GORTON

Pantograph

INSTRUCTION BOOK
And PARTS CATALOG

For All Pantograph Engraving Machines

COPY-TYPE and MASTERS

also CUTTER GRINDING

GORTON MACHINE CO.

RACINE WISCONSIN U.S.A.

SER # 41693

TRUCTION BOOK and PARTS CATALOG

For Gorton Pantograph Machines.

Models 3-U, 3-F - 3-Z, 3-X - 3-B, 3-L - 3-S - 3-K - 3-R.

Also Parts List Covering Obsolete Models

, 1-A, 1-C, 1-D, 1-G, 1-H, 1-J, 1-S, 1-T, 3-A, 3-C, 3-D, 3-G, 3-H, 3-J, 3-T.

For P13 Ratiobar Pantograph, See Page 53

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Price per copy $2.50

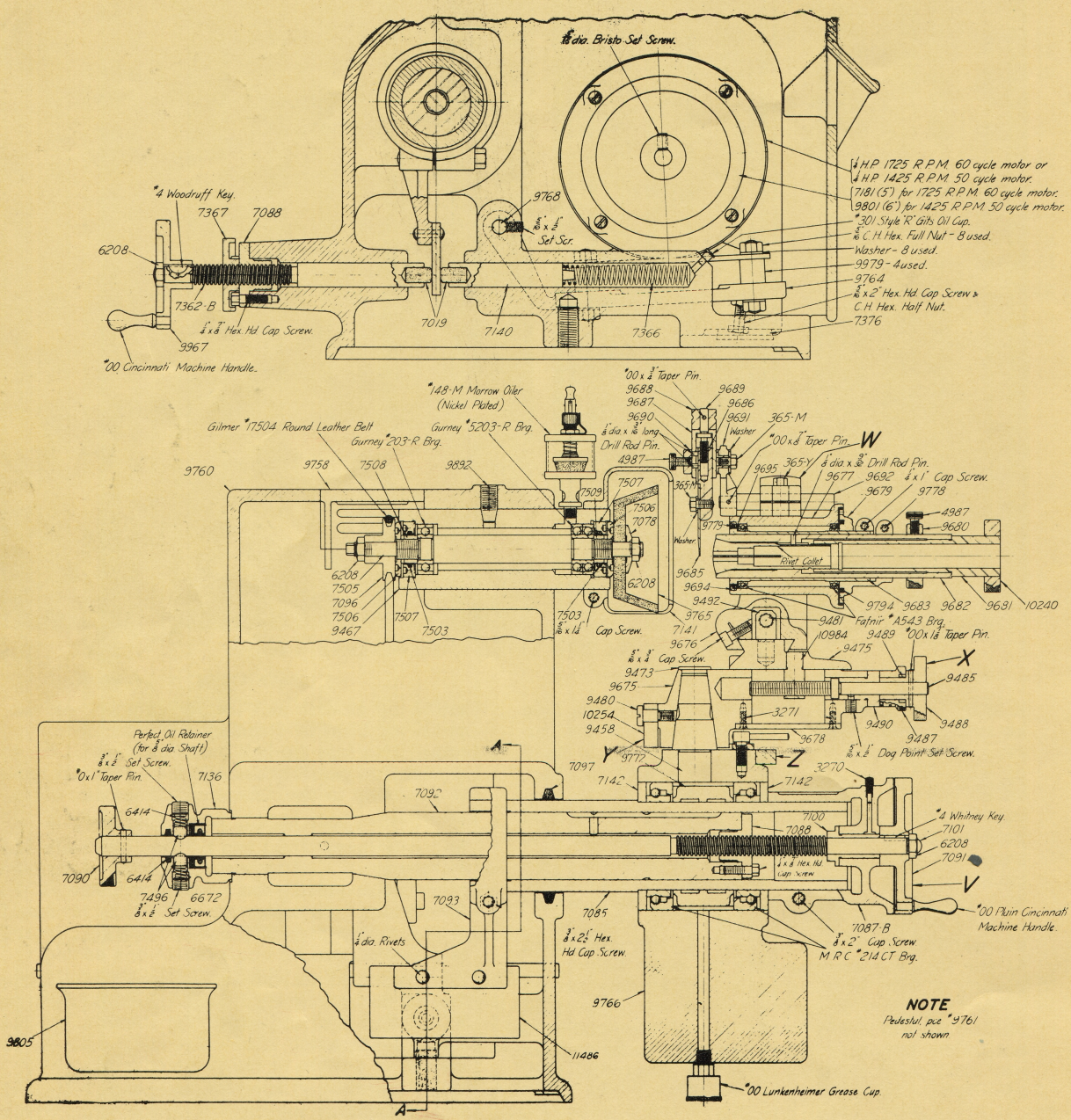
GEORGE GORTON MACHINE CO.

RACINE, WISCONSIN, U. S. A.

Form 1385-E

REG. U. S. PAT. OFF.
TRADE MARK
GORTON
RACINE, WIS., U.S.A.

375-2 Cutter Grinder with 717-1 Universal Head—

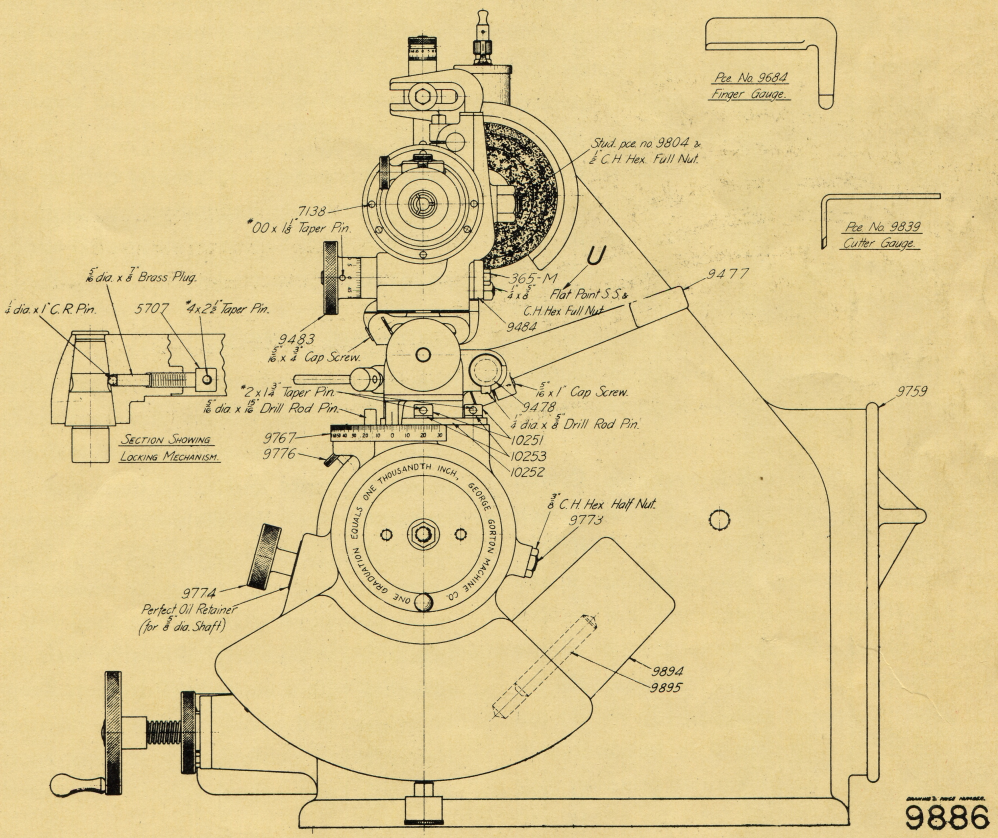


LUBRICATION: For spindle keep oiler filled with Gargoyle Spindle Oil Velocite Oil "S" or equivalent. Turn down grease cup once a week and refill with Gargoyle BRB No. 2 or equivalent. Use light or medium machine oil at all other oiling points — once a week.

SPINDLE: Is non-adjustable type. Return to factory for adjustment or repair which should only be required after years of service.

ADDITIONAL HEADS FOR USE WITH 375-2 GRINDER
(Not Shown on Drawing)

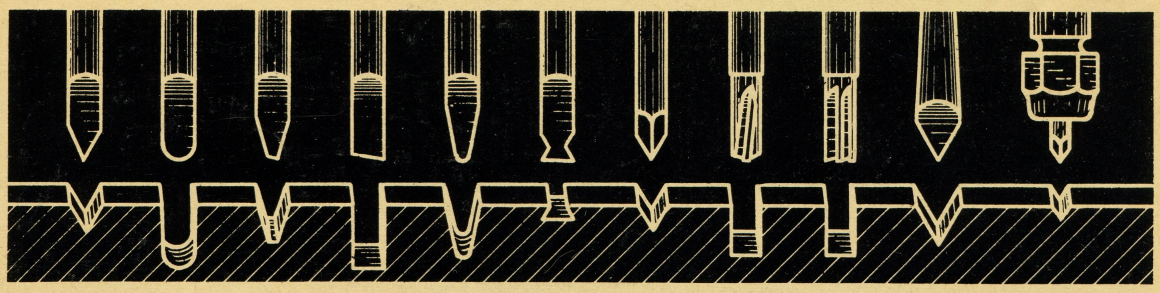
716-1 Plain Head.
737-1 "V" Block Head for 1-G, 3-G, 3-F and 3-U Removable Spindles.
738-1 "V" Block Head for 3-K, 3-L, 3-X and 3-Z Removable Spindles.



For CUTTER GRINDING INSTRUCTIONS and OPERATING SUGGESTIONS, see pages that follow.

For Mechanical Specifications and complete description of this and other Gorton Cutter Grinders and Accessories, see Gorton Accessories Catalog.

GRINDING — CUTTER SHAPES — WHEELS



Typical Cutter Points and Cuts

GENERAL

The importance of correct grinding of the cutters used on Gorton Pantograph machines cannot be stressed too strongly. Satisfactory work cannot be produced if the cutters have been incorrectly ground. The following instructions on cutter grinding should be read and carefull followed. It is *absolutely essential* that suitable equipment be available for grinding the small cutters used with Gorton machines. If you do not have such equipment, we would suggest the purchase of a Gorton 375-2 or 265-6 grinder, as shown in Gorton Accessories Catalog. Both these machines operate in the same manner. The 375-2 has many features not incorporated in the 265-6.

If no cutter grinding equipment is available, Gorton taper shank cutters can be ground on the Pantograph machine by using the mounted wheels described in our Accessories Catalog. Use maximum speed of 8,000 R.P.M. (The attachment will not handle straight shank cutters.) These have a taper shank and fit in the cutter spindle. The cutter is held by Attachment 288-1 illustrated on page 37. We do not recommend this method unless it is impossible to purchase a cutter grinder, as it throws grinding dust over the machine which works into the slides and bearings.

SHAPE OF CUTTER POINTS

Practically all of the cutters used in Gorton Pantograph machines are of the single lip type. A typical assortment is illustrated above. Occasionally for special work, 3, 4 or 6 sided cutters like cut above, are used. Standard spiral flute end mills are also used for side milling, as in profiling, and for some types of die-cutting. Reference to Accessories catalog will show suitable cutters, with collet, etc., for holding. In general, the single lip straight shank cutters are used for heavier work and the Gorton taper shank type for the lighter engraving of small characters and designs.

Single lip cutters are usually ground with a conical point, the angle depending on depth and width of face required. Tables of suggested angles and clearances are given on pages 34, 35, 36, 37.

GRINDING WHEELS

Use the correct grade of abrasive wheel as recommended in the Gorton Accessories Catalog. The wrong grade of wheel will easily draw the temper of small cutters and make them soft. Dress wheels frequently with the diamond dresser provided, and also listed in Accessories Catalog. This is very inexpensive and will repay its small purchase price many times over. (One is furnished with each Gorton grinder.) Occasionally go over wheels after diamond dressing with a star wheel dresser. Keep wheel free of grease and avoid touching with greasy fingers. Never grind continuously in one spot; keep tool moving. Keep wheel spindle snug and free from vibration.

Special wheels for grinding and lapping the new hard alloys are listed in the Gorton Accessories Catalog. These permit much faster grinding and lapping of these materials than heretofore possible. When grinding tungsten carbide tools dry, never dip in a coolant — it may cause checking. Do not force the tool against the wheel — use light pressures only.

GRINDING SINGLE FLUTE GORTON CUTTERS

Trueing Grinding Wheel — Fig. 1

Before grinding cutters, true up the grinding wheel using diamond tool 7566-A (Accessories Catalog) which is furnished with grinder. This tool has a taper shank and can be inserted in grinders having tool heads fitting Gorton taper shank tools only, or it can be held on its diameter in a ⅜" collet in any of the collet type tool heads. After inserting the diamond, set tool head at approximately the same relation to wheel as shown in Fig. 1. Then swing across face of wheel by rocking the tool head in much the same manner as for grinding the cutter. Avoid taking too heavy a cut from the wheel with the diamond. One to two thousandths of an inch should be the very maximum. If the diamond fails to cut freely, loosen it, and turn slightly in the tool head, so as to present a new and unused portion of the diamond to the wheel.

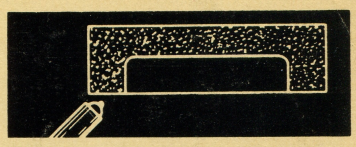


Fig. 1—Trueing Wheel

Rough and Finish Grinding Conical Point — Figs. 2 and 3

Set tool head of grinder to angle desired on cutting edge (see Fig. 2). This usually varies from 30 to 45 degrees, depending on the work desired. Recommended angles for relief characters on steel stamps for various work are given on page 41. For most sunk letter or design engraving on Bakelite panels, brass and metal plates, etc., a 30 degree angle is used (60 degrees included). Now place cutter in tool head and rough grind to approximate size by swinging across face of wheel as with the diamond dresser above. Do not rotate the cutter while in contact with face of wheel but swing straight across, turning cutter slightly *after* or *before* contact with wheel. This will produce a series of flats like Fig. 3, left. Now, grind off the flats and produce a smooth cone by feeding cutter into wheel and rotating at the same time. The finished cone should appear like Fig. 3, right. It should be very smooth and entirely free from wheel marks.

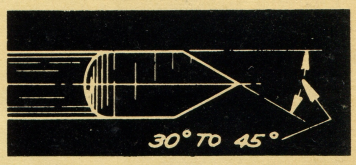


Fig. 2—Set Tool Head to Desired Cutter Angle

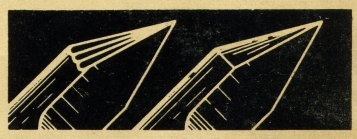


Fig. 3—Rough and Finished Conical Shape

Grinding Flat to Center — Figs. 4 and 5

Next operation is grinding the flat exactly to center. For average work this flat may be left a trifle full or oversize, up to half a thousandth. For very small delicate work however, it is absolutely essential to grind this flat *exactly* to center. If the flat is oversize it will be readily apparent after grinding the cone, and the point will appear as in Fig. 4. To correct this, grind the flat to center as in Fig. 5. For cutters used on very small accurate work, examine this point with a magnifying glass to see that flat and cone point coincide *exactly*. Be very careful *not* to grind the flat down *too far*. It is much better to leave it a trifle full.

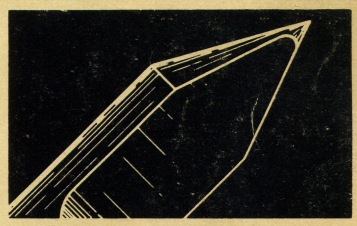


Fig. 4—Flat not Ground to Center

Grinding Chip Clearance

The cutter is now the correct angle, with a cutting edge, but it has no chip clearance. This must be provided to keep the back side of cutter from rubbing against the work and heating excessively, and to allow the hot chips to fly off readily. The amount of clearance varies with angle of cutter used. The following table will be found a very good guide in establishing sufficient clearance.

Conical Point Cutter Angles for Clearance

Angle at Cutting Edge	*Clearance Angle*	*Angle at Cutting Edge*	*Clearance Angle*
45	40	25	21
40	35	20	17
35	30	15	13
30	25	10	8
		5	4

Angles in table are for one side of cutter. For instance a cutter having 45 degree angle will have a 90 degree included angle. Now set the tool head for clearance angle desired. If the conical point was ground as described above, to 45 degrees, then a 40 degree clearance angle will be used. Set the tool head back to 40 degrees.

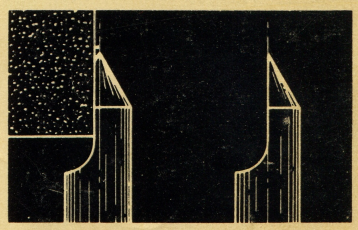


Fig. 5—Grinding Flat to Center

GRINDING SINGLE FLUTE GORTON CUTTERS

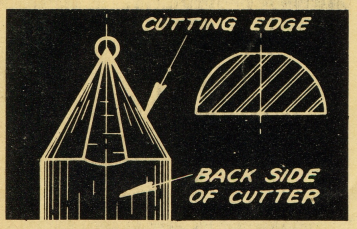


Fig. 6—First Operation in Grinding Clearance

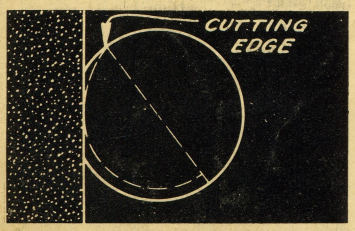


Fig. 7—Second Operation in Grinding Clearance

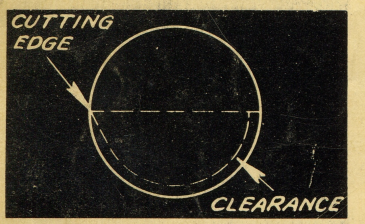


Fig. 8—Section through Cutter after Grinding Clearance

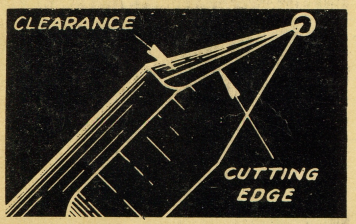


Fig. 9—External View of Fig. 8

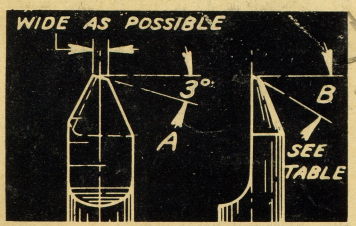


Fig. 10—A "Tipped-off" Cutter

Grinding Chip Clearance — First Operation — Fig. 6

Now feed cutter into face of wheel very gently. Do not rotate, and hold the back (round side) of conical point against wheel. Gradually feed in toward wheel rocking the cutter continuously across face of wheel and without turning, until a flat is ground which runs out *exactly* at the point of cutter, as Fig. 6. Check this very carefully, with a glass if necessary, to be sure you have reached the point with this flat. Be extremely careful not to go beyond. Now you are ready for the final operation.

Grinding Chip Clearance — Second Operation — Figs. 7, 8 and 9.

Now, without turning the feed handwheel any further, rough away stock as Fig. 3, then rotate cutter against face of wheel as Fig. 7, grinding away all stock on back of conical side, *up to* the cutting edge. Be extremely careful at this point not to turn the cutter too far, and thus grind away part of the *cutting edge*. All chatter marks must be cleaned up however and to effect this, it is general practice to remove an additional thousandth of an inch, or so, as necessary, on the cutting edge itself. Watch the point designated by small circle in diagrams. If this *very point* is not correctly ground, the cutter will not work, regardless of how perfect it may be farther out on the taper of cone. A section through the cutter should now be like Fig. 8, and an external view like Fig. 9.

Tipping Off the Cutter Point — Fig. 10

For engraving hair-line letters up to half a thousandth in depth the cutter point is not flattened or "tipped off." For all ordinary work however, it is best to flatten this point as much as the work will permit, as it is very difficult to retain a keen edge with such a fine point, and when the point breaks down, the cutter immediately fails to cut cleanly. Tipping off is usually done by holding the cutter in the hands at the proper inclination from face of grinding wheel, and touching it very lightly against the wheel, or by dressing with an oil stone as explained below. The angle "A" (Fig. 10) should be approximately 3 degrees. This causes the cutter to bite into the work like a drill, when fed down. The angle "B" (Fig. 10) varies depending on the material to be machined with the cutter. The following table will serve as a guide in maintaining this angle "B."

Rake Angle Table for All Single Flute Cutters

Material to be Cut	*Angle B-Fig. 10*
Tool steel	5-10 degrees
Machine steel	10-15 degrees
Hard Brass	15-20 degrees
Aluminum	20-25 degrees
Bakelite, Celluloid, Wood, Fibre	20-25 degrees

Caution

In all finish grinding operations extreme care should be taken not to anneal (burn) the cutting edge. This can be done by (1) Feeding too fast into the wheel, (2) Removing too much stock at a pass, (3) Holding cutter continuously against the wheel, (4) Failure to keep the wheel true and clean as recommended on page 34. The tool head is arranged to rock back and forth across the wheel so as to provide interrupted grinding cuts, thus giving the cutter a chance to cool.

Stoning Small Cutters

The tipped off point of cutter (Fig. 10) can be dressed to size and proper angle, with an oilstone. This can also be done to advantage on the cutting edge and also the flat, but we do not recommend stoning these as it is very difficult to duplicate the angles obtained in the grinder, with the cutter held by hand on an oilstone. Our experience on cutters returned to us for regrinding has proven that cutters are very frequently spoiled by stoning. For this reason we recommend that the cutter be finished entirely on the grinder (except for dressing the tipped-off point as explained above) unless the stoning is done by an expert who is thoroughly familiar with the job. If stoning is attempted, be sure to keep the flat square. It is very easy to stone a cutter down below the point so it will not cut.

GRINDING SINGLE FLUTE GORTON CUTTERS

Grinding Square Nose Single Flute Cutters — Fig. 11

When square nose single flute cutters are ground they should always be tipped off as explained on opposite page, Fig. 10, unless all the cutting will be done with the side of cutter, in which case the end will not matter. All straight side (square nose), cutters have, of course, clearance ground on the cutting edge as explained above and illustrated in Figs. 7 and 8. After grinding the flat to center (which is very easily checked with this style cutter by using a micrometer) clearance is ground by feeding in the required amount toward wheel and turning the cutter until all stock has been removed from the back (round side) right up to the cutting edge, as Figs. 7 and 8. A table of recommended clearances for various diameter Square Nose cutters is given below.

Chip Clearance Table for Square Nose Cutters

Cutter Dia.	Clearance	Cutter Dia.	Clearance
1/10"	.004"	1/4"	.010"
1/8"	.006"	5/16"	.012"
5/32"	.006"	3/8"	.015"
3/16"	.008"	7/16"	.015"
		1/2"	.020"

Example: To grind clearance on a 1/10" dia. Square Nose cutter. Grind the flat as outlined above. Then feed back (round side) of cutter against wheel until it just touches. Then feed in .004" and rotate cutter so as to grind away all material except cutting edge.

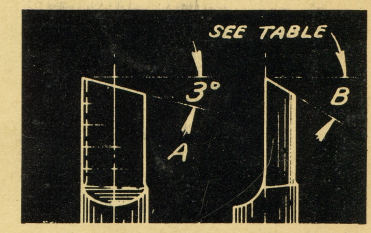


Fig. 11—Square Nose Cutter with Properly Ground Tip

Ball Nose Cutters — Figs. 12, 13 and 14

Gorton 375-2 Grinder with 717-1 Tool Head is designed especially for grinding ball nose cutters. To grind, proceed as follows:

Grinding Chip Clearance on Straight or Tapered Side

Set up in tool head and rough and finish grind for chip clearance and cutting edge as explained above for Square Nose cutters (if the ball nose cutter is to have straight sides like Fig. 12) — or as explained above for Conical point cutters, if the cutter is to have a conical side as in Fig. 14.

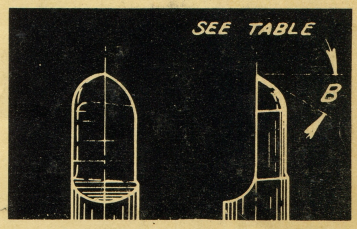


Fig. 12—Properly Ground Ball Nose Cutter

Grinding Flat to Center

Before rough grinding the ball nose, be careful to see that the flat is ground exactly to center as explained previously for square nose cutters.

Rough Grinding Chip Clearance on Ball Nose

Tilt the collet tool head to the correct angle in degrees, setting to the Rake Angle Scale, (see "W," page 31) and using the tables for clearance angle "B" Fig. 12 recommended for cutters to be used on materials listed there. We find that 10 degrees is suitable for nearly all kinds of work and all but the very softest materials.

Now insert cutter in collet, using the gauge No. 9839 which fits on flat surface of tool head and is beveled at proper angle for setting all size cutters. With the cutter set by gauge, lock from turning by means of the index pin.

When the cutter and tool head are adjusted for rake and clearance angles, it is necessary to set the collet spindle off center to obtain a perfect radius. This is accomplished by loosening stop screw "U" (Drwg. 9886, page 32) one-half turn and turning the knurled micrometer hand wheel to the *left* approximately .004" for every ⅛" of cutter diameter. To relocate spindle on center, turn stop screw back one-half turn to its original position with handwheel set at zero.

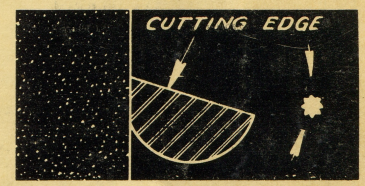


Fig. 13—Tilting Ball Nose Cutter for Clearance

**Use Gauge 9839*

IMPORTANT

For grinding a corner radius on a cutter, proceed as follows: Subtract radius desired plus .004" for every ⅛" of cutter diameter from ½ the diameter of the cutter and turn the knurled handwheel to the right by the amount of the difference. All settings are from zero line when spindle is on center.

With cutter locked, bring it parallel to and just clearing the grinding wheel, then feed into wheel using longitudinal feed handwheel on base of machine. Now swing head at right angles to wheel, feed cutter in until it touches wheel, using knurled micrometer handwheel X, page 31. Now swing head through an arc of 90 degrees until radius is formed on cutter blank, using stops to provide 90 degrees movement for blending ball into side of cutter.

Now release index pin. Rotate collet spindle back and forth, about one-half turn, being careful to keep slightly away from cutting edge. While rotating spindle, swing the tool head through an arc each time spindle is turned. About ten swings of head should rough grind the surface.

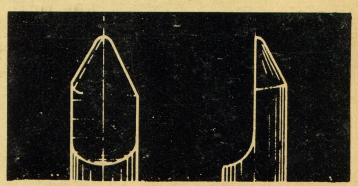


Fig. 14—Ball Nose Cutter with Conical Side

GRINDING THREE and FOUR SIDED CUTTERS

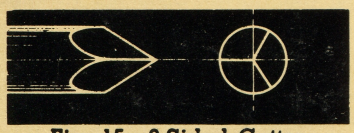


Fig. 15—3-Sided Cutter

FINISH GRINDING CHIP CLEARANCE ON BALL NOSE

Now feed cutter toward wheel with knurled micrometer handwheel X, page 31, exactly the amount of clearance in thousandths called for in table page 34. Swing the tool head back and forth, using stop Y, page 31 to limit travel on cutting edge side, until approximate center of ball is reached.

GRINDING THREE AND FOUR SIDED CUTTERS — Fig. 15

Three or four sided cutters are sometimes used for cutting small steel stamps and other small engraving. They produce a very smooth finish. The index plate on collet spindle of grinder tool head has index holes numbered 3, 4 etc. — for indexing to grind three and four sides. To do this two operations are necessary, as follows:

GRINDING ANGLES OF CUTTING EDGE

Set tool head to angle desired. Then plug pin in index hole for desired number of divisions, and grind flats.

GRINDING CLEARANCE ANGLE

Now without loosening the cutter in collet of tool head, reset the tool head to the proper clearance angle as table below. For example: you are grinding a 3 sided cutter to 45 degrees cutting edge. Referring to the table gives 26½ degrees clearance. Set tool head to 26½ degrees and grind each flat exactly to the point. Do not loosen cutter in collet or change index settings from those used when grinding the 45 degree edge.

CUTTING EDGE ANGLE

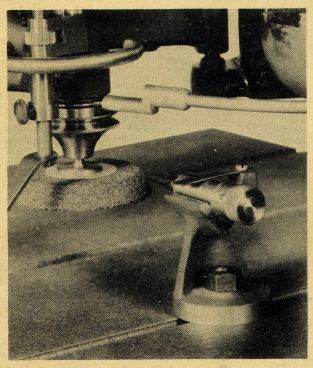
Table of Clearance Angles for 3 and 4 Sided Cutters (in degrees)
(Angle of Cut = 2 Times Cutting Edge Angle)

Degrees of Cutting		45	40	35	30	25	20	15	10	5
Angle of Clearance Degrees	3 Sides	26½	23	19½	16	13	10½	7½	5	2½
	4 Sides	35½	30	25½	22½	18½	14½	10	7	3½

7 WAYS TO INSURE PROPER CUTTER PERFORMANCE

1. Keep your cutters sharp.
2. A clean collet or spindle taper will help prevent cutters from running out of true.
3. Check spindles worn in tapers, collet holes or bearings. Excessive wear at these points causes Cutter trouble.
4. Feed fine small cutters much slower than a larger cutter.
5. Be careful to feed cutters in proportion to their strength of material to avoid breakage.
6. Cutters may break or dull from defective steel or wrong temper, but all breakage troubles are not from that cause.
7. Light Cutter Spindle Belts are recommended for extremely delicate work. These endless linen belts are lighter and operate the cutter spindle smoother and with less vibration. We can furnish these belts at slightly higher cost than standard belts.

GRINDING CUTTERS WITH ATTACHMENT 288-1 ON PANTOGRAPH MACHINES



Grinding Cutter with Attachment 288-1

First: Insert Pantograph style into hole in copy holder. This holds cutter head rigid. If cutter head is equipped with depth gauge, loosen foot nut and swing foot outward. Now insert grinding wheel and bolt cutter holder base in place, with cutter point at inside edge of wheel, all as photo at lower left.

Remove cutter holder by lifting spring slightly and insert cutter tightly, using small wrench. Replace cutter holder and grind cutter point to the proper angle by revolving cutter and shifting table with cross slides.

With cutter pointed as desired, it must be ground for clearance, as shown on Fig. 7, page 35, which means grinding away the metal back of cutting edge so that cutter will cut free and raise no burr on work. To grind this clearance, table must be shifted slightly so that wheel will grind above the cutter point.

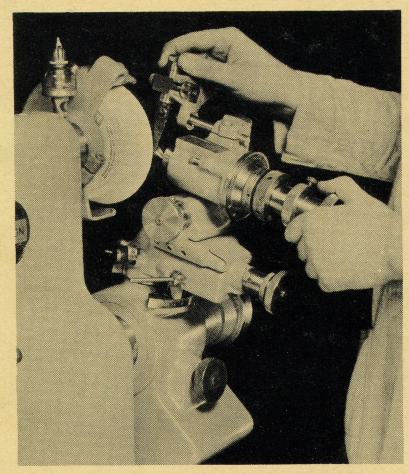
By rotating cutter (half turn) back and forth, clearance can be ground without actually grinding the point and cutting edge more than just enough to bring it to a sharp edge. Remove point slightly with a fine oilstone.

SUGGESTIONS ON OPERATION OF CUTTERS

Grinding Very Fine Cutter Points

Most of the difficulties experienced when using extremely small cutters on small lettering in dies and stamps are caused by improper grinding. This applies especially to the *very cutter point* where possibly only .01" of the point is used.

This very *point* therefore, is the part that *must* be accurately sharpened. If the actual *point* is not perfect, a cutter that may be beautifully ground in all other respects is simply no good for doing the work. Examine the point with a good magnifying glass, and do not try to use the cutter until you are satisfied that it is in perfect condition for doing the kind of work you have a right to expect of it. When trouble is experienced, usually the point is *burned*, or the flat is either *too high* or *too low*. Perhaps the clearance does not run clear out to the *point*. Sometimes stoning off the flat with a small fine oil stone will make the cutting edge keener.



Grinding a Spiral Flute Cutter on 375-2 Cutter Grinder with 717-1 Universal Tool Head

The *only* way by which a cutter point can be made to run *absolutely perfect*, is by sharpening in the cutter spindle in which it runs. Most Gorton machines have provision for removing the cutter spindle from the machine and placing in a V block Tool Head on the Cutter grinder. The cutter is then ground to the conventional shape just as previously explained, all without removing it from the cutter spindle. We find this procedure unnecessary for any but the very finest type and steel stamp work, however. For such small, fine sunk letters 1/32" to 1/16" high and say, .005" to .015" depth of cut, grind the cutter in place in the spindle of the machine to an angle of about 25 degrees. Trace the copy *evenly* and *steadily* as a sudden jerk will be almost certain to break off the cutter point. A correctly ground cutter should engrave from 30 to 50 characters this size in annealed tool steel before resharpening.

Operation of Cutters—General

After the cutter has been placed in operation, it must be kept sharp and with proper clearance at all times. This is particularly important when running at extremely high speed as a dull cutter burns quickly. If the cutter raises a burr, it is pretty certain to be dull or without clearance, or both. Cutters will not always cut the same kind of material with equal facility as materials vary in density and hardness, even in the same piece.

A dirty or worn collet may cause a cutter to run out of true. Loose or badly worn spindle bearings will frequently cause the cutter to break.

Gorton Taper Shank Cutters

Wring the cutter (if taper shank) in the spindle very tight. Do not continue with a cutter if it comes loose, or the spindle will be worn so that no cutter can be held properly. If this happens, check taper of cutter in spindle by rubbing on a little Prussian blue. The cutter should fit more tightly at small end than large. If the blue shows otherwise, and the spindle is old, it is probably worn out of true and needs replacing.

Fig. 16 — Stoning a very slight flat on the point of the cutting edge of a square nose single flute cutter will make it produce a smoother finish, especially in cutting brass.

Fig. 17 — Vertical sides of considerable depth can be milled faster and more accurately if the cutter be relieved as shown, to the same depth as for chip clearance back of the cutting edge.

Fig. 18 — In milling irregular contours, etc., faster cutting will be done if the direction of feed is upward as shown, instead of down.

Fig. 19 — For milling narrow taper slots, best results will be obtained by grinding a cutter to the full bottom width of the slot and cutting this the full depth as shown at left. The taper sides are then milled out using a taper cutter.

Fig. 16 **Fig. 17** **Fig. 18** **Fig. 19**