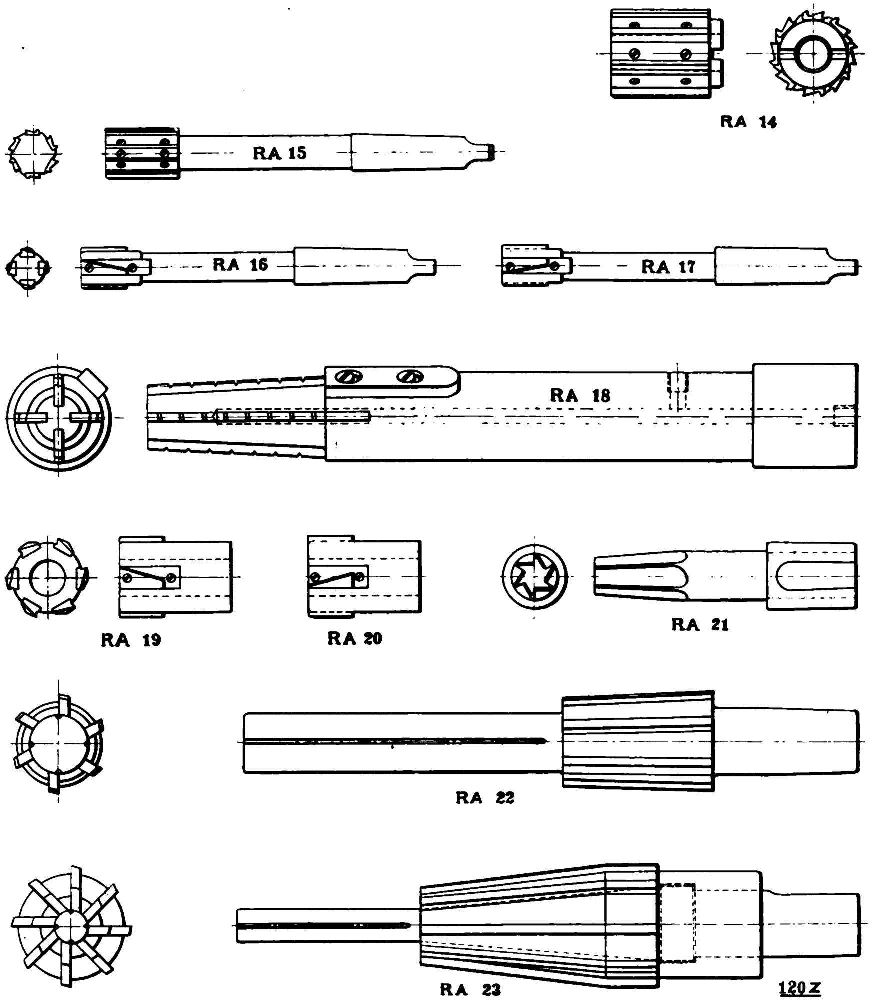
RA7. Taper shank reamer, two diameters.

RA8. Taper reamer with pilot, and depth gauge RA12.

RA9. & RA10. Shell reamers with oil tubes. Used on arbor RA5.

RA11. Shell reamers for cylinders. Each blade has only one cutting edge.

RA12. Depth gage on taper reamer RA8.


RA 14
RA 15
RA 16
RA 17
RA 18
RA 19
RA 20
RA 21
RA 22
RA 23
120 Z

*Symbol and number refer to figures on page 160.*

RA14. Shell reamer.

RA15. Taper shank reamer.

RA16. Taper shank reamer, R. H. spiral.

RA17. Taper shank reamer, L. H. spiral.

RA18. Roughing taper reamer for steel.

RA19. Shell reamer, R. H. spiral.

RA20. Shell reamer, L. H. spiral.

RA21. Taper reamer without pilot.

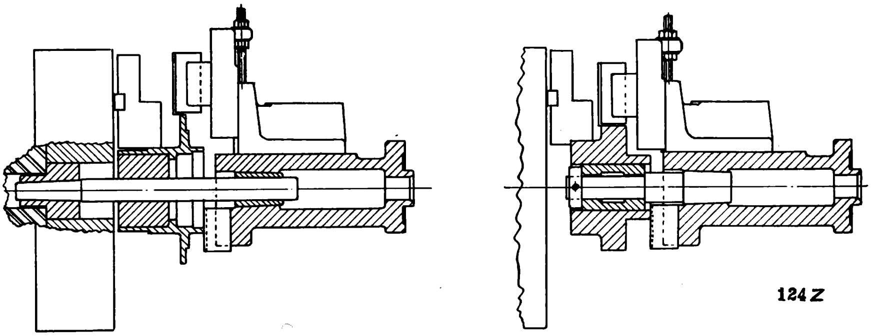
RA22. Taper reamer with pilot and inserted blades.

RA23. Taper reamer with pilot, and inserted blades, and collar on body to take end thrust on blades. Back ends of blades ream straight hole.

# Facing Heads.

Facing heads should always be kept as nearly as possible in perfect alignment with the spindle. Before clamping to turret, the base end, or that part which fits against the face of the turret, should be inspected carefully, and all burrs or dirt of any kind removed.

All the adjustable arms should be dismantled and thoroly cleaned and oiled occasionally. This should be done on all new heads before mounting any tools as when they are packed at the factory all machined surfaces are coated with a rust preventive. The gibs in these arms should be pulled up tight as adjustments of the cutters in the arms are easily made after the gibs are tightened.



124Z

A support of some kind should always be provided when heads are used. The most common method of support employed is that of holding a pilot bar in the head itself, the other end getting its support in a bushing held in the chuck bore or supported directly in the work. The latter is by far the better and is easily managed as the bore of the work can in many cases be finished at the same time that the rough facing and turning are done. The heads should not be used for *first* roughing cuts. It is sometimes done, but can only result in lowered production.

It is good practice to use a revolving bushing on these supporting arbors whenever possible, that is, when the hole in the work is large enough to permit the use of a bushing with about $\frac{1}{4}''$ wall or more and yet have the arbor of sufficient strength to withstand the strain that is thrown on it from the cutters in the head.

The bushings may be made of steel, hardened and ground providing the arbor is hardened and ground and both surfaces are *glass hard.* Cast iron bushings serve very well, altho they wear out sooner than the hardened steel, but they are very easily replaced and cost much less than steel bushings. Either kind should be well lubricated.

The right hand cut in figure 124Z above shows an ideal application of facing head arbor support. The arbor is held in the facing head and carries a revolving bushing which contains an oil chamber.

The left hand cut shows another method of support. Here the arbor is held in the chuck bore and the work is slipped over a bushing, the bore of which fits the arbor. This method illustrates one use of the face plate arbor.

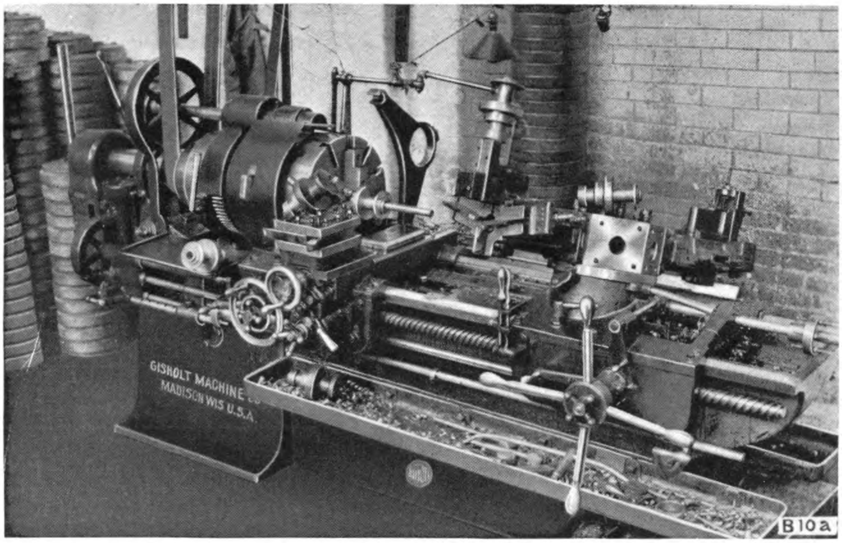
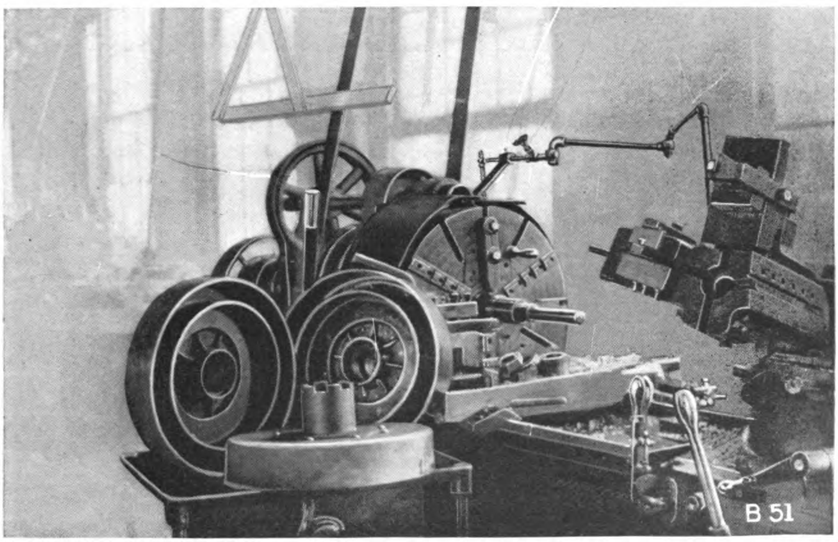


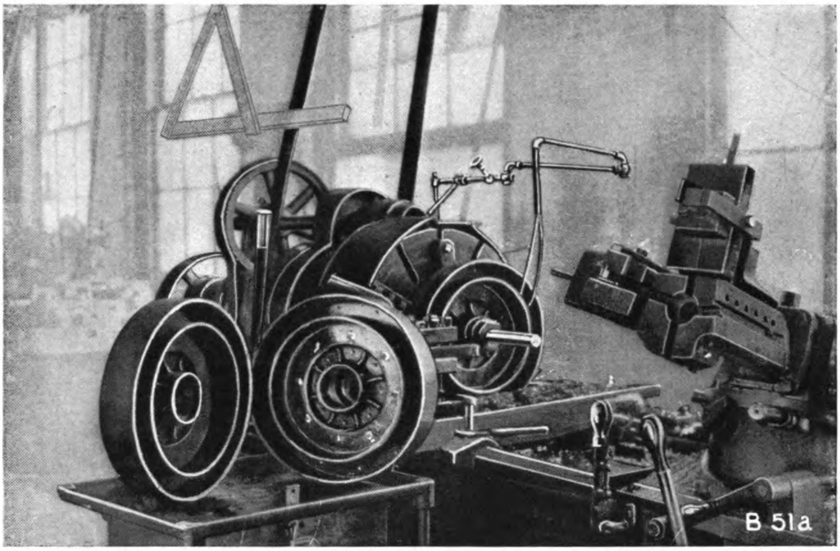

Figure B10a shows method of chucking for second operation on a countergear. In this case the arbor was held in bore of chuck and the work placed on the arbor and chucked or held with soft jaws bored to fit. The clamps shown in this illustration were added to hold the work back in the jaws, as the amount of stock to be removed on the inside face was so large that it had a tendency to pull the work out of the jaws; the material was very hard.

Occasionally a job will come up that can be handled very nicely on a stub ar-



bor, driven into the bore of the chuck and held with the jaw bases or made with a flange and bolted to face of chuck. A very good illustration of this is shown in figures B51 & B51a. This is an automobile hub, which has previously been finished and the brake drums riveted in place ready for finish turning, which operation is to be done at this time.

Both the outside and inside of the larger drum and the inside of the smaller drum, as well as the faces of both, are finished in this operation. The width of the larger drum made it necessary to have a long, narrow tool for boring. This tool had a tendency to chatter and leave a rough finish.



B 51a

The cuts referred to (B51 and B51A) show one method of correcting this difficulty after the tools were made up and the job started, also show how this tool is supported to overcome the chatter. A piece of flat stock was bolted to facing head arm and a block of steel clamped between the flat stock and the cutter.

The arbor for this piece was made with an extra long pilot which fitted a bushing in the bore of the facing head, thus supporting it.

## ARRANGEMENT OF CUTTERS.

Cutters that are to be used in the bottom arms of the facing head should always be set first, as no adjustment is provided there.

Another very important point for consideration is the arrangement of cutters to prevent interference, one with another.

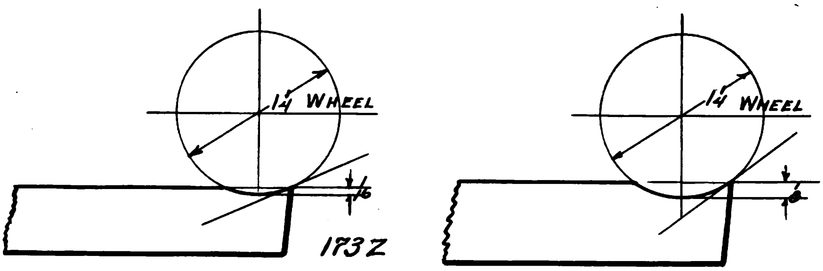
When the facing heads are used with a heavy supporting arbor, they are as strong and rigid as it is possible to have them; still those tools doing the heaviest work, such as broad facing, will slightly influence the others. Therefore, it is advisable to arrange the cutters so that those doing the heavy work will tend to pull the turning or boring tools away from the work. This works all right as the facing tools usually do not begin to work until the boring and turning is practically done. And as the head is held up against the work for the facing tools to clean up, the boring and turning tools will return to their original position. In most cases, although not always, the tool carrying the heaviest facing cut can be held in the back arm.

When the size limits on the piece to be machined are very close, it is advisable to use more than two cuts over each surface; the tool post is used for removing the scale as well as most of the stock, then a facing head set up to true those surfaces roughed by the tool post and the finishing head used only to size the most accurate dimensions, removing as little stock as possible. By following this method, the finishing cutters will require a minimum of attention and hold size much longer than if they are required to remove a large amount of stock.

The angles of clearance and top rake on these cutters are the same in principle as those described for tool post tools.

The tools, that are set for broad facing or shaving cast iron, should have from 5 to 7 degrees clearance and from 5 to 10 degrees backslope. If too much clearance is allowed on these broad forming cutters, they will be very apt to chatter. To overcome chatter, either reduce clearance angle or run the work slower.

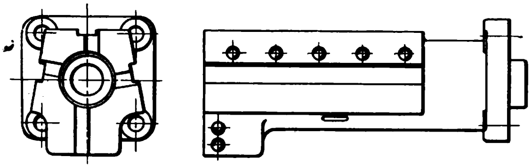
Forming cutters for steel usually require more back slope or top rake, and less clearance than those used on cast iron. A very satisfactory way of grinding the top rake is shown in figure 173Z below.



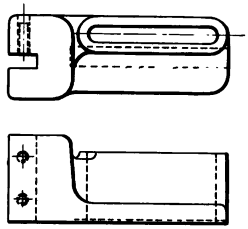

173Z

In forming steel, it is often found that the chips will adhere to the tool, and leave a rough surface. This can be very nicely overcome by polishing or burnishing the tool on top. This seems to let the chips slide off the tool freely enough so that they will not stick to the cutting edge.

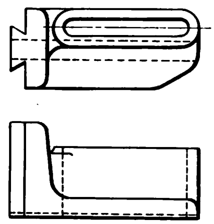
If thread cutting oil is used as a lubricant on steel work, a mixture of about one part kerosene to three or four parts oil will greatly help to overcome this trouble. Also one part powdered suphur to about forty parts lard oil will help produce better finish than will the oil alone.



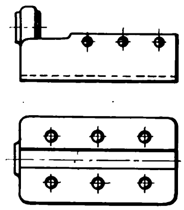
FH 1



FH 2

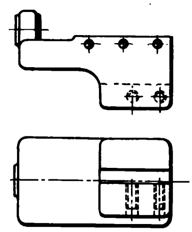


FH 3

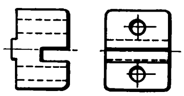


FH 4

FH 5

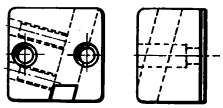


FH 6

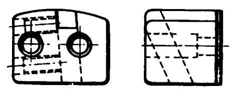


FH 7

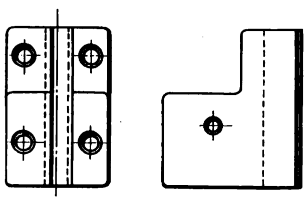
FH 8



FH 9

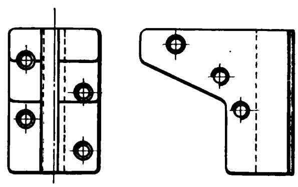


FH 10

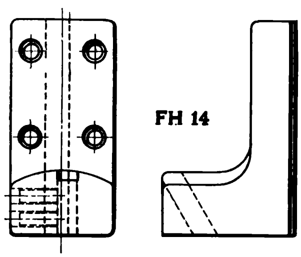


FH 11

FH 12



FH 13



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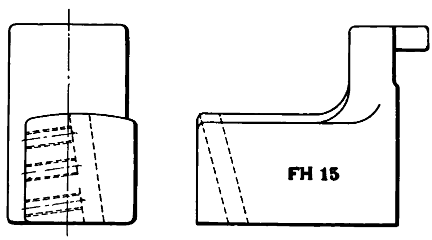


FH 15

115 Z

*Symbol and number refer to figures on page 166.*

FH1. Facing head body.

FH2. Facing head front arm.

FH3. Facing head top and rear arm.

FH4. Facing head top arm slide.

FH5. Facing head slider stud.

FH6. Facing head rear arm slide.

FH7. Facing head block used on FH4.

FH8. Facing head arm stud.

FH9. Facing head block to hold square steel for turning.

FH10. Facing head block to hold square steel for boring.

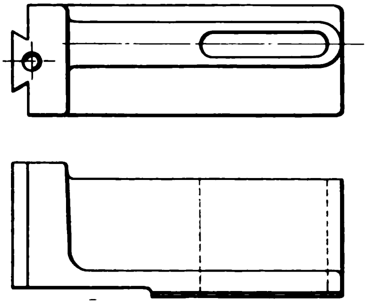
FH11. Special facing head block for wide cutter.

FH12. Drift pin.

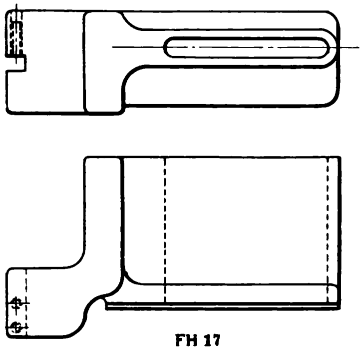
FH13. Special facing head block for boring tapers.

FH14. Special facing head block for boring.

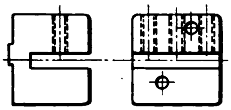
FH15. Special rear arms slide for boring.



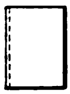
FH 16



FH 17

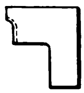


FH 18

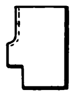


FH 19

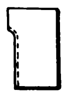
FH 20



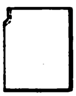
FH 21



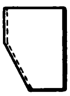
FH 22



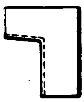
FH 23



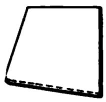
FH 24



FH 25



FH 26



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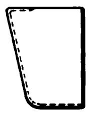

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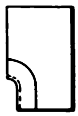
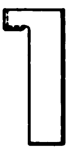


FH 29

FH 30



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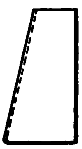
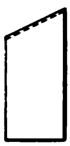
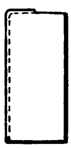


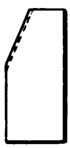
FH 32



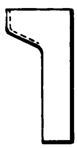
FH 33



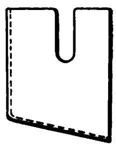
FH 34



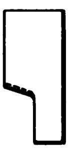
FH 35



FH 36



FH 37



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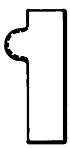
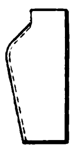


FH 39



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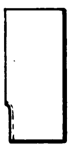

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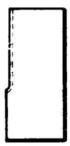
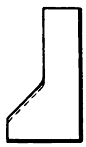
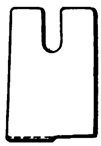


FH 42



FH 43

116 Z



FH 44

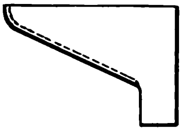
*Symbol and number refer to figures on page 168.*

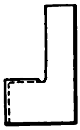
FH16. Special facing head arm for turning long work.

FH17. Special front arm.

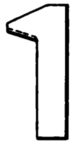
FH18. Special facing head block.

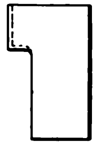
FH19. to FH44. Facing head cutters of various shapes.

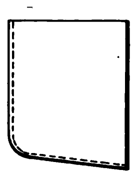

FH 45

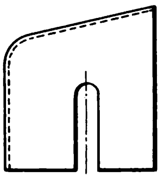

FH 46

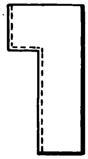

FH 47

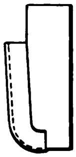

FH 48


FH 49


FH 50


FH 51


FH 52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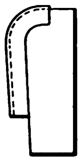
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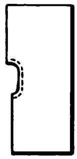
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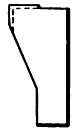
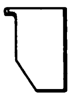
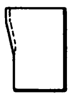

FH 56


FH 57


FH 58


FH 59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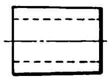
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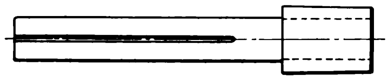
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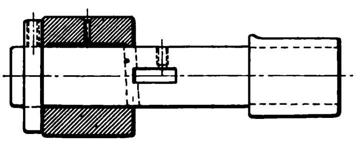
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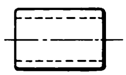
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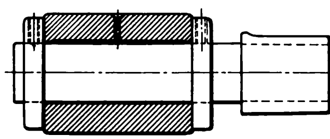
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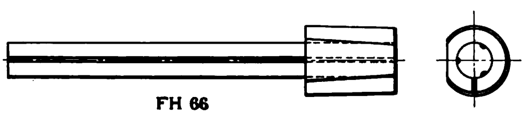
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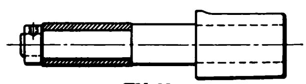
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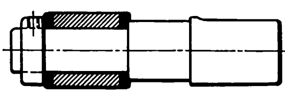
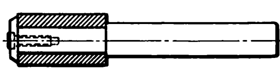
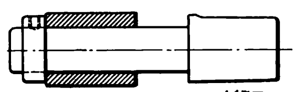

FH 68


FH 69


FH 70

117Z

*Symbol and number refer to figures on page 170.*

FH45. to FH60. Facing head cutters of various shapes.

FH61. Facing head bushing. Used in facing head body when work is held on face plate arbor.

FH62. Facing head supporting arbor, bushing shrunk on.

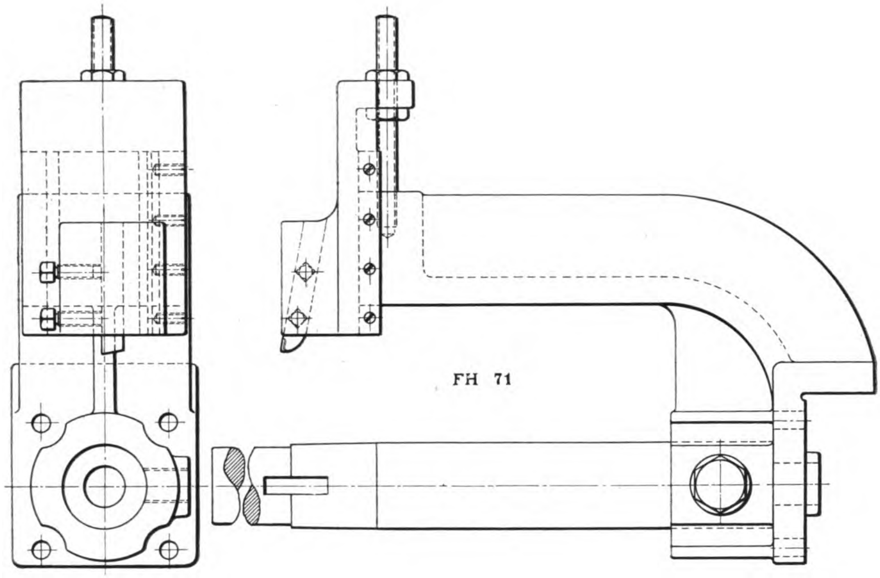
FH63. Facing head supporting arbor with bushing and slot for facing cutter.

FH64. Supporting bushing.

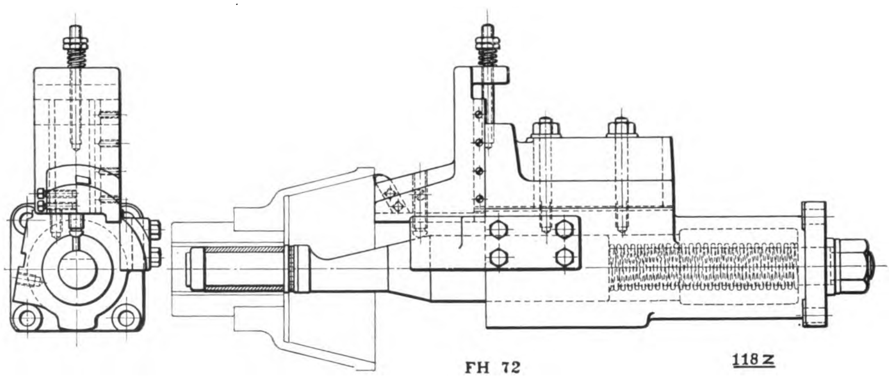
FH65. Facing head supporting arbor with bushing to adjust arbor for length.

FH66. Facing head supporting arbor with bushing to adjust arbor for length.

FH67. to FH70. Facing head supporting arbors with bushings.



FH 71



FH 72

118 Z

*Symbol and number refer to figures on page 172.*

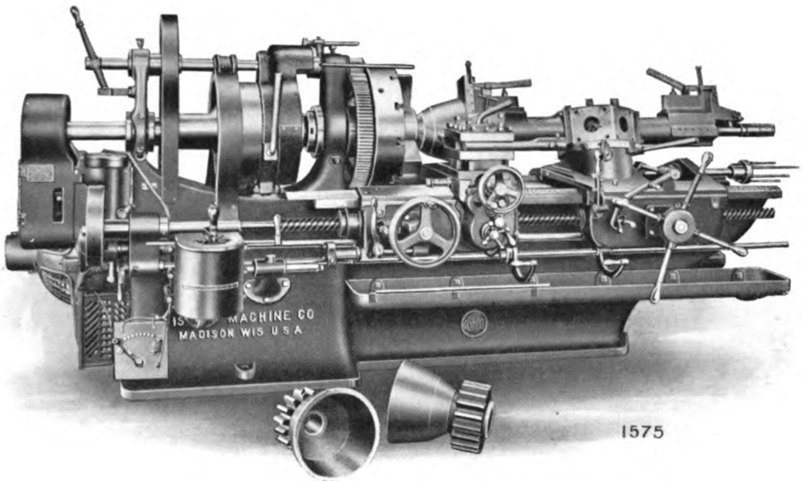
FH71. Boring bar and arm for boring and turning concentric piston rings.

FH72. Facing head for boring taper frictions.

Figure 1575 shows pair of taper boring heads as used for boring taper seat in clutch gear shown. The outside taper being turned at the same time with the tool post taper attachment. This taper boring head is the same as shown in figure FH72.

Figure 246Z. This head is more difficult to make than that shown in FH72, but is more reliable.

The principles of operation are the same except that this head is positive in operation as will be seen by cut, while the operation of the FH72 head is dependent on a spring action, and the pressure on the tool.




1575

The head or body "A" is of cast iron and held to the turret in the same manner as is the facing head.

The arbor "B" is of steel, heat treated and ground, with a sliding fit in the main body at both "C" and "D".

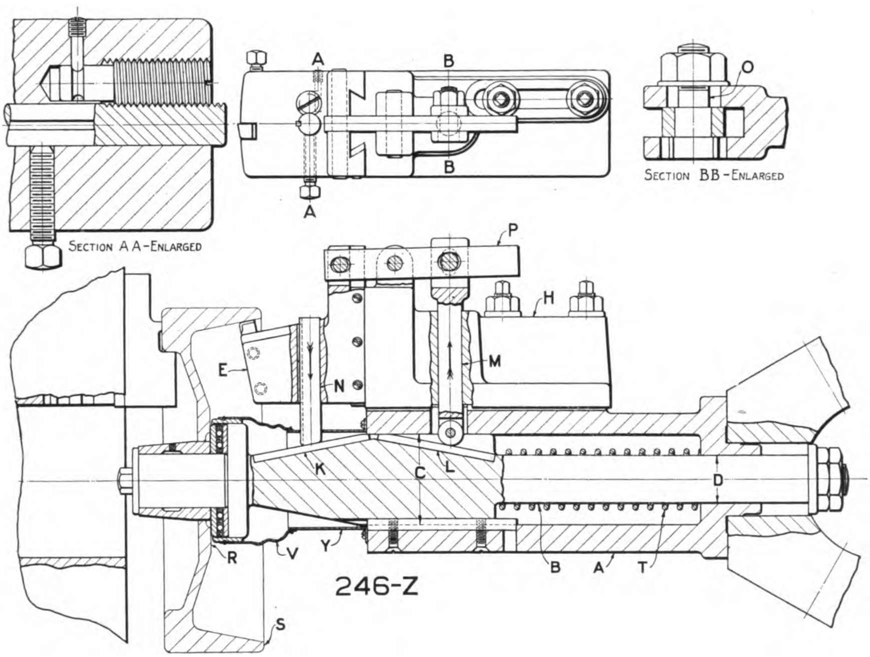
The taper at "K" and "L" is exactly the same and, of course, the same as that wanted in the work to be done. This taper is milled flat on the bar, then a groove or keyway of sufficient width is milled in the flat into which is inserted a hardened and ground flat steel key.

The outer end of the pilot is fitted with a bushing which supports directly in the work. Back of the supporting bushing is a flange against which fits a ball thrust bearing.

A sheet iron shield "Y" is bolted to face of head. A close fitting hole is made for stud "N". Then a canvas sleeve "V" is fastened to this shield and the arbor. This keeps the chips out of taper bearing "K" and the canvas sleeve does not interfere with movement of arbor.

After the center hole in the work has been bored for the supporting bushing, and the web of wheel faced, the head is brought forward and the pilot enters the hole. The ball thrust bearing rests against the web of the work and pushes the pilot back into the head as the head is fed forward. This movement forces stud "M" up and stud "N" down thus causing the tool to travel on a taper plane.

The cutter or tool is held in arm "E," which is a gib sliding fit on main arm "H."




Adjustment for size is obtained by stud "N" which is more clearly shown in enlarged section "AA". When adjustment is made, the clamp bolt "O" shown in enlarged section "BB" should be loosened, and, after proper setting is made, the clamp bolt should be tightened up. The cross beam "P" should be held up tight and the stud "M" pushed down tight, so as to remove all lost motion in these parts before tightening the clamp bolt.

To produce accurate diameters or duplicate work, the faces "R" and "S" should be finished before the finish boring of the taper is done.

As head is pulled out of work, the spring "T" returns the arbor "B" to position for starting another cut.

Other arms are frequently arranged on these heads to do outside turning or other operations in connection with the taper boring.

# Thread Cutting and Feed Changes.

Nine change gears are furnished with each size of the Gisholt Standard Turret Lathe. Each gear will fit on the upper stud, and also the feed reverse shaft shown in figure 1868, page 14.

In each set of nine gears are two with the same number of teeth; one of these two should always be on upper stud in order to obtain the feeds and threads that are shown on the chart below. This leaves eight of the set to be used on the feed reverse shaft.

| Driven Gear | | 32 | 36 | 40 | 44 | 46 | 48 | 52 | 56 |
|---|---|---|---|---|---|---|---|---|---|
| Threads Per Inch | A | 4 | 4.5 | 5 | 5.5 | 5.75 | 6 | 6.5 | 7 |
| | B | 8 | 9 | 10 | 11 | 11.5 | 12 | 13 | 14 |
| | C | 16 | 18 | 20 | 22 | 23 | 24 | 26 | 28 |
| | D | 32 | 36 | 40 | 44 | 46 | 48 | 52 | 56 |
| Fine Feed In Thousandths | A | .0215 | .019 | .017 | .0156 | .015 | .014 | .0132 | .012 |
| | B | .0107 | .0095 | .0086 | .0078 | .0075 | .007 | .0066 | .006 |
| | C | .0053 | .0048 | .0043 | .004 | .0037 | .0036 | .0033 | .003 |
| | D | .0027 | .0024 | .0021 | .002 | .0019 | .0018 | .0016 | .0015 |

With the eight standard change gears, sixty-four different feed changes are available, ranging from ¼" to .0015" per revolution. Thirty-two changes are shown on chart as threads per inch (which also means cuts per inch) and are obtained with the pull pin in the feed box pulled *out* as far as it will go. The feeds given in decimal figures are obtained with pull pin *in* as far as it will go. (See figure 1868, page 14.)

Thirty-two different leads of thread may be cut with the standard change gears furnished, ranging from 4 to 56 threads per inch. Among these are even threads per inch, such as 4, 6, 8, etc., odd numbers per inch such as 5, 7, 9, etc., also 4½, 5½, 6½, 11½, and 5¾ threads per inch. All of these may be cut without the use of backing or reverse belts.

The different size lathes have the following pitch lead screws: the G-13", 3"; H-21", 3½"; I-24", 4"; J-28", 4½"; K-34", and L-41", 5".

The lead screw nuts have a number of notches into which a pull pin fits when cutting threads.

On the lead screw nuts having the following pitches—3", 4" and 5", the notches are located so that one notch equals 1″ travel of the carriage, there being three notches in the 3″ lead screw nut, four in the 4″ and five in the 5″.

The 3½″ and 4½″ lead screw nuts have 7 and 9 notches, respectively, one notch being equal to ½″ travel of the carriage.

Threads of even pitch, such as 4, 6, 8, etc., may be cut on any of the lathes regardless of the pitch of the lead screw and you can catch a full thread with the pull pin in any notch on the lead screw nut. An example of this is shown on page 178, figure 187Z. Three tools shown in figure as A, A1 and A2 are located ½″ apart, it being ½″ from A to A1, and 1″ from A to A2. This shows that all threads of even pitch, such as 4, 6, 8, etc., can be caught with the pull pin in any notch on any of the machines, as on some of the machines, each notch represents ½″ travel of the carriage, while on others each notch represents 1″ travel. In figure 188Z on page 178 is shown a screw with 5 threads per inch. As 5 is an odd number, it is necessary to move the carriage back one full inch in order to catch a full thread. This requires two notches or any number of notches evenly divided by two on H-21″ and J-28″ machines (where one notch is equal to ½″ travel of carriage), while on the others, it is possible to catch full threads with every notch. Three tools shown in figure 31 are located as follows: ½″ from A to B and 1″ from A to A1. The tool B being ½″ from A or, 2½ threads, strikes on top of the thread, as shown.

Figure 189Z on page 178 shows a screw with 5½ threads per inch. As before stated, it is necessary to move the carriage back by half inches or inches, depending entirely on the pitch of the lead screw or the number of notches in lead screw nut. Therefore, in cutting 5½ threads, it is necessary to move the carriage 2″ or, 11 threads, to be able to catch a full thread.

The distance from A to B is ½″ or one notch on H-21″ and J-28″ machines and it is apparent that the tool would strike the thread if the carriage were moved back ½″. The distance from A to C is 1″ and shows where the tool would strike the thread if the carriage were moved back 1″. The distance from A to A1 is 2″ or 11 threads and shows the tool at the bottom of the thread.

In figure 190Z on page 178 is shown a screw with 5¾ threads per inch. In cutting 5¾ threads per inch it is necessary to move back 4″, or 23 threads, to catch a full thread.

The distance between A and B in figure 33 is ½″ and shows where the tool would strike if the carriage were only moved ½″.

The distance from A to C is 1″ and from A to D, 2″ and from A to E is 3″, so that the tool would strike the thread if the carriage were moved back 1, 2 or 3″. The distance from A to A1 is 4″ and the tool is shown in position to catch a full thread.

The foregoing rules and the following tables do not apply to lathes, which do not have the notches in lead screw nuts.

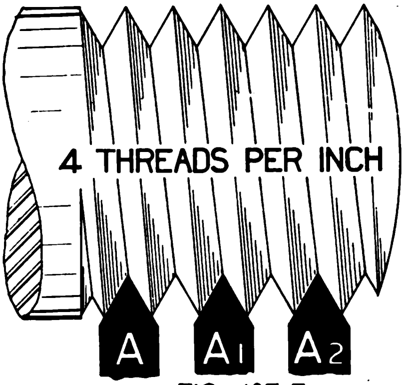



FIG. 187-Z

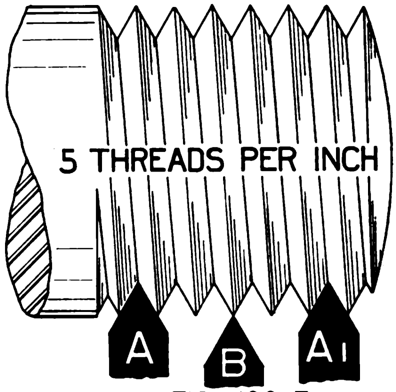



FIG. 188-Z

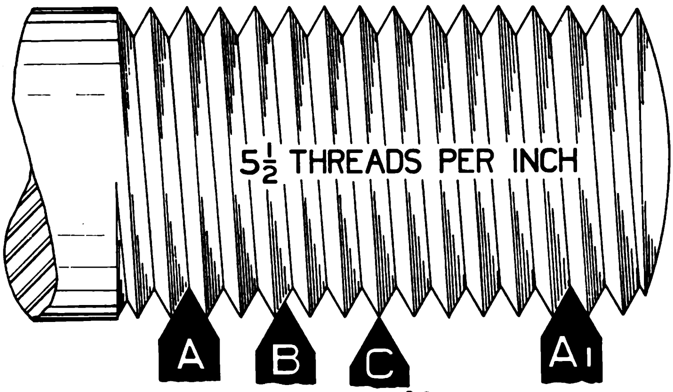



FIG. 189-Z

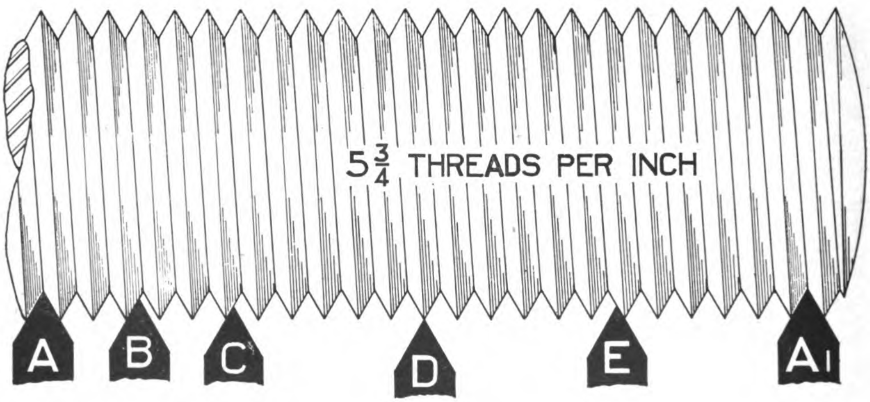
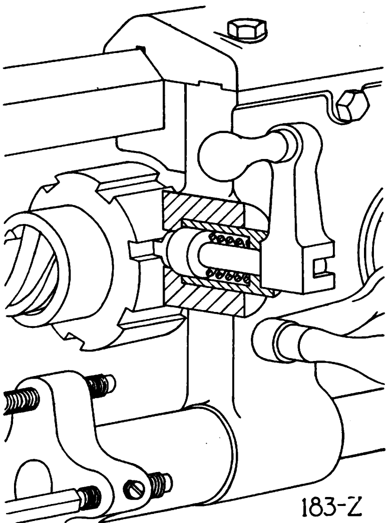



FIG. 190-Z

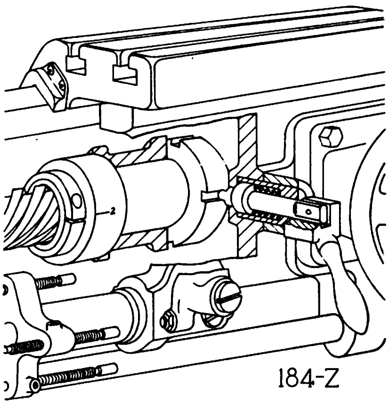
# THREAD CUTTING REFERENCE CHART

FOR

Size H–21″ with Lead Screw Pitch 3½″.
Size J–28″ with Lead Screws Pitch 4½″.




**Old Type**




**New Type**

**Letters in Table Refer to Foot Notes**

| THREADS PER INCH | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4-R | 4.5-Y | 5-X | 5.5-Y | 5.75-Z | 6-R | 6.5-Y | 7-X |
| 8-R | 9-X | 10-R | 11-X | 11.5-Y | 12-R | 13-X | 14-R |
| 16-R | 18-R | 20-R | 22-R | 23-X | 24-R | 26-R | 28-R |
| 32-R | 36-R | 40-R | 44-R | 46-R | 48-R | 52-R | 56-R |

**R**–ANY NOTCH WILL CATCH A FULL THREAD.

**X**–TWO NOTCHES OR ANY NUMBER EVENLY DIVIDED BY TWO WILL CATCH A FULL THREAD.

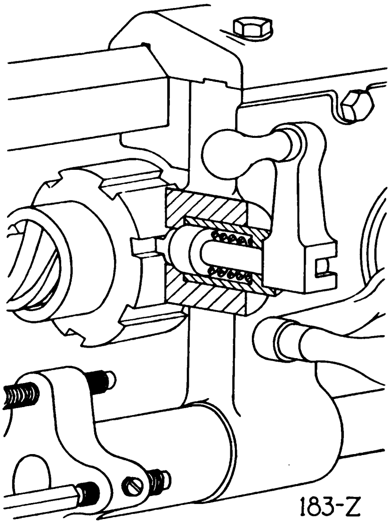
**Y**–FOUR NOTCHES OR ANY NUMBER EVENLY DIVIDED BY FOUR WILL CATCH A FULL THREAD.

**Z**–EIGHT NOTCHES OR ANY NUMBER EVENLY DIVIDED BY EIGHT WILL CATCH A FULL THREAD. 191-Z

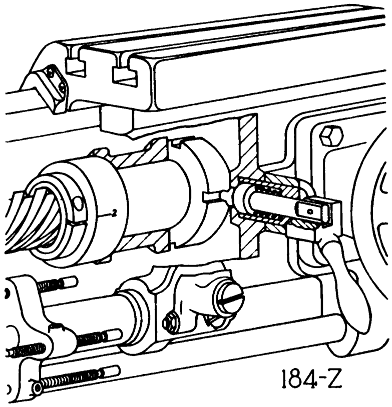
## THREAD CUTTING REFERENCE CHART

**FOR**

Size G–13″ with Lead Screw Pitch 3″.
Size I–24″ with Lead Screw Pitch 4″.
Size K–34″ with Lead Screw Pitch 5″.



183-Z



184-Z

**Letters in Table Refer to Foot Notes.**

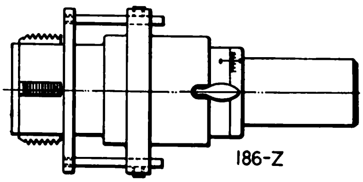
| THREADS PER INCH | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4-R | 4.5-X | 5-R | 5.5-X | 5.75-Y | 6-R | 6.5-X | 7-R |
| 8-R | 9-R | 10-R | 11-R | 11.5-X | 12-R | 13-R | 14-R |
| 16-R | 18-R | 20-R | 22-R | 23-R | 24-R | 26-R | 28-R |
| 32-R | 36-R | 40-R | 44-R | 46-R | 48-R | 52-R | 56-R |

**R**–ANY NOTCH WILL CATCH A FULL THREAD.

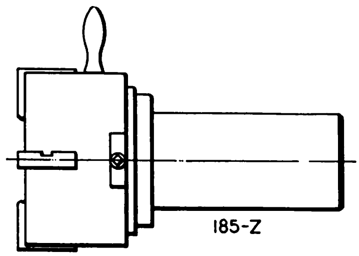
**X**–TWO NOTCHES OR ANY NUMBER EVENLY DIVIDED BY TWO WILL CATCH A FULL THREAD.

**Y**–FOUR NOTCHES OR ANY NUMBER EVENLY DIVIDED BY FOUR WILL CATCH A FULL THREAD. 192-Z

## COLLAPSIBLE TAPS AND SELF-OPENING DIES




Collapsible Tap.




Self-Opening Die.

The demand for accurate, rapid production in large quantities has not only helped to develop the turret lathe, but also many time saving devices used in connection with the turret lathe, among which are the Collapsible Tap and Self-Opening Dies for various forms of thread cutting.

The collapsible tap is made with a number of blades inserted in a steel body. When the proper depth is obtained the blades collapse, eliminating the necessity of backing the tap out of the hole.

Straight threads ranging from 1¼″ to 5½″ in diameter, and from ⅜″ to 2½″ deep; also pipe threads from 1″ to 5″ in diameter may be tapped at a great saving with collapsible taps.

The self-opening die is made to open automatically when reaching a predetermined point on the screw, eliminating the necessity of screwing it off the work, and will cut straight threads ranging from 1/16″ to 3½″ in diameter and pipe threads from ⅜″ to 3″ diameter.

The shanks of both taps and dies can be made to suit holders in use.

The principles of operation are practically the same in both the collapsible tap and self-opening die.

The blades or dies vary in number with the size of the head, and are brought into cutting position by cams and plungers, and are usually released by a spring action of some kind. Many of them are arranged to take roughing and finishing cuts, thereby getting a better and smoother thread. Adjustment being provided to compensate for wear, gives the dies a very long life and also makes it possible to hold a standard size.

By reference to the current issues of the trade papers, names of various makers will be found who are glad to furnish catalogs with data and information covering the use and operation of their taps and dies.

At times, two taps are used to finish a thread of particular dimensions, one as a rougher which may be of the collapsible type, and one as a finisher which may be of either the collapsible or solid type.

It may be found a little difficult always to start the second tap in the lead of the first tap if the second tap is held solid in the turret.

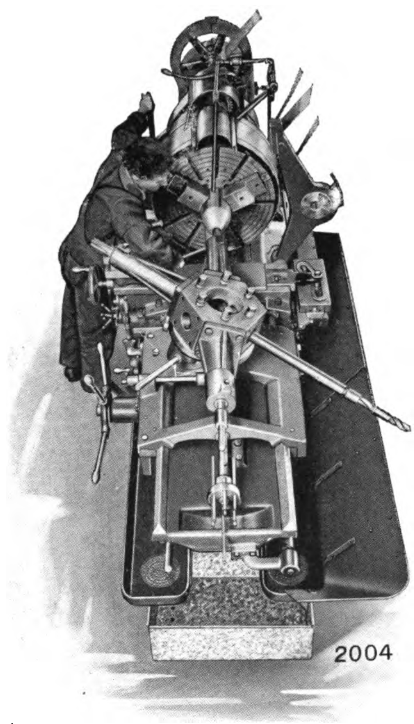
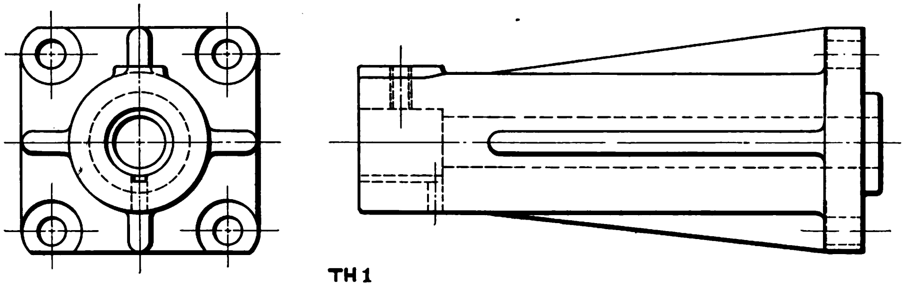


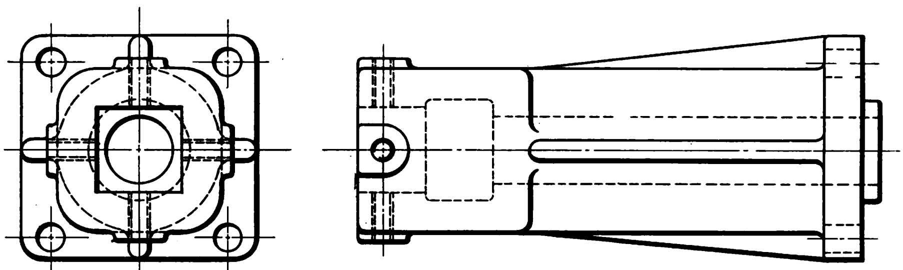

Figure 2004 shows a method which we have used successfully. Here the shank of tap is a sliding and revolving fit in the tap holder. It has a hole thru it in which is inserted a round piece of stock that serves as a driver.

The operator starts the tap by this driver as he would in hand tapping. After tap is started in a couple of threads, the driver may be allowed to rest on cross slide until tap has reached its proper depth.

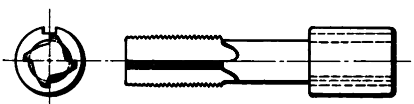
The work shown in this cut is a 6″ high explosive shell and a solid tap is used for finish tapping. It is run all the way thru the piece and removed when piece is taken from jaws.



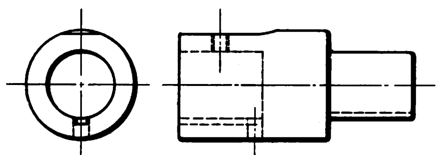
TH 1



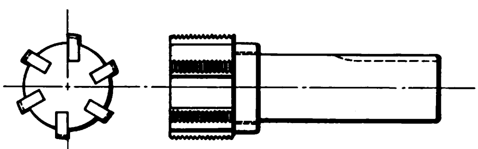
TH 2



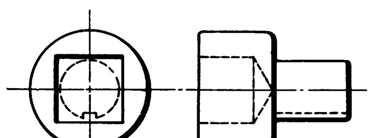
TH 3



TH 4



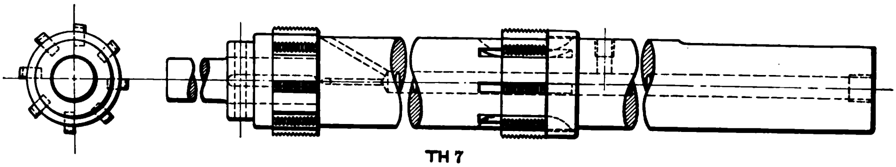
TH 5



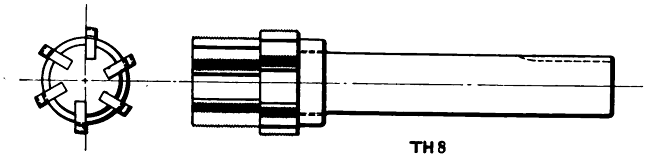
TH 6

121Z

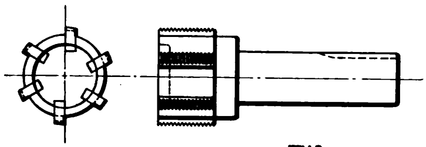
TH1. Standard tap holder.
TH2. Holder for square shank taps. Part of bar tool equipment.
TH3. Solid tap.
TH4. Tap holder extension.
TH5. Tap with inserted blades.
TH6. Extension for using square shank taps in standard tap holder.



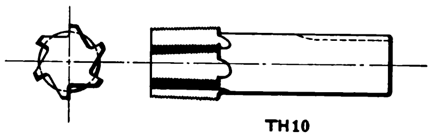
TH 7



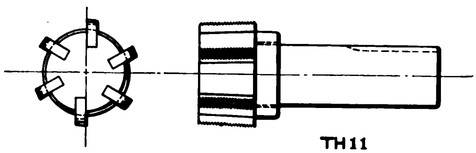
TH 8



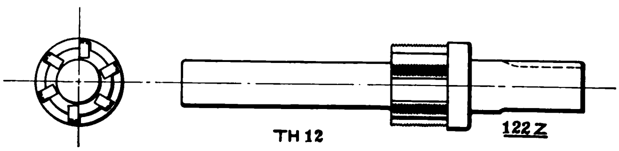
TH 9



TH 10

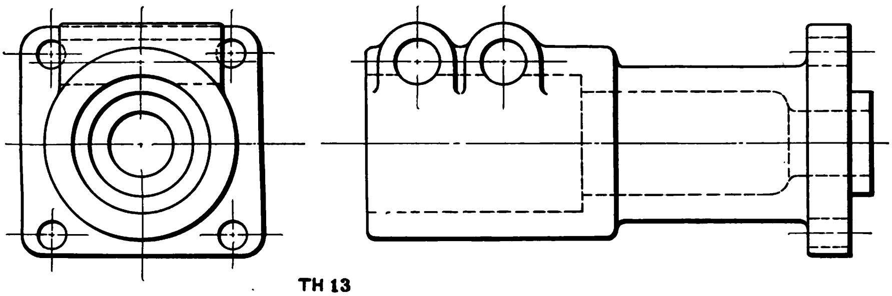


TH 11




TH 12

TH7. Tap bar for tapping threads on both ends of work.
TH8. Tap for cutting thread of two diameters and same pitch at same time.
TH9. Special tap, inserted blades.
TH10. Pipe tap, solid.
TH11. Pipe tap, inserted blade.
TH12. Tap with pilot.

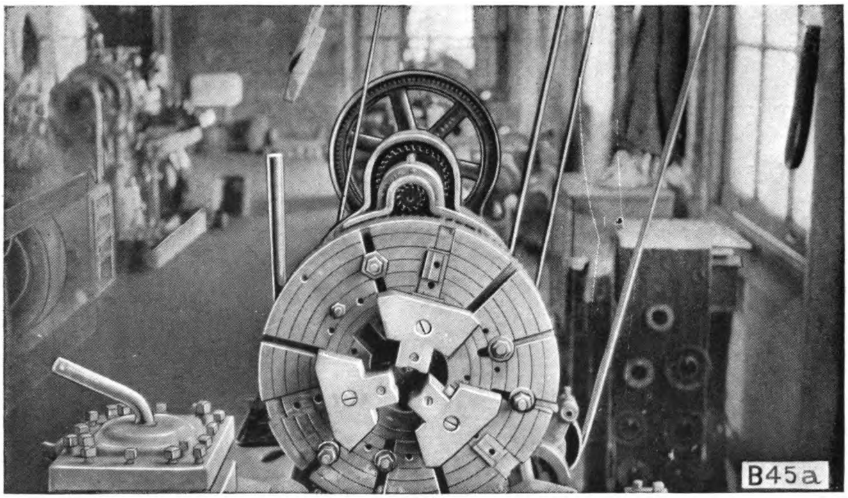



TH13. Standard die holder.

# Machining of Heavy Pieces.

On this and the following pages are a few illustrations, showing how a rather heavy automobile fly wheel (see cut 137Z page 188) was finished complete in two operations on a Gisholt Turret Lathe.

In figure B45a is shown a set of three oscillating jaws, each having two points bearing on the work, giving a six point bearing. These jaws were used for chucking on the inside of the fly wheel rim. In one of these jaws is shown a pin which serves as a driver and holds that jaw solid, the other two being arranged so that they are free to oscillate and adjust themselves to the rough surface of the casting.


B45a

You will note there are six studs located on the face of the chuck, three of which are used for locating the wheel for the first operation and three for the second. The circles, at which the studs support the fly wheel for the first and second operations, are of different diameters so it is possible to leave all six studs permanently located.

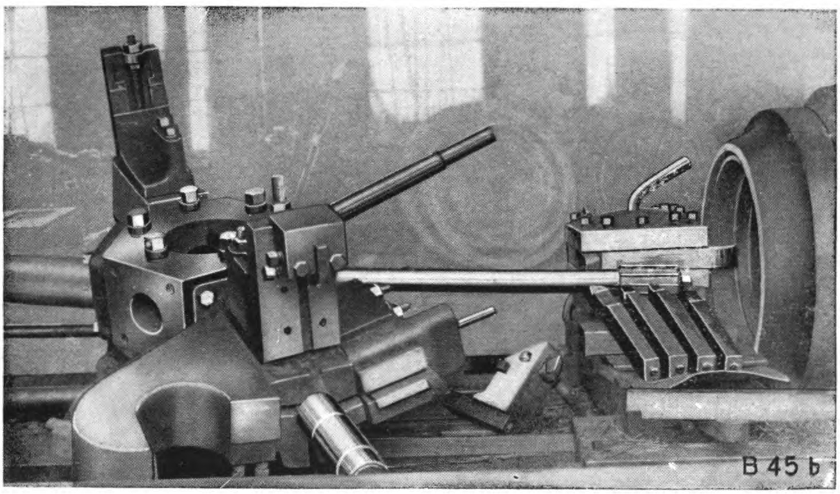
The amount of work on this particular wheel requires more than four tool post tools.

In figure B45b, six of these tools, are shown on bed and cross slide, which were used and changed in one side of the tool post. These tools were all used in connection with carriage stops and the index dial on the cross feed screw.

Adjusting screws were placed in the end of each tool and used as locating points against a small square block set in the corner of the tool post. This plan works out very nicely and also very accurately, it being necessary to adjust the screw in the end only after each grinding, and, by having a finished piece in the machine, the tool can be ground and the screws adjusted to the proper length.

The wheel being very large and quite wide, a special arm was made and used on the back side of the facing head for finish turning the outside diameter.

Figure B45c illustrates how a casting may be rough turned with a tool in the tool post and finish turned with a tool in the facing head at the same time. The finishing tool, or 2nd roughing tool, follows the tool post roughing tool within approximately 1/4". A better illustration of this particular point is shown in figure 137Z, page 188.

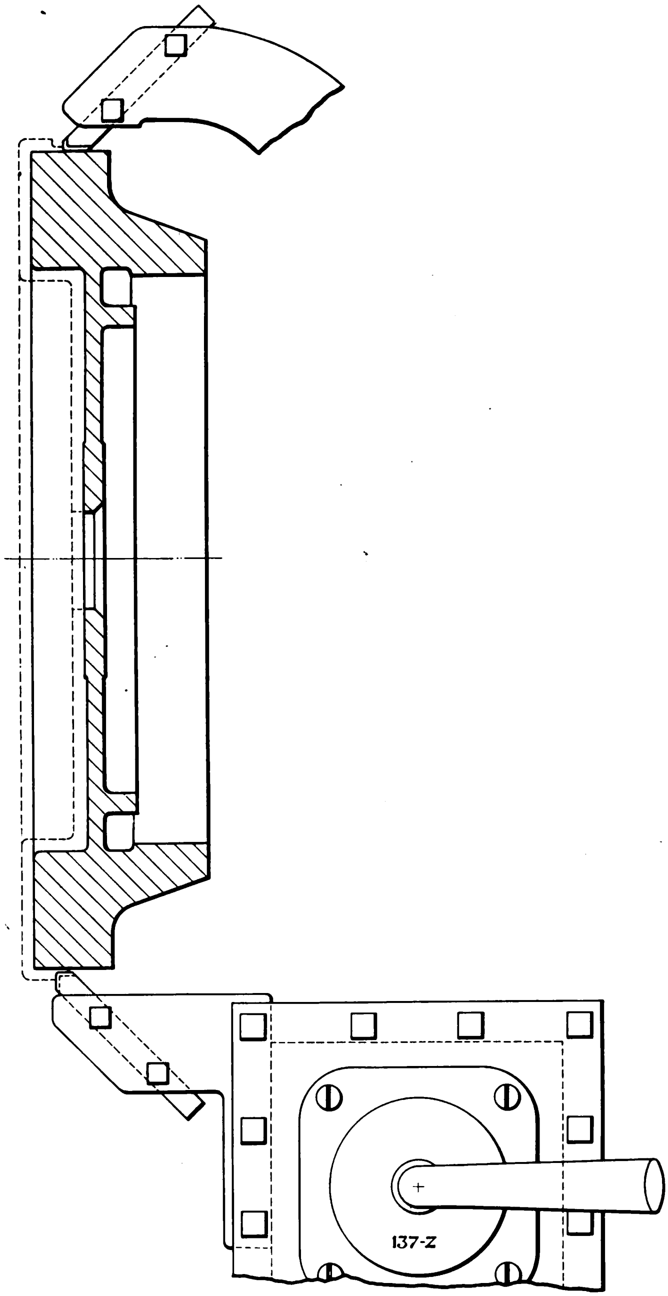


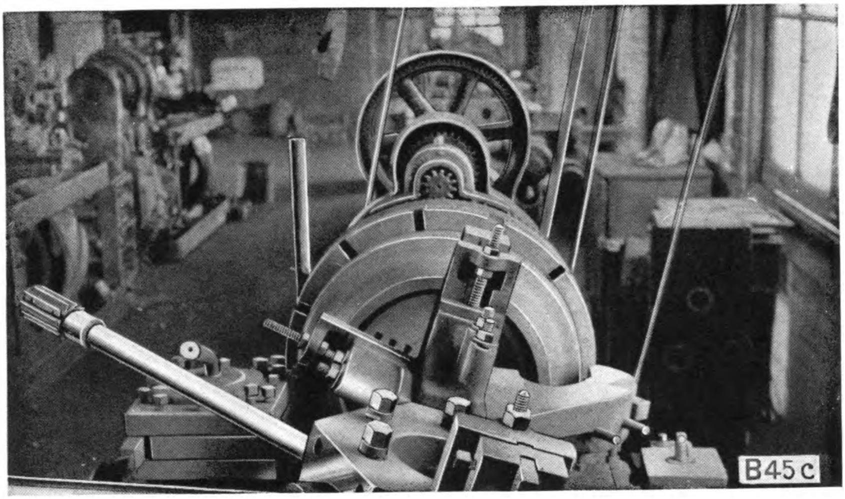

By this method, it is possible to take two cuts over the same surface in the time of one.

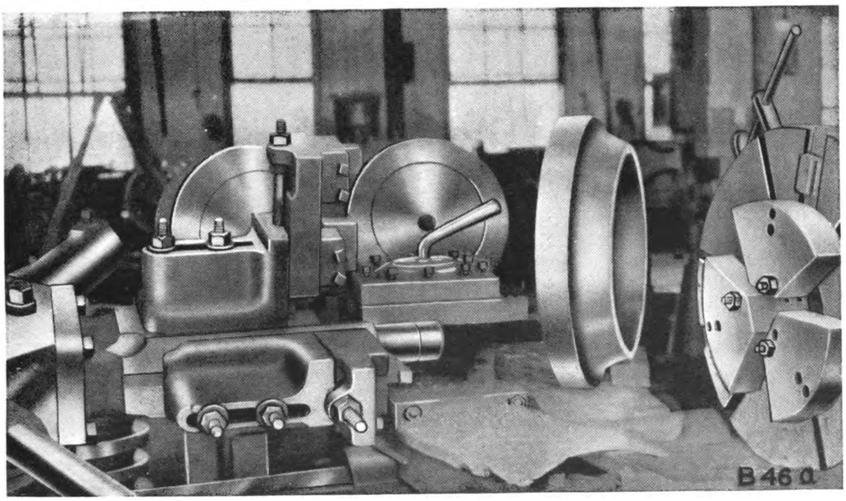
In figure B46a, page 189, is shown a set of special extra wide, soft jaws, turned to fit the bore as finished in the first operation.

The studs shown at the small end, or inner circle of the jaws, support the web of the wheel when rough facing the opposite side; the wheel is also supported on the rim by studs in the face of the chuck. On wheels of this kind, where the web is comparatively thin, the web will spring away from the tool during roughing cut. By keeping the distance from the face of the rim to the face of the finished web accurate on the first operation, it is possible to arrange supporting studs at both these points.

This fly wheel is quite heavy for an automobile fly wheel, weighing approxi-

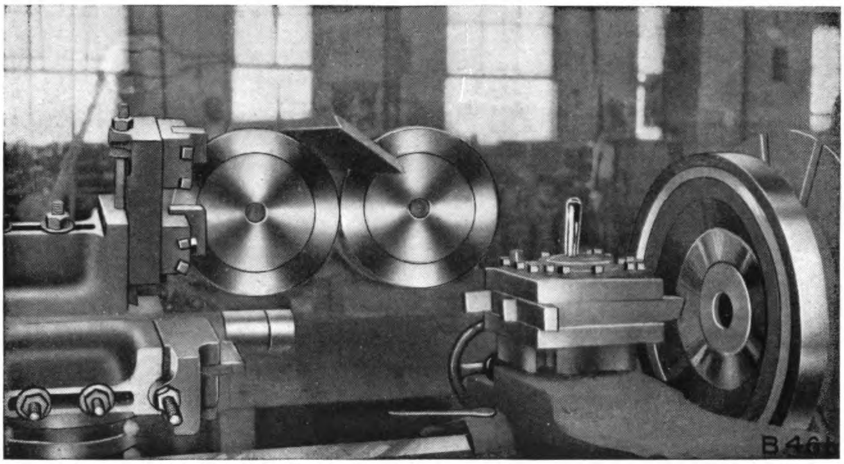

137-Z


B45c


B46a

mately 225 lbs. in the rough. For this reason, a table was built about the same height as the top of the tool post carriage and placed in front of the machine far enough away so as not to interfere with movements of the operator. The table was then loaded with wheels as often as necessary by helpers, and, by means of a removable board between the table and the machine, the wheels could be rolled very easily to and from the machine by the operator. Thus he could proceed with his work at all times without having to wait for assistance to take a piece in and out of the machine, or bothering with a hoist of any kind.

Figure B46b shows two tool posts tools at work at the same time, facing the web and the rim of the wheel.



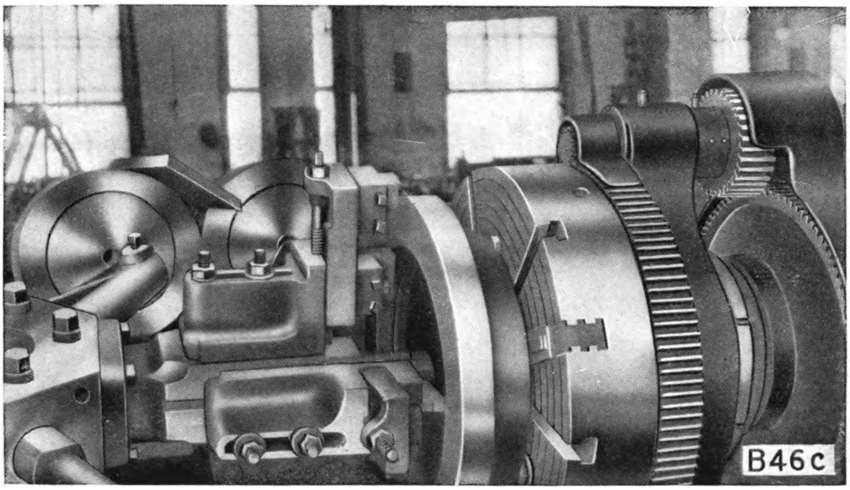
It shows the serving table as previously described and shown in figure B46a.

The inside of the rim of this wheel is rough bored with a tool post tool and finish bored with a tool held in the facing head.

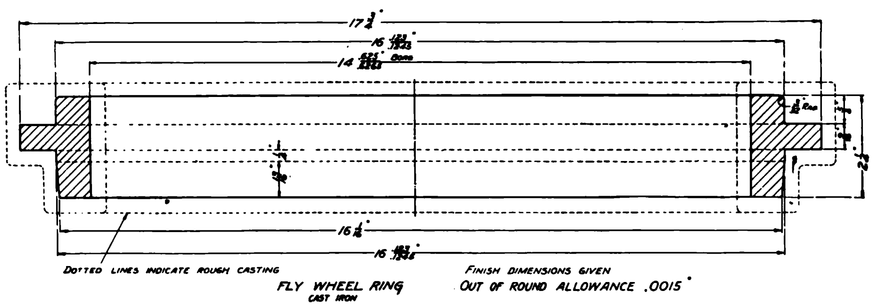
In figure B46c, the tool post tool is rough boring and the facing head tool is finish boring at the same time, the finishing cutter following very close to the roughing cutter. The other tools shown in the top arm are arranged for rounding the corners.

## Layout, Instruction and Time Study Sheets.

The cast iron fly wheel ring as shown in figure EB5, page 191, was finished complete, within the size limits shown, in four operations on a standard 24"–6¼" bore Gisholt Turret Lathe. This work was done in a plant, which, like many others, is compelled to run thru work in rather small quantities, necessitating frequent changes from one job to another. To enable an operator or set-up man to accomplish these changes in the shortest possible time, form sheets have been worked out and successfully used to record the location of tools in a very efficient manner. Also records of feeds, speeds, etc., may be kept.




*These sheets may be obtained at cost upon application to the Gisholt Machine Company*, and, when called for, should always be ordered by form number which is found in the lower left hand corner of the sheet. These are called layout, instruction and time study sheets.




E.B. 5 250-2

The layout sheet (form No. 96) is used primarily to lay out the location of the tools in the turret and the tool post, when considering new equipment for a job. On page 193 is shown a sample of the layout sheet, as it was filled in when planning the tools for the Cast Iron Fly Wheel Ring, shown in figure EB5.

Another way in which they are used is shown on pages 205 and 206. Here the number of each tool is recorded opposite the tool, and when they are being arranged on the machine, this proves a very valuable guide and time saver for the set-up man.

After the tools have been tried out in actual practice and all changes made, their location should be recorded on instruction sheet (Form No. 57).

Provision is made on this sheet to record the change gear used in the feed box and also the length of any special stop screws for either the tool post carriage or the turret.

A cut of the Drill Support is shown where any standard or special bushing may be recorded.

On some of these sheets, you will note that an end view of the facing head is shown, giving the numbers of the cutters with arrows running to the slots in which they are used.

The time study sheet (form No. 90) is for belt driven machines and is used to record all the data on operating machine, including feeds and speeds, the position of the operating levers, and the step of the cone pulley which is used.

On pages 195, 198, 201 and 204, are samples of these forms which have been filled out complete including detail time for each cut.

The term "operate machine" used on these sheets means the time used between cuts or the time required to turn the tool post and turret, and change them from one position to another, or all the time spent when no tool was actually cutting.

Form No. 365, page 207, is used to record this data for motor driven machines. A controller is shown at the top of sheet with graduations from one to ten in both forward and reverse directions. The controller on your machine may not be marked in this way, but in order to get the greatest benefit from the Time Study Sheet they should be marked, and numbered.

The column headed by "Controller at" should be filled in with the graduation number at which the lever pointer stands when proper speed is found.

The column headed "Speeds" is filled in with either of the letters "H", "I", or "S" thus recording the position of the operating levers and whether the High, Intermediate, or Slow Speed was used.

The "Spindle R. P. M." column is for recording the revolutions per minute of the spindle.

The "Pull pin" is in the feed box and a record should be made as to its location whether "*in*" or "*out*".

The "Feed" used should be recorded in the column provided for that purpose.

The last column is for the time required for each individual cut or operation.

The rest of the sheet is very plain, as is the one used for Belt Driven Machines which is shown filled in with an actual record made.

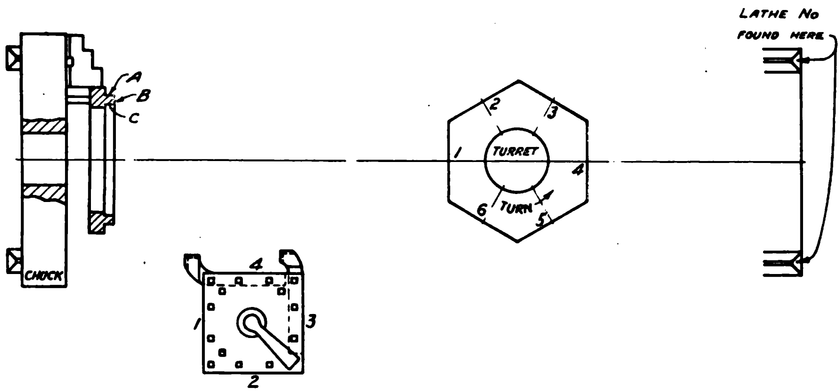
LAYOUT SHEET ~ Operation No 1 202-Z

For arranging tools on 24" Gisholt Turret Lathe, No 6-601 Date 6-6-66.

Company HIGH POWER MOTOR PARTS CO., BAY CITY, CAL.

Part Flywheel Ring Mat C I Drawing No 11798 Part No. 11798

Change Gear 40 Teeth




REMARKS:—

1-Chuck on O. D. with soft jaws.

2-Rough turn A with tool in side 4 of tool post.

3-Rough face B with tool in side 4 of tool post

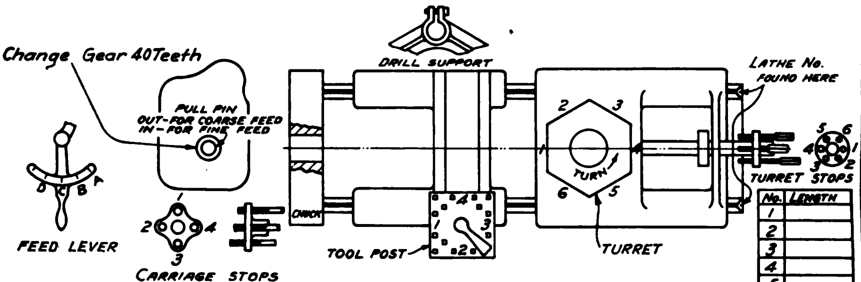
4-Rough bore C with tool in side 3 of tool post, 1" deep.

INSTRUCTION SHEET—Operation No. 1 204-Z

For arranging tools on 24" GISHOLT TURRET LATHE, No. 6-601 Date 6-6-66.

Company HIGH POWER MOTOR PARTS CO., BAY CITY, CAL.

Part FLYWHEEL RING Mat. C.I. Drawing No. 11798 Part No. 11798



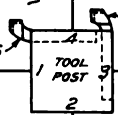

| No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| LENGTH | | | | |

| No. | LENGTH |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |

TOOL POST

Tool for rough turning and rough facing. D-6

Tool for rough boring. D-7




CHUCK

DRILL SUPPORT

TURRET

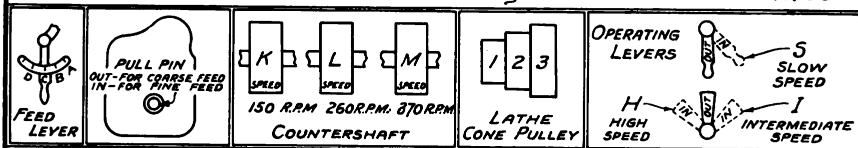
| | | |
|---|---|---|
| FACE No. 1 | FACE No. 2 | FACE No. 3. |
| FACE No. 4 | FACE No. 5 | FACE No. 6 |

BELT DRIVE TIME STUDY — Operation No. 1 203-Z

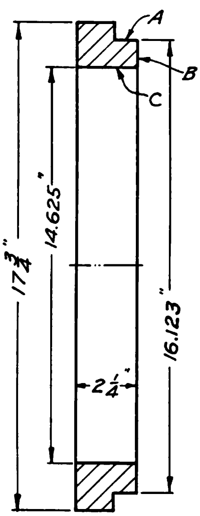
For 24" — 4¼" GISHOLT TURRET LATHE, No. 6-601 Date 6-6-'66.

Company HIGH POWER MOTOR PARTS CO., BAY CITY CAL.

Part FLYWHEEL RING Mat. C. I. Drawing No. 11798 Part No. 11798




Change Gear 40 Teeth




| | Belt on cone step | Speeds | Spindle R.P.M. | Pull Pin | Feed | Min.-Sec. |
|---|---|---|---|---|---|---|
| Chuck | | | | | | :30 |
| Rough turn A | 3 | M-S | 14 | Out | B-10 | :45 |
| Rough bore C-1" deep | 3 | M-S | 14 | | B-10 | 1:00 |
| Rough face B | 3 | M-S | 14 | | B-10 | :40 |
| Operate machine | | | | | | 1:05 |

Total floor to floor time
- 1st Operation ........ 4:00
- 2nd ........
- 3rd ........
- 4th ........
- Complete ........

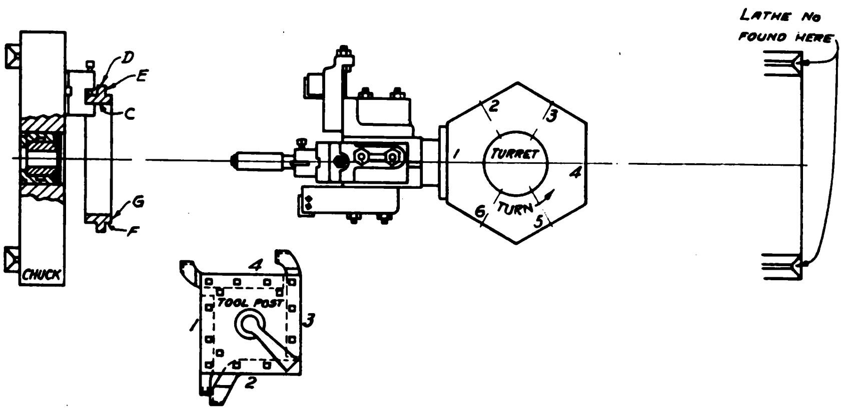
LAYOUT SHEET ~ Operation No 2 199-Z

For arranging tools on 24" Gisholt Turret Lathe, No 6-601 Date 6-6-66

Company HIGH POWER MOTOR PARTS CO., BAY CITY, CAL.

Part Flywheel Ring Mat. C.I. Drawing No 11798 Part No 11798

Change Gear 40 Teeth




REMARKS:—

1-Chuck in special split jaws

2-Rough turn D with tool in side 4 of tool post

3-Rough face E with tool in side 4 of tool post.

4-Rough turn F with tool in side 4 of tool post.

5-Rough face G with tool in side 4 of tool post

6-Rough bore C to jaws with tool in side 3 of tool post.

7-Finish face E & G with tools in side 1 & 2 of tool post.

8-Finish turn D & F & finish bore C with tools in facing head, side 1 of turret

9-Break corners with file

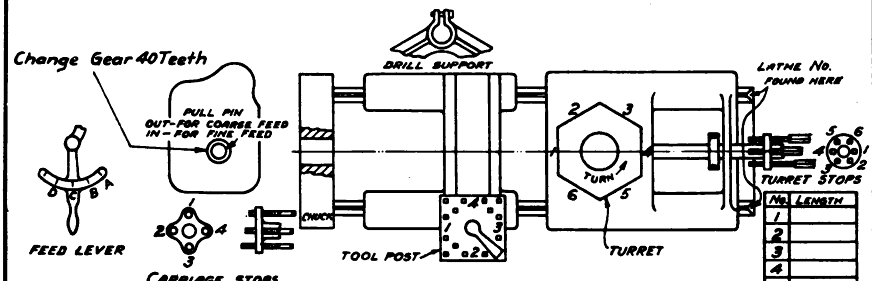
Form No. 96 GISHOLT MACHINE CO., MADISON, WIS. SHEET No. L-311-2

INSTRUCTION SHEET — Operation No 2 201-Z

For arranging tools on 24" GISHOLT TURRET LATHE, No 6-601 Date 6-6-66.

Company HIGH POWER MOTOR PARTS CO., BAY CITY, CAL.

Part FLYWHEEL RING Mat. C.I. Drawing No 11798 Part No. 11798




CARRIAGE STOPS

| No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| LENGTH | | | | |

TURRET STOPS

| No. | LENGTH |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |

TOOL POST

Tool for rough turning and rough facing. D-6

Tool for rough boring. D-7

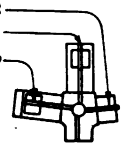

Tools for finish facing. D-12 D-13

CHUCK in special split jaws.

DRILL SUPPORT

TURRET

FACE No. 1 FACING HEAD
Cutter No D-8
" " D-9
" " D-10
Tools for finish turning and finish boring.



FACE No. 2

FACE No. 3

FACE No. 4

FACE No. 5

FACE No. 6

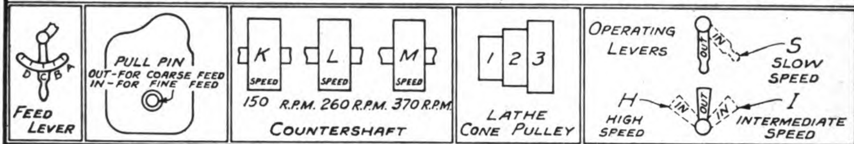
Form No. 57 GISHOLT MACHINE CO., MADISON, WIS. SHEET No. I-311-2

BELT DRIVE TIME STUDY — Operation No. 2 200-Z

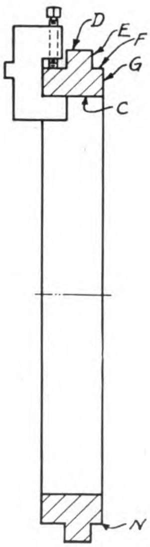
For 24"–4¼" GISHOLT TURRET LATHE, No. 6-601 Date 6-6-66

Company HIGH POWER MOTOR PARTS CO., BAY CITY, CAL.

Part FLYWHEEL RING Mat. C.I Drawing No. 11798 Part No 11798




Change Gear 40 Teeth




| | Belt on cone step | Speeds | Spindle R.P.M. | Pull Pin | Feed | Min.-Sec. |
|---|---|---|---|---|---|---|
| Chuck | | | | | | 1:30 |
| Rough turn D - 17¾" dia. | 3 | L-S | 10 | Out | C-20 | 3:00 |
| 1st Rough face E to 16⅛" dia. | 3 | L-S | 10 | Out | C-20 | 1:30 |
| 2nd Rough face E to 16⅛" dia. | 3 | M-S | 14 | Out | B-10 | :30 |
| Rough turn F - 16⅛" dia | 3 | M-S | 14 | Out | B-10 | :25 |
| Rough face G | 3 | M-S | 14 | Out | B-10 | :40 |
| Round corner N | 3 | M-S | 14 | | Hand | :15 |
| Rough bore C to jaws. | 3 | M-S | 14 | Out | B-10 | 1:00 |
| Finish face G with | | | | | | |
| tool post. | 3 | M-S | 14 | Out | B-10 | :45 |
| Finish D-F & C with | | | | | | |
| facing head. | 3 | L-S | 10 | Out | B-10 | 1:15 |
| Break corners with a file | 3 | K-H | 100 | | | :15 |
| Operate machine | | | | | | 3:55 |

Total floor to floor time

| | |
|---|---|
| 1st Operation | 4:00 |
| 2nd | 15:00 |
| 3rd | |
| 4th | |
| Complete | |

Form No. 90 GISHOLT MACHINE CO., MADISON, WIS. SHEET No. T-311-2

196-Z

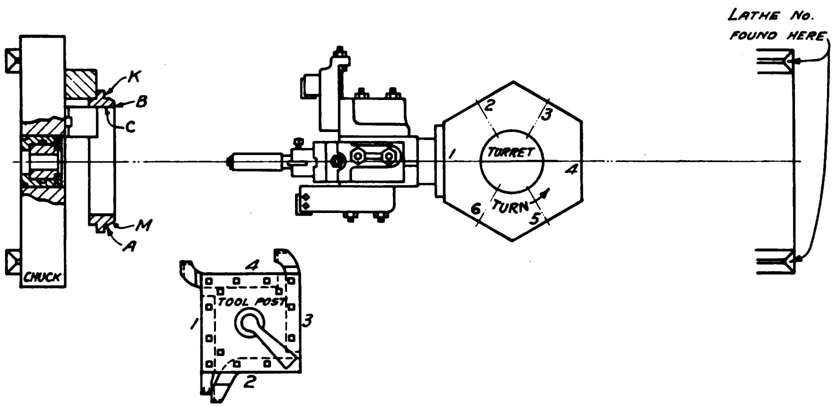
LAYOUT SHEET— Operation No. 3

For arranging tools on 24" GISHOLT TURRET LATHE, No. 6-601 Date 6-6-66.

Company HIGH POWER MOTOR PARTS CO., BAY CITY, CAL.

Part FLYWHEEL RING  Mat. C. I.  Drawing No. 11798  Part No. 11798

Change Gear 40 Teeth




REMARKS:—

1-Chuck in face plate fixture driving with soft jaws turned to fit

2-Rough face K with tool in side 4 of tool post.

3-Rough turn A with tool in side 4 of tool post.

4-Rough face B with tool in side 4 of tool post.

5-Rough bore C with tool in side 3 of tool post.

6-Finish face K & B with tools in side 1 & 2 of tool post.

7-Finish turn A & M & bore C with tools in facing head, side 1 of turret.

8-Break corners with file.

Form No. 96 GISHOLT MACHINE CO., MADISON, WIS.  SHEET No. L-311-3

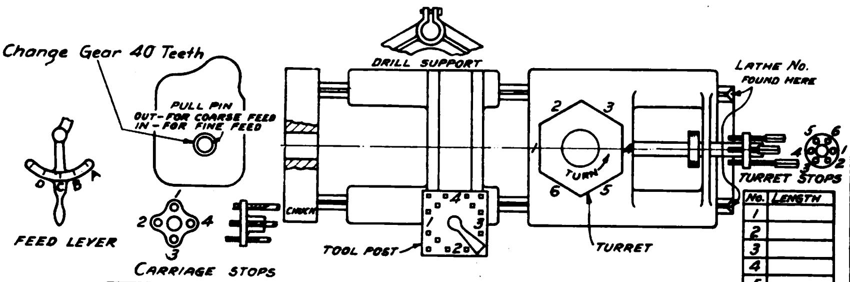
198-Z

INSTRUCTION SHEET—Operation No. 3

For arranging tools on 24" Gisholt Turret Lathe, No. 6-601 Date 6-6-66.

Company HIGH POWER MOTOR PARTS CO., BAY CITY, CAL.

Part Flywheel Ring Mat. C. I. Drawing No. 11798 Part No. 11798




| No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| LENGTH | | | | |

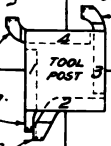
| No. | LENGTH |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |

TOOL POST

Tool for rough turning and rough facing. D-6

Tool for rough boring. D-7

Tools for finish facing. D-12 D-13

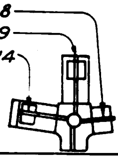



Chuck in fixture D-1 with soft jaws D-4 turned to fit for driving

Drill support

TURRET

Face No. 1 Facing Head
Cutter No. D-8
" " D-9
" " D-14
Tools for finish turning and finish boring



Face No. 2

Face No. 3

Face No. 4

Face No. 5

Face No. 6

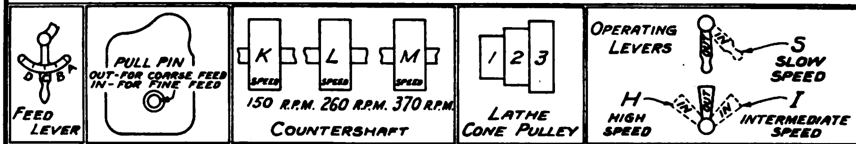
Form No. 57 Gisholt Machine Co., Madison, Wis. Sheet No. I-311-3

BELT DRIVE TIME STUDY — Operation No. 3 197-Z

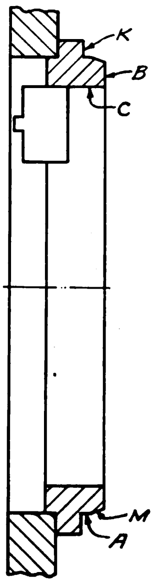
For 24"-4¼" GISHOLT TURRET LATHE, No 6-601 Date 6-6-66

Company HIGH POWER MOTOR PARTS CO, BAY CITY, CAL

Part FLYWHEEL RING Mat C.I Drawing No. 11798 Part No. 11798




Change Gear 40 Teeth




| | BELT ON CONE STEP | SPEEDS | SPINDLE R.P.M. | PULL PIN | FEED | MIN.-SEC. |
|---|---|---|---|---|---|---|
| Chuck | | | | | | 1:30 |
| Rough face K to 16⅛" dia. | 3 | L-S | 10 | OUT | B-10 | :45 |
| Rough turn A – 16⅛ dia. | 3 | M-S | 14 | OUT | B-10 | :50 |
| Rough face B | 3 | M-S | 14 | OUT | B-10 | :35 |
| Rough bore C | 3 | M-S | 14 | OUT | A-5 | :25 |
| Finish face K & B with | | | | | | |
| tool post. | 3 | M-S | 14 | OUT | B-10 | :45 |
| Finish A-M & C with | | | | | | |
| facing head | 3 | L-S | 10 | OUT | B-10 | 1:10 |
| Break corners with file | 3 | K-H | 100 | | | :10 |
| Operate machine | | | | | | 3:20 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Total floor to floor time

| | |
|---|---|
| 1ST OPERATION | 4:00 |
| 2ND | 15:00 |
| 3RD | 9:30 |
| 4TH | |
| Complete | |

193-Z

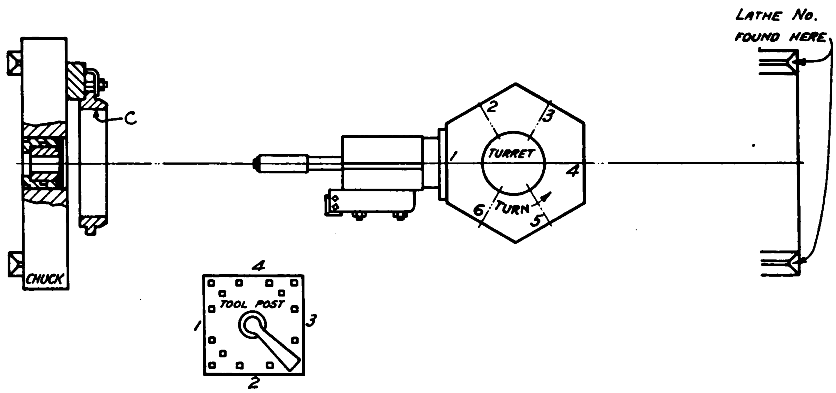
LAYOUT SHEET ~ Operation No. 4

For arranging tools on 24" Gisholt Turret Lathe, No. 6-601 Date 6-6-66.

Company HIGH POWER MOTOR PARTS CO., BAY CITY, CAL.

Part Flywheel Ring Mat. C.I. Drawing No. 11798 Part No. 11798

Change Gear 40 Teeth




REMARKS:—

1-Chuck in face plate fixture & hold with clamps.

2-Finish bore C with tool in facing head, side 1 of turret.

Form No. 96 GISHOLT MACHINE CO., MADISON, WIS. SHEET NO. L-311-4

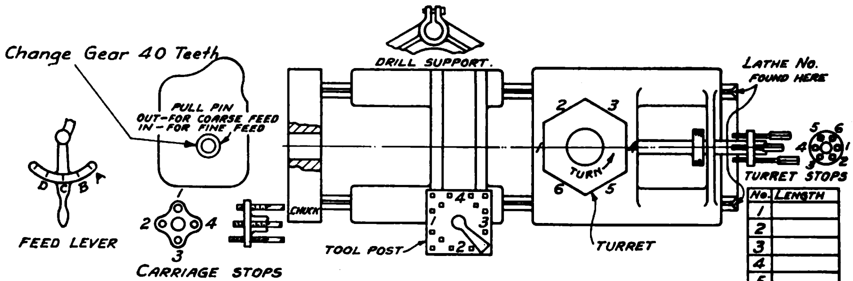
195-Z

INSTRUCTION SHEET—Operation No. 4

For arranging tools on 24" Gisholt Turret Lathe, No. 6-601 Date 6-6-66.

Company HIGH POWER MOTOR PARTS CO., BAY CITY, CAL.

Part Flywheel Ring Mat. C.I. Drawing No. 11798 Part No. 11798




Carriage stops:

| No. | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Length | | | | |

Turret stops:

| No. | Length |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |

TOOL POST

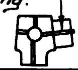
Tool post: 1, 2, 3, 4

Chuck in face plate with clamps D-13 for driving.

Drill support

TURRET

| Face No. 1 | Face No. 2 | Face No. 3 |
|---|---|---|
| Facing head<br>Cutter No. D-8<br>Tool for finish boring. | | |
| **Face No. 4** | **Face No. 5** | **Face No. 6** |
| | | |



Form No. 57 GISHOLT MACHINE CO., MADISON, WIS. SHEET No. I-311-4

BELT DRIVE — TIME STUDY — Operation No 4 — 194-Z

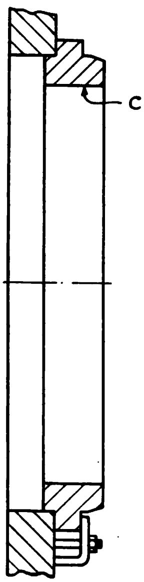
For 24" – 4 1/4" GISHOLT TURRET LATHE, No. 6-601 Date 6-6-66.

Company HIGH POWER MOTOR PARTS CO., BAY CITY, CAL.

Part FLYWHEEL RING Mat C.I. Drawing No. 11798 Part No. 11798

| FEED LEVER | PULL PIN OUT-FOR COARSE FEED IN-FOR FINE FEED | K SPEED 150 R.P.M. — L SPEED 260 R.P.M. — M SPEED 370 R.P.M. COUNTERSHAFT | 1 2 3 LATHE CONE PULLEY | OPERATING LEVERS: S SLOW SPEED; H HIGH SPEED; I INTERMEDIATE SPEED |
|---|---|---|---|---|

Change Gear 40 Teeth




| | BELT ON CONE STEP | SPEEDS | SPINDLE R.P.M. | PULL PIN | FEED | MIN.-SEC. |
|---|---|---|---|---|---|---|
| Chuck | | | | | | 1:00 |
| Finish bore C with | | | | | | |
| facing head. | 3 | M-S | 14 | OUT | B-10 | 1:35 |
| Operate machine | | | | | | :55 |

Total floor to floor time

| | |
|---|---|
| 1ST OPERATION | 4:00 |
| 2ND " | 15:00 |
| 3RD " | 9:30 |
| 4TH " | 3:30 |
| Complete | 32:00 |

Form No. 90 GISHOLT MACHINE CO., MADISON, WIS SHEET No. T-311-4

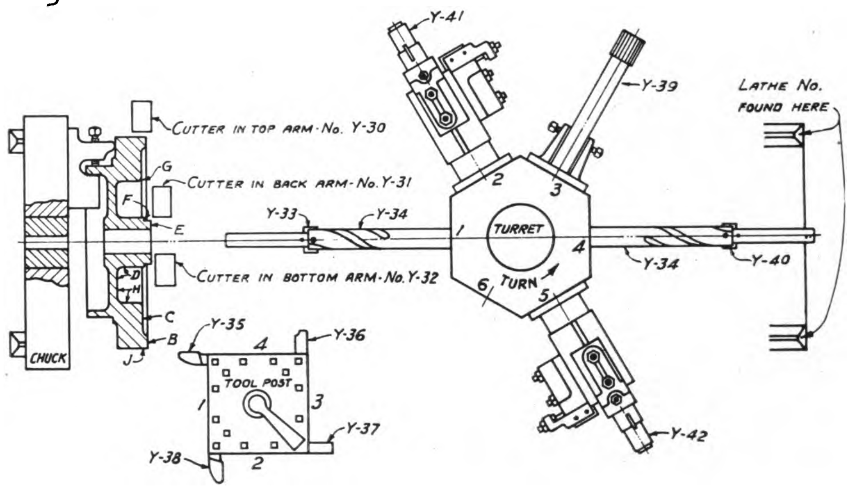
LAYOUT SHEET ~ Operation No. 1 205-Z

For arranging tools on 34" GISHOLT TURRET LATHE, No. 10-702 Date 6-6-66

Company HIGH POWER MOTOR PARTS CO., BAY CITY, CAL.

Part FLYWHEEL Mat C. I Drawing No. 2819 Part No. 2819

Change Gear 32 Teeth




REMARKS:—

1-Chuck with special jaws as shown.

2-Rough E-C-B & H with tool in side 1 of tool post

3-Rough D with tool in side 4 of tool post.

4-Rough bore with cutter in bar, side 1 of turret

5-Finish bore with cutter in bar, side 4 of turret.

6-Ream with reamer in side 3 of turret

7-Rough J with tool in side 4 of tool post. First cut. Cut ahead of facing head.

8-Rough E-F & J with cutters in facing head, side 2 of turret

9-Finish E-F & J with cutters in facing head, side 5 of turret.

10-Finish B with tool in side 2 of tool post

11-Round corner G with tool in side 3 of tool post.

FORM No. 96 GISHOLT MACHINE CO., MADISON, WIS. SHEET No. L-287-1

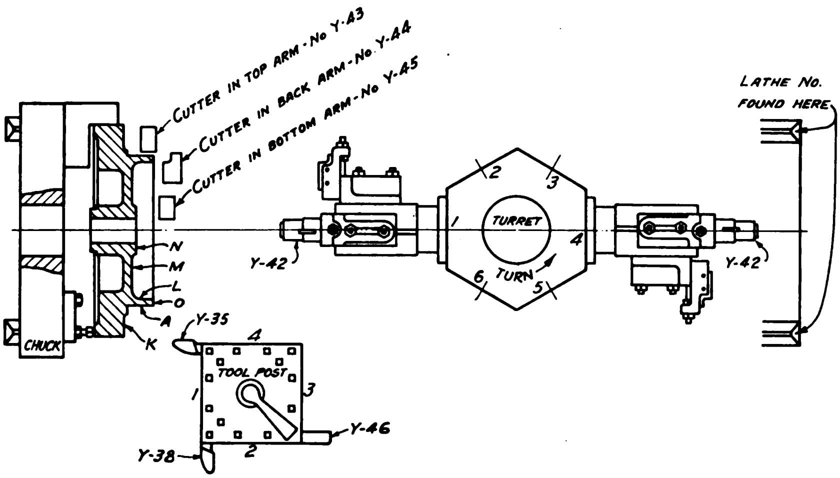
LAYOUT SHEET ~ Operation No. 2 206-Z

For arranging tools on 34" GISHOLT TURRET LATHE, No. 10-702 Date 6-6-66.

Company HIGH POWER MOTOR PARTS CO., BAY CITY, CAL.

Part FLYWHEEL Mat. C.I Drawing No. 2819 Part No. 2819

Change Gear 32 Teeth




REMARKS:—

1-Chuck with soft jaws against 3 chuck jacks faced off parallel.

2-Rough L-M-N & O with tool in side 2 of tool post.

3-Rough K with tool in side 4 of tool post.

4-Rough A with tool in side 4 of tool post. First cut.

5-Rough A-N & O with cutters in facing head, side 1 of turret.

6-Finish A-N & O with cutters in facing head, side 4 of turret.

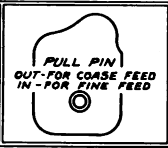
7-Finish K with tool in side 2 of tool post.

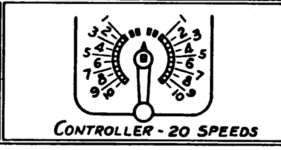
MOTOR DRIVE TIME STUDY — Operation No. 245-Z

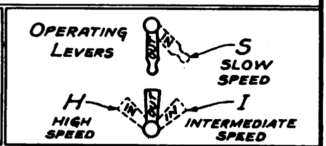
For GISHOLT TURRET LATHE, No. Date

Company

Part Mat. Drawing No. Part No.


| Change Gear Teeth | Controller at | Speeds | Spindle R.P.M. | Pull Pin | Feed | Min. Sec. |
|---|---|---|---|---|---|---|
| Chuck | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
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| | | | | | | |

Total floor to floor time
- 1st Operation
- 2nd
- 3rd
- 4th
- Complete

FORM No. 365 GISHOLT MACHINE CO., MADISON, WIS. SHEET No.


TOOL STORAGE.

In order to have a department of turret lathes working to the highest point of efficiency, it is necessary to have a place of some kind in which to store and properly take care of all extra tools, and tools not in use.

Figure B5a shows a cabinet containing open bins, as well as drawers, which was used in a department of ten Gisholt Turret Lathes.

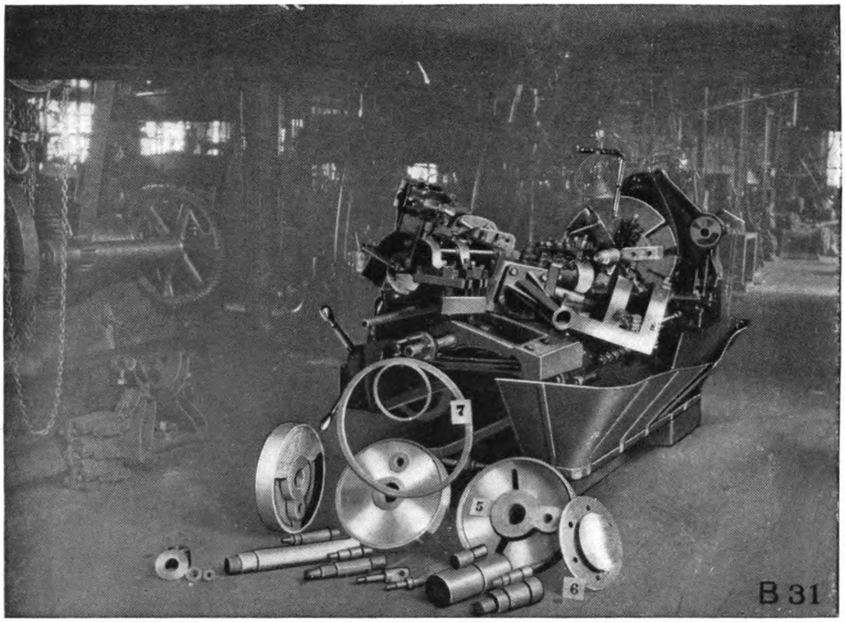
Some of the drawers were used for blue prints and other data concerning the department work.

Correctly machined samples of the different pieces were made and used to gage the setting of facing head cutters when setting up the jobs.

A desk for the department foreman was built in one end of the cabinet and proved very convenient.

All the tool post tools were ground on the Gisholt Universal Tool Grinder shown, and then stored away, sharpened, ready for use.

Small cabinets, like one shown at the left hand of large cabinet, were made for each machine. These were for individual use of each operator in which he kept all tools for his particular machine, such as standard chuck jaws, wrenches, etc. The two drawers were fitted with separate locks and were used by the night and day man for their own private tools.




RANGE OF GISHOLT TURRET LATHE.

In above figure B31, is shown a standard 24″ Gisholt Turret Lathe and tools for finish turning and cutting off cross head pins.

On the floor at the end of the machine are shown a number of jobs which were successfully handled on this machine, ranging from small nuts and washers to comparatively large piston rings, crank discs and cylinder heads.

This machine is used in rather a small plant, engaged in the manufacture of steam engines and employing about fifty men. The size of the shop in a way accounts for the great variety of work, and large variation in the sizes of the parts. This work is done in lots of not more than twelve pieces of a kind at one time.

## HELPFUL SUGGESTIONS.

Locate your trouble, then remove the cause.

Keep the machine well oiled at all times.

Keep the spindle bearings properly adjusted. Bearings will wear longer and proper adjustment helps to prevent tool chatter.

Keep end play out of spindle. The work will be more nearly true and the tools less apt to chatter.

Provide support for all tools as near as possible to cutting edge. Lack of support sometimes causes unnecessary breakage and chatter.

Have no more clearance on cutters and tools than absolutely necessary. This insures longer life to cutters and helps to reduce chatter.

Excessive speed will cause chatter.

As a last resort, to eliminate chatter, reverse the tool and run the lathe backward.

Have all cutting tools ground on bottom, after hardening, if possible. If bottom is uneven, they are apt to break when clamped in position.

Keep your tools sharp and have a suitable place in which to store them when not in use.

If cutters require grinding too often, have them tested for hardness.

Reamer blades should never be backed off closer than .006″ to .010″ to the cutting edge.

Always use cutting oil of some kind when reaming steel. Be sure reamer has plenty of chip clearance and keep it sharp.

The corners of blades in reamers, boring bars or cutter heads should never be ground by hand, as they should be exactly even.

If reamer cuts just a little large in cast iron use a little oil for a few holes, then discontinue oil.

Leave as little stock as possible for reaming.

The slower the speed and the finer the feed for forming cutters, the better the finish.

Kerosene or coal oil gives a fine finish on aluminum. Also when mixed: one part kerosene to three or four of lard oil, it produces fine finish on steel, if run slow, with fine feed for forming cutters.

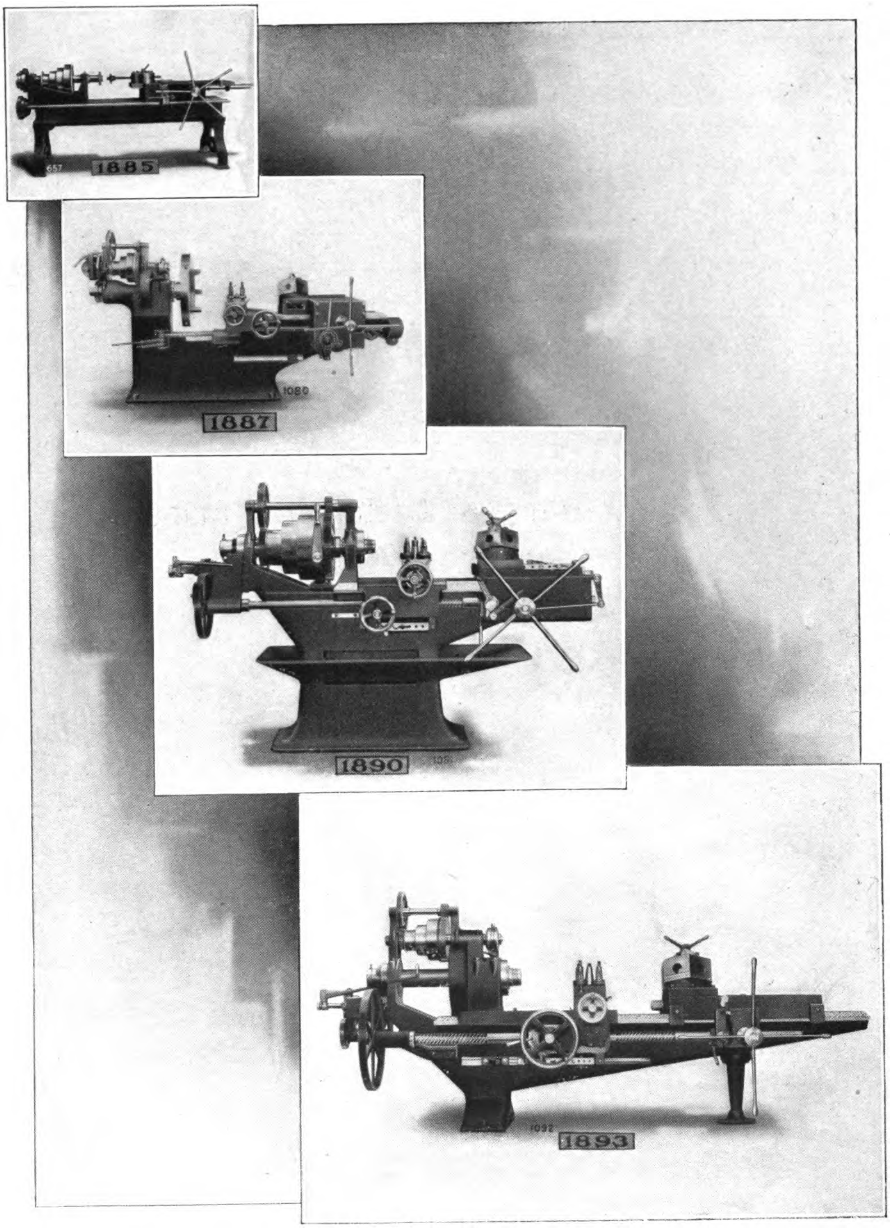
One part powdered sulphur to forty parts thread cutting oil will help produce fine finish on steel, especially soft mushy steel.

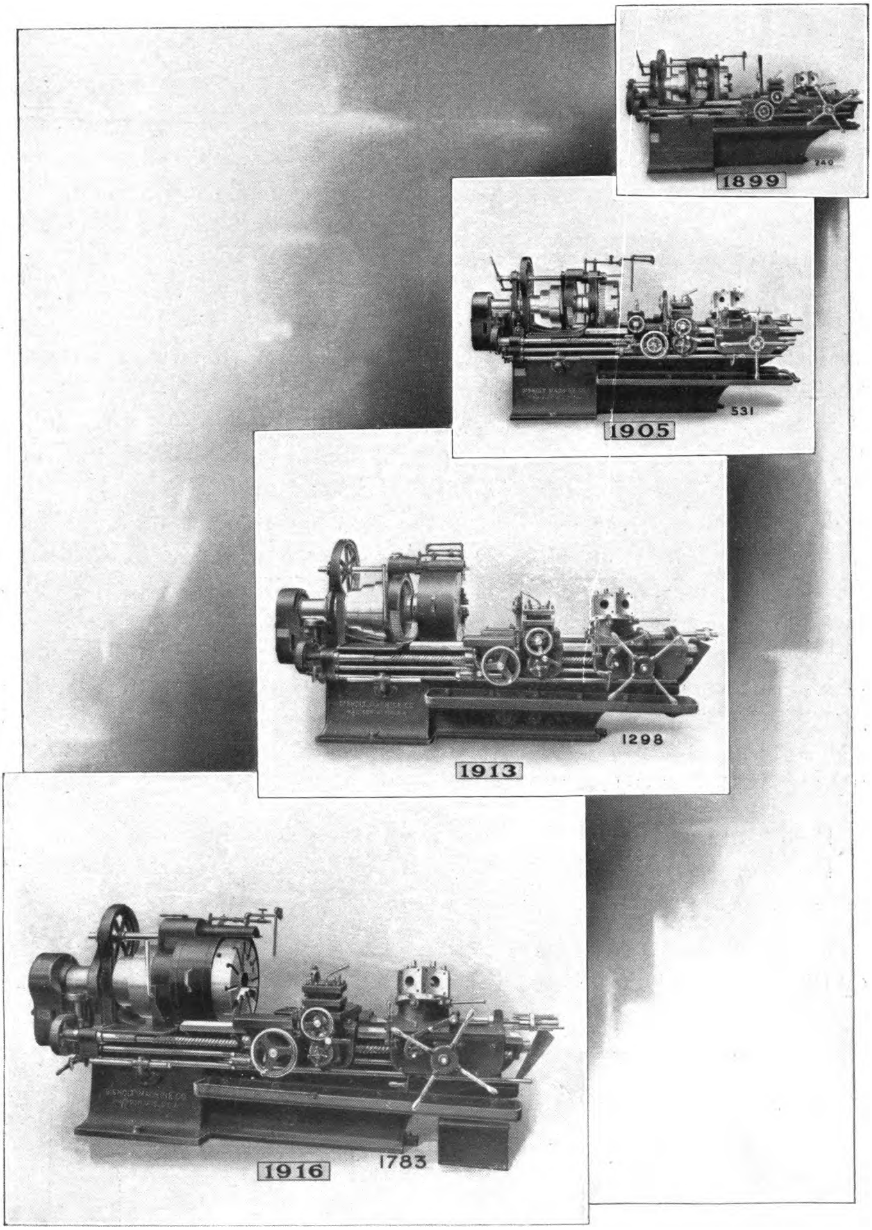
A little sulphur mixed with machine oil will increase its lubricating qualities.

Running fits or boring bar pilots and supporting bushings require approximately .001″ clearance to each inch in diameter.

If rapid traverse frictions do not engage readily put in a little kerosene or coal oil. NEVER GASOLINE.

# Instructions for Ordering Parts.


1885
1887
1890
1893


1899
240
1905
531
1913
1298
1916
1783

# Repair Parts.

In its quarter century of manufacturing experience, the Gisholt Machine Company has furnished to the manufactures of the world several thousand turret lathes.

The machines from the start have been so simple in design, and so well constructed that the repair part of the business has been relatively very small.

However, accidents occasionally will happen, and at times repairs must be made, at which time speed is generally all important.

After many months of painstaking effort, our service department has compiled a list of parts, giving symbols, numbers and names, also illustrated by photographs and line drawings, so as to enable anyone who desires to get what he needs quickly and exactly.

When parts are ordered from these lists, we must have the SYMBOL, NUMBER AND FULL NAME OF PIECE, also the NUMBERS FOUND ON THE ENDS OF THE V'S OF THE LATHE (See fig. 1).

If the numbers cannot be found on the ends of the V's, the EXTREME WIDTH OF THE BED AT THE V'S SHOULD BE GIVEN (See fig. 2), also the BORE OF THE SPINDLE. This information is essential owing to the different sizes and types of lathes that have been built.

In case the part wanted cannot be found in these lists, and, if that part shown, which performs the same function, is not near enough like the part wanted, a SKETCH WITH THE PRINCIPAL DIMENSIONS should be furnished with the above mentioned information regarding NUMBERS ON V'S OR DISTANCE BETWEEN V'S, ALSO THE SPINDLE BORE.

Parts for types 1899, 1905, 1913 and 1916 are usually carried in stock.

Parts for types 1885, 1887, 1890 and 1893 must be made up after receipt of order. (See pages 212 and 213.)

When ordering parts for chucks, always send a SKETCH OF PART REQUIRED WITH PRINCIPAL DIMENSIONS.

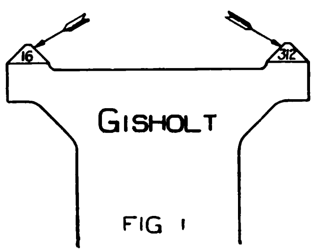


FIG 1

172Z

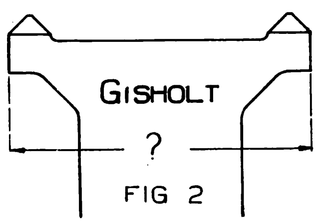


FIG 2

## HEADSTOCK. UNIT A. SYMBOL H.


**WHEN ORDERING REPAIRS FOLLOW INSTRUCTIONS ON PAGE 214.**

# LISTS OF PARTS FOR HEADSTOCK

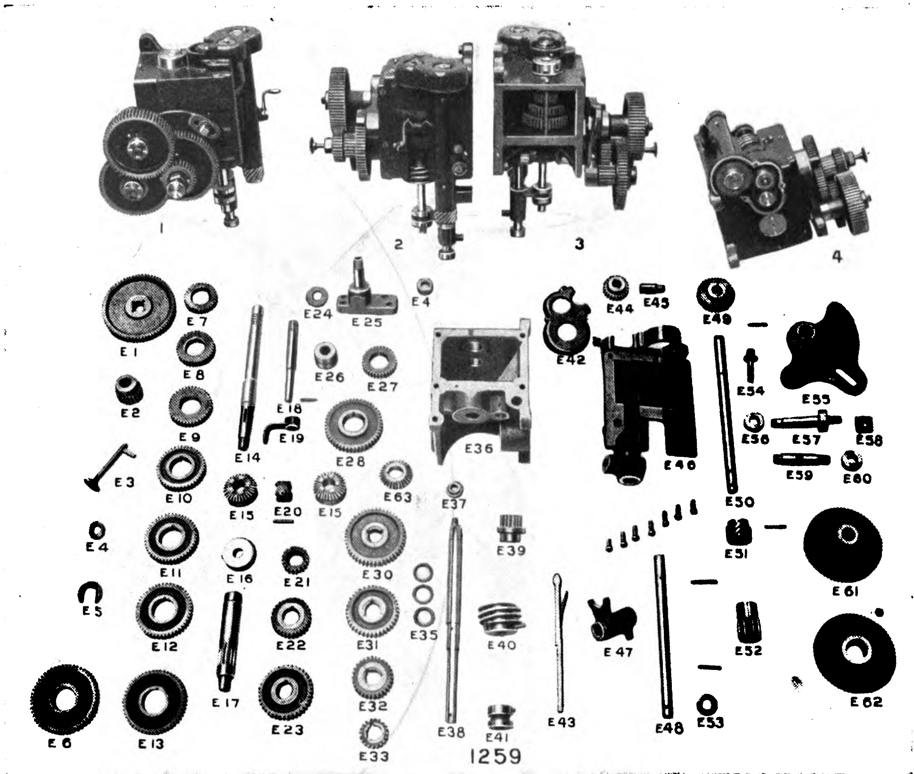
## 1 Assembled Headstock

| Symbol and No. | Code Word | Name |
|---|---|---|
| H1 | Fabab | Friction, Long |
| H2 | Fabdi | Headstock, Rear Bushing |
| H3 | Fabed | Friction, Short |
| H4 | Fabho | Friction Gear |
| H5 | Fabig | Chuck, Ring Gear |
| H6 H7 | Fabju | Spindle, Rear Box Adj. Nuts |
| H8 | Fabry | Cone Pulley Adj. Nut |
| H9 | Fabun | Spindle |
| H10 | Fabva | Spindle, Front Thrust Washer |
| H11 | Facaz | Spindle, Front Box Rear Adj. Nut |
| H12 | Facdo | Spindle, Front Box Front Adj. Nut |
| H13 | Facef | Back Gear Shaft Lever Bracket |
| H14 | Fachu | Back Gear Shaft, End Collar |
| H15 | Facjy | Back Gear Shaft Lever Link |
| H16 | Facok | Back Gear Feather Key |
| H17 | Facra | Back Gear Shaft, Locating Collar |
| H18 | Facup | Back Gear Shaft |
| H19 | Facve | Headstock, Front Bushing |
| H20 | Fadad | Spindle, End Thrust Washer |
| H21 | Faddu | Spindle, End Thrust Adj. Nut |
| H22 | Fadeg | Back Gear |
| H23 | Fadhy | Back Gear Nut |
| H24 | Fadja | Friction Slider Blocks |
| H25 | Fadol | Friction Slider Block Screws |
| H26 | Fadre | Headstock Bracket Plunger |
| H27 | Fadur | Headstock Bracket Plunger Spring |
| H28 | Fadvi | Headstock Friction Lever Yoke Shaft |
| H29 | Fafaf | Back Gear Shaft Lever |
| H30 | Fafdy | Back Gear Shaft Lever Bracket, Single Shoulder Screw |
| H31 | Fafha | Back Gear Shaft Lever, Double Shoulder Screw |
| H32 | Fafik | Friction Slider Dog Pins |
| H33 | Fafje | Friction Slider Dogs |
| H34 | Fafom | Spindle Driving Nut Screws |
| H35 | Fafri | Friction Slider |
| H36 | Fafus | Friction Gear Driving Pinion |

| Symbol and No. | Code Word | Name |
|---|---|---|
| H37 | Fafvo | Spindle, Front Box Oil Ring |
| H38 | Fagag | Headstock Friction Lever |
| H39 | Fagda | Headstock Friction Lever Yoke |
| H40 | Fagej | Spindle, Feed Driving Gear |
| H41 | Faghe | Back Gear Driving Pinion |
| H42 | Fagil | Spindle Driving Nut |
| H43 | Fagji | Spindle, Rear Box Oil Ring |
| H44 | Fagon | Spindle, Rear Box |
| H45 | Fagro | Cone Pulley |
| H46 | Fagut | Friction Gear Adj. Nut |
| H47 | Fagvu | Spindle, Front Box |
| H48 | Fajah | Headstock Bracket |

**WHEN ORDERING REPAIRS FOLLOW INSTRUCTIONS ON PAGE 214.**

MAIN FEED BOX. UNIT B. SYMBOL E.




WHEN ORDERING REPAIRS FOLLOW INSTRUCTIONS ON PAGE 214.

## LIST OF PARTS FOR MAIN FEED BOX

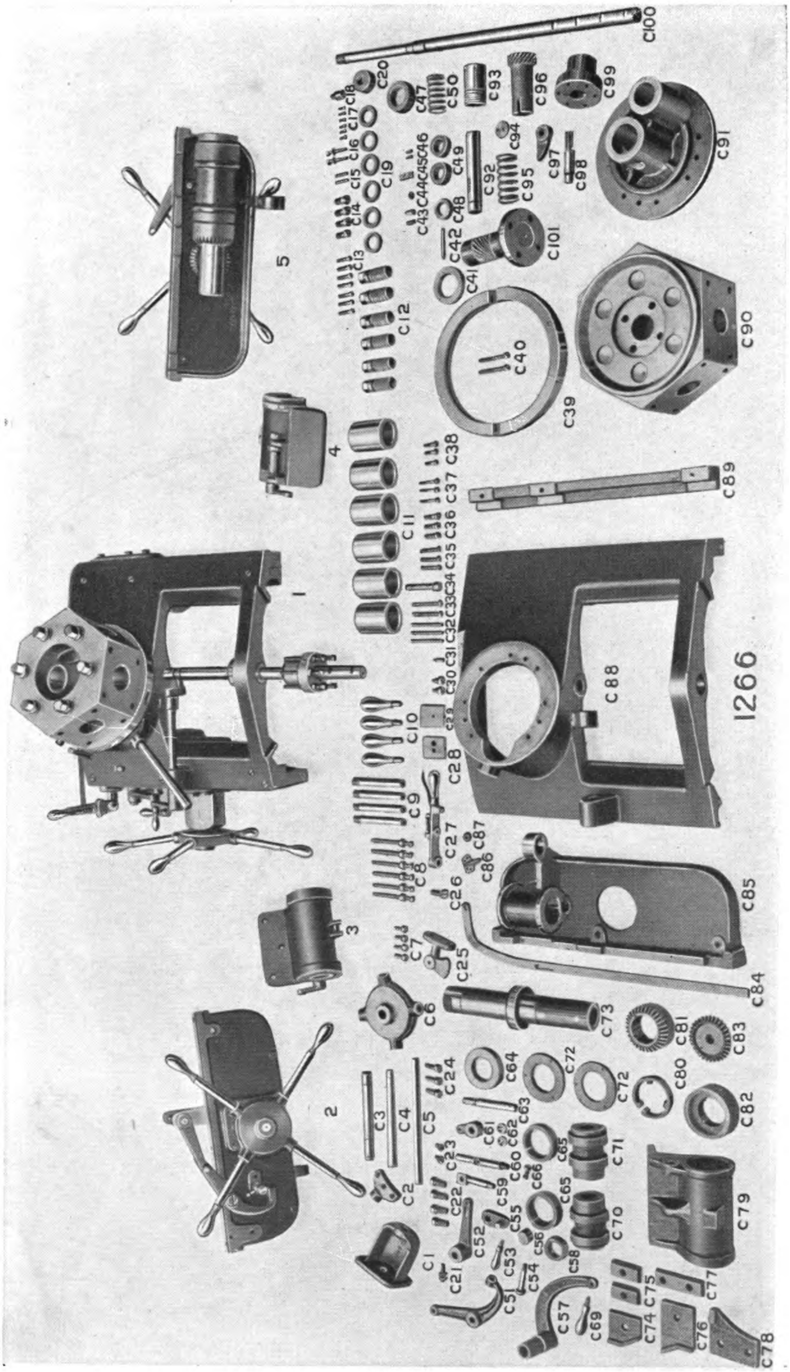
1—End View Assembled Feed Box
2—Front View Assembled Feed Box
3—Back View Assembled Feed Box
4—Top View Assembled Feed Box

| Symbol and No. | Code Word | Name |
|---|---|---|
| E1 | Falky | Fine Feed Loose Gear |
| E2 | Falni | Fine Feed Driving Pinion |
| E3 | Falos | Pull Pin & Cross Pin for Coarse or Fine Feed |
| E4 | Falta | Change Gear Nuts |
| E5 | Falux | Change Gear Washer |
| E6 | Famal | Change Gear 56 Tooth |
| E7 | Fambu | Change Gear 32 Tooth |
| E8 | Famen | Change Gear 36 Tooth |
| E9 | Famfy | Change Gear 40 Tooth |
| E10 | Famir | Change Gear 44 Tooth |
| E11 | Famka | Change Gear 46 Tooth |
| E12 | Famno | Change Gear 48 Tooth |
| E13 | Famot | Change Gear 52 Tooth |
| E14 | Famte | Feed Reserve Shaft |
| E15 | Famuz | Feed Reserve Shaft Mitre Gear Complete |
| E16 | Fanam | Feed Gear Shaft Collar |
| E17 | Fanby | Feed Gear Shaft |
| E18 | Fanco | Feed Reverse Sector |
| E19 | Fanep | Feed Reverse Lever |
| E20 | Fanfa | Feed Reverse Clutch |
| E21 | Fanis | Feed Gear 20 Tooth |
| E22 | Fanke | Feed Gear 30 Tooth |
| E23 | Fannu | Feed Gear 40 Tooth |
| E24 | Fanov | Intermediate Stud Washer |
| E25 | Fanti | Intermediate Gear Bracket & Stud |
| E26 | Fapan | Intermediate Gear Bushing |
| E27 | Fapba | Intermediate Stud DrivingGear |
| E28 | Faper | Intermediate Stud Driven Gear |
| E30 | Fapit | Feed Worm Shaft Gear 48 Tooth |
| E31 | Fapki | Feed Worm Shaft Gear 40 Tooth |
| E32 | Fapny | Feed Worm Shaft Gear 30 Tooth |
| E33 | Fapoc | Feed Worm Shaft Gear 20 Tooth |
| E35 | Fapud | Feed Worm Shaft Feather Key Disengaging Rings |

| Symbol and No. | Code Word | Name |
|---|---|---|
| E36 | Farap | Feed Box |
| E37 | Farbe | Feed Worm Shaft Feed Pinion Retaining Nut |
| E38 | Farfi | Feed Worm Shaft |
| E39 | Faric | Feed Worm Shaft Feed Pinion & Collar |
| E40 | Farko | Feed Worm |
| E41 | Farna | Feed Worm Shaft Slider |
| E42 | Farox | Feed Box Front Housing Top Cover |
| E43 | Fartu | Feed Worm Shaft Feather Key & Spring |
| E44 | Faruf | Feed Worm & Vertical Spiral Gear Shaft Idler Gear |
| E45 | Fasar | Feed Worm & Vertical Spiral Gear Shaft Idler Stud |
| E46 | Faset | Feed Box Front Housing |
| E47 | Fasgo | Feed Change Slider |
| E48 | Fasiv | Feed Change Slider Shaft |
| E49 | Faslu | Vertical Spiral Gear Shaft Drive Gear |
| E50 | Fasme | Vertical Spiral Gear Shaft |
| E51 | Fasoz | Vertical Spiral Gear |
| E52 | Faspy | Fine Feed Back Gear Pinion |
| E53 | Fasug | Feed Change Slider Shaft Collar |
| E54 | Fatas | Quadrant Clamping Bolt |
| E55 | Fatev | Quadrant |
| E56 | Fatgu | Quadrant Idler Gear Stud Collar |
| E57 | Fatix | Quadrant Idler Gear Stud |
| E58 | Fatly | Quadrant Idler Gear Stud Nut |
| E59 | Fatmi | Fine Feed Back Gear Stud |
| E60 | Fatob | Fine Feed Back Gear Collar |
| E61 | Fatpa | Quadrant Idler Gear |
| E62 | Fatso | Fine Feed Back Gear |
| E63 | Favat | Feed Gear Shaft Bevel Gear |

WHEN ORDERING REPAIRS FOLLOW INSTRUCTIONS ON PAGE 214.

TURRET SLIDE. UNIT C. SYMBOL C.




**WHEN ORDERING REPAIRS FOLLOW INSTRUCTIONS ON PAGE 214.**

# LIST OF PARTS FOR TURRET SLIDE

1—Turret Slide Complete
2—Turret Apron (Front View)
3—Rapid Traverse Friction Housing
4—Rapid Traverse Friction Housing
5—Turret Apron (Rear View)

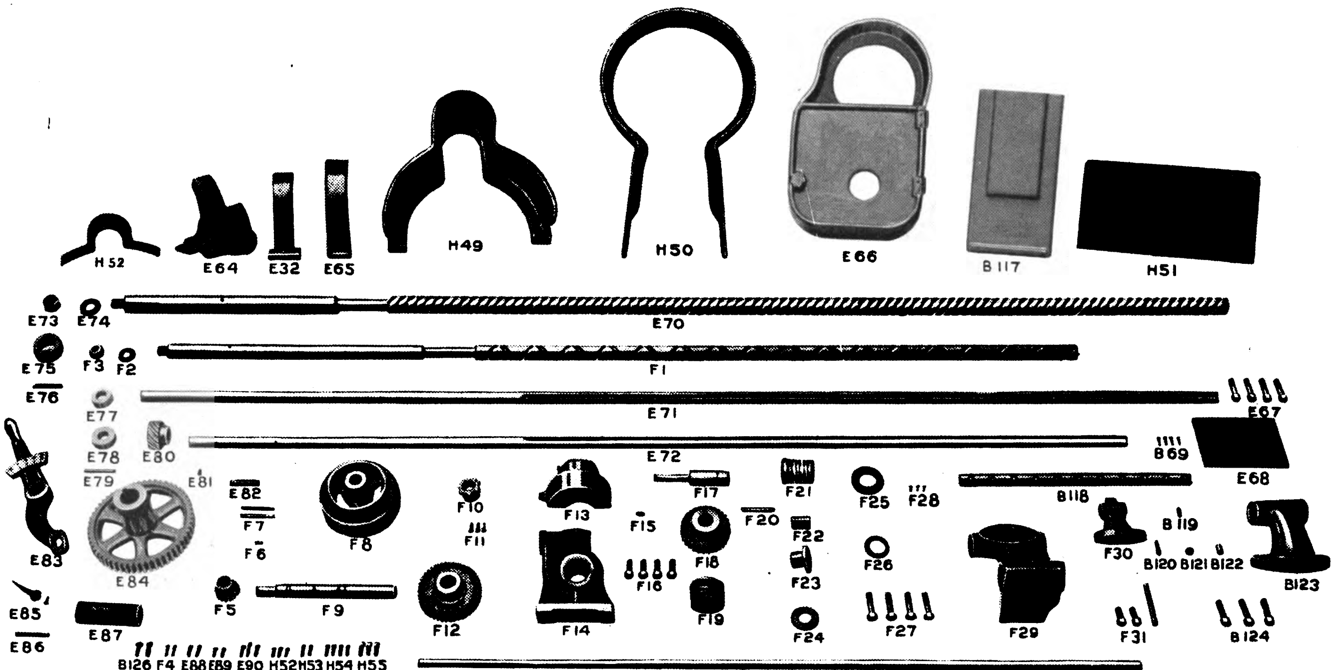
| Symbol and No. | Code Word | Name |
|---|---|---|
| C1 | Fefut | Turret Apron Bonnet |
| C2 | Fefvu | Turret Clamp Ring Bracket |
| C3 | Fegah | Turret Apron Pilot Wheel Shaft |
| C4 | Fegde | Turret Clamp Ring Bracket Handle |
| C5 | Fegek | Turret Slide Feed Trip Crank Shaft |
| C6 | Feghi | Turret Apron Pilot Wheel |
| C7 | Fegim | Turret Apron Bonnet Retaining Screws |
| C8 | Fegjo | Turret Stop Screws |
| C9 | Fegop | Turret Apron Pilot Wheel Handle Bar |
| C10 | Fegru | Turret Apron Pilot Handle |
| C11 | Feguv | Turret Bushings |
| C12 | Fegvy | Turret Clamping Screws |
| C13 | Fejaj | Turret Base Retaining Screws |
| C14 | Fejbi | Turret Spindle Retaining Screws |
| C15 | Fejel | Rapid Traverse Friction Ring Plungers |
| C16 | Fejfo | Rapid Traverse Friction Ring Adjusting Screws |
| C17 | Fejin | Rapid Traverse Friction Nut Thrust Washer Screws |
| C18 | Fejku | Turret Clamp Ring Stud |
| C19 | Fejne | Turret Locating Pin Bushings |
| C20 | Fejor | Turret Stop Bar Nut |
| C21 | Fejty | Turret Apron, Feed Friction Link Catch Screw |
| C22 | Fejuc | Turret Slide Stop Block Clamp Screws |
| C23 | Fekak | Rapid Traverse Friction, Link Retaining Screw |
| C24 | Fekbo | Rapid Traverse Friction Housing Retaining Screws |
| C25 | Fekem | Rapid Traverse Friction Operating Lever Bracket |
| C26 | Fekfu | Rapid Traverse Friction Operating Lever Retaining Screw |
| C27 | Fekip | Rapid Traverse Friction Operating Lever |
| C28 | Fekky | Turret Slide Gib Front (Left) |
| C29 | Fekni | Turret Slide Gib Front (Right) |
| C30 | Fekos | Turret Slide Front Gib Screws |
| C31 | Fekta | Turret Stop Bar Rotating Screw |
| C32 | Fekux | Turret Base Dowel Pins |

| Symbol and No. | Code Word | Name |
|---|---|---|
| C33 | Felal | Turret Slide Gib Adjusting Screw (Front) |
| C34 | Felbu | Turret Slide Front Gib Clamp Screw (Left) |
| C35 | Felen | Turret Slide Gib Adjusting Screws (Rear) |
| C36 | Felfy | Turret Apron Screws |
| C37 | Felir | Turret Slide Gib Clamp Screws (Rear) |
| C38 | Felka | Turret Clamp Ring Bracket Retaining Screws |
| C39 | Felno | Turret Clamp Ring |
| C40 | Felot | Turret Clamp Ring Clamping Screw |
| C41 | Felte | Turret Spindle, End Thrust Adjusting Nut |
| C42 | Feluz | Turret Base, Locating Pin Collar Retaining Pin |
| C43 | Femam | Turret Stop Bar Stop Carrier Plunger and Spring |
| C44 | Femby | Turret Stop Bar Carrier Plunger and Spring Retaining Screw |
| C45 | Femco | Turret Locating Pin Pinion Tappet Plate and Screws |
| C46 | Femep | Turret Base, Locating Pin Retaining Plate Screws |
| C47 | Femfa | Turret Stop Bar Positive Stop Adjusting Nut |
| C48 | Femis | Turret Base, Locating Pin Collar |
| C49 | Femke | Turret Base Bushings for Guiding Locating Pin |
| C50 | Femnu | Turret Stop Bar Spring |
| C51 | Femov | Turret Apron, Feed Trip Link |
| C52 | Femti | Turret Apron, Feed Trip Lever |
| C53 | Fenan | Turret Apron, Feed Trip Lever Handle |
| C54 | Fenba | Turret Apron, Feed Trip Link Stud |
| C55 | Fener | Turret Slide Feed Trip Crank |
| C56 | Fenfe | Turret Apron, Feed Friction Dog Plug |
| C57 | Fenit | Turret Apron, Feed Change Lever |
| C58 | Fenki | Turret Apron, Feed Change Lever Collar |
| C59 | Fenny | Turret Apron, Feed Friction Dog |
| C60 | Fenoc | Turret Apron, Feed Friction Dog Handle |
| C61 | Fento | Rapid Traverse Friction Eccentric Shaft Crank |
| C62 | Fenud | Rapid Traverse Friction Eccentrics |
| C63 | Fepap | Rapid Traverse Friction Eccentrics Shaft |
| C64 | Fepbe | Turret Apron Lead Screw Adjusting Nut |
| C65 | Fepes | Rapid Traverse Friction Ring |
| C66 | Fepfi | Turret Apron, Feed Friction Dog Handle Catch Pin |
| C69 | Fepna | Turret Apron, Feed Change Lever Handle |
| C70 | Fepox | Rapid Traverse Friction Nut (Left Hand Thread) |
| C71 | Feptu | Rapid Traverse Friction Nut (Right Hand Thread) |
| C72 | Fepuf | Rapid Traverse Friction Nut Thrust Washer |
| C73 | Ferar | Turret Apron Lead Screw Nut |

| Symbol and No. | Code Word | Name |
|---|---|---|
| C74 | Feret | Rapid Traverse Friction, Release Cam (Rear) |
| C75 | Fergo | Rapid Traverse Friction, Release Cam Clamp |
| C76 | Feriv | Rapid Traverse Friction, Release Cam (Front) |
| C77 | Ferlu | Turret Slide Stop Block Clamp |
| C78 | Ferme | Turret Slide Stop Block |
| C79 | Feroz | Rapid Traverse Friction Housing |
| C80 | Ferpy | Turret Apron, Feed Friction Ring |
| C81 | Ferug | Turret Apron Lead Screw Nut Pinion |
| C82 | Fesas | Turret Apron, Feed Friction Ring Housing |
| C83 | Fesev | Turret Apron Pilot Wheel Shaft Bevel Gear |
| C84 | Fesgu | Rapid Traverse Friction Lever Link |
| C85 | Fesix | Turret Apron |
| C86 | Fesly | Rapid Traverse Friction, Shifter Plate |
| C87 | Fesmi | Rapid Traverse Friction, Shifter Plate Roller |
| C88 | Fesob | Turret Slide |
| C89 | Fespa | Turret Slide Gib (Rear) |
| C90 | Fesso | Turret |
| C91 | Fetat | Turret Base |
| C92 | Fetcu | Turret Base, Turret Locating Pin |
| C93 | Fetec | Turret Stop Bar Sleeve |
| C94 | Fetgy | Turret Base, Locating Pin Retaining Plate |
| C95 | Fetiz | Turret Base, Locating Pin Spring |
| C96 | Fetla | Turret Stop Bar Spiral Pinion |
| C97 | Fetmo | Turret Locating Pin Pinion Tappet |
| C98 | Fetod | Turret Locating Pin Pinion |
| C99 | Fetpe | Turret Stop Bar Stop Screw Carrier |
| C100 | Fetuj | Turret Stop Bar |
| C101 | Fevav | Turret Spindle |

**WHEN ORDERING REPAIRS FOLLOW INSTRUCTIONS ON PAGE 214.**

MISCELLANEOUS PARTS. UNIT D. SYMBOL B, E, F, H.

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WHEN ORDERING REPAIRS, FOLLOW INSTRUCTIONS ON PAGE 214.

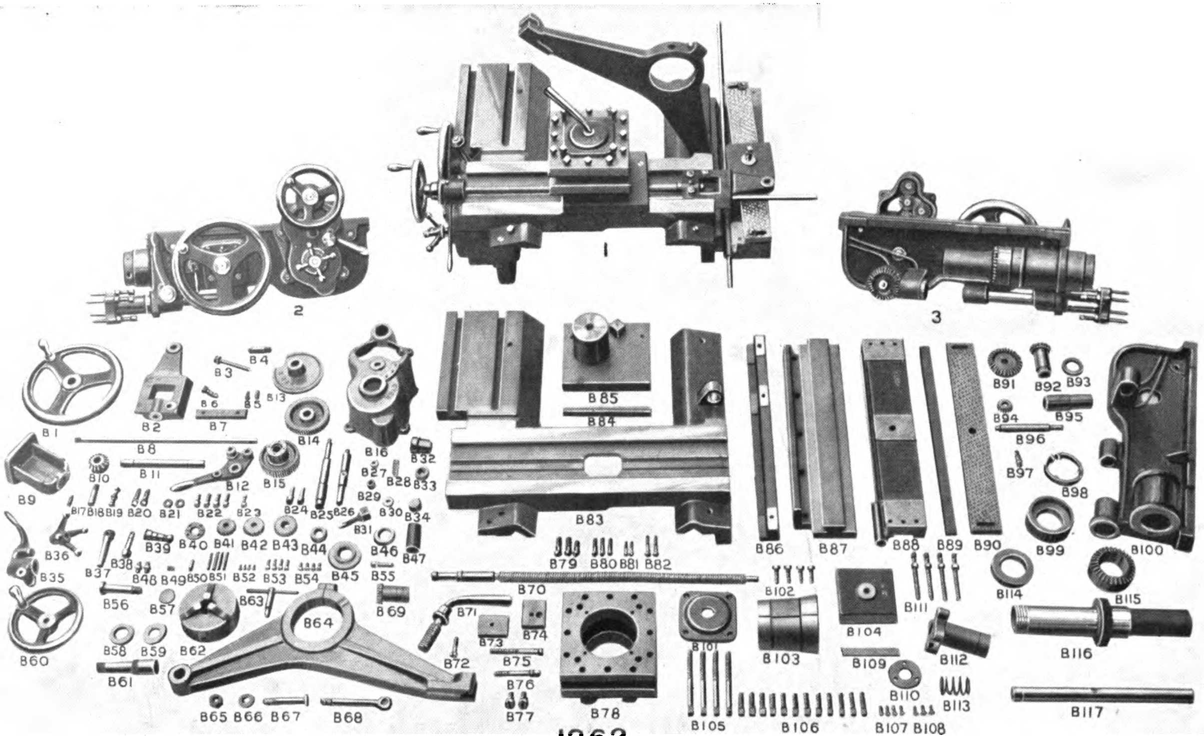
## LIST OF MISCELLANEOUS PARTS

| Symbol and No. | Code Word | Name |
|---|---|---|
| B117 | | (Order B130) |
| B118 | Fofor | Carriage Stop Bar on Bed |
| B119 | Fofty | Carriage Stop Bar Bracket Plunger Spring |
| B121 | Fogak | Carriage Stop Bar Bracket Plunger Screw |
| B122 | Fogbo | Carriage Stop Bar Bracket Plunger |
| B123 | Fogem | Carriage Stop Bar Bracket |
| B125 | Fogip | Taper Attachment Slide Rod |
| B130 | Fogux | Cross Slide Shield |
| | | |
| E32 | | (Order F32) |
| E64 | Favcu | Lead Screw Feed Worm Gear Oil Pan |
| E65 | Favec | Lead Screw Feed Worm Gear Shield |
| E66 | Favgy | Fine Feed Gear Shield |
| E68 | Favla | Feed Box Back Shield |
| E70 | Favod | Lead Screw |
| E71 | Favpe | Feed Change Spline Shaft |
| E72 | Favuj | Cross Feed Spline Shaft |
| E75 | Febef | Lead Screw Collar |
| E77 | Febjy | Feed Change Spline Shaft Collar |
| E78 | Febok | Cross Feed Spline Shaft Collar |
| E80 | Febup | Cross Feed Spline Shaft Spiral Gear |
| E83 | Fecdu | Feed Change Lever |
| E84 | Feceg | Lead Screw Feed Worm Gear |
| E85 | Fechy | Feed Change Lever, Index Pointer and Screw |
| E87 | Fecol | Cross Feed Spline Shaft Bed Bushing |
| | | |
| F1 | Ficik | Rapid Traverse Screw |
| F5 | Ficus | Rapid Traverse Screw Bracket Shaft Pinion |
| F8 | Fidda | Rapid Traverse and Pump Drive Pulley |
| F9 | Fidej | Rapid Traverse Screw Bracket Shaft |
| F10 | Fidhe | Rapid Traverse Worm Shaft Sprocket |
| F12 | Fidji | Rapid Traverse Screw Gear |
| F13 | Fidon | Rapid Traverse Worm Gear Housing Cover |
| F14 | Fidro | Rapid Traverse Worm Gear Housing |
| F17 | Fifah | Rapid Traverse Worm Shaft |
| F18 | Fifde | Rapid Traverse Screw Worm Gear |
| F19 | Fifek | Rapid Traverse Worm |

| Symbol and No. | Code Word | Name |
|---|---|---|
| F21 | Fifim | Rapid Traverse Worm Gear Housing Screw Bushing |
| F22 | Fifjo | Rapid Traverse Worm Gear Housing Bronze Bushing |
| F23 | Fifop | Rapid Traverse Worm Gear Housing Steel Bushing |
| F24 | Fifru | Rapid Traverse Worm Thrust Washer |
| F25 | Fifuv | Rapid Traverse Housing Felt Washer Retaining Washer |
| F26 | Fifvy | Rapid Traverse Housing Felt Washer |
| F29 | Figel | Rapid Traverse Screw Bracket |
| F30 | Figfo | Taper Attachment Slide Rod Bracket |
| F32 | Figku | Rapid Traverse Screw Gear Shield |
| H49 | Fajde | Friction Gear Shield |
| H50 | Fajek | Back Gear Shield |
| H51 | Fajhi | Tool Shelf |
| H52 | Fajim | Chuck Ring Gear Pinion Shield |

**WHEN ORDERING REPAIRS, FOLLOW INSTRUCTIONS ON PAGE 214.**

# TOOL POST CARRIAGE. UNIT E. SYMBOL B.

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**WHEN ORDERING REPAIRS, FOLLOW INSTRUCTIONS ON PAGE 214.**

## LIST OF PARTS FOR TOOL POST CARRIAGE

1—Tool Post Carriage & Cross Slide Complete
2—Carriage Apron (Front)
3—Carriage Apron (Rear)

| Symbol and No. | Code Word | Name |
|---|---|---|
| B1 | Fikno | Carriage Apron Hand Wheel |
| B2 | Fikot | Cross Feed Screw Tail Block |
| B3 | Fikte | Cross Feed Screw Tail Block Dowel Pin |
| B4 | Fikuz | Taper Attachment Swivel Slide Stud |
| B5 | Filam | Cross Feed Screw Tail Block Gib Screws |
| B6 | Filby | Cross Slide Retaining Rod Clamp Screw |
| B7 | Filco | Cross Feed Screw Tail Block Gib |
| B8 | Filep | Cross Slide Retaining Rod |
| B9 | Filfa | Carriage Apron Bonnet |
| B10 | Filis | Carriage Apron Bonnet Shaft Bevel Gear |
| B11 | Filke | Carriage Apron Bonnet Shaft |
| B12 | Filnu | Cross Feed Tumbler Lever |
| B13 | Filov | Cross Feed, Friction Gear Housing Back Plate |
| B14 | Filti | Cross Feed Internal Friction Gear |
| B15 | Fiman | Cross Feed External Friction Gear |
| B16 | Fimba | Cross Feed Housing |
| B17 | Fimer | Carriage Stop Bar, Stop Carrier Retaining Screw |
| B18 | Fimfe | Carriage Stop Bar Stud |
| B19 | Fimit | Carriage Apron Feed, Trip Lever Catch |
| B20 | Fimki | Taper Attachment Swivel Clamp Screws |
| B21 | Fimny | Taper Attachment Swivel Clamp Screw Washers |
| B22 | Fimoc | Carriage Apron Bonnet Retaining Screws |
| B23 | Fimto | Carriage Apron Feed, Friction Dog Handle Catch Pin |
| B24 | Fimud | Cross Feed Tumbler Lever, Pinion Studs |
| B25 | Finap | Cross Feed Friction Gear Shaft |
| B26 | Finbe | Carriage Apron Feed, Friction Dog Handle |
| B27 | Finfi | Cross Feed Friction Star Nut Retaining Collar |
| B28 | Finic | Carriage Apron, Thread Cutting Pull Pin Spring |
| B29 | Finko | Cross Feed Tumbler Lever, Idler Gear Stud Bushing |
| B30 | Finna | Cross Feed Tumbler Lever, Idler Gear Stud Washer |
| B31 | Finox | Carriage Apron, Thread Cutting Pull Pin Lever |
| B32 | Fintu | Carriage Apron, Thread Cutting Pull Pin Bushing |
| B33 | Finuf | Cross Feed, Internal Friction Gear Retaining Collar |

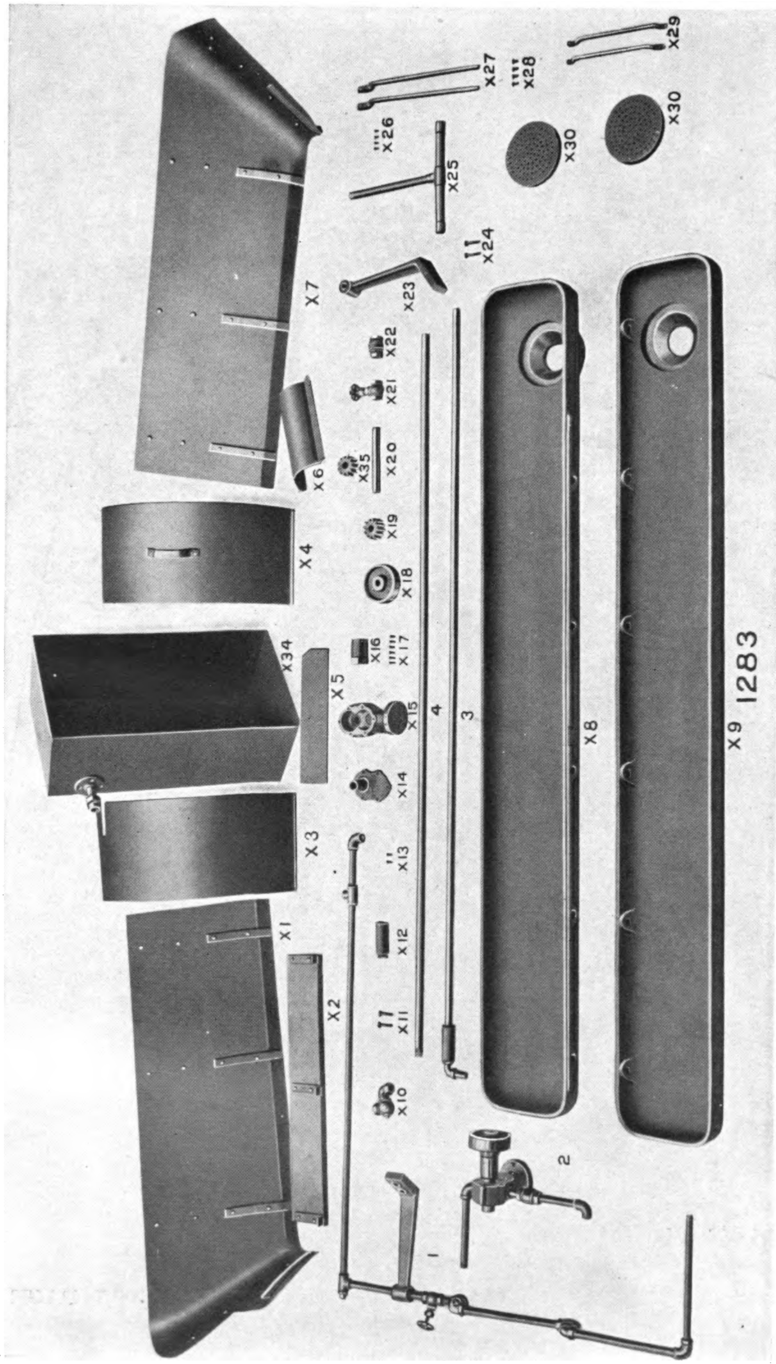
| Symbol and No. | Code Word | Name |
|---|---|---|
| B34 | Fipar | Carriage Apron Feed, Friction Dog Plug |
| B35 | Fipet | Carriage Apron Feed Trip Lever |
| B36 | Fipgo | Cross Feed Friction Star Nut |
| B37 | Fipiv | Carriage Apron Feed, Friction Dog |
| B38 | Fiplu | Carriage Apron, Thread Cutting Pull Pin |
| B39 | Fipme | Cross Feed Tumbler Lever, Idler Gear Stud |
| B40 | Fipoz | Cross Feed Friction Star Nut, Split Retaining Washer |
| B41 | Fippy | Cross Feed Tumbler Lever, Small Pinion |
| B42 | Fipug | Cross Feed Tumbler Lever, Large Pinion |
| B43 | Firas | Cross Feed Tumbler Lever, Idler Gear |
| B44 | Firev | Cross Feed Friction Gear Shaft, End Collar |
| B45 | Firgu | Cross Feed Screw Dial |
| B46 | Firix | Cross Feed Screw Pinion Nut |
| B47 | Firly | Cross Feed Screw Nut |
| B48 | Firmi | Carriage Apron Feed, Trip Lever Adjusting Screw |
| B49 | Firob | Cross Feed Tumbler Lever, Pull Pin Spring |
| B50 | Firpa | Cross Feed Tumbler Lever, Pull Pin |
| B51 | Firso | Cross Feed Housing Dowel Pins |
| B52 | Fisat | Cross Feed Friction Star Nut, Split Washer Retaining Screws |
| B53 | Fiscu | Cross Feed Housing Retaining Screws |
| B54 | Fisec | Cross Feed, Friction Gear Housing Back Plate Retaining Screws |
| B55 | Fisgy | Drill Support Chuck Clamping Bolt |
| B56 | Fisiz | Carriage Apron Feed, Trip Lever Stud |
| B57 | Fisla | Cross Feed Tumbler Lever, Pull Pin Knob |
| B58 | Fismo | Drill Support Stud Adjusting Nut |
| B59 | Fisod | Drill Support Stud Washer |
| B60 | Fispe | Cross Feed Screw Hand Wheel |
| B61 | Fisuj | Drill Support Stud |
| B62 | Fitav | Drill Support Chuck |
| B63 | Fitex | Drill Support Chuck Wrench |
| B64 | Fitga | Drill Support |
| B65 | Fitib | Drill Support Clamp Bolt, Stud Nut |
| B66 | Fitle | Drill Support Clamp Bolt Stud Washer |
| B67 | Fitmu | Drill Support Clamp Bolt Stud |
| B68 | Fitof | Drill Support Clamp Bolt |
| B69 | Fitpi | Cross Feed Screw Pinion |
| B70 | Fitsy | Cross Feed Screw |
| B71 | Fituk | Tool Post Elevating Handle |

| Symbol and No. | Code Word | Name |
|---|---|---|
| B72 | Fivaw | Carriage left front Gib Adjusting Screw |
| B73 | Fivca | Carriage left front Gib |
| B74 | Fivez | Carriage right front Gib |
| B75 | Fivge | Carriage right front Gib Adjusting Screw |
| B76 | Fivid | Carriage right front Gib Clamping Screw |
| B77 | Fivli | Carriage Front Gib Screws |
| B78 | Fivmy | Tool Post |
| B79 | Fivog | Carriage Apron Retaining Screws |
| B80 | Fivpo | Carriage Gib Adjusting Screws (Rear) |
| B81 | Fivul | Cross Slide Gib Screws |
| B82 | Fobaf | Carriage Gib Clamp Screws (Rear) |
| B83 | Fobdy | Tool Post Carriage |
| B84 | Fobha | Cross Slide Gib |
| B85 | Fobik | Cross Slide (Complete) |
| B86 | Fobje | Carriage Gib (Rear) |
| B87 | Fobom | Taper Attachment Base |
| B88 | Fobri | Taper Attachment Slide |
| B89 | Fobus | Taper Attachment Gib |
| B90 | Fobvo | Taper Attachment Swivel |
| B91 | Focag | Carriage Apron, Cross Feed Shaft Bevel Gear |
| B92 | Focda | Carriage Apron Spline Shaft Bevel Pinion |
| B93 | Focej | Carriage Apron Spline Shaft Bevel Pinion Retaining Collar |
| B94 | Foche | Carriage Apron, Cross Feed Shaft Pinion |
| B95 | Focil | Carriage Apron, Cross Feed Shaft Bushing |
| B96 | Focji | Carriage Apron, Cross Feed Shaft |
| B97 | Focon | Taper Attachment Swivel Stud |
| B98 | Focro | Carriage Apron Feed, Friction Ring |
| B99 | Focut | Carriage Apron Feed, Friction Ring Housing |
| B100 | Focvu | Carriage Apron |
| B101 | Fodah | Tool Post Top Plate |
| B102 | Fodde | Taper Attachment Base Retaining Screws |
| B103 | Fodek | Tool Post Cone |
| B104 | Fodhi | Taper Attachment Swivel Slide |
| B105 | Fodim | Tool Post Adjusting Screws |
| B106 | Fodjo | Tool Post Tool Set Screws |
| B107 | Fodop | Tool Post Top Plate Retaining Screws |
| B108 | Fodru | Tool Post Washer Screws |
| B109 | Foduv | Taper Attachment Swivel Slide Gib |
| B110 | Fodvy | Tool Post Washer |

| Symbol and No. | Code Word | Name |
|---|---|---|
| B111 | Fofaj | Carriage Stop Screws |
| B112 | Fofbi | Carriage Stop Bar Stop Carrier |
| B113 | Fofel | Carriage Stop Bar Spring |
| B114 | Foffo | Carriage Apron Lead Screw Adjusting Nut |
| B115 | Fofin | Carriage Apron Lead Screw Nut Pinion |
| B116 | Fofku | Carriage Apron Lead Screw Nut |
| B117 | Fofne | Carriage Stop Bar |

**WHEN ORDERING REPAIRS, FOLLOW INSTRUCTIONS ON PAGE 214.**

PUMP. UNIT F. SYMBOL X.




**WHEN ORDERING REPAIRS, FOLLOW INSTRUCTIONS ON PAGE 214.**

# LIST OF PARTS FOR PUMP

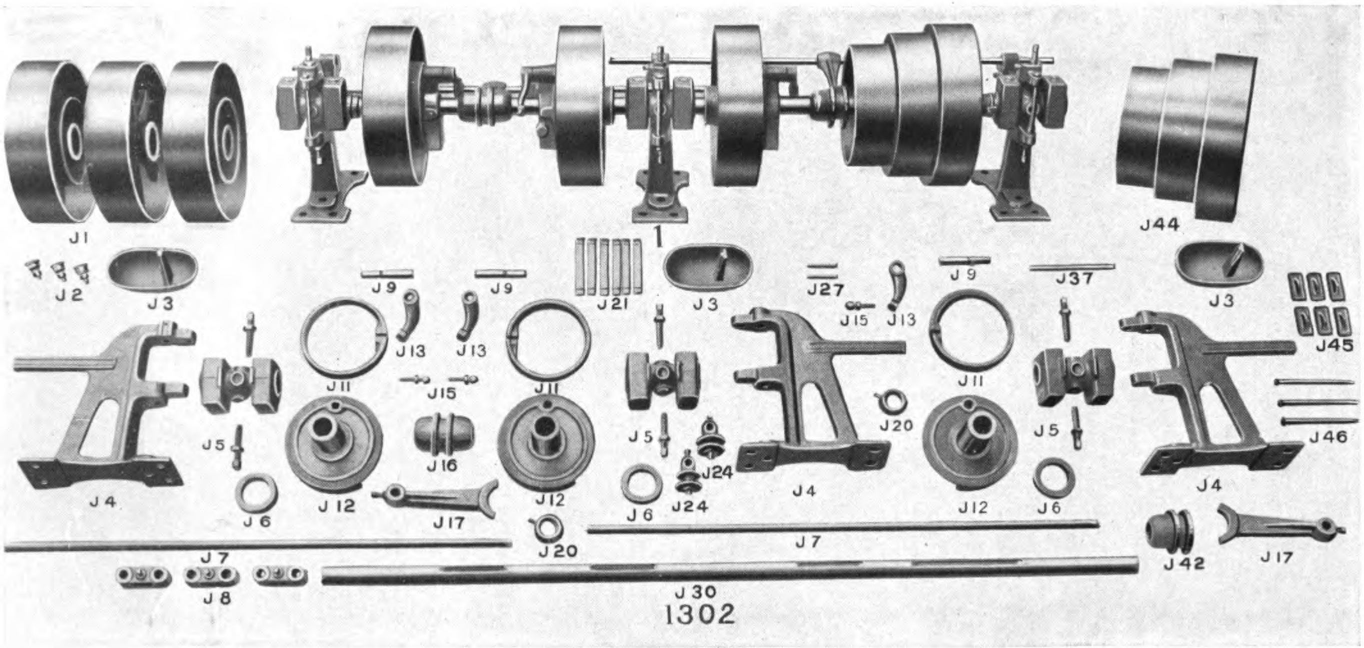
1—Piping and Swing Joints

2—Complete Pump with Check Valve

| Symbol and No. | Code Word | Name |
|---|---|---|
| X1 | Folan | Rear Oil Pan Splash Guard, Front |
| X2 | Folba | Front Oil Pan Splash Shield |
| X3 | Foler | Chuck Splash Guard, Rear |
| X4 | Folfe | Chuck Splash Guard, Front |
| X5 | Folit | Chip Pocket Shield |
| X6 | Folki | Chuck Splash Guard, Top |
| X7 | Folny | Rear Oil Pan Splash Guard, Rear |
| X8 | Foloc | Rear Oil Pan |
| X9 | Folto | Front Oil Pan |
| X10 | Folud | Swing Joint |
| X11 | Fomap | Pump Body Screws |
| X12 | Fombe | Relief Valve |
| X13 | Fomes | Button Head Screws |
| X14 | Fomfi | Pump Body Cap |
| X15 | Fomic | Pump Body |
| X16 | Fomko | Pump Body Cap Stuffing Box |
| X17 | Fomna | Pump Body Cap Screws |
| X18 | Fomox | Pump Body Gear Shaft Pulley |
| X19 | Fomtu | Pump Body Gear |
| X20 | Fomuf | Pump Body Gear Shaft |
| X21 | Fonar | Globe Valve |
| X22 | Fonet | Check Valve |
| X23 | Foniv | Pipe Bracket |
| X24 | Fonlu | Pipe Bracket Screws |
| X25 | Fonme | Oil Distributer |
| X26 | Fonoz | Chuck Splash Guard Guide Screws |
| X27 | Fonpy | Chuck Splash Guard Guides, Top |
| X28 | Fonug | Chuck Splash Guard Guide Screws |
| X29 | Fopas | Chuck Splash Guard Guides, Bottom |
| X30 | Fopev | Oil Pan Strainer |
| X34 | Fopmi | Oil Tank |
| X35 | Fopob | Pump Body Gear |

WHEN ORDERING REPAIRS, FOLLOW INSTRUCTIONS ON PAGE 214.

## COUNTERSHAFT. 3 STEP CONE. UNIT G. SYMBOL J.




**WHEN ORDERING REPAIRS, FOLLOW INSTRUCTIONS ON PAGE 214.**

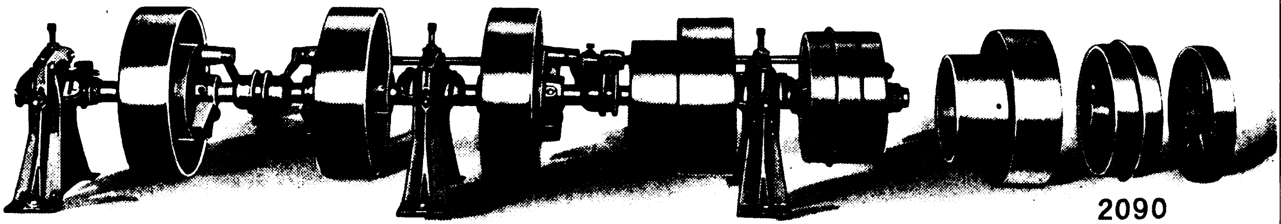
## LIST OF PARTS FOR COUNTERSHAFT. 3 STEP CONE.

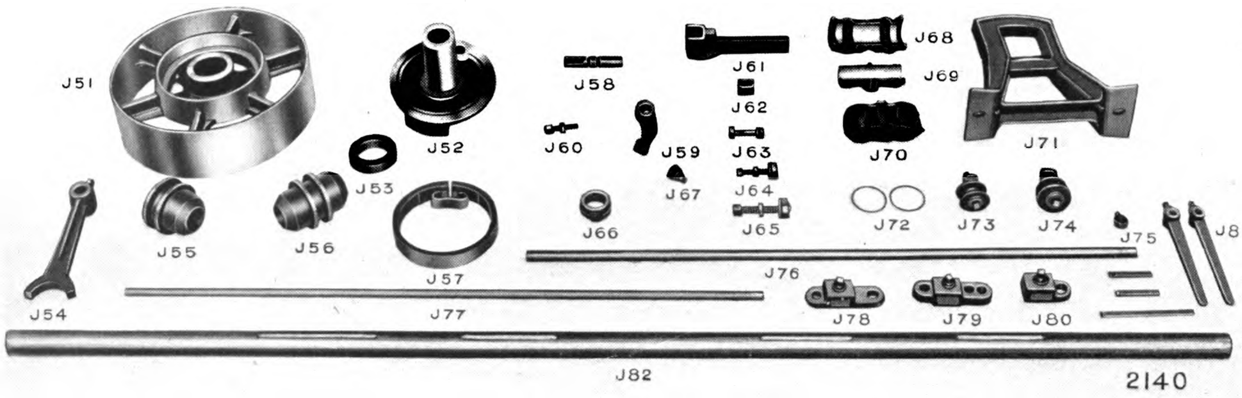
### 1. Complete Turret Lathe Countershaft

| Symbol and No. | Code Word | Name |
|---|---|---|
| J1 | Fossy | Friction Pulleys |
| J2 | Fosuk | Friction Pulley Dog Plate Grease Cups |
| J3 | Fotaw | Hanger Box Drip Pans |
| J4 | Fotca | Hangers |
| J5 | Fotez | Hanger Boxes and Adjusting Screws |
| J6 | Fotge | Friction Pulley Dog Plate Collars |
| J7 | Fotid | Shifter Rods |
| J8 | Fotli | Shifter Rod Guides |
| J9 | Fotmy | Friction Ring Expanding Pins |
| J11 | Fotpo | Friction Pulley Friction Rings |
| J12 | Fotul | Friction Pulley Dog Plates |
| J13 | Fovax | Friction Ring Expanding Pin Dogs |
| J15 | Fovgi | Friction Ring Expanding Pin Dog Adjusting Screws |
| J16 | Fovif | Double Cam |
| J17 | Fovlo | Cam Shifter Arms |
| J20 | Fovpu | Countershaft End Thrust Collars |
| J21 | Fovse | Hanger Box Oil Wicks |
| J24 | Fubda | Shifter Rod Dogs |
| J27 | Fubil | Friction Pulley Dog Plate Keys |
| J30 | Fubro | Countershaft |
| J37 | Fucim | Cone Pulley Key |
| J42 | Fucvy | Single Cam |
| J44 | Fudbi | Cone Pulley |
| J45 | Fudel | Hanger Box Oil Chamber Covers |
| J46 | Fudfo | Hanger Pins |

WHEN ORDERING REPAIRS, FOLLOW INSTRUCTIONS ON PAGE 214.

## COUNTERSHAFT—2 STEP CONE—UNIT G. SYMBOL J.



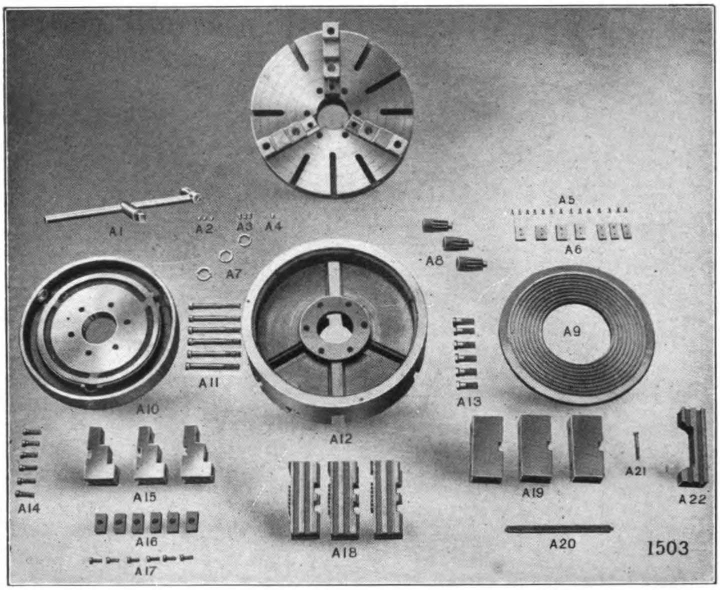

**WHEN ORDERING REPAIRS, FOLLOW INSTRUCTIONS ON PAGE 214.**

## LIST OF PARTS FOR COUNTERSHAFT. 2 STEP CONE

| Symbol and No. | Code Word | Name |
|---|---|---|
| J51 | Fumar | Friction Pulley |
| J52 | Fumet | Friction Pulley Dog Plate |
| J53 | Fumgo | Friction Pulley Dog Plate Collar |
| J54 | Fumiv | Cam Shifter Arm |
| J55 | Fumlu | Single Cam |
| J56 | Fumme | Double Cam |
| J57 | Fumoz | Friction Pulley Friction Rings |
| J58 | Fumpy | Friction Ring Expanding Pin |
| J59 | Fumug | Friction Ring Expanding Pin Dog |
| J60 | Funas | Friction Ring Expanding Pin Dog Adjusting Screw |
| J61 | Funev | Shifter Rod Guide Arm |
| J62 | Fungu | Shifter Rod Guide Arm Block |
| J63 | Funix | Shifter Rod Guide Arm Clamp Screw |
| J64 | Funly | Hanger Box Adjusting Screw, Side |
| J65 | Funmi | Hanger Box Adjusting Screw, Top and Bottom |
| J66 | Funob | Countershaft End Thrust Collar |
| J67 | Funpa | Grease Cup |
| J68 | Funso | Hanger Box, Upper Half |
| J69 | Fupat | Hanger Box, Lower Half |
| J70 | Fupcu | Hanger Box Oil Pan |
| J71 | Fupec | Hanger, Pressed Steel |
| J72 | Fupgy | Hanger Box Oil Rings |
| J73 | Fupiz | Loose Pulley Shifter Rod Dog |
| J74 | Fupla | Friction Pulley Shifter Rod Dog |
| J75 | Fupmo | Shifter Rod Collar |
| J76 | Fupod | Friction Pulley Shifter Rod |
| J77 | Fuppe | Loose Pulley Shifter Rod |
| J78 | Pupuj | Shifter Rod Guide, Cone Pulley End |
| J79 | Furav | Shifter Rod Guide, Center Hanger |
| J80 | Furex | Shifter Rod Guide, Friction Pulley End |
| J81 | Furga | Loose Pulley Shifter Rod Fingers |
| J82 | Furib | Countershaft |

**WHEN ORDERING REPAIRS, FOLLOW INSTRUCTIONS ON PAGE 214.**

CHUCK. UNIT H. SYMBOL A.




**WHEN ORDERING REPAIRS, FOLLOW INSTRUCTIONS ON PAGE 214.**

## LIST OF PARTS FOR CHUCK

1. Complete 3 jawed scroll chuck.

| Symbol and No. | Code Word | Name |
|---|---|---|
| A1 | Fugir | Chuck Wrench |
| A2 | Fugka | Chuck Scroll Pinion Nut Lock Screw Brass Plugs |
| A3 | Fugno | Chuck Scroll Pinion Nut Lock Screws |
| A4 | Fugot | Oil Hole Screw Plug |
| A5 | Fugte | Felt Block, Flat Head Screws |
| A6 | Fuguz | Felt Blocks |
| A7 | Fujam | Chuck Scroll Pinion Retaining Nuts |
| A8 | Fujby | Chuck Scroll Pinions |
| A9 | Fujco | Chuck Scroll |
| A10 | Fujep | Chuck Body Back Plate |
| A11 | Fujfa | Chuck Body Spindle Screws |
| A12 | Fujis | Chuck Body |
| A13 | Fujke | Chuck Jaw, Screws |
| A14 | Fujnu | Chuck Body Back Plate Screws |
| A15 | Fujov | Chuck Jaw, Base Tops (Hard) |
| A16 | Fujti | Chuck Jaw Base Top Cross Tongues |
| A17 | Fukan | Chuck Jaw Base Top Cross Tongue Screws |
| A18 | Fukba | Chuck Jaw Bases, Dust Proof |
| A19 | Fuker | Chuck Jaw, Base Tops (Soft) |
| A20 | Fukfe | Screw Driver |
| A21 | Fukit | Chuck, False Jaw Screw |
| A22 | Fukki | Chuck, False Jaw |

Pieces A10 and A12 cannot be furnished separately.

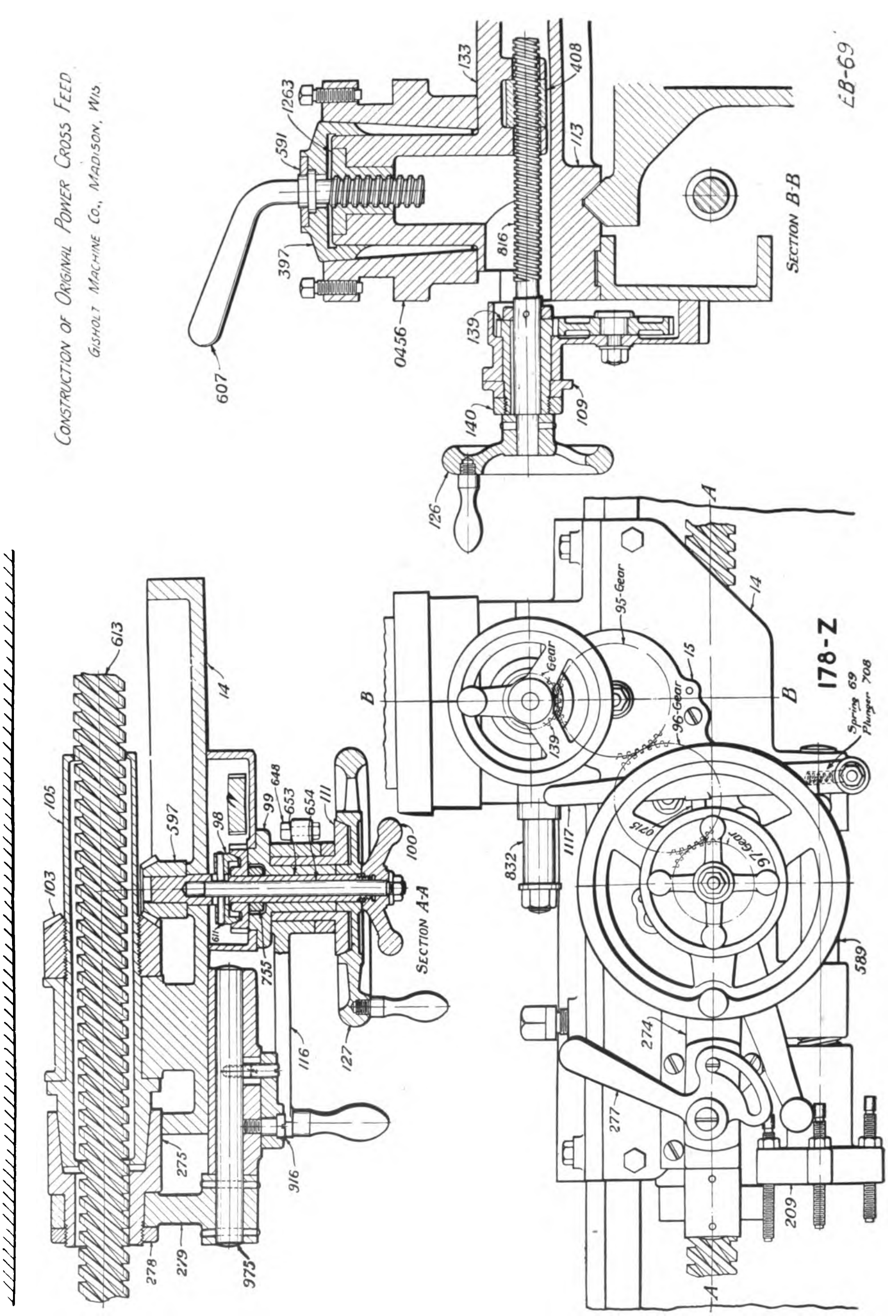
**WHEN ORDERING REPAIRS, FOLLOW INSTRUCTIONS ON PAGE 214.**

# PIECE NUMBERS AND NAMES FOR ORIGINAL POWER CROSS FEED

See Drawing 178Z page 242

**WHEN ORDERING PARTS FROM THIS LIST ALWAYS MENTION 178Z**

| | | |
|---|---|---|
| 14 | B—100 | Carriage Apron |
| 15 | B—16 | Cross Feed Housing |
| 69 | | Spring |
| 95 | | Carriage Shield Gear |
| 96 | | Carriage Shield Gear |
| 97 | | Carriage Shield Gear |
| 98 | | Hand Wheel Friction |
| 99 | | Bonnet for Power Cross Feed |
| 100 | B—36 | Cross Feed Friction Star Nut |
| 103 | B—115 | Carriage Apron Lead Screw Nut Pinion |
| 105 | B—116 | Carriage Apron Lead Screw Nut |
| 109 | B—45 | Cross Feed Screw Dial |
| 111 | | Carriage Feed Friction |
| 113 | B—83 | Tool Post Carriage |
| 116 | | Carriage Friction Feed Lever |
| 126 | B—60 | Cross Feed Screw Hand Wheel |
| 127 | B—1 | Carriage Apron Hand Wheel |
| 133 | B—85 | Cross Slide |
| 139 | B—69 | Cross Feed Screw Pinion |
| 140 | B—46 | Cross Feed Screw Pinion Nut |
| 209 | B—112 | Carriage Stop Bar Stop Carrier |
| 274 | | Apron Bracket |
| 275 | | Friction Clutch |
| 277 | | Hatchet Lever |
| 278 | | Collar |
| 279 | | Connecting Bracket |
| 397 | B—103 | Tool Post Cone |
| 408 | B—47 | Cross Feed Screw Nut |
| 589 | B—117 | Carriage Stop Bar |
| 591 | B—110 | Tool Post Washer |
| 597 | B—10 | Carriage Apron Bonnet Shaft Bevel Gear |
| 607 | B—71 | Tool Post Elevating Handle |
| 611 | | Pin for Friction on Power Cross Feed |


CONSTRUCTION OF ORIGINAL POWER CROSS FEED
GISHOLT MACHINE CO., MADISON, WIS.
SECTION B-B
SECTION A-A
178-Z
EB-69
95-Gear
96-Gear
97-Gear
Gear
Spring 69
Plunger 708
607
591
1263
397
0456
133
408
113
816
139
140
109
126
613
105
103
597
14
98
99
648
653
654
111
100
611
755
116
127
916
275
278
279
975
832
1117
15
589
274
277
209

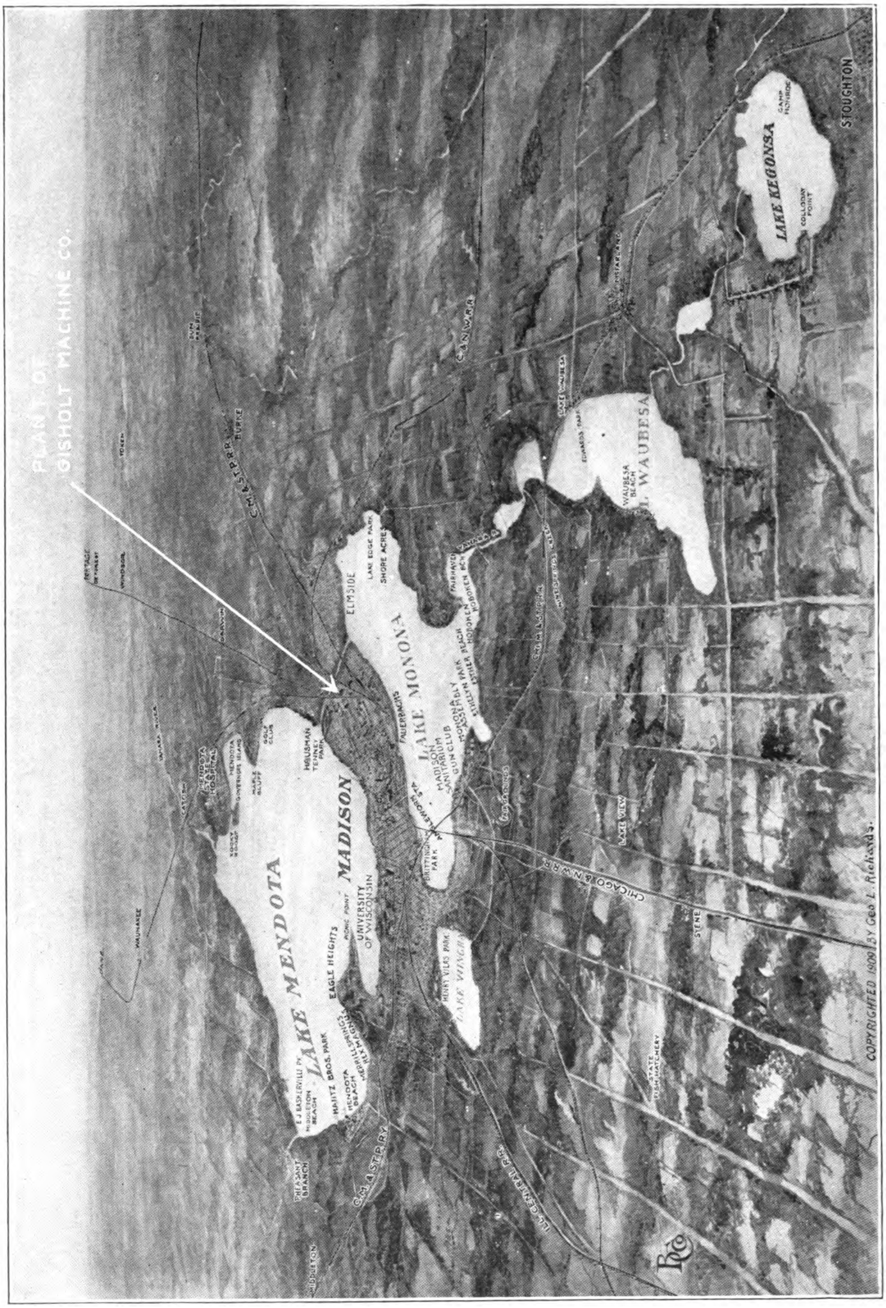
| | | |
|---|---|---|
| 613 | E—70 | Lead Screw |
| 653 | B—11 | Carriage Apron Bonnet Shaft |
| 648 | | Carriage Feed Friction Lever Catch Pin |
| 654 | | Clamp Rod on Power Feed Carriage |
| 708 | | Plunger |
| 755 | | Carriage Hand Wheel Shaft Collar |
| 816 | B—70 | Cross Feed Screw |
| 832 | | Drill Support Stud |
| 916 | | Shoulder Screw |
| 975 | | Friction Bracket Shaft |
| 1117 | B—35 | Carriage Apron Feed Trip Lever |
| 1263 | | Cross Slide Block Nut |
| 0456 | B—78 | Tool Post |

Numbers refer to figure 178Z, page 242.

"B" numbers refer to Tool Post Carriage section, page 229.

"E" numbers refer to Miscellaneous Parts section, page 226.

**WHEN ORDERING REPAIRS, FOLLOW INSTRUCTIONS ON PAGE 214.**




**MADISON AND THE FOUR LAKE REGION**

## COME TO MADISON

"*What is there left in Madison for a community organization to do except to say to the rest of the world, 'Come'* ".—HOWARD STRONG.

The Gisholt plants are always open to visitors.

A cordial invitation is extended to all to visit us—see the modern buildings and equipment, as well as to become acquainted with the organization which has made Gisholt Service a by-word in metal working industries.

The home plant and office is at Madison, Wisconsin, the "city of the four lakes," situated on an isthmus between two beautiful lakes—Mendota and Monona. In describing the scenery on Monona, Rev. C. H. Richards says, "The far-famed bay of Naples is not more lovely than Monona."

The scenery in and about Madison holds many surprises for a stranger and we can best describe it in the words of U. S. Senator Moses E. Clapp when he said, "It is hard to speak of the beauties of Madison without being charged with exaggeration."

Madison is reached by three railroads, with 102 passenger trains daily. It is only a four hours ride over either of two direct lines from Chicago, where connections are made from all points East, West, South and Southwest. There is one line running directly West, from Madison, another directly South and two lines to St. Paul and Minneapolis, connecting with all points for the great Northwest.

## MADISON IN A NUTSHELL

Population—in 1916, 32,136; including suburbs and students, over 40,000; 7th city in state.

Area—9 square miles.

Water front—8 miles.

Boating—100 miles by lake and river.

Water—11 artesian wells.

Altitude—974 feet above the sea.

Parks—282 acres.

Sewage disposal—Bacteriological process.

Streets—Over 75 miles improved.

Capitol—$7,000,000 statehouse.

Residences—7,000.

Bank deposits—$13,000,000.00.

Electric street railway—15 miles.

Telephones—9,700.

Passenger trains—Three roads, 102 trains daily.

Hospitals—General, St. Mary's, Stoeber, Contagious and Madison Sanitaruim.

Churches—43.

Educational—Site of University, enrollment over 7,600; four high schools; thirteen graded schools; five parochial schools; two business colleges; two academies and two schools of music.

Distances—To Milwaukee, 82 miles; Chicago, 130; St. Paul, 269.

Newspapers—Three Dailies, 9 Weeklies.

City library—144,762 volumes.

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