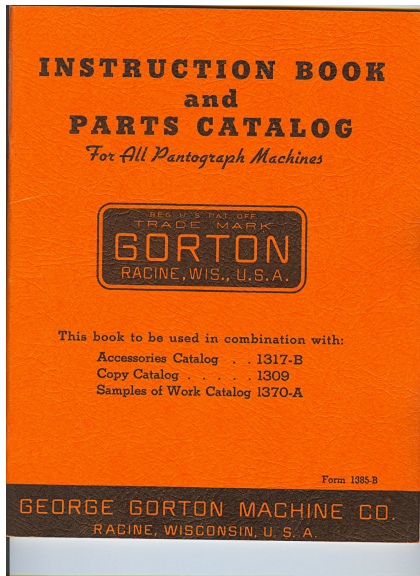


Photo 1



GEORGE GORTON
BORTON
RACINE, WIS., U.S.A.

INSTRUCTION BOOK and PARTS CATALOG

" " For Gorton Pantograph Machines. " "
Models 3-F, 3-U · 3-X, 3-Z · 3-B, 3-L · 3-S · 3-K · 3-H · 3-R · 1-H.

" " Also Parts List covering obsolete models. " "
1-A, 1-C, 1-D, 1-J, 1-T, 3-A, 3-C, 3-G, 3-J.

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GEORGE GORTON MACHINE CO.
RACINE, WISCONSIN, U. S. A.

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Form 1385-B

Photo 3



THE GORTON
WORKS, U.S.A.

UNPACKING and ERECTING

Note: Disregard paragraphs 5 and 6 for 3-B, 3-L and 3-S machines. These machines are shipped with pantograph in place.

1. UNPACKING

Examine the box in which the machine is received to see that it is intact and that the machine has not been damaged in transit. All Gorton machines are shipped boxed tight, not crated, to eliminate dust or cinders and so prevent anything being thrust through the spaces of a crate to damage the machine. After removing box, check up all parts with the packing list. Carefully examine all packing paper and excelsior to make sure that no small parts have been overlooked.

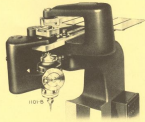


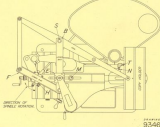
Fig. 1—Cutter Head Looked for Shipping

2. CLEANING

For cleaning the machine of dusting grease, kerosene is preferable. The container used should be thoroughly cleaned before filling. Rags are better than waste as they leave no lint. When removing the grease from Pantograph, be careful not to immerse Pantograph in the kerosene and thus soak up the fumes.

3. LOCATING THE MACHINE

All machines are completely assembled, ready for use, with exception of Pantograph, which is boxed separately. Before installing this, place the machine in desired location, close to a good window light if possible, opposite the center of window and with the operator facing the window (see the machine table). This is especially important if the machine is to be used for small delicate work, as daylight is always better than artificial light.



4. LEVELLING

Machine should then be levelled by means of a small machinist level placed on the machine table. While the base is drilled for leg screws, these are necessary only for shipping. It is important, however, that the machine be placed on as flat and solid a floor as possible.

5. SETTING THE SLIDER HEAD

With the wrench provided, loosen hole "M" which clamps the Forming and Routing attachment to the slider head.

The front end can then be pushed down (or gently pried and tapped with wood block) releasing the bigged cutter head and link. This cutter head and link is also held in the shipping position when it is desired to operate machine as a vertical miller or router with a fixed spindle. (Instructions for converting the Pantograph into a router are engraved on former bar.) Now, with bolt "N" loosened, move the slider head to the position indicating on the graduated scale at right side of head, the scale of reduction to be used. Then clamp bolt firmly. This setting of slider head need only be approximate without altering accuracy of the machine.

6. PUTTING THE PANTOGRAPH IN PLACE

Now, holding Pantograph in position shown below, place SLIDER BAR "F" in SLIDER BLOCK "H," with index spot to the front. Then insert SLIDER BAR "B" in SLIDER BLOCK "E" with index spot toward "S," making sure gill cup screws (S6-L, Dow 9342, Page 5) are loosened. Take care that edges of blocks and bars are not dented or battered in this operation. These parts are carefully fitted and so force is necessary to slip the bars into the blocks, if started properly. After setting to the desired reduction and locking the bars in the blocks by means of the hexagon cap screws in each block, the machine is ready for use.

Fig. 2—Top View of Machine with Assembly Reference Points

1922-1926
GORTON
MACHINE WORKS

LUBRICATION and ADJUSTMENT of 3-F, 3-U, (small size) MACHINES

UNPACKING and ERECTING

Same as page 3.

LUBRICATION

Correct grades of oils and greases:

Only pure neutral mineral oils and greases should be used. For lubricating the cutter spindle use preferably a spindle oil such as Gargyle Oil Company's Vaseline Oil "C" or equivalent, having a viscosity approximating 80 seconds at 100 degrees F. Do not use 3 in 1 and similar utility oils. These may gum the bearings. For all other oil holes and oil cups either a light or medium machine oil. For all grease cups use a light grease equivalent to Gargyle BRB No. 2. For repacking Pantograph bearings use vasoline or preferably Gargyle BRB No. 2.

Oil twice a day:

Cutter spindle, through oil hole "A" and "B", page 6. Guide pulley oil cups "C" and "D", page 5.

Oil once a week:

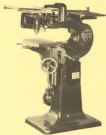
All other oil holes and oil cups. Run out work table to extreme position and squirt a few drops of oil on table and saddle screws. Give drive pulley stud grease cup "E", page 5, one turn.

Once a month:

Lubricate motor oilers with a few drops of medium machine oil preferably Gargyle Esna Oil Heavy. Be careful not to use too much oil.

Once a year:

Remove grease plugs "F" on cutter head link, page 5, and insert a grease cup or gun, fill. Remove the polished dust washers 6945-A, page 5, covering Pantograph bearings, by inserting a thin bladed knife in the washer slot. Repack bearings with vasoline, packing it in tightly so as to force new supply into lower bearing. Squish washers back into place with fingers. Remove nuts 3356-A, page 5, which hold Pantograph link and repack these bearings. Remove cap 7110-A, page 5, and repack chamber with cup grease.



3-U Machine

occasional greasing as above. Should play develop in the joints after several years' use, it can easily be removed by tightening nuts 3355-A on Pantograph studs 3363-A, page 6. These should be tightened very slightly, as too much will cause the balls to cut into the cups, causing rapid wear and inaccuracy. Before tightening, loosen cap screw 365-A-3 on cutter head, page 5, to allow Pantograph to realign itself properly. Then remove Pantograph entirely and test the Pantograph block 226-A attached to slider head and Block 224-A attached to cutter head, taking these up first. Then lower Pantograph in slider head block only, with cutter head swung out of the way, and test Pantograph bearings.

THE CUTTER HEAD LINK

Cutter head link bearings should not require attention other than greasing. If, after several years, these become a trifle loose, they can be taken up by loosening slightly (not entirely) the Beimo cap screw "G", page 6, and tipping downward against top of the plug 8715-A or 8716-A.

GENERAL CARE

The machines should be thoroughly cleaned at least once a week and the scraped ways wiped clean and oiled.

THE CUTTER SPINDLE

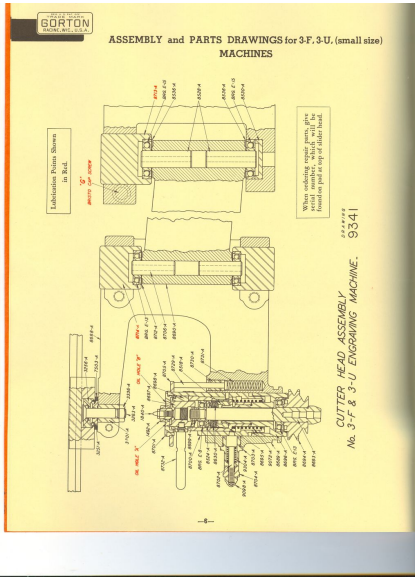
Spindle has non-adjustable bearings which automatically take up wear and require no attention except oiling. The spindle is quickly removable and should trouble of any kind develop, we suggest that it be returned to us for overhaul, which will be done promptly and at nominal cost as there is very little to wear on these spindles.

To remove cutter spindle, first remove belt, and push feed lever (8732-A) to left, disengage lock pin (8704-A) in center of cutter head, and swing back spring bolt (8706-A) on right of cutter head. Then hold cutter head by pulleys with right hand and with left hand swing front half of cutter head out of place and lift spindle free.

THE PANTOGRAPH

Pantograph needs no care except occasional greasing as above. Should play develop in the joints after several years' use, it can easily be removed by tightening nuts 3355-A on Pantograph studs 3363-A, page 6. These should be tightened very slightly, as too much will cause the balls to cut into the cups, causing rapid wear and inaccuracy. Before tightening, loosen cap screw 365-A-3 on cutter head, page 5, to allow Pantograph to realign itself properly. Then remove Pantograph entirely and test the Pantograph block 226-A attached to slider head and Block 224-A attached to cutter head, taking these up first. Then lower Pantograph in slider head block only, with cutter head swung out of the way, and test Pantograph bearings.

Mechanical specifications and complete description in Booklet 1380. Areas covered in one setting shown actual size at rear of this book. Accessories for use with these machines in Accessories catalog 1317. Copy for use with these machines in Copy catalog 1309.



MADE IN U.S.A.
GORTON
 PATENT MACHINES, U.S.A.

LUBRICATION and ADJUSTMENT of 3-X, 3-Z, (medium size) MACHINES

UNPACKING and ERECTING

Same as page 5.

LUBRICATION

Correct grades of oils and greases:

Same as page 4, for 3-F, 3-U machines.

Oil twice a day:

Cutter spindle, through holes "C" and "D", page 9. Oil cup, 501, page 9. Guide pulley oil cups 1305, page 8.

Oil once a week:

All other oil holes and oil cups. (Do not forget to replace oil hole plugs). Run nut table to extreme positions and squirt a few drops of oil on table and saddle screws. Lift the knee elevating screw cover and squirt a few drops of oil on screw. Give drive pulley stud grease cup 000, page 8, one turn, also cutter head link grease cups 00, page 8.

Once a year:

Remove the polished dust washers 6795-A, page 8, covering the Pantograph bearings, by inserting a thin bladed knife in the washer slot. Repack bearings with vaseline, or preferably Gargoyle BRB No. 2, packing it in tightly so as to force a new supply into lower bearing. Snap washers back into place with fingers. Remove nuts 6209-A, page 8, holding Pantograph link. Repack these bearings as above. Remove cap 7110-A, page 8, and repack chamber with cup grease equivalent to Gargoyle BRB No. 2. Inspect the ball bearing grease packed motor journals and repack if necessary, although this should only be required once every two years.

THE CUTTER SPINDLE

Spindle has no adjustable bearings and requires no attention except oiling. If, after several years of use, the spindle becomes inaccurate through ball bearing wear, new ones can be inserted at low cost which will make the spindle as accurate as new. Care should be taken not to use cutters more than one or two thousandths undersize. Smaller ones require the collet nut to be pulled



3-Z Machine

up very tight to prevent cutter slippage and may permanently spring the spindle, causing cutters to run out of true.

On machines equipped with removable spindle 698-1 the same instructions apply as above, with this addition: When spindle is removed from machine, care should be taken to prevent small chips and grinding dust from lodging around top seal. Always clean outside of spindle thoroughly before inserting in machine.

THE PANTOGRAPH

Pantograph needs no care except occasional greasing as above. Should play develop in the joints after several years of use, it can easily be removed by tightening nuts 6913-A on Pantograph studs 6184-B, 6185-B, pages 8 and 9. These should be tightened very slightly, as too much will cause the balls to cut a groove in the cups causing inaccuracy and rapid wear. Before tightening, loosen hex. cap screw "E" on cutter head (page 8) to allow Pantograph to realign itself properly.

THE CUTTER HEAD LINK

Cutter head link bearings should require no attention except greasing. If, after several years of use, they become loose, they can easily be taken up by loosening the Bristo set screws "F" at top, page 9, and tightening slotted head adjusting screws 6359-A. This should rarely if ever be necessary.

TABLE GIBS

Table gibs are tapered with adjusting screw at one end of gib and locking screw at other end. To tighten gib, loosen locking screw at small end of gib, tightening the screw at opposite end as required. Knee gib has a tapered side and a glangle will show how to take it up.

GENERAL CARE

The machine should be thoroughly cleaned at least once a week and the scraped ways wiped clean and oiled.

Mechanical specifications and complete description in Booklet 1300. Areas covered at one setting shown actual size at back of this book. Accessories for use with these machines in Accessories catalog 1317. Copy for use with these machines in Copy catalog 1308.

Photo 9

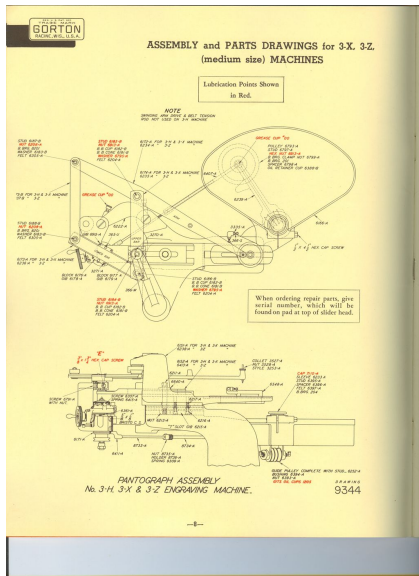
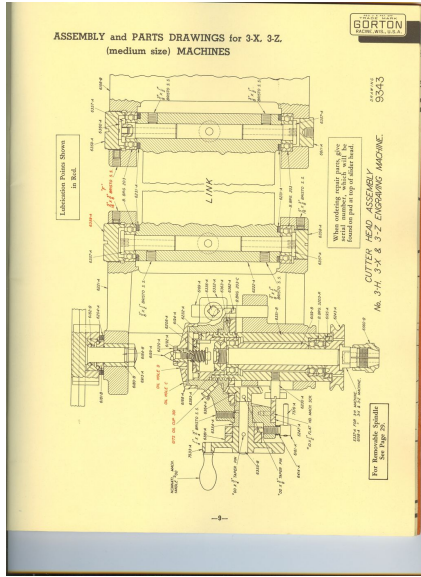
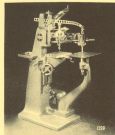


Photo 10

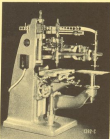


MADE IN THE U.S.A.
GORTON
 ENGINE WORKS, U.S.A.

LUBRICATION and ADJUSTMENT of 3-B, 3-L (3-Dimensional) MACHINES



3-B Machine



3-L Machine

UNPACKING and ERECTING

Same as paragraphs 2, 3, 4, 5, page 5. 3-B and 3-L machines are shipped with Paragraph completely assembled. A special casting lining around the cutter spindle and behind its mounting table, secures Paragraph during shipment. Loosen the bolts holding this casting and remove. The machine is then ready to operate, after slipping on the motor drive and cutter spindle belts.

LUBRICATION

Correct grade of oils and greases:

Same as page 4, for 3-L, 3-L machines, except Gortale 300B No. 2 grease is used in Paragraph bearings also, and is ball bearing grease. Use Gortale Free Oil Medium for plain bearing grease.

Oil twice a day:

Cutter spindle, through hinge lid cap at top of spindle (not shown on page 11), "A" page 13.

Oil once a week:

All other oil holes and oil cups. Run out work table to extreme position and squirt a few drops of oil on table and saddle screws. Give all grease caps one turn. Lift the knee elevating screw cover and squirt a few drops of oil on screw, (face covered on 3-B). Wipe all polished Paragraph surfaces with oily rag to prevent rust.

Once a year:

Remove cap corresponding to 7110-A, page 8, covering slider pulley pinion steel and repack chamber with grease. If ball bearing grease, inspect and add grease if necessary.

Once every two years:

Remove the 1/2" shouldered pin plugs at top and bottom of every Paragraph pivot joint, and by inserting grease cup, grease gun, or Alorose fitting and gun, fill with new grease until the old grease and second sides of seals, using Gortale 300B No. 2. Be very careful not to use a stiffer grease than this.

THE CUTTER SPINDLE

Cutter spindle has no adjustable bearings and requires no attention except oiling. If, after several years of use, the spindle becomes inaccurate through wear of the ball bearings, new ones can be inserted at low cost which will make the spindle as accurate as new. Care should be taken not to use cutters more than one or two thousandths over-size, as smaller ones require the cutter run to be pulled up very tight to prevent cutter slippage and may permanently spring the spindle, causing cutters to run out of true.

3-L spindle is removable by turning to right and unbolting. When spindle is removed from machine care should be taken to prevent small chips and grinding dust lodging around top seal. Always clean outside of spindle thoroughly before inserting in machine.

TABLE GIBS

3-L table gibs are tapered with adjusting screw at rear end of gib and locking screw on other end. To tighten gibs, loosen locking screw at small end of gib, tightening the screw at opposite end as required. When gib has tapered side and a glenoid will show how to take it up.

GENERAL CARE

The machine should be thoroughly cleaned at least once a week and the scraped ways wiped clean and oiled.

Mechanical specifications and complete description in Booklet 1580. Areas covered at one setting shown ball size at back of this book. Reduction formula and schedules on page 42. Accessories for use with these machines in Accessories catalog 1317. Copy for use with these machines in Copy catalog 1309.

Photo 12

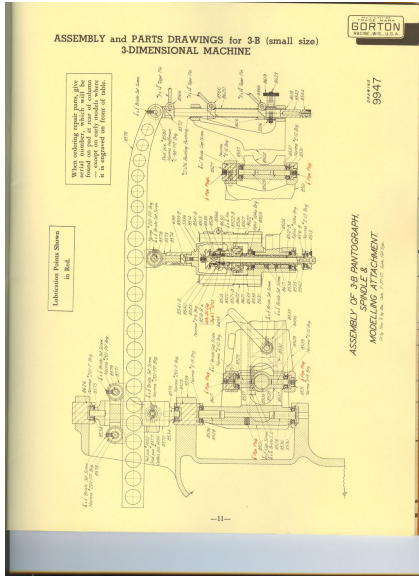


Photo 13

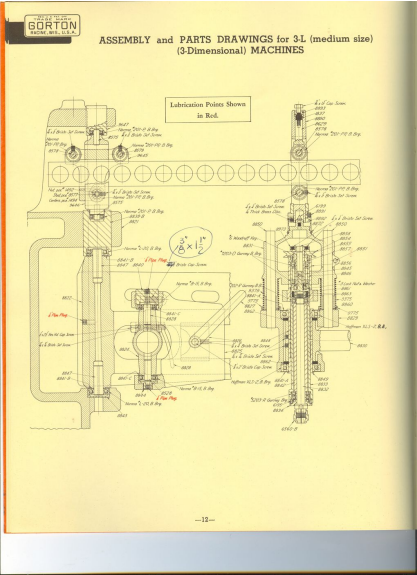
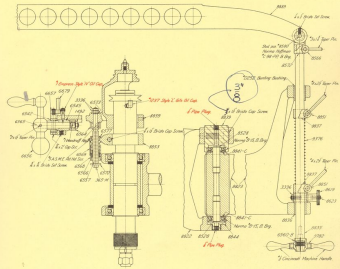


Photo 14

2012 10 25
GORTON
MACHINE WORK, U.S.A.

ASSEMBLY and PARTS DRAWINGS for 3-L (medium size) (3-Dimensional) MACHINES

Lubrication Points Shown
in Red.



When ordering repair parts, give serial number, which will be found on pad at rear of column.

ASSEMBLY OF 3-L PANTOGRAPH
SPINDLE &
MODELLING ATTACHMENT.
9900
© by Geo. F. Co. Inc. 1926. 9-1-27. 3000. 100-200.

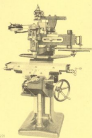
Photo 15

ESTD 1887
GORTON
MACHINE CO. INC.

LUBRICATION and ADJUSTMENT of '3-S (large size) MACHINE

UNPACKING and ERECTING

Same as paragraphs 1, 2, 3, 4, 5, page 3. 3-S machines are shipped with Pantograph completely assembled, except on machines for export, when the Pantograph is disassembled and boxed separately. For all domestic shipments, a special casting is made, fitting around cutter spindle and clamped to table of machine. Loosen the bolts holding this casting and remove. The machine is then ready to operate.



3-S Machine

LUBRICATION

Correct grades of oils and greases:

Same as page 4, for 3-F, 3-U machines, except Gargoyle BRB No. 2 grease is used exclusively in Pantograph bearings also.

Oil twice a day:

Cutter spindle, through oil cup "A", page 16.
Cutter spindle drive pulley 6536-A, page 16,
through oil hole "B".

Oil once a week:

All other oil holes and oil cups. Run out table to extreme positions and squirt a few drops of oil on table and saddle screws. Lift the knee elevating screw cover and squirt a few drops of oil on screw. Give all grease cups one turn and Alemite fittings one shot, except Pantograph bearings, which are only necessary to lubricate twice a year. *Once a year:* The cap 7110-A, page 11, should be removed and chamber repacked with

grease. Inspect the ball bearing motor and add grease (BRB No. 2) if necessary.

THE CUTTER SPINDLE

Cutter spindle has no adjustable bearings and requires no attention except oiling. If, after several years of use, the spindle becomes inaccurate through wear of the ball bearings, new ones can be inserted at low cost which will make the spindle as accurate as new. Care should be taken

not to use cutters more than one or two thousandths undersize, as smaller ones require the collet nut to be pulled up very tight to prevent cutter slippage and may permanently spring the spindle, causing cutters to run out of true.

TABLE GIBS

Table gibs are tapered with adjusting screw at one end of gib and locking screw at opposite end. To tighten gib, loosen locking screw at small end of gib, tightening the screw at opposite end as required. Knee gib has a tapered side and a glance will show how to take it up.

GENERAL CARE

The machine should be thoroughly cleaned at least once a week and the scraped ways wiped clean and oiled.

*NOTE: All instructions on this page also apply to model 1-S machines, now obsolete. The improvement in design has not altered construction or operation of any essential parts of the machine.

Mechanical specifications and complete description in Booklet 1216. Areas covered at one setting shown actual size in rest of book. Accessories for use with these machines in Accessories catalog 1217. Copy for use with these machines in Copy catalog 1203.

Photo 17

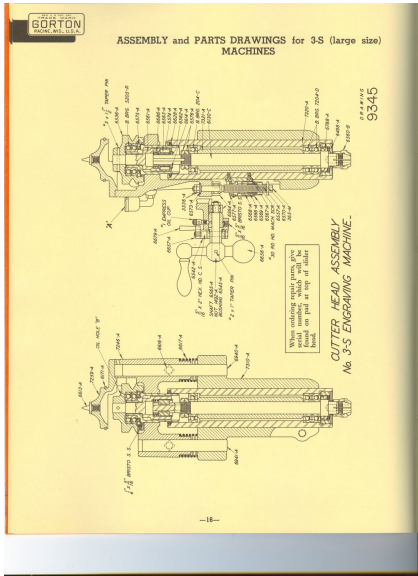


Photo 18

THE BORTON
MACHINE CO., U.S.A.

LUBRICATION and ADJUSTMENT of 3-K, 3-R, 1-H, 3-H MACHINES

UNPACKING and ERECTING

Same as page 3 for all models above.

LUBRICATION

The correct grades of oils and greases for all of the above models are the same as given on page 4. Follow the oiling instructions given on page 7 for models 3-K, 3-R and 3-H, and on page 4 for model 1-H.

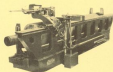
ADJUSTMENT

The 3-K, 3-R and 3-H models are adjusted as described on page 7, except all 3-K machines are equipped with removable cutter spindles. Instructions for adjusting 3-K cutter head links are the same as for 3-F, 3-U machines on page 4. Model 1-H is adjusted as described on page 4.

IMPORTANT 3-K INSTRUCTIONS

Before attempting to adjust or disassemble the ball bearing cutter head auxiliary support, as shown in drawing 7554-B on page 8 of booklet 1242, send to factory for complete assembly drawings of these parts and instructions. This entire assembly must be in perfect alignment to insure smooth and accurate operation, and it can easily be thrown out of adjustment or damaged by incorrect adjustment. For additional instructions on these machines consult the following specification booklets:

3-K.....see Booklet 1242
3-R.....see Booklet 1256
3-H.....see Booklet 1060
1-H.....see Booklet 1057



3-R—No. 1256-R



1-H—No. 1081



3-H—No. 1175-B



3-K—No. 1255

Accessories for use with these machines in Accessories catalog 1317. Copy for use with these machines in Copy catalog 1309.

Photo 19

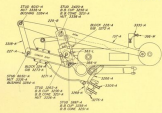
WILLIAM W. GORTON
PATENT ATTORNEY
NEW YORK, N. Y.

LUBRICATION and ADJUSTMENT of MODELS 1-A. 1-C. 1-T.

(These Models Now Obsolete)

3-A. 3-C. 3-T

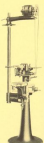
NOTE—1-C, 1-T and 3-C, 3-T are identical with 1-A and 3-A except for Pantograph indications.



PANTOGRAPH ASSEMBLY
No. 1-A ENGRAVING MACHINE. 9340



3-A Machine



1-A Machine

When ordering repair parts, give serial number, which will be found on pad at top of slider head.

LUBRICATION

Correct Grades of Oils and Greases
Same as page 4 for 3-F, 3-U machines.

Oil Twice a Day

Turn spindles, through oil holes in top; see drawing. Guide pulley bearings, see drawing. (For 3-A, C, T guide pulley oiling, refer to page 4. All other lubrication same as page 4).

THE PANTOGRAPH

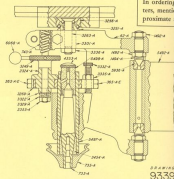
Same as page 4.

THE CUTTER HEAD LINK CENTERS

The four link centers supporting the cutter head frame should be drawn through the holes which carry them, by means of nuts on either side, and so adjusted that a very slight stiffness of these joints is perceptible when the parts are moved by hand. For this purpose Pantograph and belt must be removed so that cutter frame can be examined separately.

CUTTER SPINDLE BEARINGS

To adjust, loosen cap screw which clamps yoke to the spindle sleeve. Adjust bronze end thrust by means of the knurled head, and tighten screw. See drawing.



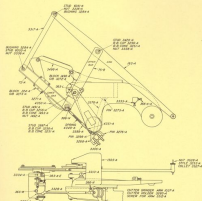
In ordering Cutters, mention approximate size.

CUTTER HEAD ASSEMBLY
No. 1-A ENGRAVING MACHINE. 9339

Photo 20

LUBRICATION and ADJUSTMENT of MODELS 1-D, 3-D (These Models Now Obsolete)

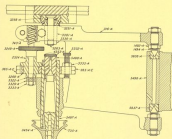
— 2002 THE END —
GORTON
MACHINE CO., U.S.A.



PANTOGRAPH ASSEMBLY
No. 1-D ENGRAVING MACHINE.

9363

Areas covered at one setting for all machines listed on these two pages shown actual size on rear flap of this book. Accessories for use with these machines in Accessories Catalog 1317. Copy for use with these machines in Copy Catalog 1309.



CUTTER HEAD ASSEMBLY
No. 1-D ENGRAVING MACHINE.

9362

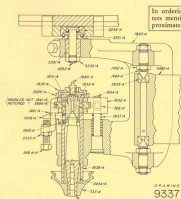
When ordering repair parts, give serial number, which will be found on pad at top of slider head.

NOTE—Instructions for the Lubrication and Adjustment of models above is identical with page 14. These 1-D, 3-D models cover greater range however, which makes necessary the slightly different assembly and parts drawings.

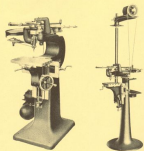
Photo 21

W. F. & G. GORTON
MACHINE WORKS, U.S.A.

LUBRICATION and ADJUSTMENT of MODELS 1-G, 1-J, 3-G, 3-J (These Models Now Obsolete)



CUTTER HEAD ASSEMBLY
No. 1-G & 1-H ENGRAVING MACHINE.



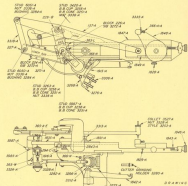
3-G Machine 1-G Machine

When ordering repair parts, give serial number, which will be found on pad at top of slider head.

NOTE—Instructions for the Lubrication and Adjustment of models above is identical with that for models shown on pages 18 and 19, except that models on this page (3-G) work on curved surfaces, which makes necessary a different cutter spindle, using different parts, as shown, and requiring different adjustment.

TO ADJUST CUTTER SPINDLE BEARINGS FOR 1-G, 1-J, 3-G, 3-J

Remove cap on top of spindle sleeve, exposing end thrust. Loosen steel lock nut slightly, and using T shaped key, furnished with machine, adjust the bronze end thrust, which is threaded RH. Proper adjustment is obtained when, with driving belt removed, a very slight amount of shake is felt at pulley. When adjusted, tighten lock nut and replace cap. See drawing below.



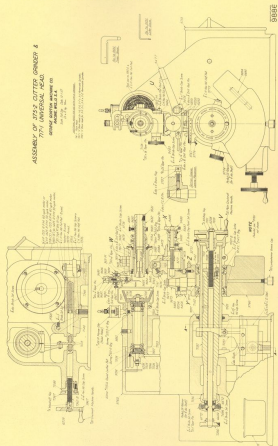
PANTOGRAPH ASSEMBLY
No. 1-G & 1-H ENGRAVING MACHINE.

Photo 22

LUBRICATION, ADJUSTMENT, ASSEMBLY and PARTS LIST of 375-2 CUTTER GRINDER

MADE IN U.S.A.
GORTON
MACHINE WORKS, U.S.A.

LUBRICATION: The spindle bearings are filled with Gorton's Spindle Oil. Vegetable Oil "2" or equivalent. Turn down grease cup once a week and add oil. The spindle is non-adjustable. Bearings for adjustment or repair which should only be required after years of service.



SETTING THE PANTOGRAPH, USE OF COPY, MASTERS AND TEMPLATES

1. Setting the Pantograph

The copy is laid out to keep within the range limits of the Pantograph. See the chart in the rear of this book. The setting of the Pantograph is then determined from the size of the work to be engraved.

2. **Example:** If length of copy is 10" and length of job desired is 2", divide the length of job into the length of copy: $2" \div 10" = .2$. Therefore, set your Pantograph bars at reduction 5. If length of copy is 11" and length of job desired is 4", then the reduction is $4" \div 11.60" = 2.75$. You will note that reduction 2.75 is not marked on Pantograph bars. To find it, look in rear of this book at correct Reduction Chart for your machine. If it is not found there, it can be obtained by using the reduction formula, also at back of book.

3. All settings are measured from first reduction marked on machine. On some models this begins with 3, others 2, and others 1 and 2. (Note: Upper bar on 3-U and 3-Z machines measured from line marked 2, not line marked 1.) In setting lines in this manner, for special reductions, use hundredths inch scale and magnifying glass, if accurate work is required.

It is best, after a special reduction has been set, to check pantograph. First place a point in spindle, then raise table, until point clears by a fraction of an inch; next follow inside of copy holder with tracing style. If the point follows parallel to T-slots, the reduction is proper. If the point forms an arc or angle, the setting should be recalculated and reset. If point still runs off, it can be corrected by loosening either of the slider blocks and tapping one way or the other, until path of point is parallel.

(For 1 to 1 reduction on 3-U, 3-F, 3-Z and 3-X machines, transfer style cutter from end box so second box on tracer arm, set lower bar on graduation marked 1 and 2, and upper bar set on graduation 1.)

4. To set the Pantograph, proceed as outlined in paragraph 6, page 3. Never force the Pantograph bar blocks by striking with a hammer or any hard object. These blocks are moved before leaving the factory and, if at any time while setting the Pantograph, you find these blocks too tight, ascertain the cause. It may be that you have not loosened the nuts sufficiently, or they have become gummed with oil.

5. Use of Copy, Masters or Templates

The originals from which reproductions are made are known by various terms. "Copy" is the term most used. It applies specifically to the standard brass letters or type which are set up in the copy holder of the machine and which guide the Pantograph in reproducing. Shapes as distinguished from characters are also called masters, special copy, or templates.

6. Over 700 sizes and styles of special copy are listed in our 48 page Copy catalog. The examples shown on page 1 of the Copy catalog will give a good idea of the variety of forms available for Pantograph work. The setting up and use of standard copy on the machines, ordering instructions, etc., are given on pages 2 and 3 of the Copy catalog. For making up copy in special shapes, the descriptions on pages 20 to 27 of the Copy catalog will be found helpful.

7. The numerous illustrations of actual work, produced with various kinds of copy, in our 32 page Samples of Work catalog will also be helpful in considering copy.

8. Copy is not strictly self-spacing, therefore the spaces between the characters should be adjusted by inserting suitable blank spacers which are furnished with each set of copy. Each line when set in the copy holder should be confined without shake between the clamps furnished, as shown on page 2, Copy catalog.

9. After setting up the copy in the holder, and before engraving, be sure that the holder is firmly against the stop screws "N" or "T" (page 3) in copy holder base. It is then square with table. Do not disturb these stops. They are properly adjusted when machines leave factory, and any change will throw copy holder out of square with table. T slots in the machine table are also parallel with front edge of table. This is also true of T slots or dovetail grooves in copy holders. This makes it easy to set up work and copy in accurate parallel relation to each other.

10. When several lines of reversed copy are set up in a copy holder, an easy way to check for spelling and position of characters is by making a rubbing with a sheet of tissue, then look on reverse side and read.

MAKING SPECIAL COPY or MASTERS FOR FLAT or 2-DIMENSIONAL WORK

Enamel Board

When such, you groove characters or designs are to be cut in fairly soft materials as wood, Bakelite, fibre and sometimes brass, the design may be drawn on or transferred to a piece of Enamel board. Then, using a small knife or tool with a beveled edge ground to 90 degrees included angle, and having a slightly dulled point, run over the drawn lines. Press fairly hard so as to get a line $1/64"$ to $1/32"$ deep. Now smooth over this line with a hard lead pencil having a point approximately 90 degrees also. This smooths out the roughness. Then give the whole a coat of shellac for added stiffness. Enamel board copy should always be made up 3 to 10 times larger than the work, and never used to produce very accurate work.

Transparent Celluloid

Celluloid of any thickness that is transparent, preferably about $1/16"$, can be conveniently used as master copy for cutting in harder materials than given above under Enamel board, and is satisfactory for light cutting in steel. It is largely used for jewelry dies and other dies and molds where the entire design is cut into the die or mold. The transparency of this material permits having the drawing under the celluloid and cutting in the lines as described above, using a hollow ground 45 degree angle hand grinder. It is not necessary to go over the lines with pencil or to shellac as it is with Enamel board. An oily rag rubbed over the celluloid copy will cause the tracing style to follow the grooves more freely.

Linoleum

Linoleum such as artists use making black prints, about $1/8"$ thick, is also suitable for light cutting in steel and for the same character of work as the celluloid. We find that for linoleum it is best to use in the designs, using a round nose tool instead of an angular one. The tracing style of machine is then rendered to conform and polished for greater smoothness. A little oil rubbed on the copy helps the tracer to slide smoothly.

Brass

All Gorton standard copy is made of brass. It is the material most generally used where a permanent copy is desired and where it is necessary to do heavy cutting. Get Diagram's brass such as found on page 21 of Copy catalog. Ordinary brass is hard to work, and raises a heat when cut. Since brass is so much harder than any of the foregoing materials, it is not practical to work it with a hand tool and it will be found necessary to run the designs on a vertical mill, or by using the Paragraph machine spindle locked in the tracing position. Being the radii required for characters and designs with a circular table or by means of the graduated circle copy illustrated on page 22 of

Copy catalog. This latter device will be found very convenient even where a circular table is already at hand.

Dow Metal

This is obtained in sheet, rods, etc., from Dow Chemical Co., Midland, Michigan. This is lighter than aluminum and free cutting than other aluminum or brass. It is very useful for masters requiring deep cutting with small delicate corners.

Zinc

Zincs made by a photo-engraver, direct from a drawing, are often used for reproducing raised patterns of intricate design in steel dies. This process eliminates practically all hand work in producing the master, frequently saving much time. A drawing of the design, exact size of master desired or enlarged, is given to the photo-engraver and he reproduces it to the desired size in the zinc. Special instructions should be given to such the plates deeper than standard for ordinary printing practice $1/32"$ deep if possible. Before using the zinc on the Paragraph machine, wipe up all the lines to eliminate any ragged edges, and leave a square bevel on the cutting.

Hard Chrome

Hard chrome plated copy, both standard and special, can now be furnished. This is low expense steel copy and stands up well under hard usage.

Steel

For production work where copy will be used thousands of times and subjected to continual hard use, steel copy, hardened, is often used. This is particularly true where heavy cutting will be done, such as the printing illustrated in Samples of Work Cat.

Special Copy

We specialize in the making of special masters for those companies not having facilities or time to make their own.

Making Models for 3-Dimensional Work

Metal Models

For reproduction of extremely delicate detail such as might be required in a model for the final design on a silver spoon die, or a die simulating feathers on an eagle's head involving hair shafts of minute lines and radii, it is almost impossible to reproduce from anything except hard metal. Softer materials will chip or scratch, and if this happens when the die is almost finished, it is very often spoiled. There are several methods for making metal models.

WATER TIGHT
GORTON
FACING BRICK, U.S.A.

MAKING MODELS for 3-DIMENSIONAL WORK

Metal Models from Wax or Clay

Sculptor's models of wax or clay can be used as originals for the making of working models to use on the Paragonaph machine by pouring a stone mold around them as outlined under "Stone Composition Models." From this stone mold a hard alloy brass casting can be poured. Ordinary brass castings are too soft, but properly alloyed the material can be made extremely hard, so as to withstand pressure of the smallest tracing probe without denting or breaking off. Such hard alloy brass models are generally preferred for such delicate designs as are mentioned in the first paragraph.

Metal Models by the Enlarging Process

A new photographic process is now being used for making enlarged models. This method is being used successfully in many types of work. Full information can be obtained from the Prof. Gortank Am. Co., Columbus, Ohio.

Cast Iron and Bronze Models

These materials make good models, the cast iron being practically as good as a steel original, for all but the smallest relief designs, on which it is more apt to crack.

Metal Coating of Models

Several spray gun processes are now used for spray coating with almost any metal desired. One of these is known as Metallizing, the Metallizing Company of America, with branches in various sections of the country. By this process a harder brass, lead bronze or zinc, etc. We do not recommend the process for creating stress or wood models as the final metal coating (due to its decrease in density) does not take a perfect head and tends to loosen and crack under continued pressure of the tracer. See also below, "Material for proof casting and impressions."

Bakelite and Other Plastic Models

These materials make very good models, and can be easily worked by hand or with a milling cutter. Other materials than Bakelite which we recommend are: Castin, made by the American Castin Corporation, 1 Park Ave., New York City, or Mathlone made by the Mathlone Corporation, 37-21 Thirtieth St., Long Island City, N. Y. Any of these materials can be obtained in block, sheet, and rods. They can be sawed, drilled, planed, carved and polished.

Hard Wood Models

Hard wood can be used but we recommend the plastic materials as being harder and less likely to be dented by the tracing style. The size and shape of smallest tracing style will largely determine the hardness required in the model. When hard wood is used it should be cut or carved on the end grain if possible.

Stone Composition Models

For comparatively simple shapes, having smooth, flowing lines without sharp corners or projections which might chip off, stone models are very practical and the least expensive of all to make. They consist of a powder and liquid which is mixed

together and poured into a mold or around the original to be reproduced. The materials recommended, when fully set, in 12 to 30 hours have a tensile strength upwards of 1,000 lbs. per sq. inch with a smooth, hard surface. They do not expand, warp or crack and hold accurately to size and detail. These materials can be turned, planed, drilled, filed or finished and when fully set resemble marble in hardness. The material takes complete impressions for use. We recommend the following: Lava Compound, made by Stone Pattern Mosaic Co. of 1600 Broadway St., Philadelphia, Pa.; also Vitracite made by The S. Obermayer Co., 250 W. 18th St., Chicago, Ill., with branches in Cincinnati and Pittsburgh. In using these materials it is advisable to sprinkle model with powdered graphite.

In reproducing from stone composition models, the ground touch burrs shown on page 5 of Accessories catalog will be found very useful — an account of the many uses continuously is commensurate with the work, character and possibility of chipping the model is greatly reduced. These burrs will also produce an extremely smooth finish.

Materials for Proof Castings and Impressions

Stemuth Alloys

The Gen. de Pains Copper Corporation, at Wall St., New York City, make a Stemuth Alloy known as Certhase, which melts at 795 degrees F. and has a zero shrinkage. This is suitable for making proof castings of dies and models. It can also be used for models, but is softer and easily dented with a sharp tracing style. It is quite strong, however, and forms a good base for a hard spray gun coating or electrolytic coat of hard chromium. With this treatment it makes a very excellent model. Complete description and instructions for use are issued by its makers.

Scotch Tape

Double faced Scotch Tape is now being used extensively for use in making special masters and for holding down small work which cannot be held conveniently in clamps, vices or other work holding devices. To use, place tape on brass sheet, making sure tape is smooth, and press on, then place copy type or work on top of tape. Pressing down with other piece will make copy type or work held securely enough for any ordinary work.

Putty

Another very satisfactory and inexpensive material which we use altogether for making impressions of dies and models is our Gortank Impression Putty, put up in 1/2 lb. pails. This can be driven into the mold and pulled out, retaining its shape better than ordinary plaster or modeling clay commonly used. The material is lined in Accessories catalog. It is very hard and before using should be softened by keeping in a warm place or heating with the hands. In using, one piece is on the end of a hard wood block or dowel if for a small die, driving it in by striking the wood block with a hammer. To remove from die, pull over the wood block, and if care is used the putty will come with the block. Before applying the putty to die block, the die should be annealed slightly with the heat, or the powdered chalk or suspension sprinkled on so prevent the putty from sticking. If the putty cracks, it can be kneaded together when thoroughly warm.

COPY HOLDERS . . . USE OF TRACING STYLES

Fig. 3—Copy Set up in Copy Holder



Copy Holders

Copy is held on the machine by means of the copy holders provided for that purpose. A number of different styles and sizes are provided. These are illustrated on Page 9 of Accessories catalog. Where special copy is used exclusively, we recommend holder 36-1, or for very large copy plates, holder 36-1. Gorton standard brass copy characters have beveled edges fitting the beveled groove holders. All these holders are interchangeable, can quickly be removed from the machine whenever the work requires different sizes of copy, etc.

Use of Tracing Styles—Kinds

Three different kinds of tracing styles are used with Gorton Standard Pantograph machines. For all centering of sunk letters and designs from 90 degree Vee groove copy, as shown on page 3 of Copy catalog, style No. 3253-A (page 8, Accessories catalog) is used. For cutting sunk letters and designs from square bottom groove copy, also for relief (raised) letters and designs from relief copy, the 25-1 or 286-1 tracing style sets are used. See Accessories catalog, page 8.

For 3-B and 3-L 3-dimensional machines, round nose tracing styles are used a great deal. Such tracing style sets are illustrated on page 8, Accessories catalog.

Care and Use of Style 3253-A

This style should be kept ground to a cone of 90 degrees included angle in a Gorton cutter grinder by means of the 2/10" dia. collets which can be supplied for this purpose. See page 6, Accessories catalog. If the grinder is not of the collet type, use the small V block attachment furnished, and the small collet which slips on style. All sunk Vee groove copy is made to 90 degree angle and if the style is not accurately ground to this angle and kept sharp, the copies will soon be damaged so as to cause imperfect lettering.

Keep copy grooves clean by rubbing out several times a day with slightly greasy rag. This takes but a few seconds and style moves over the copy with much less effort. The style, when placed in the lines of the copy, should be clamped in its collar on the long arm of the Pantograph in such a way that no excessive straining of the Pantograph joints is caused. The slight springing when the style is moved from one letter to another will do no harm.

Care and Use of Styles 286-1, 25-1

These are for engraving raised letters and designs, or sunk lettering in which the thickness of line is not uniform, as it is with plain block letters. Where the reduction ratio is large, the styles and rollers 25-1 are used. Where it is small, and for final finishing, the styles with-out rollers (286-1) are used.

If the cutter is in the exact ratio of reduction to the styles to which the Pantograph is set, the forms engraved will be accurately proportioned to the forms of the copy. The exact size may be conveniently calculated in decimals of an inch by reducing the diameter marked on the roller in the ratio of reduction to which the Pantograph is set. Thus, if the Pantograph be set to reduce to one-tenth the size of copy, a cutter .60" diameter must be used with the 6" roller. It is generally desirable to use the largest roller with a proportionately large cutter to do the rough work of outlining and removing the bulk of the work, and to use the smaller rollers, or styles alone, with corresponding centers, only when necessary to reach into fine spaces or corners of the work.

Care and Use of Round Nose Tracing Styles

The same general rules apply as above, except that for accurate work the round nose of the style must be ground to exact radius, as well as the style diameter. The same instructions apply as for grinding round nose cutters, page 31.



Fig. 4
Using Sunk Vee Groove Copy on Machine



Fig. 5
Using Relief (Raised) Copy on Machine



Fig. 6
Using Model on 3-Dimensional Machine

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USE OF FORMING GUIDE

For curved work on all 2-dimensional type Gorton Pantograph machines a hardened steel forming guide is necessary in addition to the flat copy or master template. Illustrations of the forming guide in use are shown on these pages and in the Samples of Work Catalog. Various types of forming guides are illustrated here.

The forming guide should be the exact opposite of the work and preferably made of tool steel hardened. For instance, if the work is convex, the forming guide should be concave. Before using, it should be matched with work, through the use of lamp black, mechanic's blue, etc.

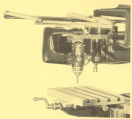
The making of forming guides can be avoided, in many cases, through the use of adjustable forming guides, described in Pantograph Catalog 1580. These save the expense of making hardened guides from solid steel blocks.

Forming guides may be made by turning on a lathe, shaping on a shaper, milled with a formed cutter or by hand with a file or hand grinder.

The forming guide is secured to the forming bar by means of four small screws in position shown in photographs.

Assuming that the work is secured to the work table and copy on copy holder the general procedure is as follows: (A detailed account of one particular setup is described later).

1. Check to see that cutter point and former point are approximately the same size, especially on a small radius.



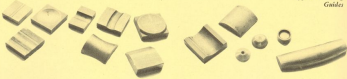
2. Lock spindle floating movement and locate work in relation to copy.
3. Release spindle floating movement and allow former point to come in contact with guide, which should be directly above work.
4. Extreme care should be observed in locating forming guide in relation to work. Place a cutter blank, having a conical point, in the cutter spindle and raise work close to cutter. Now move the cutter point over surface of work by moving tracing style.

If the point does not follow the curved surface of the work, move work table in the necessary direction.

5. When the work is in direct relation with the forming guide, the copy will probably be found out of alignment with work, due to moving the table.
6. Copy should now be located by shifting it back and forth and placing tracing style at extreme points, noting when cutter point locates laterally with work. After lining up, lock the table and do not move again.
7. Cover forming guide with grease so former point will slide without friction.

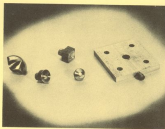
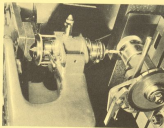
When this has been done, the engraving can proceed without further thought to the forming guide. The spring in the spindle will always keep the former point secure against the guide, thus causing the cutter to follow the same course as the forming guide surface.

Typical Forming Guides



SETUP TO ENGRAVE STRAIGHT DIAL

MADE IN U.S.A.
GORTON
 TRADE MARK, U.S.A.



Place dial on work holder 53-1 or 256-1 and make sure dial is running true by indicating within .002". Square work holder with table T-slots and clamp tight. Fasten forming guide, exactly the opposite shape of the dial, to former bar—square with the bar.

For this work, we should use circular copy holder 33-1 in which copy cannot be shifted sideways, making it necessary to shift work instead, when lining up.

Turn copy dial to zero, which should have a center line. Place tracing style in center line and place a point in spindle. Then line point with approximate center of dial. Loosen former lock pin in front of spindle and make sure spindle works free and that the former point follows guide perfectly.

If spindle does not "float" freely, it may be due to belt tension being too great. If spindle sticks after adjusting belt, remove spindle, clean and coat with light oil.

Bring point to about $1/16"$ from work, then move tracer to see if point follows job surface for about $3/4"$ each side of center line. If it appears to follow closely, move the work closer to point and continue to move style back and forth. As the point gets closer to the work check to see if the point comes closer to one side than the other of the dial. Compensate by moving table until the point follows surface perfectly.

Next loosen nut holding dial in place and turn it until the index line, which is to match the zero,

lines up with point when style is in the center line on master.

The job is now ready to be engraved. Remove point and place cutter in spindle. Cutters ground 30 degrees are recommended for most work of this kind. Use cutters suited to job if it runs eccentric or a steeper angle is preferred. Cut about .007" deep for numbers.

General Forming Guide Setups

1. Concave surfaces are primarily the same as described for straight dial work.
2. Jobs where whole copy plates are used are treated practically the same as the above, with the exception of truing the job up with the former, then placing point in center of job and moving copy plate until style point falls in center hole of copy.
3. Jewelers find that for intricate work a special Matrix Feed Works No. 205-2 (shown in Pantograph catalog) proves quite useful. This device gives the operator more feel and control of the cutter, resulting in greatly increased accuracy of work.
4. In jewelry die work, operators find it works well to use drill rod blanks turned to the proper form and hardened. These blanks are turned to a $5/16"$ shaft. These formers fit a special holder which fastens onto the former bar the same as a solid forming guide. Formers may be changed in this holder in a few seconds. (Holder and a few guides are shown in photograph on this page.)

THE GORTON
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ROLL ATTACHMENTS

727-1 ROLL ATTACHMENT

Mounting

On 3-L 3-dimensional machines, place graduated scale of roll attachment toward operator's position. On other late model Patograph machines, the scale should point towards front of machine.

Lower machine table and wipe clean. Match both holes in attachment with Tuckon and adjuster bolts in place, making sure attachment is square with front of table. Free lock on top slide and lower base to permit attachment to move freely. On 3-L and 3-U machines shipped since June, 1949, spindles have been prepared for use with the roll attachment. Older machines of these models and all 3-Z and 3-B machines must have spindles prepared for mounting the attachment. This may be done by the user, or the spindle may be shipped to the factory to be fitted free of charge.

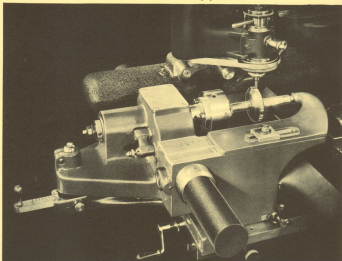
ON 2-DIMENSIONAL MACHINES: Belt must be removed and belt tension rod and brass lock that fit against spindle removed by loosening slip nut. Then lock spindle in lower position. Next insert dowel pins of attachment connecting bracket into counterbore with set screws. Then replace belt tension rod and nut lock over proper pulley and tighten.

ON 3-DIMENSIONAL MACHINES: Frame bracket connecting with upper slide of attachment over machine spindle, when spindle is locked in lowest position. It is not necessary to remove bolts or tension rods on these machines.

Rotation of attachment spindle is accomplished by a steel band, running over rollers, under sufficient tension to prevent slippage of the spindle. The band is adjusted before leaving the factory, and should not require any attention for a long time. If this band should require tightening, remove the saddle by loosening the small set screws. The tension adjusting screws can then be adjusted to exert exact tension on the band. Excessive tension should not be applied, only enough to prevent the spindle from slipping. If the band is too tight it will cause the mechanism to drag, and not operate as sensitively as it should. Band should be left lax when attachment is not in use.

For mounting work on the attachment spindle, the tension on the band should be released by means of the small lever with plunger locking pin, bringing it to an up-position. The spindle and work can then be rotated freely without any movement of the carriage slide and the work can then be properly lined up and the lever returned to its locked position, which will auto-

Roll Attachment 727-1 on 3-U Patograph Machine



SET-UP AND OPERATION

TRADE MARK
GORTON
MACHINE WORKS

manually tighten the hand to its original position. As the lever is moved to its latched position, the work may rotate slightly and if it is necessary to line the job up accurately with the center, it is only necessary to move the table slightly with the table screw.

Work placed on the machine may be held with a chuck, arbor or special fixture, and should be accurate to .001". Check attachment to see that it runs true with the copy holder, by placing a point in the spindle, and marking marking style along edge of copy holder to see if the point follows edge of roll to be engraved. If the point does not follow properly, loose flangeing bolts and adjust attachment on table until roll is parallel with spindle axis.

Measure diameter of roll to be engraved, loose brass thrust screws holding engraved scale and set scale for proper diameter. Each graduation on scale is for $\frac{1}{16}$ " of diameter. Then center work with master.

Replace point in machine spindle with center and proceed with engraving the same as on flat work, with the exception of making lighter cuts. Center must be kept sharp, even more so than for highly accurate flat engraving, to insure a clean, even cut.

It is important that the ball bearing slides be kept clean and free from chips. While the slides are protected by shields and bearing clip apertures, the use of an air blast in cleaning the machine may

force some chips into the ball bearings, causing the slides to stick and possibly damage them. For this reason it is advisable to use a brush for removing chips.

750-1 ROLL ATTACHMENT

Roll Attachment 750-1 can be used only with 3-L and 3-Z machines. On these machines the setting and operation is exactly the same as with the 727-1 Roll Attachment, the operation of which is described above, except that only one-half the roll, regardless of diameter, can be engraved at one setting.

The graduated scale is set for the exact diameter of the roll to be engraved (each graduation represents $\frac{1}{16}$ " of diameter) and engraving started, first making sure the engraving to be done will exactly surround the roll or portion of roll to be covered.

When half the roll has been engraved, release drive hand tension by means of the small lever with locking pin holding it to its up-position. Then revolve roll until work corresponds with copy with fine character of copy remaining to be engraved following last character engraved. It will be necessary to start copy in most cases, moving unsharpened portion to opposite end of copy holder. (An aid in resetting work is the carrying over of the last character engraved so that copy and work can be lined up accurately.)

Otherwise, proceed exactly as with the 727-1 Roll Attachment.

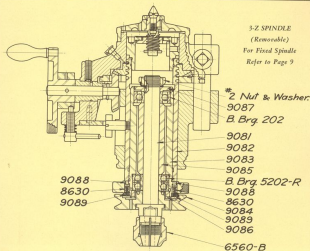


Photo 31

— GORTON —
GORTON
MACHINE AND TOOL CO.

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 carefully 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 265-5 grinder, as shown in separate booklet. Both these machines do the same class of work and operate in the same manner. The 375-2 is the more expensive and has many refinements not incorporated in the 265-5.

If no cutter grinding equipment is available, Gorton taper shank cutters can be ground on the Pantograph machine by using the mounted wheels described on page 23, Accessories catalog. Use maximum speed of 8,600 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 54. 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 32, 33, 34.

Grinding Wheels

The wrong grade of wheel will easily draw the temper of small cutters and make them soft. Use the correct grade of wheel. Suggested grades for different purposes are listed on page 23 of Accessories catalog. 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 on page 23 of 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

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GORTON
INC. WILM., DEL.

Truing Grinding Wheel—Fig. 1

Before grinding cutter, true up the grinding wheel using diamond tool 7566-A (Aerocut cutting) which is furnished with grinder. This tool has a super shank and can be inserted in grinders having tool heads fitting Gorton super shank tools only, or it can be held on its diameter in a $\frac{1}{8}$ " roller in any of the collar 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. Use as few diameters of an inch should be the very maximum. If the diamond fails to cut freely, loosen it, and run slightly in the tool head, so as to present a new and unused portion of the diamond to the wheel.

Rough and Finish Grinding Conical Point — Figs. 2 & 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 tool stamps for various work are given on page 39. For most work lenox or design engineering 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 flutes like Fig. 3, left. Now, grind off the flutes 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.

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 safe full to 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 readily appear 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 safe full.

In grinding off flat, always keep it square with original surface — to do this it will be found necessary to lock the tool head spindle with the indexing plunger set in No. 4 hole. Now, using the gauge 5864 furnished with all 7171 Tool Heads, square up center and tighten collar nut. Then setting tool head spindle 90 degrees, plug in next No. 4 hole to square flat with wheel.

Grinding Chip Clearance

The center 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 bar 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 of Cutting Edge	Clearance	Angle of Cutting Edge	Clearance
45	.40	25	.21
40	.35	20	.17
35	.30	15	.15
30	.25	10	.10
		5	.07

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 to a desired angle, to 45 degrees, then a 40 degree clearance angle will be used. Set the tool head back to 45 degrees.



Fig. 1—Truing Wheel



Fig. 2—Set Tool Head to Desired Cutter Angle



Fig. 3—Rough and Finished Conical Shape

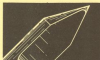


Fig. 4—Flat not Ground to Center



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

New tool cutter into face of wheel very gently. Do not retreat and hold the back (round side) of central point against wheel. Gradually feed in toward wheel rocking the cutter continuously across face of wheel and without retreating, until a flat is ground which runs out exactly as the point of cutter, as Fig. 5. 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 cutting, do final handwheel any further, rough away stock as Fig. 3, then rotate cutter against face of wheel as Fig. 6, grinding away all stock on back of central side, up to the cutting edge. Be extremely careful so this point out to turn the cutter too far, and then grind away part of the cutting edge. All clearance 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 diagram. This is where the cutting is done. If this very point is not correctly ground, the cutter will not work, regardless of how perfect it may be farther out on the top of case. A section through the cutter should now be like Fig. 8, and an external view like Fig. 9. Here in Fig. 9 we have again called attention to the point that does all the work with the small circle. Watch this point!

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 re-sharpen 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 5 degrees. This causes the cutter to bite into the work like a chisel, 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".

Bake Angle Table for All Single Flute Cutters

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

Caution

In all feed grinding operations extreme care should be taken not to retreat (over) the cutting edge. This can be done by (1) Feeding too fast into the wheel, (2) Retreating too much stock at a pass, (3) Holding cutter continuously against the wheel, (4) Failure to keep the wheel true and clean as recommended page 29. 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 so dressed so far regarding hair lines proves 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 their should always be tipped off as explained above and Fig. 9, unless all the cutting will be done with the side of corner, 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 Figs. 7 and 8. After grinding the flat top corner (which is very easily checked with this style center by using a microscope) clearance is provided by feeding in the required amount toward wheel and turning the cutter until all slack has been removed from the back (round side) right up to the cutting edge, as Fig. 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. over	Clearance	Cutter Dia. over	Clearance
1/16".....004"	1/2".....014"	Example: To grind clearance on a 1/16" dia. Square Nose cutter. Grind the flat as outlined above. Then feed back (toward side) of cutter against wheel until it just touches. Then feed to .001" and rotate cutter so as to grind away all material except cutting edge.	
1/8".....006"	5/16".....017"		
5/32".....009"	3/8".....021"		
1/4".....012"	7/16".....025"		
3/16".....018"	1/2".....030"		

Ball Nose Cutters — Figs. 12, 13 and 14

Corson 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. Of the ball nose cutter is to have straight sides like Fig. 12 — or as explained above for Conical nose cutters, if the cutter is to have a conical side as in Fig. 14.

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

Tip the cutter tool head so the correct angle in degrees, setting to the Bore Angle Scale, W page 21 and using the tables for clearance angle "B" Fig. 12 recommended for cutters to be used on maximum liquid shank. 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 angle, it is necessary to set the collet spindle at center so obtain a perfect radius. This is accomplished by loosening screw "U" (Draw. 9846, page 21) one-half turn and turning the knurled handwheel back toward the left approximately .004" for every 1/16" of cutter diameter. To release spindle on center, turn screw step back one-half turn to its original position with handwheel set at zero.

For grinding a corner radius on a cutter, proceed as follows: Subtract radius desired plus .004" for every 1/16" of cutter diameter from 1/2 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 21. Now swing head through an arc of 90 degrees until radius is formed on corner blank, using stop to provide 90 degree movement for blending ball into side of corner.

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 size spindle is turned. About ten settings of head should rough grind the clearance.

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WHEELS AND TOOLS



Fig. 11—Square Nose Cutter with Properly Ground Tip



Fig. 12—Properly Ground Ball Nose Cutter



Fig. 13—Tilting Ball Nose Cutter for Clearance
Use Gauge 9839



Fig. 14—Ball Nose Cutter with Conical Side

WALTER
GORTON
MACH. TOOL, U.S.A.



Fig. 15—3-Sided Cutter

Keep your cutters sharp. A dirty collet or spindle taper will cause cutters to run out of true.

A spindle worn in the taper, or collet hole, or in its bearings is a prolific source of cutter troubles.

Cutters may break or dull from defective steel or wrong temper, but it does not follow that all troubles are from that cause.

Be careful not to feed small cutters beyond the strength of the material of which they are made.

Feed fine small cutters much slower than you would a larger cutter.

Light Cutter Spindle Belts
For extremely delicate work we would suggest the use of lighter endless linen belts than are ordinarily used.

These belts operate the cutter spindles smoother and with less vibration. We can furnish these belts when desired, at a slightly higher cost than standard belts.



Grinding Cutter with Attachment 288-1

GRINDING THREE and FOUR SIDED CUTTERS

Finish Grinding Chip Clearance on Ball Nose

New feed cutter (round wheel) with beveled sides must be handshod X exactly the amount of clearance in dimensions called for in table page 31. Swing the tool head back and forth, using stop Y, page 21 to limit travel on cutting edge side, until approximate center of ball is finished.

Grinding Three and Four Sided Cutters — Fig. 15

Three or four sided cutters are sometimes used for turning small shafts and other small engraving. They produce a very smooth finish. The index plate on collar 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 face.

Grinding Clearance Angle

New without lowering the cutter in collet of tool head, raise 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. Referencing to the table gives 20½ degree clearance. Set tool head to 20½ 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.

Table of Clearance Angles for 3 and 4 Sided Cutters

3 Sides Degrees	Angle of Clear- ance Degrees	4 Sides Degrees	Angle of Clear- ance Degrees
45	20½	45	15½
40	22	40	16
35	24½	35	17½
30	26	30	18½
25	28	25	19½
20	30½	20	20
15	33½	15	10
10	36	10	7
5	39½	5	3½

GRINDING CUTTERS WITH ATTACHMENT 288-1 ON PANTOGRAPH MACHINES

First: Insert Pantograph style into hole in copy holder. This both cutter head rigid. If cutter head is equipped with depth gauge, loosen face nut and swing face outward. Now insert grinding wheel and ball cutter holder face in place, with corner point at inside edge of wheel, all in plane as lower right.

Remove cutter holder by lifting spring slightly and insert cutter rigidly, using small wrench. Replace cutter holder and grind corner 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 30, which means grinding away the usual 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 corner point.

By raising cutter (ball nose) 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 file, if necessary.

SUGGESTIONS ON OPERATION OF CUTTERS

—1922—
GORTON
CUTTER WORKS, U.S.A.

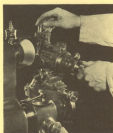
Grinding Very Fine Cutter Points

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 *forward*, or the flat is either *too high* or *too low*. Perhaps the clearance does not run clear out to the point. Sometimes scoring off the flat with a small fine oil stone will make the cutting edge keener.

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, $.205'$ to $.015'$ depth of cut, grind the cutter



Grinding a Spiral Flute Cutter on 373-2 Cutter Grinder with 717-1 Universal Tool Head

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

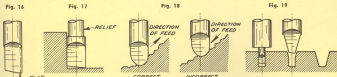
When the cutter (if taper shank) in the spindle is very tight. Do not continue with a cutter if it comes loose, or the spindle will be worn so that no cutter can be held properly. If this happens, check taper of cutter in spindle by rubbing on a little Prussian blue. The cutter should fit more tightly 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.

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 50 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 speeds as a dull cutter wears 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.

Fig. 16 — Scoring 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 is 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 full depth as shown at left. The taper sides are then milled out using a taper cutter.



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CUTTER SPEED CHART

Revolutions per minute for High Speed Steel Cutters, single flute type.
Use two-thirds of speeds shown for 2 and 4, one-half speeds for 6 flute end mills.

Cutter Diameter (or cutting point)	1/32"	1/16"	1/8"	3/16"	1/4"	5/16"	3/8"	7/16"	1/2"
Hard Wood (550-800 Ft. per Min.)	10,000 to 20,000	Diets	Diets	Diets	Diets	5,000	8,000	7,000	6,000
*Bakelite (170-250 Ft. per Min.)	10,000	8,000	6,000	4,000	3,000	2,200	1,800	1,500	1,300
Hagston's Brass and Aluminum (175-425 Ft. per Min.)	10,000 to 15,000	10,000 to 10,000	10,000 to 15,000	8,000	6,000	5,000	4,000	3,500	3,000
Cast Iron (170-250 Ft. per Min.)	8,000	7,500	5,500	3,500	2,500	2,000	1,650	1,400	1,200
Hard Bronze and Machine Steel (60-300 Ft. per Min.)	7,000	6,000	3,000	2,200	1,600	1,200	975	800	700
Annealed Tool Steel (70-100 Ft. per Min.)	5,000	4,500	2,500	1,600	1,200	1,000	850	725	600
Stainless, Monel, Etc. (40-75 Ft. per Min.)	3,500	2,750	1,600	1,050	700	575	500	435	350
Very Hard Die and Alloy Steels (80-45 Ft. per Min.)	2,000	1,250	800	600	475	400	350	300	250

*Also cellulosid, hard rubber, ivory, and synthetic plastics.

Tungsten or Tantalum carbide cutters can be run at much higher speeds on wood, Bakelite, brass, aluminum, and cast iron than given in table. They are not recommended in these small sizes, for harder materials.

†Slightly lower speeds for ordinary brass, zinc, copper, silver, gold, soft bronzes, Gorton silicon.

‡Diamond cutters—same speeds for all materials as for cutting in brass with usual cutters.

USING THE CHART

The speeds worked out on the chart above are the result of our own experience over a period of years, coupled with what is considered good modern practice. In using the chart it must be kept in mind that the speeds recommended will vary greatly, depending on the depth of cut, and particularly the rate at which the cutter is fed through the work. Since Gorton machines are fed manually the rate of feed is subject to a wide variation in the hands of individual operators, which will in many cases affect the spindle speeds used. The experienced operator will have found by trial the speeds and feeds best suited to his own work and for him this chart is only a means of comparison. It will be found invaluable however, for the inexperienced operator or persons not familiar with the operation of the small, high speed cutters used in Gorton machines.

ROUGHING CUTS

Considerable latitude has been given in the recommended Ft. per Min. cutting speeds listed after the various materials. In most instances the minimum Ft. per Min. speeds were used for calculating the RPM given on the chart. Consequently these chart speeds may be used for most medium roughing cuts. For a very heavy roughing cut, where considerable stock is removed, it may be necessary to use slower speeds than the chart. For these cuts

much depends on the rate at which cutter is fed through the work. For any given depth of cut the speed must be decreased as the feed is increased.

FINISHING CUTS

Considerably higher speeds than given on the chart may be used for finishing cuts where a very slight amount of stock is removed. Take for instance the chart speeds for cutting cast iron. These are based on the lowest, 150 Ft. per Min. rate and are intended for use in taking roughing cuts. For finishing in some instances, the rate of 250 Ft. per Min. might be used, which would mean speeds almost double those given on the chart.

HELPFUL SUGGESTIONS

With all Pantographs and Duplicators, run cutters at highest speeds possible, and remove stock with several light, fast cuts rather than one heavy cut at slower spindle speeds. Always use the highest speed possible without burning the cutter. In cutting steel, and all hard materials, start with a slow speed and work up to the fastest which cutter will stand without losing its cutting edge. Sometimes it may be advisable to sacrifice cutter life in order to obtain the smoother finish possible at higher speeds. With a little experience, the operator can feel when the cutter is running at maximum efficiency.

CUTTERS, MATERIALS, CUTTING LUBRICANTS

Cutter Steels

For average work in steel, cast iron and brass the best cutting tools we have found are high speed steel. For a limited amount of work which requires a very keen, hard cutting edge, but no high speeds or feeds, our Special Carbon steel is best. (See page 5, Accessories catalog.)

Cutters of New Hard Alloys

We have tested the new hard alloy cutters known by trade names such as Carboloy, Widia, Ramet, etc., and recommend them very highly for cutting soft abrasive materials like Bakelite, hard rubber, celluloid and all other synthetic plastics. On these materials such cutters have 15 to 20 times greater life between grinds than the best high speed steels. On tests we have cut the equivalent of 50,000 letters $\frac{1}{8}$ " high in Bakelite panels without regrinding cutter, and without the cutter showing appreciable wear. On rubber rolls we have used similar cutters for 50 hours without regrinding. For all this work we list on page 4, Accessories catalog. Carboloy blanks for insertion in 21-2, 22-4 collets (listed in Accessories catalog page 6) also larger dia. blanks for holding in regular collets, and inserted Carboloy tipped Cutters.

Characteristics of New Hard Alloys

These cutters are not suited, however, to work requiring frequent grinding of tip to various angles and clearances, since they are almost as hard as a diamond and require special wheels for grinding. These cutter materials are formed of very hard small grains held together by a bond. On account of this granular structure it is almost impossible to grind such cutters to a fine, keen point for the very finest line engraving, but points small enough for engraving $\frac{3}{32}$ " and $\frac{1}{8}$ " high characters can be maintained. We have special equipment for grinding these cutters and can supply any angle and clearance, or customer can grind them (see Grinding, page 31).



Sample Cutters Used on Gorton
Photograph Machines

Ordering New Hard Alloys

These new hard alloys are made in a great many different grades and hardnesses for every condition of service. In ordering such cutters, it is necessary to state the materials desired to cut, and general information regarding operating conditions, to insure receiving correct grade and type.

Diamond Cutters

For engraving lettering on glass and hardened steel, diamond cutters can be furnished; see Accessories catalog, page 4. They will engrave a line .003' to .005' deep. They are run at 10,000

R.P.M. or more.

Cutting Lubricants

For all grades of steels shown on the chart, page 36, any good cutting oil or mineral lard oil is best, although it is not always necessary to use a lubricant with small cutters. These oils can be obtained from such concerns as Socony Vacuum Oil Company, Sun Oil Co., E. F. Houghton, etc. For die work or any purpose requiring maximum visibility at all times use an emulsifying oil or some similar light thin compound rather than a dark, heavy base oil. The heavy base oils cover up the work completely and hinder chip removal, making it difficult for the operator to see what he is doing. For cast iron, Bakelite (and associated materials on chart) also brass, no lubricant is necessary. Houghton's "Fropol" is good for cutting stainless steel and Monel metal, although these new steels are made in over 30 different grades, with greatly varying characteristics.

For fine cutting in aluminum or to avoid burrs, use half lard oil and kerosene, mixed. For engraving glass or hardened steel with a diamond cutter, flood the work with turpentine and do not allow to dry.

For cutting plastics or cast iron with the new hard alloy cutters as Carboloy, Widia, etc., no lubricant is necessary.

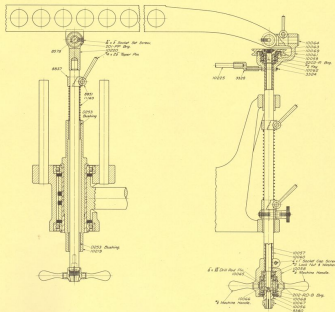
Photo 39

GORTON
MACHINE CO. U.S.A.

ENLARGING SPINDLE 747-1

To mount Enlarging Spindle 747-1 on S-L machine first remove modelling bar, belt tension rod, cutter spindle (by unscrewing), and spindle yoke. Next place large bushings, furnished with attachment, in former position of spindle, inserting from the top. Remove the tracer spindle from its normal position and mount in large bushing, locking smaller roller yoke to top of tracer spindle and using special spring furnished with assembly to balance spindle. Tension on this spring may be adjusted with clamp collar placed on spindle above spring.

Assemble auxiliary cutter spindle in former tracer position and use tracer spring and clamp bushings to balance. Replace belt tension rod with long one furnished, attaching to auxiliary spindle, and replace modelling bar. Unit is now ready for operation and requires only that Pantograph bars be set for the desired enlargement. We do not recommend using enlargements greater than two or three. Enlargement settings are exactly the same as for reductions when machine is used in its normal operation.



CUTTING STEEL DIES AND STAMPS

Die Steel

A high grade of well annealed tool steel should be used. Very tough steels may be necessary on some stamps intended for severe service, but for most work a freer cutting steel will be just as serviceable and much easier to cut. The time and trouble saved in cutting more than makes up for the higher cost of a good steel. Use enough lubricant to avoid burning the cutters. Single lip cutters cut freest but 3 or 4 sided cutters are sometimes useful for finishing as they leave a smooth finish.

Proportions of Steel Stamp Letters

A practical way to proportion steel stamps is to make the raised height of stamp about 1/6 of the height of the characters (on the center line). For instance, if the letter is .125" printed height, then the raised height of stamp would be .021". (See diagram.)



For roughing always use the largest diameter tracing style possible. If your tracing style is too large to pass through some portions of the copy, that will make no difference.

Raise cutter out of work and pass the style to the next portion of copy where it will

trace through, etc. Three sizes of cutters are generally used, the last one for removing only 3 or 4 thousandths of stock. Eighty percent of material is removed with the first cut.

Corners of Letters

Corners can be removed by "stepping up." Set the cutter at half depth when stamp is otherwise finished, and use a tracing style as small as possible without under-cutting.

Recommended Angles for Relief Characters

The taper desired on relief characters will determine the angle to which the cutter is ground. On

stamps designed for hard use, such as large, heavy steel stamps, the characters should be cut with a cutter having an angle of 37 to 45 degrees (on a side) on the cutting edge. For light steel stamps, to be used on brass, copper, lead and other soft materials, 25 to 35 degrees will be found strong enough. For stamps to be used on wood, 10 or 15 degrees on the cutting edge is sufficient.

Determining Cutter Angles for Sunk Characters

It may frequently be necessary to engrave sunk characters to a predetermined width of face. To find this, when the angle of cutter is known, simply multiply by the proper tangent, then multiply the result by two (2). Below is a table of tangents. (More complete tables can be found in any Machinist Hand Book.)

15	degrees	=	.267
17	"	=	.305
20	"	=	.364
22.5	"	=	.414
25	"	=	.466
30	"	=	.577
33	"	=	.649
35	"	=	.700
37.5	"	=	.767
40	"	=	.839
42.5	"	=	.916
45	"	=	1.000

Example: If a 60 degree included angle cutter is being used and depth of cut is .012", multiply the tangent of 30 degrees (.577) by the depth, which will equal .0069". Multiply this by two which will equal .0138", or the face of cut. If the cutter is to be used with the point "tipped off", proceed as above and add the diameter of the cutter tip.

NOTE: The width of face in all cases above is taken at surface of work.

REDUCTION SCHEDULES in INCHES and MILLIMETERS

MADE IN U.S.A.
GORTON
EASTON, W.V. U.S.A.

988-A			
SCHEDULE OF REDUCTIONS FOR ENGRAVING MACHINES NOS. 1D, 1J, 3D, 3J, 3U, 3Z.			
REDUCTION	LOWER BAR (MILLIMETERS)	UPPER BAR (MILLIMETERS)	UPPER BAR (INCHES)
2.00	0.000	0.000	0.000
2.10	0.017	0.133	0.005
2.20	0.033	0.267	0.010
2.30	0.050	0.400	0.015
2.40	0.067	0.533	0.020
2.50	0.083	0.667	0.025
2.60	0.100	0.800	0.030
2.70	0.117	0.933	0.035
2.80	0.133	1.067	0.040
2.90	0.150	1.200	0.045
3.00	0.167	1.333	0.050
3.10	0.183	1.467	0.055
3.20	0.200	1.600	0.060
3.30	0.217	1.733	0.065
3.40	0.233	1.867	0.070
3.50	0.250	2.000	0.075
3.60	0.267	2.133	0.080
3.70	0.283	2.267	0.085
3.80	0.300	2.400	0.090
3.90	0.317	2.533	0.095
4.00	0.333	2.667	0.100
4.10	0.350	2.800	0.105
4.20	0.367	2.933	0.110
4.30	0.383	3.067	0.115
4.40	0.400	3.200	0.120
4.50	0.417	3.333	0.125
4.60	0.433	3.467	0.130
4.70	0.450	3.600	0.135
4.80	0.467	3.733	0.140
4.90	0.483	3.867	0.145
5.00	0.500	4.000	0.150
5.10	0.517	4.133	0.155
5.20	0.533	4.267	0.160
5.30	0.550	4.400	0.165
5.40	0.567	4.533	0.170
5.50	0.583	4.667	0.175
5.60	0.600	4.800	0.180
5.70	0.617	4.933	0.185
5.80	0.633	5.067	0.190
5.90	0.650	5.200	0.195
6.00	0.667	5.333	0.200
6.10	0.683	5.467	0.205
6.20	0.700	5.600	0.210
6.30	0.717	5.733	0.215
6.40	0.733	5.867	0.220
6.50	0.750	6.000	0.225
6.60	0.767	6.133	0.230
6.70	0.783	6.267	0.235
6.80	0.800	6.400	0.240
6.90	0.817	6.533	0.245
7.00	0.833	6.667	0.250
7.10	0.850	6.800	0.255
7.20	0.867	6.933	0.260
7.30	0.883	7.067	0.265
7.40	0.900	7.200	0.270
7.50	0.917	7.333	0.275
7.60	0.933	7.467	0.280
7.70	0.950	7.600	0.285
7.80	0.967	7.733	0.290
7.90	0.983	7.867	0.295
8.00	1.000	8.000	0.300
8.10	1.017	8.133	0.305
8.20	1.033	8.267	0.310
8.30	1.050	8.400	0.315
8.40	1.067	8.533	0.320
8.50	1.083	8.667	0.325
8.60	1.100	8.800	0.330
8.70	1.117	8.933	0.335
8.80	1.133	9.067	0.340
8.90	1.150	9.200	0.345
9.00	1.167	9.333	0.350
9.10	1.183	9.467	0.355
9.20	1.200	9.600	0.360
9.30	1.217	9.733	0.365
9.40	1.233	9.867	0.370
9.50	1.250	10.000	0.375
9.60	1.267	10.133	0.380
9.70	1.283	10.267	0.385
9.80	1.300	10.400	0.390
9.90	1.317	10.533	0.395
10.00	1.333	10.667	0.400
10.10	1.350	10.800	0.405
10.20	1.367	10.933	0.410
10.30	1.383	11.067	0.415
10.40	1.400	11.200	0.420
10.50	1.417	11.333	0.425
10.60	1.433	11.467	0.430
10.70	1.450	11.600	0.435
10.80	1.467	11.733	0.440
10.90	1.483	11.867	0.445
11.00	1.500	12.000	0.450
11.10	1.517	12.133	0.455
11.20	1.533	12.267	0.460
11.30	1.550	12.400	0.465
11.40	1.567	12.533	0.470
11.50	1.583	12.667	0.475
11.60	1.600	12.800	0.480
11.70	1.617	12.933	0.485
11.80	1.633	13.067	0.490
11.90	1.650	13.200	0.495
12.00	1.667	13.333	0.500
12.10	1.683	13.467	0.505
12.20	1.700	13.600	0.510
12.30	1.717	13.733	0.515
12.40	1.733	13.867	0.520
12.50	1.750	14.000	0.525
12.60	1.767	14.133	0.530
12.70	1.783	14.267	0.535
12.80	1.800	14.400	0.540
12.90	1.817	14.533	0.545
13.00	1.833	14.667	0.550
13.10	1.850	14.800	0.555
13.20	1.867	14.933	0.560
13.30	1.883	15.067	0.565
13.40	1.900	15.200	0.570
13.50	1.917	15.333	0.575
13.60	1.933	15.467	0.580
13.70	1.950	15.600	0.585
13.80	1.967	15.733	0.590
13.90	1.983	15.867	0.595
14.00	2.000	16.000	0.600
14.10	2.017	16.133	0.605
14.20	2.033	16.267	0.610
14.30	2.050	16.400	0.615
14.40	2.067	16.533	0.620
14.50	2.083	16.667	0.625
14.60	2.100	16.800	0.630
14.70	2.117	16.933	0.635
14.80	2.133	17.067	0.640
14.90	2.150	17.200	0.645
15.00	2.167	17.333	0.650
15.10	2.183	17.467	0.655
15.20	2.200	17.600	0.660
15.30	2.217	17.733	0.665
15.40	2.233	17.867	0.670
15.50	2.250	18.000	0.675
15.60	2.267	18.133	0.680
15.70	2.283	18.267	0.685
15.80	2.300	18.400	0.690
15.90	2.317	18.533	0.695
16.00	2.333	18.667	0.700

NOTE—
Only 3-U, 5-Z
machines will
operate be-
tween reduc-
tions 1 and 2.

For reductions
from 1 to 2,
see chart 7561.

989-A			
SCHEDULE OF REDUCTIONS FOR ENGRAVING MACHINES NOS. 1D, 1J, 3D, 3J, 3U, 3Z.			
REDUCTION	LOWER BAR (MILLIMETERS)	UPPER BAR (MILLIMETERS)	UPPER BAR (INCHES)
2.00	0.000	0.000	0.000
2.10	0.017	0.133	0.005
2.20	0.033	0.267	0.010
2.30	0.050	0.400	0.015
2.40	0.067	0.533	0.020
2.50	0.083	0.667	0.025
2.60	0.100	0.800	0.030
2.70	0.117	0.933	0.035
2.80	0.133	1.067	0.040
2.90	0.150	1.200	0.045
3.00	0.167	1.333	0.050
3.10	0.183	1.467	0.055
3.20	0.200	1.600	0.060
3.30	0.217	1.733	0.065
3.40	0.233	1.867	0.070
3.50	0.250	2.000	0.075
3.60	0.267	2.133	0.080
3.70	0.283	2.267	0.085
3.80	0.300	2.400	0.090
3.90	0.317	2.533	0.095
4.00	0.333	2.667	0.100
4.10	0.350	2.800	0.105
4.20	0.367	2.933	0.110
4.30	0.383	3.067	0.115
4.40	0.400	3.200	0.120
4.50	0.417	3.333	0.125
4.60	0.433	3.467	0.130
4.70	0.450	3.600	0.135
4.80	0.467	3.733	0.140
4.90	0.483	3.867	0.145
5.00	0.500	4.000	0.150
5.10	0.517	4.133	0.155
5.20	0.533	4.267	0.160
5.30	0.550	4.400	0.165
5.40	0.567	4.533	0.170
5.50	0.583	4.667	0.175
5.60	0.600	4.800	0.180
5.70	0.617	4.933	0.185
5.80	0.633	5.067	0.190
5.90	0.650	5.200	0.195
6.00	0.667	5.333	0.200
6.10	0.683	5.467	0.205
6.20	0.700	5.600	0.210
6.30	0.717	5.733	0.215
6.40	0.733	5.867	0.220
6.50	0.750	6.000	0.225
6.60	0.767	6.133	0.230
6.70	0.783	6.267	0.235
6.80	0.800	6.400	0.240
6.90	0.817	6.533	0.245
7.00	0.833	6.667	0.250
7.10	0.850	6.800	0.255
7.20	0.867	6.933	0.260
7.30	0.883	7.067	0.265
7.40	0.900	7.200	0.270
7.50	0.917	7.333	0.275
7.60	0.933	7.467	0.280
7.70	0.950	7.600	0.285
7.80	0.967	7.733	0.290
7.90	0.983	7.867	0.295
8.00	1.000	8.000	0.300
8.10	1.017	8.133	0.305
8.20	1.033	8.267	0.310
8.30	1.050	8.400	0.315
8.40	1.067	8.533	0.320
8.50	1.083	8.667	0.325
8.60	1.100	8.800	0.330
8.70	1.117	8.933	0.335
8.80	1.133	9.067	0.340
8.90	1.150	9.200	0.345
9.00	1.167	9.333	0.350
9.10	1.183	9.467	0.355
9.20	1.200	9.600	0.360
9.30	1.217	9.733	0.365
9.40	1.233	9.867	0.370
9.50	1.250	10.000	0.375
9.60	1.267	10.133	0.380
9.70	1.283	10.267	0.385
9.80	1.300	10.400	0.390
9.90	1.317	10.533	0.395
10.00	1.333	10.667	0.400
10.10	1.350	10.800	0.405
10.20	1.367	10.933	0.410
10.30	1.383	11.067	0.415
10.40	1.400	11.200	0.420
10.50	1.417	11.333	0.425
10.60	1.433	11.467	0.430
10.70	1.450	11.600	0.435
10.80	1.467	11.733	0.440
10.90	1.483	11.867	0.445
11.00	1.500	12.000	0.450
11.10	1.517	12.133	0.455
11.20	1.533	12.267	0.460
11.30	1.550	12.400	0.465
11.40	1.567	12.533	0.470
11.50	1.583	12.667	0.475
11.60	1.600	12.800	0.480
11.70	1.617	12.933	0.485
11.80	1.633	13.067	0.490
11.90	1.650	13.200	0.495
12.00	1.667	13.333	0.500
12.10	1.683	13.467	0.505
12.20	1.700	13.600	0.510
12.30	1.717	13.733	0.515
12.40	1.733	13.867	0.520
12.50	1.750	14.000	0.525
12.60	1.767	14.133	0.530
12.70	1.783	14.267	0.535
12.80	1.800	14.400	0.540
12.90	1.817	14.533	0.545
13.00	1.833	14.667	0.550
13.10	1.850	14.800	0.555
13.20	1.867	14.933	0.560
13.30	1.883	15.067	0.565
13.40	1.900	15.200	0.570
13.50	1.917	15.333	0.575
13.60	1.933	15.467	0.580
13.70	1.950	15.600	0.585
13.80	1.967	15.733	0.590
13.90	1.983	15.867	0.595
14.00	2.000	16.00	

ESTABLISHED 1898
GORTON
INCORPORATED

REDUCTION FORMULA and SCHEDULES in INCHES for 3-B, 3-L MACHINES

FORM 1461
SCHEDULE OF REDUCTIONS FOR No 3-B ENGRAVING MACHINE.

REDUCTIONS	DISTANCE IN INCHES TO SET ALL SLIDER BLOCKS FROM GRADUATION 2
2.0	0.000
2.1	0.221
2.2	0.442
2.3	0.663
2.4	0.884
2.5	1.105
2.6	1.326
2.7	1.547
2.8	1.768
2.9	1.989
3.0	2.210
3.1	2.431
3.2	2.652
3.3	2.873
3.4	3.094
3.5	3.315
3.6	3.536
3.7	3.757
3.8	3.978
3.9	4.199
4.0	4.420
4.1	4.641
4.2	4.862
4.3	5.083
4.4	5.304
4.5	5.525
4.6	5.746
4.7	5.967
4.8	6.188
4.9	6.409
5.0	6.630
5.1	6.851
5.2	7.072
5.3	7.293
5.4	7.514
5.5	7.735
5.6	7.956
5.7	8.177
5.8	8.398
5.9	8.619
6.0	8.840
6.1	9.061
6.2	9.282
6.3	9.503
6.4	9.724
6.5	9.945
6.6	10.166
6.7	10.387
6.8	10.608
6.9	10.829
7.0	11.050
7.1	11.271
7.2	11.492
7.3	11.713
7.4	11.934
7.5	12.155
7.6	12.376
7.7	12.597
7.8	12.818
7.9	13.039
8.0	13.260

FORM 1463
FORMULA FOR OBTAINING SPECIAL REDUCTIONS ON No 3-B ENGRAVING MACHINE.

EXAMPLE
REDUCTION REQUIRED 2.4

CONSTANT $\rightarrow 1.6$ — 6.667
REDUCTION $\rightarrow 2.4$

CONSTANT $\rightarrow 8.000$
REDUCTION $\rightarrow 2.4$
 $\rightarrow 1.333$

DISTANCE IN INCHES TO SET ALL FOUR SLIDER BLOCKS FROM GRADUATION 2 FOR 2.4 REDUCTION.

For 3-B, 3-L Area chart. See folded flap at back of book.

FORM 1464
FORMULA FOR OBTAINING SPECIAL REDUCTIONS ON No 3-L ENGRAVING MACHINE.

EXAMPLE
REDUCTION REQUIRED 2.4

CONSTANT $\rightarrow 2.4$ — 10.000
REDUCTION $\rightarrow 2.4$

CONSTANT $\rightarrow 12.000$
REDUCTION $\rightarrow 2.4$
 $\rightarrow 2.000$

DISTANCE IN INCHES TO SET ALL FOUR SLIDER BLOCKS FROM GRADUATION 2 FOR 2.4 REDUCTION.

FORM 1462
SCHEDULE OF REDUCTIONS FOR No 3-L ENGRAVING MACHINE.

REDUCTIONS	DISTANCE IN INCHES TO SET ALL SLIDER BLOCKS FROM GRADUATION 2
2.0	0.000
2.1	0.371
2.2	0.742
2.3	1.113
2.4	1.484
2.5	1.855
2.6	2.226
2.7	2.597
2.8	2.968
2.9	3.339
3.0	3.710
3.1	4.081
3.2	4.452
3.3	4.823
3.4	5.194
3.5	5.565
3.6	5.936
3.7	6.307
3.8	6.678
3.9	7.049
4.0	7.420
4.1	7.791
4.2	8.162
4.3	8.533
4.4	8.904
4.5	9.275
4.6	9.646
4.7	10.017
4.8	10.388
4.9	10.759
5.0	11.130
5.1	11.501
5.2	11.872
5.3	12.243
5.4	12.614
5.5	12.985
5.6	13.356
5.7	13.727
5.8	14.098
5.9	14.469
6.0	14.840
6.1	15.211
6.2	15.582
6.3	15.953
6.4	16.324
6.5	16.695
6.6	17.066
6.7	17.437
6.8	17.808
6.9	18.179
7.0	18.550
7.1	18.921
7.2	19.292
7.3	19.663
7.4	20.034
7.5	20.405
7.6	20.776
7.7	21.147
7.8	21.518
7.9	21.889
8.0	22.260

Photo 46

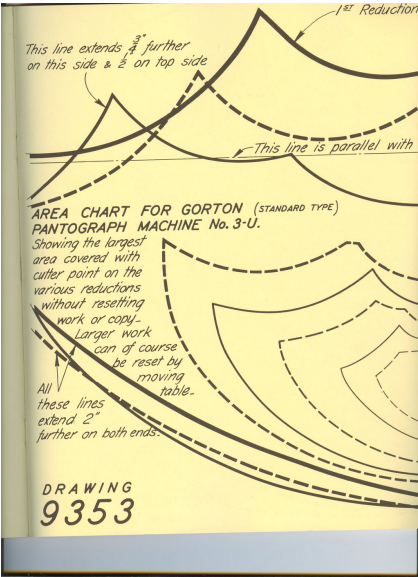


Photo 47

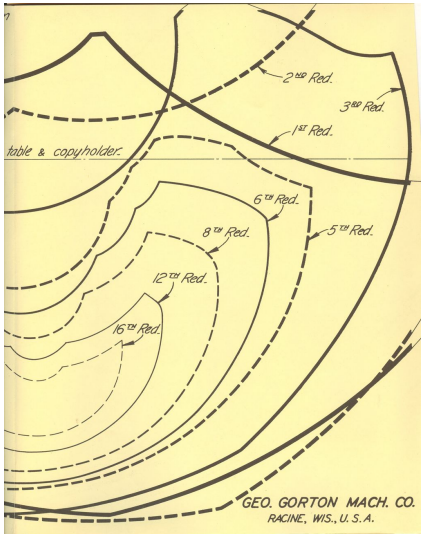


Photo 48

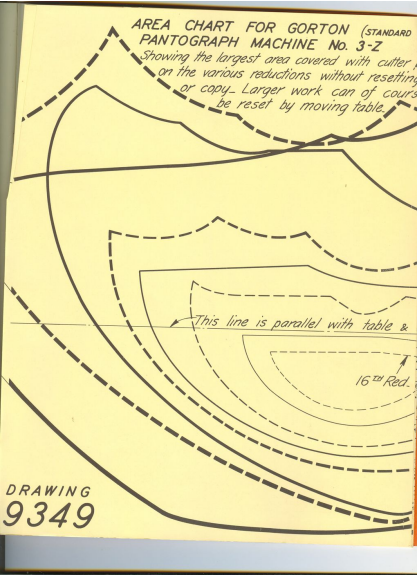


Photo 49

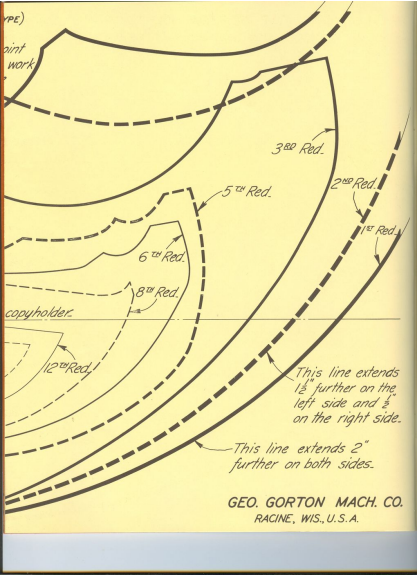


Photo 50

AREA CHART FOR 3-S DIE CUTTING AND PROFILING MACHINE - (STANDARD TYPE)

Showing the largest area covered with cutter
point on the various reductions
without resetting work or copy.

Work can of course
be set by moving
table.

FORMULA

For obtaining any intermediate reduction
not given on pantograph scales.

EXAMPLE 3.5 (Reduction required)

$$\begin{array}{r} \text{CONSTANT } 3.5 \\ \rightarrow + 1.0 \\ \hline 4.5 \end{array}$$

$$\begin{array}{r} \text{CONSTANT } 24. \\ \rightarrow \hline 4.5 = 5.333 \end{array}$$

$$\begin{array}{r} \text{CONSTANT } 5.333 \\ \rightarrow - 3.000 \\ \hline 2.333 \text{ Inches} \end{array}$$

NOTE

The one to one
pantograph setting
is too large to show
hereon. Blue-print 6499
of same will be sent on re-
quest. On the one to one setting, the
following areas can be covered at one
setting of work & copy:

14" x 9 $\frac{3}{4}$ " ~ 18" x 8 $\frac{3}{8}$ " ~ 21" x 4" ~ 23" x 2 $\frac{1}{2}$ "

Set all three
Pantograph scales to this
reading for 3.5 reduction.

Photo 51

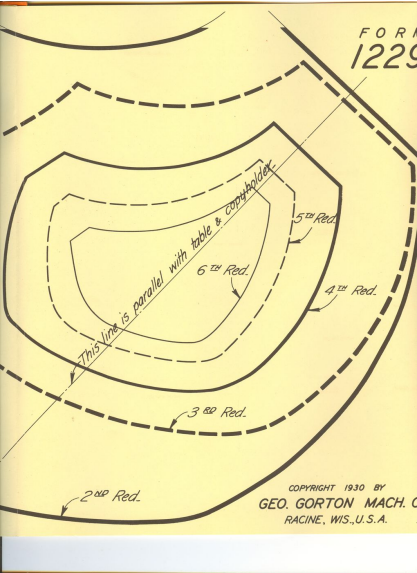


Photo 52

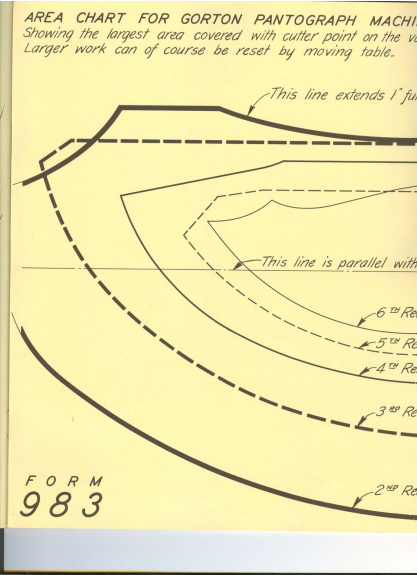


Photo 53

ES. (STANDARD TYPE) NoS. 1-D, 1-J, 3-D, 3-J. (NOW OBSOLETE)
ious reductions without resetting work or copy.

her on both sides.

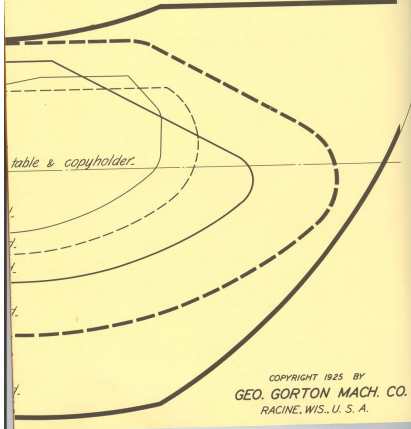


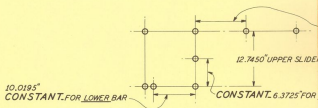
table & copyholder.

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Photo 54

FORMULA FOR OBTAINING SPECIFIC REDUCTIONS FROM 1 TO 1, TO 2 TO 1

ON ENGRAVING MACHINES, NUMBERS 3U, 3Z.



EXAMPLE: REQUIRED THE SETTINGS IN INCHES FOR REDUCTIONS FROM 1 TO 1, TO 2 TO 1

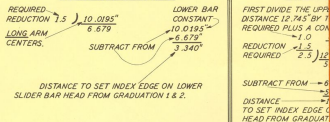


Photo 55

IAL
TO 1.

10.0195" LONG ARM.

UPPER SLIDER BAR
PANTOGRAPH CENTERS.

UPPER BAR.

REDUCING 1.5 TO 1.

UPPER SLIDER BAR.

UPPER SLIDER BAR CENTER

FROM THE REDUCTION

CONSTANT OF 1.

UPPER SLIDER BAR CENTERS.

.745"
.098"

.3725" — UPPER BAR
.098" CONSTANT.

.2743"
FROM UPPER SLIDER BAR
CONSTANT.

**SCHEDULE OF VARIOUS REDUCTIONS
BETWEEN 1 TO 1 & 2 TO 1 ON NOS.
3U & 3Z MACHINES—
WITH TRACING STYLE IN NEAREST
HOLE OF PANTOGRAPH ARM.**

DISTANCES GIVEN IN INCHES.

REDUCTION	DISTANCE NECESSARY TO SET INDEX EDGE ON LOWER SLIDER BAR HEAD FROM GRAD- UATION MARKED 1 & 2.	DISTANCE NECESSARY TO SET INDEX EDGE ON UPPER SLIDER BAR HEAD FROM GRAD- UATION MARKED 1.
	1.0	0
1.1	.911"	.303"
1.2	1.879"	.579"
1.3	2.812"	.828"
1.4	3.863"	1.082"
1.5	4.945"	1.375"
1.6	5.757"	1.477"
1.7	6.126"	1.851"
1.8	6.453"	1.821"
1.9	6.748"	1.978"

TO OBTAIN ANY SPECIAL REDUCTION
NOT GIVEN ABOVE, USE FORMULA.

FOR GREATER REDUCTIONS USE
SCHEDULE AS PER INSTRUCTION
BOOK WITH TRACING STYLE AT
EXTREME END OF PANTOGRAPH ARM.

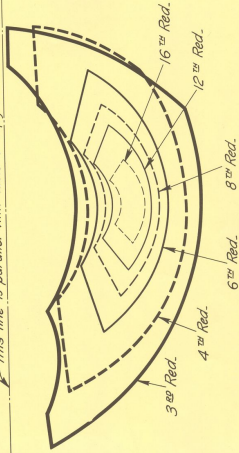
DRAWING
7561

AREA CHART FOR GORTON PANTOGRAPH MACHINES.

(STANDARD TYPE) NOS. 1-A, 1-G, 1-H, 3-A, 3-G, 3-H. (NOW OBSOLETE)

Showing the largest area covered with cutter point on the various reductions without resetting work or copy. Larger work can of course be reset by moving table.

← This line is parallel with table & copyholder.



FORM
949

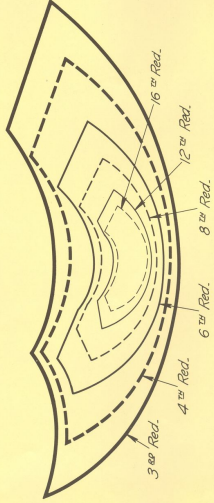
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AREA CHART FOR GORTON PANTOGRAPH MACHINES.

(STANDARD TYPE) NOS. 3-F, 3-X.

Showing the largest area covered with cutter point on the various reductions without resetting work or copy. Larger work can of course be reset by moving table.

↙ This line is parallel with table & copyholder.



DRAWING
9358

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Photo 58

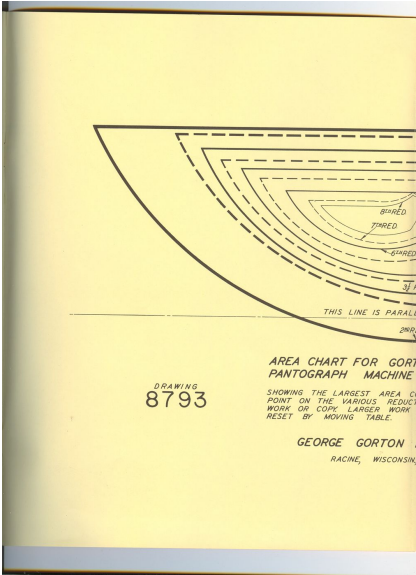


Photo 59

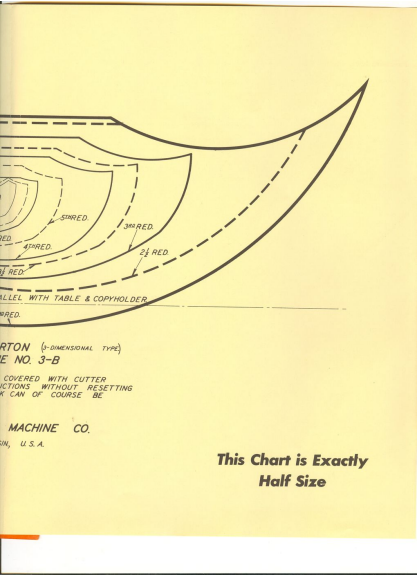


Photo 60

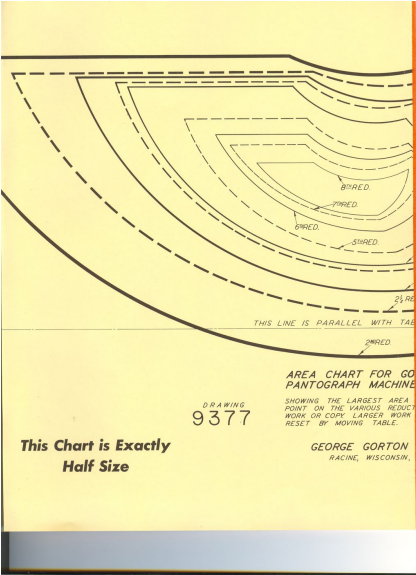


Photo 61

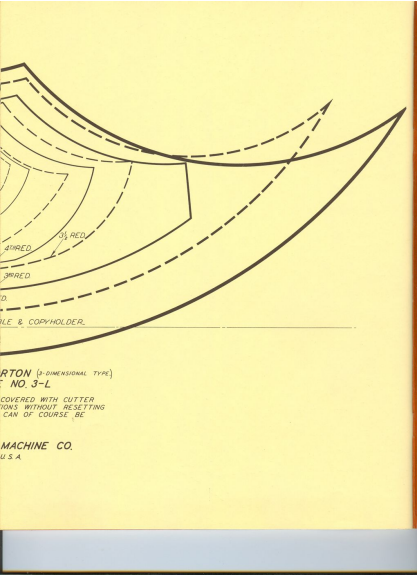


Photo 62

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