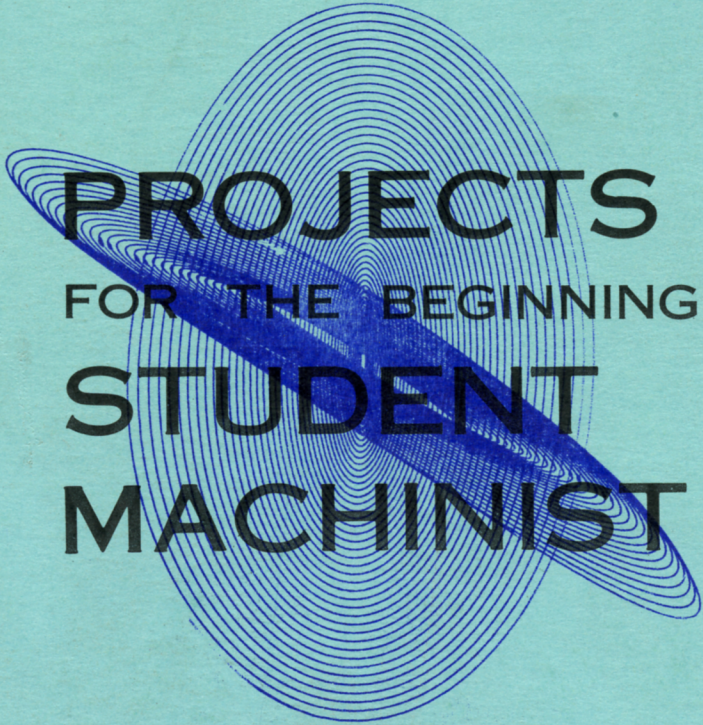


machine shop



PROJECTS FOR THE BEGINNING STUDENT MACHINIST

CONNECTICUT STATE
DEPARTMENT OF EDUCATION

HARTFORD, CONNECTICUT

FOREWORD

It is felt that this set of basic jobs will do much to develop a uniform foundation throughout the Machine Shops of the Vocational-Technical schools in the State of Connecticut. Only fifteen projects were selected so that the instructor's "academic freedom" will not be infringed upon. Experience dictates that these jobs can be easily completed in less than a years time thus allowing ample time for each instructor to develop supplemental material to fit in with his teaching program.

INTRODUCTION

The following set of jobs have been developed and used with much success by the faculty and students of the Machine Shop at the Eli Whitney Regional Vocational-Technical School, Hamden, Connecticut, and were carefully selected to incorporate the various manipulative operations which are expected to be learned in the first year. These projects are all valuable tools which will be constantly used by the student machinist while working at his trade.

The Job Sheet which accompanies each blueprint carefully lists the primary skills which are to be learned with each job thus emphasizing the importance of the manipulating operations which are to be expanded with the making of each project.

The Instruction Sheets, which were developed with the corresponding material by Mr. James Spillane and Mr. Robert M. Reilly, will enable the student to more fully understand the methods of performing the set-ups and operations which are required to make these tools.

These sheets will be a boon to the instructor with a heterogeneous group, the students can advance their own pace by these instruction sheets.

The State of Connecticut has received permission from Mr. R.M. Reilly and Mr. J.F. Spillane to reproduce this book for experimental distribution.

MACHINE SHOP BEGINNING CLASS

[illegible]

Manipulative Operations

The projects in this manual were carefully selected to give the beginning student experience in the following skills:

LATHE

OPERATION	PROJECT	PAG
1 Centering stock	(4) Bushing knockout	14
2 Visual alignment of centers	" "	"
3 Face on centers	" "	"
4 Rough turn to caliper dimension	" "	"
5 Turn shoulder to scale	" "	"
6 Turn diameter to micrometer dimension	" "	"
7 Finish filing	" "	"
8 Knurling	" "	"
9 Mounting and removing chucks	(7) Bench block	20
10 Spotting and centering	" "	"
11 Drilling and reaming	" "	"
12 Turn on mandrel	" "	"
13 True work in independent chuck	" "	"
14 Inside facing	" "	"
15 Screw arbor work	" "	"
16 Mount work in collets	(3) Center punch & scrib.	8
17 Turn work in 3 jaw chuck	(13) Planer jacks	47
18 Tapping work with tail center	" "	"
19 Cutting threads, die stock	" "	"
20 Turn taper - compound rest	" "	"
21 Facing and recessing	" "	"
22 Taper turning - tailstock offset	(9) Babbitt hammer	29
23 Cut chamfer and fillets	" "	"
24 Cut threads with tool bit	(8) Tap wrench	24
25 Cut left hand threads	" " "	"
26 Turn taper with taper attach.	(14) Lathe centers	50
27 Mount tool post grinder	" "	"
28 Grind centers	" "	"

MILLING MACHINE

29 Cut hexes and squares	(13) Planer jacks	47
30 Mill flats	" "	"
31 Roughing and squaring stock	(12) Parallel clamp	43
32 Squaring ends	" "	"
33 Milling slots with cutter	(10) Th'd tool grind fix.	32
34 Line up work with indicator	(11) "V" Block	36
35 Mill with angular cutters	(7) Bench block	20
36 Face mill flat surfaces	(6) Parallels	17

MANIPULATIVE OPERATIONS (CONT.)

SHAPER

37 Shape work in vise	(6)	Parallels	17
38 Shape square & to decimals	(15)	1-2-3 Block	53
39 Shape angular work	(10)	T'd tool grind. fix.	32
40 Shape vee shapes	(11)	"V" Block	36
41 Shape to shoulder		" "	"
42 Shape to layout		" "	"

DRILL PRESS

43 Center drilling	(4)	Screw gage	11
44 Mounting and removing chucks	(7)	Bench block	20
45 Drill to simple layout	(1)	Square	2
46 Drill thin stock	(12)	Parallel clamp	43
47 Drill for tapping	(4)	Screw gage	11
48 Spot for transfer	(12)	Parallel clamp	43
49 Countersinking	(4)	Screw gage	11
50 Drill and reaming	(7)	Bench block	20
51 Drill to accurate layout		" "	"

GRINDER

52 Grind flat surfaces	(6)	Parallels	17
53 Mount wheels and dress	(10)	Th'd tool grind fix.	32
54 Grind surface at right angles		" "	"
55 Grind th'd tool with fixture		" "	"
56 Grind to shoulder	(11)	"V" block	36
57 Grind steps in vise		" "	"
58 Grind angles - magnetic block		" "	"

CONTOUR SAW

59 Saw to line	(2)	Drill gage	5
60 Saw to irregular layout	(11)	"V" block	36

MANIPULATIVE OPERATIONS (CONT.)

BENCH AND LAYOUT

61 Prepare work for layout	(4)	Screw gage	11
62 Layout from drawing		" "	"
63 Scribing and punching		" "	"
64 Tapping work held in vise		" "	"
65 Layout from sample	(2)	Drill gage	5
66 File to layout - machine		" "	"
67 Layout center on rounds	(7)	Bench block	20
68 Sawing by hand	(1)	Square	2
69 Filing by hand		"	"
70 Threading with a die	(13)	Planer jacks	47
71 Harden - open flame	(3)	Center punch	8
72 Tempering		" "	"
73 Tapping to bottom	(9)	Babbitt hammer	29
74 Layout with protractor	(10)	T'dtool grind fix.	32

MACHINE SHOP

NAME _____

DATE _____

GROUP _____

9 (A)

Excellent quality in good time
Can figure own set-ups
Instructed only once on new
setups
Willing to do any job
Always working
Keeps machine and area clean
Starts and stops on time
Has tools

8 (B)

Good quality in good time
Can set up own work
Willing to do any job
Always working
Keeps machine and area clean
Starts and stops on time
Has tools

7 (C)

Good quality in fair time
Can set up own work
Willing to do any job
Does not loaf or bother others
Keeps machine and area clean
Has tools

6 (D)

Fair quality or poor time
Has to be spoken to about
wasting Time or cleaning
Constantly needs help t-ups

5 or less (F)

Poor quality or extra long time
Bothers others
Has to be spoken to about wasting time
or cleaning up
Does not have necessary tools
Makes poor set-ups

JOB NAME Square

BLUE PRINT NUMBER: C1-A-1

INFORMATION: A square is a precision tool which is used to check the relationship of sides which are to be at right angles to each other.

PRIMARY SKILL LEARNED: The making of this tool will provide the student with experience in hacksawing and filing work flat and square.

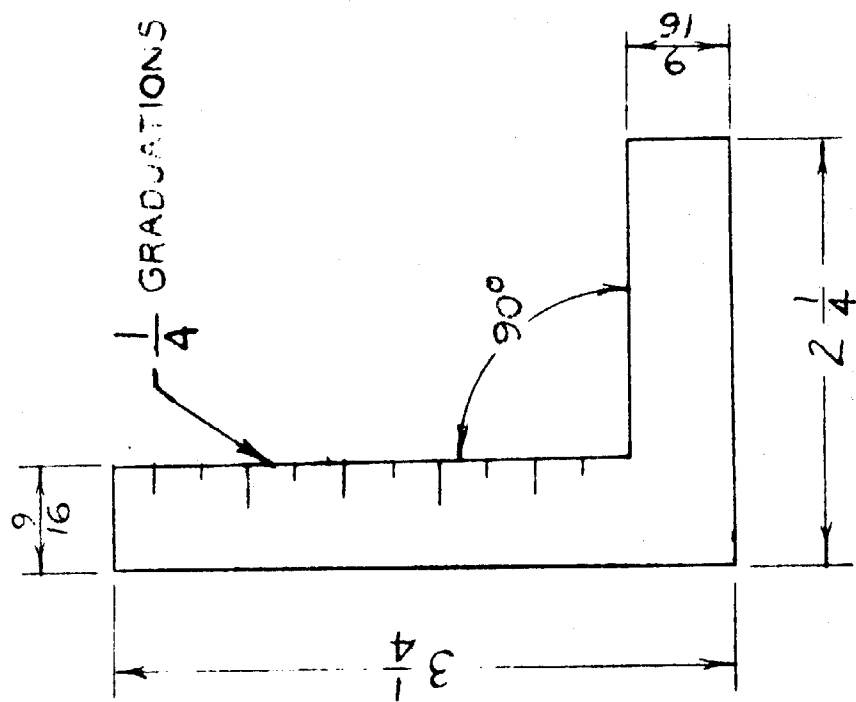
PRECAUTIONS:

1. File all burrs immediately after piece is cut off.
2. Hold piece low in vise while filing.
3. Raise file on return stroke.
4. Have stop on drill press table to prevent work from spinning.
5. Do not stamp name near edge of square. (It will cause metal to bulge.)

STOCK: 1/8" x 2 1/4" Cold Rolled Steel.

OPERATIONS:

1. Cut off stock 3 3/8" long.
2. File burrs.
3. Draw file one side of 3 1/4" length.
4. Apply layout fluid.
5. Layout end with square.
6. File end square.
7. Layout inside of square. (use hermaphrodite calipers)
8. Prickpunch.
9. Drill 3/16" holes.
10. Hacksaw through holes.
11. File long inside edge parallel to outside.
12. File inside end square.
13. Stamp name and date.



BREAK ALL UNNECESSARY CORNERS

DO NOT SCALE THIS DRAWING

ELI WHITNEY REGIONAL VOCATIONAL TECHNICAL SCHOOL		MATERIAL Cold Rolled Steel	PART NAME	SQUARE	
DIMENSIONAL TOLERANCES FRACTION $\pm 1/64$ DECIMAL $\pm .002$ UNLESS OTHERWISE SPECIFIED: ANGULAR $\pm 1^\circ$ CONCENTRICITY $\pm .001$				DATE:	DWG. No. 01-A-1
				HEAT TREAT	SCALE:

SQUARE

Consult your blueprint at all times.

Select and cut the proper material $1/8"$ X $2"$ X $3\ 3/8"$
Cold Roll Steel - use 8" Mill File.

1. Remove burrs with file.
2. Draw file $3\ 3/8"$ side flat.
Check with Square. Light
should not show through.
Fig. 1

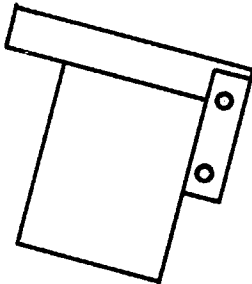


Fig. 2

3. File $2\ 1/4"$ end square with
first side. Check with
Square. Fig. 2
4. Apply layout dye and layout
from print. Use hermaphrodite
calipers set at $9/16"$ Fig. 3

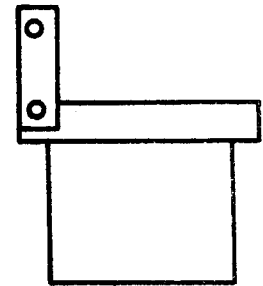


Fig. 1

5. Layout to remove excess metal
Fig. 4. Set Calipers to $23/32"$
scribe line. Use Dividers and
locate marks for $3/16"$ diameter
holes. The marks will be $1/4"$
apart.

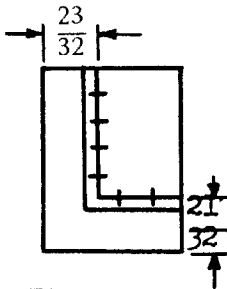


Fig. 4

6. Secure project to a large flat
piece of wood and drill $3/16"$
holes on location. Fig. 5
7. Remove project from wood
support and file burrs.
8. At the Bench Vise, Hacksaw
through the holes and remove the excess
metal.
9. File the long inside edge
parallel to the outside.
Fig. 6
10. File the short inside edge
square.
11. Stamp your name and date.

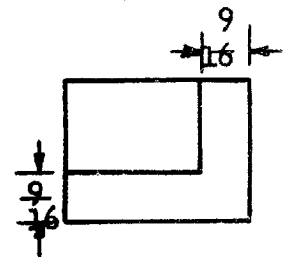


Fig. 3

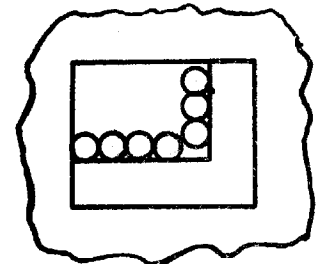


Fig. 5

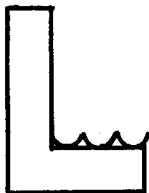


Fig. 6

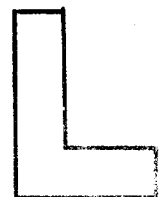


Fig. 7

JOB NAME Drill Gage

BLUE PRINT NUMBER: 01-A-2

INFORMATION: A drill gage is used to check accurately the angles on the point of a drill.

PRIMARY SKILL LEARNED: In the making of this tool the student will receive experience in laying out from sample as well as sawing and filing to irregular layout by machine.

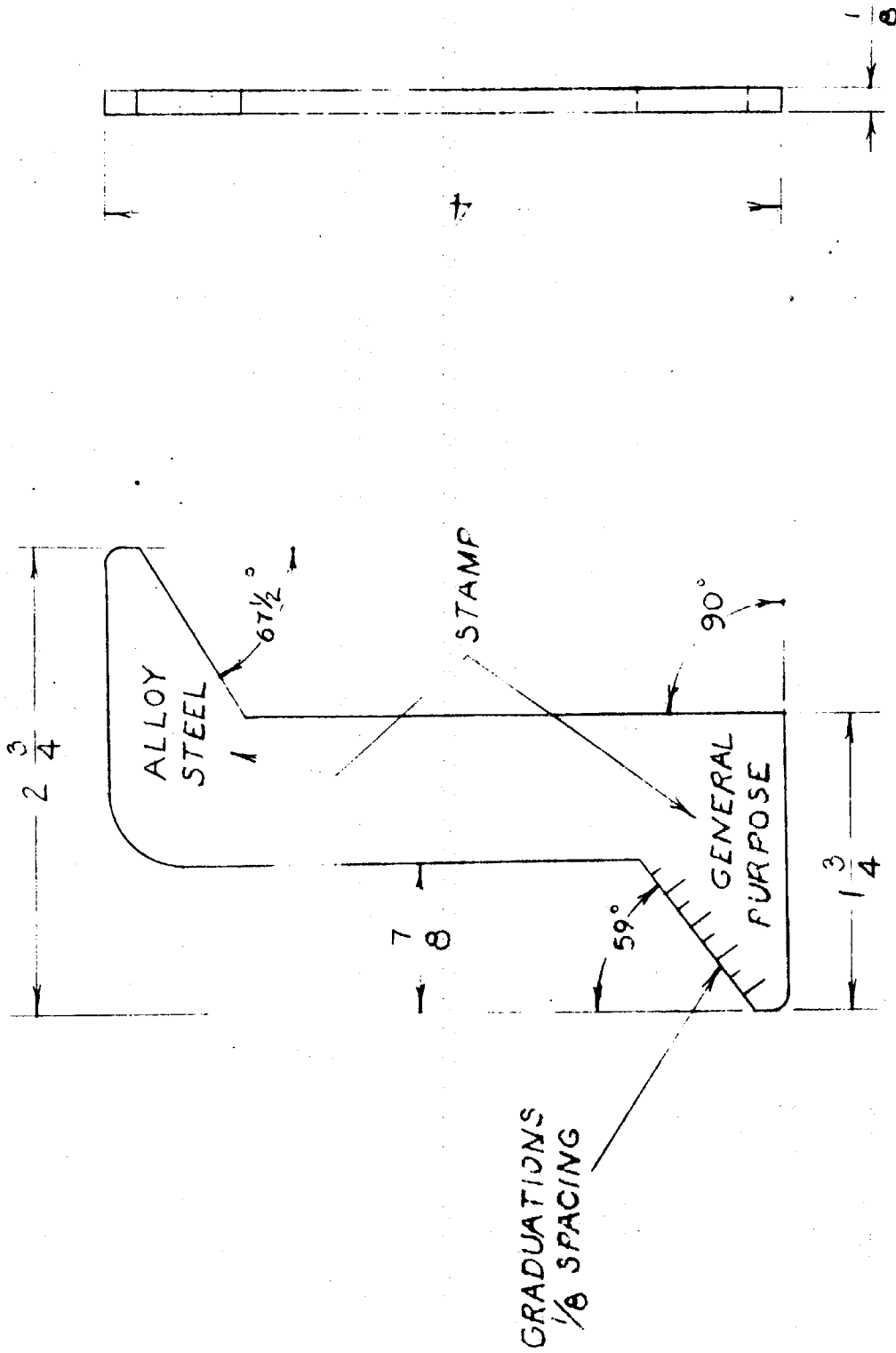
PRECAUTIONS:

1. Band saw $1/32$ " from layout lines.
2. Check angles with gage. (there are two different angles on this tool)
3. Observe safety rules when band sawing and machine filing.

STOCK: $1/8$ " x 2" Cold Rolled Steel.

OPERATIONS:

1. Cut off stock $4\ 3/4$ " long.
2. File burrs.
3. Layout from template.
4. Band saw.
5. Machine file to layout lines.
6. Mill graduations. (if required)
7. Stamp angles, name and date.



BREAK ALL UNNECESSARY CORNERS

DO NOT SCALE THIS DRAWING

ELI WHITNEY REGIONAL VOCATIONAL TECHNICAL SCHOOL			MATERIAL	PART NAME	DRILL GAUGE
			Cold Rolled Steel		
DIMENSIONAL TOLERANCES			HEAT TREAT	DATE:	D.W.G. No. 01-A-2
UNLESS OTHERWISE SPECIFIED:				SCALE:	
FRACTIONAL $\pm 1/64$					
ANGULAR $\pm 1^\circ$					
DECIMAL $\pm .002$					
CONCENTRICITY $\pm .001$					

DRILL GAGE

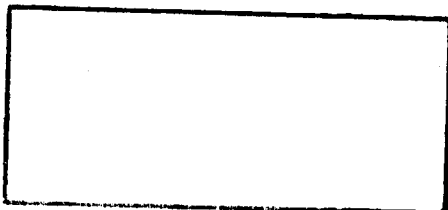


Fig. 1

Select $1/8"$ X $2"$ Cold Roll Steel
4 $3/4"$ long. Remove burrs. Coat the
surface with "Layout Dye" and scribe
around the Drill Gage Template.

Band Saw $1/32"$ from the scribed line to
remove the excess metal. Saw the short
sides first. Fig. 2

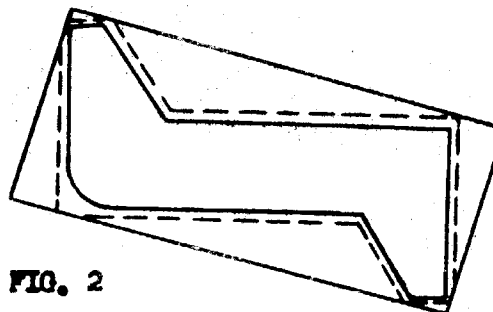


FIG. 2

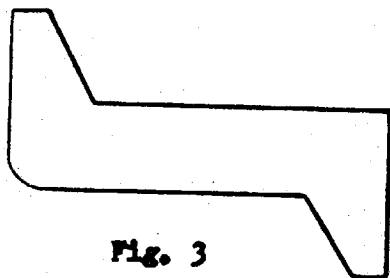


Fig. 3

Band Saw the long lengths, file to
the scribed lines. Use the angle
gag to check the angle dimensions.
Fig. 3

Mill the $1/16"$ graduations. Stamp name
and date. Remove burrs. French finish both
sides. Fig. 4

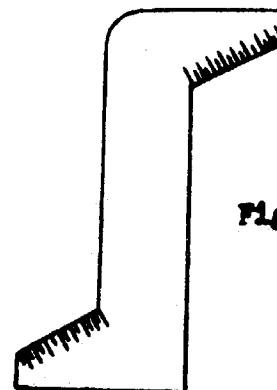


Fig. 4

JOB NAME Center Punch and Prick Punch

BLUE PRINT NUMBER: 01-A-3

INFORMATION: 1. A center punch is a tool commonly used to mark the location of a hole. The sixty degree point makes a cone shaped impression large enough to allow the point of a drill to start.

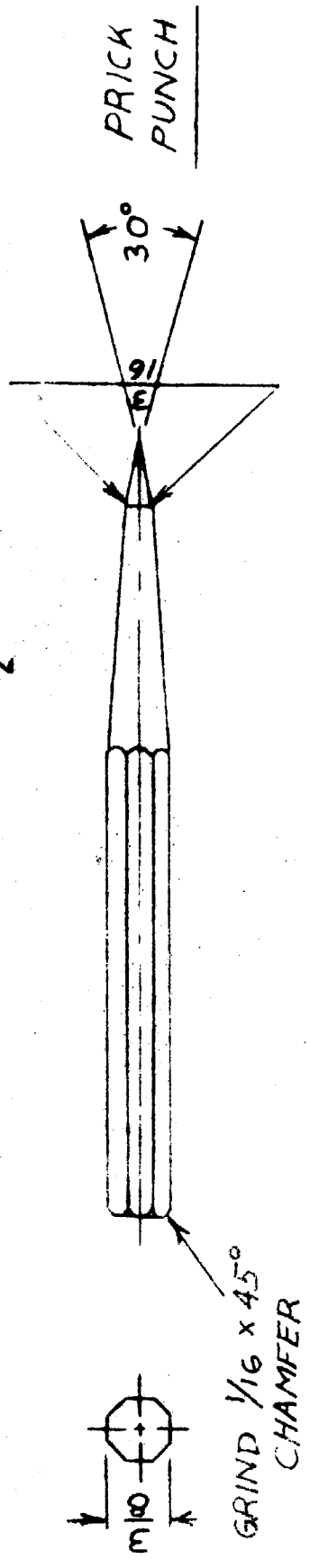
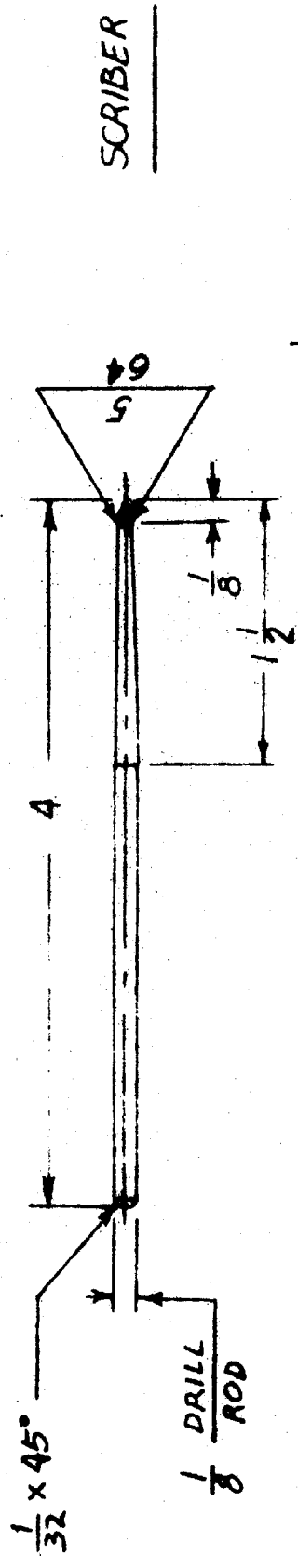
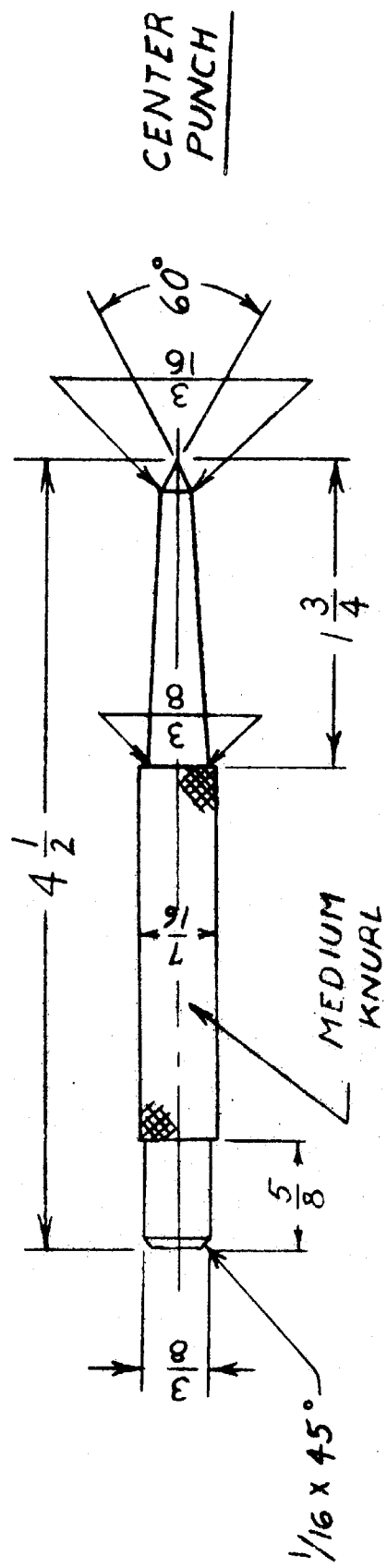
 2. A prick punch is used to mark scribed or layout lines with small indentations to prevent removal of layout lines by accident. This punch has a thirty degree angle on its point.

PRIMARY SKILL LEARNED: 1. Mount work in collet.
 2. Turn taper with compound rest.
 3. Harden in open flame.
 4. Tempering.

PRECAUTIONS: 1. When turning long taper, hold piece in collet as short as possible.
 2. Note different points on punches.
 3. Observe safety precautions when using emery cloth on lathe.

STOCK: 3/8" Octagon oil hardening steel.

OPERATIONS: 1. Cut off stock 4 9/16" long.
 2. Face end in collet.
 3. Chamfer.
 4. Reverse piece and turn long taper.
 5. File point.
 6. Harden and temper
 7. Polish with emery cloth.



ELI WHITNEY REGIONAL VOCATIONAL TECHNICAL SCHOOL		MATERIAL	PART NAME	CENTER PUNCH	SCRIBER
		Tool Steel		PRICK PUNCH	
DIMENSIONAL TOLERANCES		HEAT TREAT	DATE	D.W.G. NO.	
FRACTIONAL ± 1/64				01-A-3	
DECIMAL ± .002					
ANGULAR ± 1°					
CONCENTRICITY ± .001					
UNLESS OTHERWISE SPECIFIED:					

CENTER PUNCH, PRICK PUNCH & SCRIBER

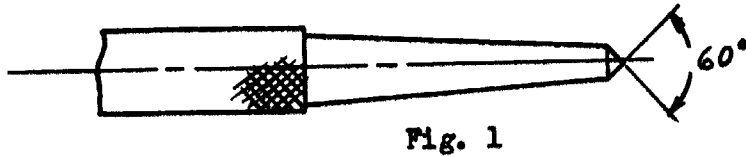


Fig. 1

Fig. 1 Shows how the point of a center punch should be ground. The angle is 60° . The taper will be about 3°



Fig. 2

Fig. 2 Shows how the point of a prick punch should be ground. The angle is 30° .

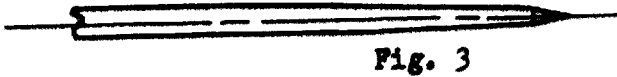


Fig. 3

Fig. 3 Shows the shape of a scribe made of $1/8$ Drill Rod. The point should be formed from a long narrow angle. To harden and temper, heat to a bright cherry-red and immerse into a bar of brown soap.

JOB NAME Screw Gage

BLUE PRINT NUMBER: 01-A-4

INFORMATION: This is a valuable tool for checking fine and coarse threads under $\frac{1}{2}$ " in diameter.

PRIMARY SKILL LEARNED:

1. Scribing and center punching.
2. Center drilling in a drill press.
3. Drilling for tapping. (tap size drills)
4. Countersinking.
5. Tapping work held in a vise at right angles to the workpiece.

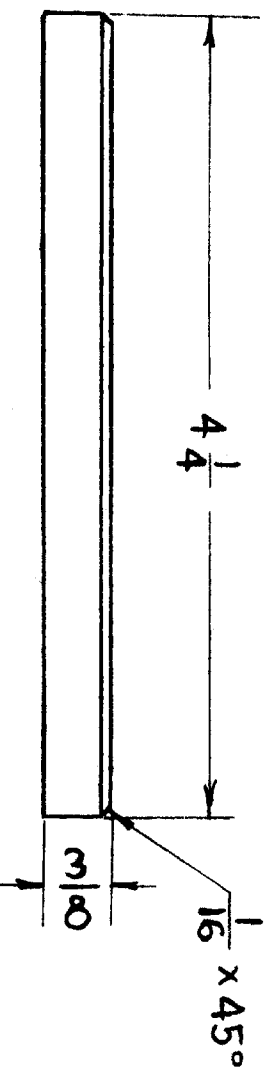
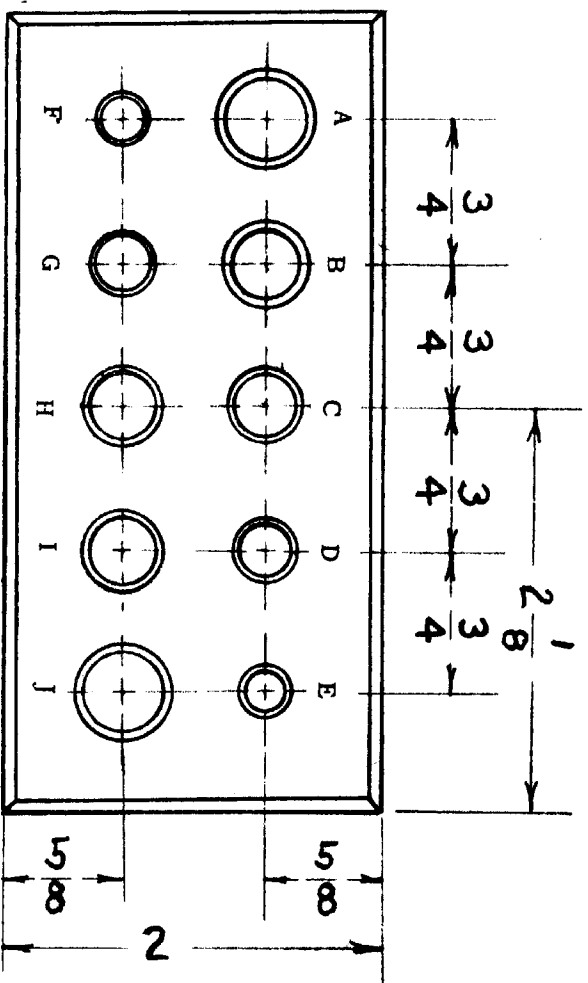
PRECAUTIONS:

1. Layout from center lines.
2. Use thin parallels under work when drilling.
3. Tap largest holes first to get feel of tap wrench.
4. Use small tap wrench for small holes.
5. Use oil when tapping.
6. Check tap from two directions to make sure it is at right angles to the workpiece.

STOCK: $\frac{3}{8}$ " x 2" Cold rolled steel.

OPERATIONS:

1. Cut stock 4 $\frac{3}{8}$ " long.
2. Remove burrs.
3. File outside edges square.
4. File bevel.
5. Apply layout fluid and layout holes.
6. Center drill all holes.
7. Drill all holes.
8. Countersink all holes.
9. Tap all holes.
10. Stamp sizes, name and date.



HOLE	TAP DRILL	Th'd Per 1/16 inch
A	$\frac{27}{64}$	$\frac{1}{2}$ -13
B	U	$\frac{7}{16}$ -14
C	$\frac{5}{16}$	$\frac{3}{8}$ -16
D	F	$\frac{5}{16}$ -18
E	7	$\frac{1}{4}$ -20
F	3	$\frac{1}{4}$ -28
G	I	$\frac{5}{16}$ -24
H	Q	$\frac{3}{8}$ -24
I	$\frac{25}{64}$	$\frac{7}{16}$ -20
J	$\frac{29}{64}$	$\frac{1}{2}$ -20

BREAK ALL UNNECESSARY CORNERS

ELI WHITNEY REG. VOCATIONAL TECH. SCHOOL

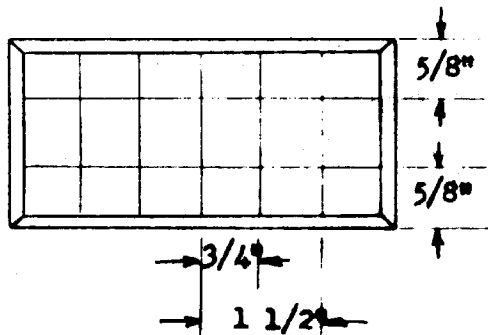
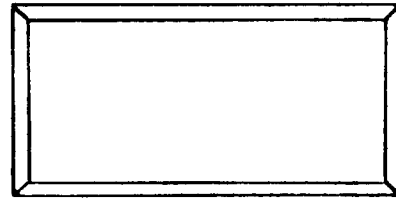
DIMENSIONAL TOLERANCES FRACTIONAL $\pm \frac{1}{64}$ DECIMAL .002
UNLESS OTHERWISE SPECIFIED:- ANGULAR $\pm 1^\circ$ CONCENTRICITY $\pm .001$

DO NOT SCALE DRAWING

MATERIAL	PART	SCREEN GAGE
Cold Rolled St.	NAME	
HEAT TREAT	DATE	D.T.W.G. NO.
SCALE		01-A-4

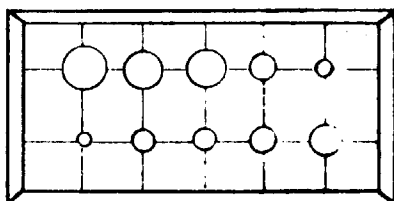
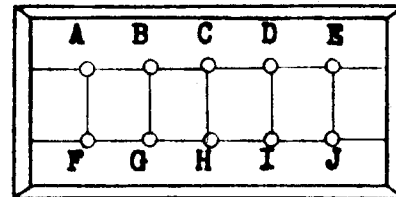
**INSTRUCTION SHEET
SCREW GAGE**

Select and cut proper material
3/8" X 2" X 4 3/8". Remove burrs.
File edges square and draw
file bevel 1/16" X 1/16" X 45°.
Paint layout fluid on top.



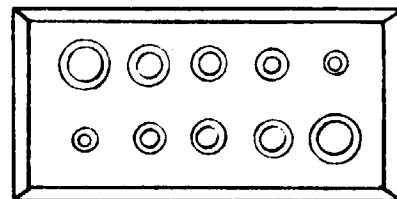
Use Hermaphrodite Caliper, scribe
5/8" line from sides. Find center
and scribe lines 3/4" to the right
and to the left of center, then
1 1/2" to the right and left of
center line.

Center punch and Center drill
all intersections. Drill all
locations with a #7 drill.
Scribe locations A, B, C, D, E,
F, G, H, I, J.



Drill all locations with the
proper tap size drill, use vise
when drilling. Note chart on print
for tap size drill.

Countersink both sides of all
holes 1/16" deep with a 90°
Countersink. Tap holes with
the proper tap. Use oil-
STAMP tap sizes at locations.
Stamp name and date. Finish.



JOB NAME Bushing Knockout

BLUE PRINT NUMBER: 01-A-5

INFORMATION: This tool is used primarily to knock out standard size, inserted, bushings from castings and fixtures.

PRIMARY SKILL LEARNED:

1. Centering stock.
2. Visual alignment of centers.
3. Facing on centers.
4. Rough turn to caliper dimensions.
5. Turn shoulders to scale dimensions.
6. Turn diameters to micrometer dimensions.
7. Turn shoulders to stop.
8. Knurling.

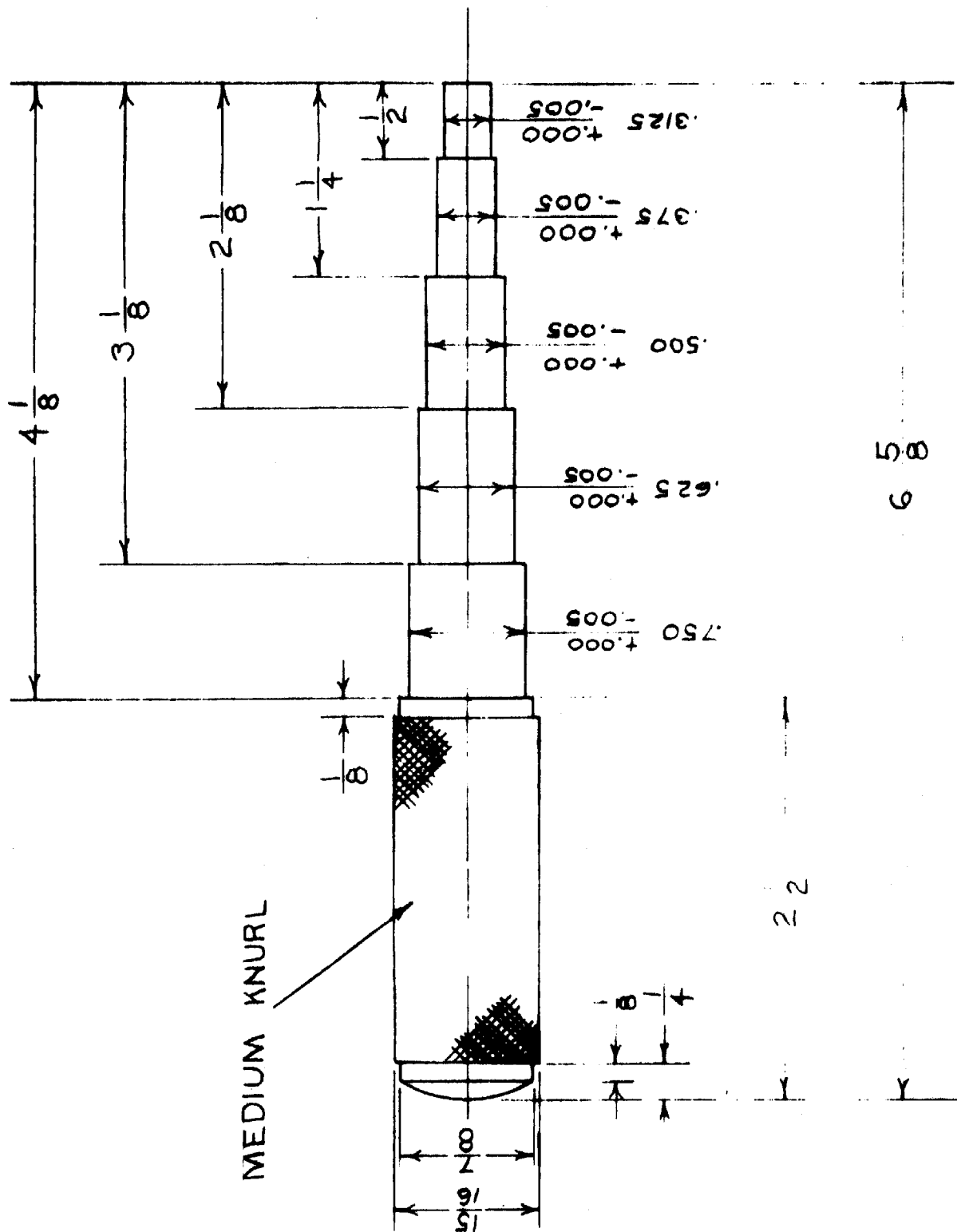
PRECAUTIONS:

1. Set tool bit on center.
2. Oil center hole.
3. Have proper tailstock pressure.
4. Use copper under screw on lathe dogs to protect knurl.
5. Use proper speeds and feeds.
6. Use micrometer dial on lathe to turn diameter to size.
7. Check diameter at beginning of cut.
8. Observe lathe safety precautions.

STOCK: 1 1/8" Diameter Machine Steel.

OPERATIONS:

1. Cut off stock to 6 3/4" length.
2. Center drill both ends.
3. Face ends.
4. Turn 1" diameter 3" long.
5. Knurl 1" diameter
6. Cut radius on end.
7. Reverse piece and turn 3/4" diameter 4 1/8" long.
8. Turn 5/8" diameter 3 1/8" long.
9. Turn 1/2" diameter 2 1/8" long.
10. Turn 3/8" diameter 1 1/4" long.
11. Turn 5/16" diameter.
12. Mill flat on handle.
13. Stamp name and date.
14. Case harden.



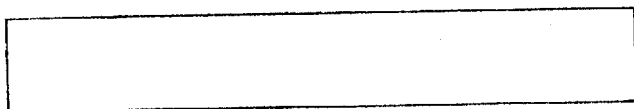
MEDIUM KNURL

BREAK ALL UNNECESSARY CORNERS

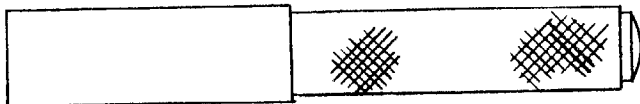
DO NOT SCALE THIS DRAWING

ELI WHITNEY REGIONAL VOCATIONAL TECHNICAL SCHOOL			MATERIAL	PART	BUSHING KNOCK OUT	
DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED:-			Cold Rolled Steel	NAME		
			HEAT TREAT	DATE:-		
Fractional $\pm 1/64$					D.W'G. No.	01-A-5
Angular $\pm 1^{\circ}$						
Decimal $\pm .002$						
Concentricity $\pm .001$						

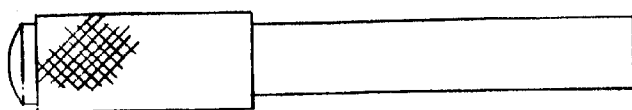
BUSHING KNOCK OUT



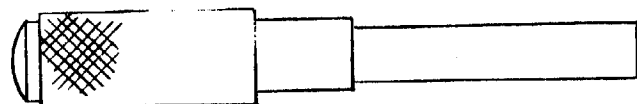
Material: Machine steel - 1 1/8" diameter X 6 3/4" long.
Face and center drill using a three jaw chuck.



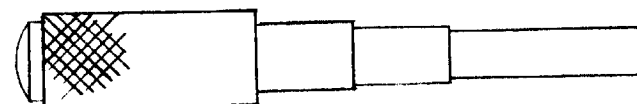
Place on centers, take a test cut for straight turning.
Turn O.D. to 15/16 diameter 3" long. Use form tool to
turn radius on end, medium knurl.



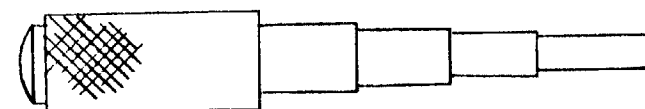
Reverse on centers. protect knurl with soft piece of
copper. Turn to 3/4" diameter, 4 1/8" long.



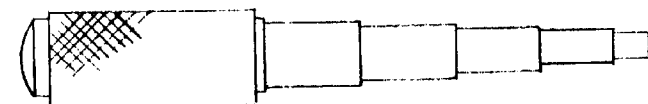
Turn 5/8" diameter step 3 1/8" long.



Turn 1/2" diameter step 2 1/8" long.



Turn 3/8" diameter step 1 1/4" long.



Turn 5/16" diameter step, 1/2" long.
Undercut handle, 1/8" X 1/8".
Stamp name and date. Case harden and finish.

JOB NAME Parallels

BLUE PRINT NUMBER: 01-A-6

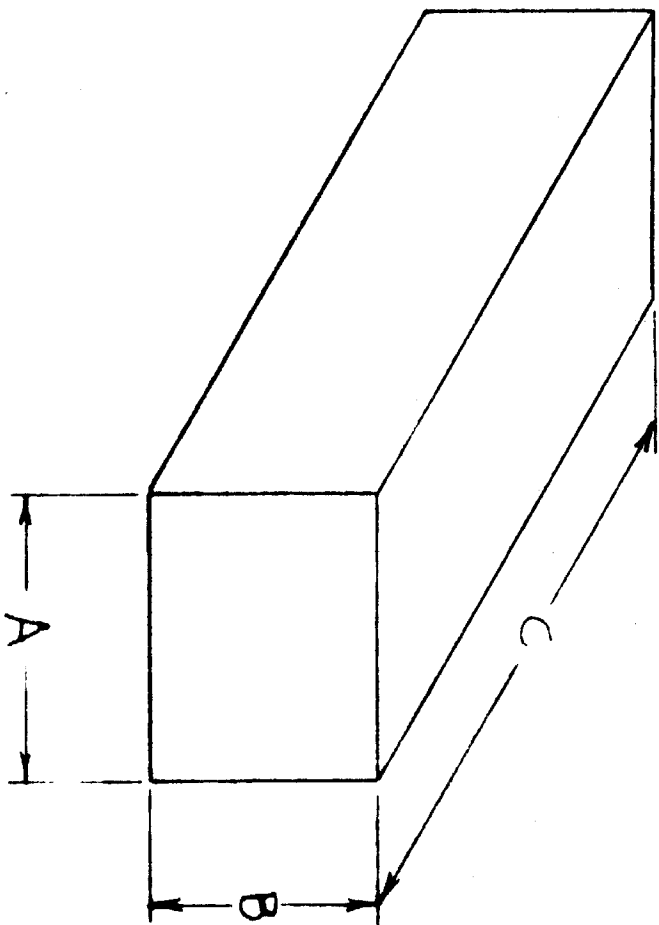
INFORMATION: A parallel is a handy tool which is commonly used to support work held in a milling machine or shaper vise. Both sides are parallel to each other.

PRIMARY SKILL LEARNED: 1. Shaping work held in a vise.
2. Grinding flat and parallel surfaces.

PRECAUTIONS: 1. Make two parallels the same size.
2. Dimensions will be determined by your instructor.
3. Check the length of the stroke of the ram.
4. Check the speed of the ram.

STOCK: Tool Steel.

OPERATIONS: 1. Cut stock to length.
2. Shape one side of stock flat to size required.
3. Put first side against stationary jaw and shape second side to proper dimension.
4. Turn piece over with the second side down and the first side still facing the stationary jaw.
5. Shape third side, check with a square.
6. Shape last side, check with a square.
7. Harden and temper.
8. Grind to size.



A $\begin{matrix} +.001 \\ -.000 \end{matrix}$

B $\begin{matrix} +.001 \\ -.000 \end{matrix}$

C $\begin{matrix} +.001 \\ -.000 \end{matrix}$

ELL WHITNEY REGIONAL VOCATIONAL TECHNICAL SCHOOL

DIMENSIONAL TOLERANCES Fractional $\pm 1/64$
 UNITS OTHERWISE Angular $\pm 1^\circ$ Decimal $\pm .002$
 SPECIFIED: Concentricity $\pm .001$

MATERIAL		PART	
Tool Steel		NAME	
HEAT TREAT		DATE:	
		SCALE:	
		DWT N	
		01-A-6	

PARALLEL

PARALLELS

Use this procedure when shaping any rectangular block.

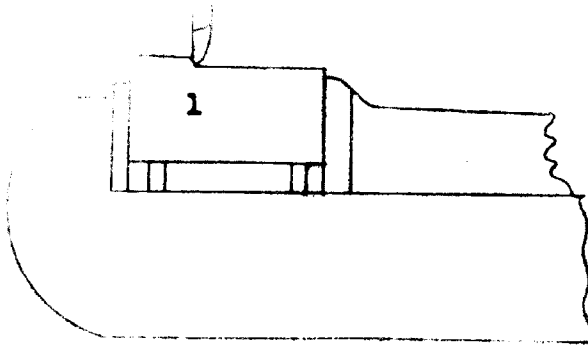


Fig. 1

Place parallels under the work and shape one of the large surfaces first. Set the stroke to cut the length rather than the width. Shape all work toward the stationary jaw. Fig. 1.

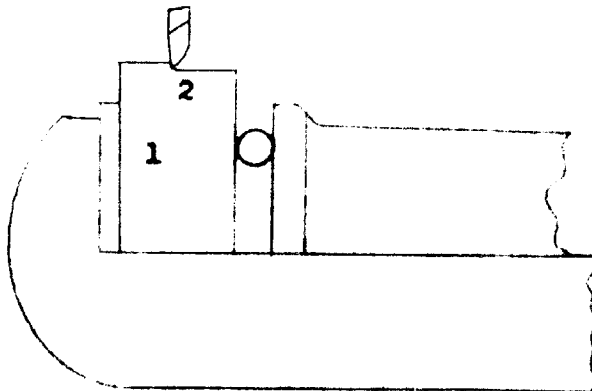


Fig. 2

Place the first shaped surface against the stationary jaw with a soft round rod between the piece and the movable jaw. Shape the second surface. Fig. 2

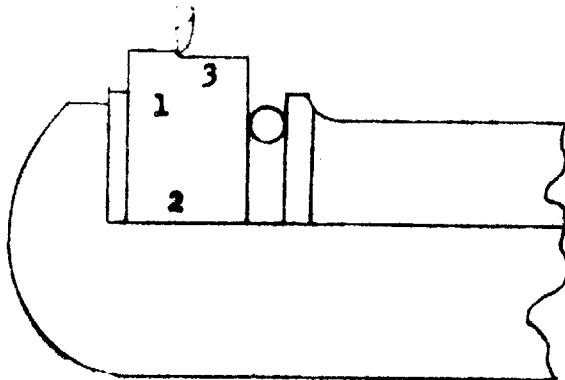


Fig. 3

Shape the third surface using the same set-up as for machining the second surface. Note, the width should now be the correct size. Fig. 3

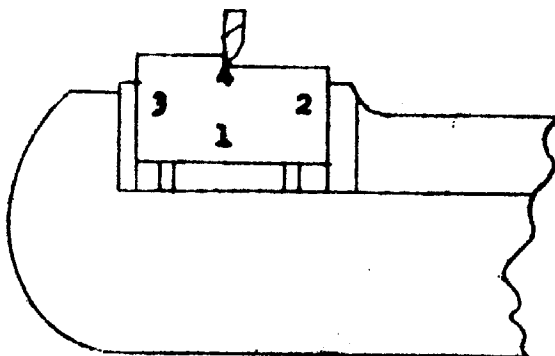


Fig. 4

Place parallels under the work and shape the fourth surface. The thickness should be the correct size. Fig. 4

JOB NAME Bench Block

BLUE PRINT NUMBER: 01-A-7

INFORMATION: This tool is very handy for holding small round or square work while drilling, it is also used for driving out small pins.

PRIMARY SKILL LEARNED:

1. Mounting and removing chucks.
2. Spotting and centering.
3. Mount work in independent chuck.
4. Inside facing.
5. Mounting and removing chucks and taper shank sleeves in drill press.
6. Mill with angular cutter.
7. Screw arbor work in lathe.
8. Drill and ream holes in drill press.

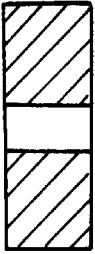
PRECAUTIONS:

1. Do not remove from chuck until you have checked with your instructor.
2. Turn outside dimension and knurl on thread mandril.
3. Use slow speed and plenty of oil when reaming.
4. Make sure the "V" is milled across the 5/8" and 7/16" holes.

STOCK: 2 3/4" Machine steel.

OPERATIONS:

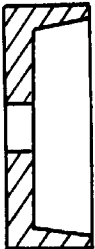
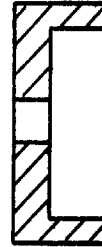
1. Cut stock to 1 1/16" length.
2. Put in four jaw chuck and true up.
3. Face one side.
4. Drill 31/64" hole.
5. Ream 1/2" hole.
6. Face and bore angle.
7. Reverse piece in chuck and face second side.
8. Put bench block on thread mandril and turn diameter.
9. Knurl, medium knurl.
10. Cut undercuts on each end of knurl.
11. Apply layout dye and layout holes.
12. Center drill all holes.
13. Drill and ream holes.
14. Mill "V" slot.
15. Remove burrs.
16. Case harden.
17. Surface grind.



Center the stock in a four jaw chuck.
Face, center drill, $31/64$ " drill, and $1/2$ "
machine ream thru. Fig. 1

Do not remove project from the
chuck until so informed by your
instructor.

Bore inside diameter to 2", $9/16$ " deep. Fig. 2

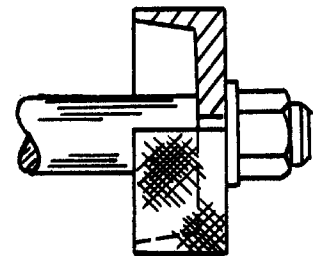


Set compound rest at 10° and bore
 10° internal angle to $2 \frac{3}{16}$ " dimension.
Fig. 3

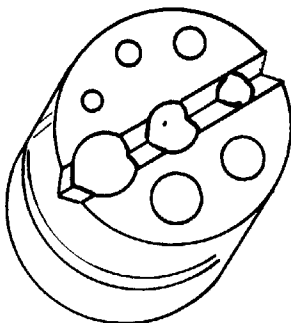
Before removing from the chuck
have project checked by your
instructor.

Remove from chuck.

Place project on a special threaded mandril and
face. Turn the outside diameter to $2 \frac{1}{2}$ ".
Medium knurl turned area. Undercut $1/16$ " X
 $1/8$ " dimensions. Fig. 4



Remove from mandril



Surface grind top to clean up.
Layout and drill proper size holes
at intersections. Mill 90° "V"
slot across the $7/16$ " and $5/8$ "
holes. Fig. 5

Stamp name and date.

JOB NAME Tap Wrench

BLUE PRINT NUMBER: C1-A-8

ITEM: Handles.

INFORMATION: The tap wrench is a tool designed to exert equal pressure on a tap, while tapping, in order to prevent the breakage of a tap.

PRIMARY SKILL LEARNED: 1. Cut right hand thread with tool bit.
2. Cut left hand thread with tool bit.

PRECAUTIONS: 1. Note that one handle has a right hand thread and other handle has left hand thread.
2. Make block first so that you may fit threads to block.

STOCK: 5/8" Diameter Cold Rolled Steel.

OPERATIONS: 1. Cut stock to 5 3/8" length.
2. Face off and center drill.
3. Turn on centers to 1/2" diameter x 4" long.
4. Medium knurl.
5. Undercut knurl.
6. Reverse piece, (use copper to protect knurl).
7. Turn to .570 diameter x 1 7/8".
8. Cut threads.

JOB NAME Tap Wrench

BLUE PRINT NUMBER: 01-A-8

ITEM: Block

INFORMATION: The proper size tap wrench must always be used when tapping, too large a tap wrench will exert too much pressure and break the tap.

PRIMARY SKILL LEARNED: 1. Drilling to simple layout.
2. Tap left hand thread.

PRECAUTIONS: 1. Allow .015 on a side for grinding.
2. Make sure the letter "W" drilled holes are drilled in opposite holes
3. When milling radius keep same side of block against stationary jaw of vise.
4. When tapping left hand hole turn tap in counter clockwise direction.

STOCK: 5/8" X 1 1/2" Machine steel

OPERATIONS: 1. Shape block to size.
2. Grind to finish dimension.
3. Mill radius.
4. Drill two 5/16" holes.
5. Drill "W" size holes 7/8" deep in opposite holes in opposite directions.
6. Tap holes.
7. Cut piece in half.
8. Surface grind ends.
9. Mill 90 degree angle

TAP WRENCH

Z Handles



Fig. 1

Select two pieces of Cold Roll Steel,
5/8" diameter 5 3/8" long.
Face and center drill in a three jaw chuck.
(two pieces \emptyset Fig.1

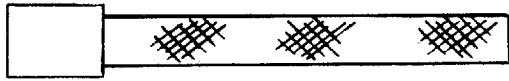


Fig. 2

Turn the outside diameter of both
pieces to 1/2" diameter 4 1/4" long.
Medium knurl, 3 3/4" long. Fig. 2

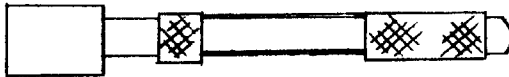


Fig. 3

Turn undercut to remove knurl.
See Fig. 3. Use Form Tool
to turn radius at end.

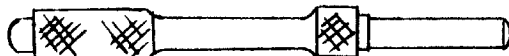


Fig. 4

Reverse piece on centers.
Turn to .370 diameter 1 3/8"
long. Turn chamfer on this
end. Fig. 4

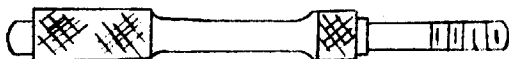


Fig. 5

Cut thread one 3/8" X 16
right hand, 7/8" long, cut
3/8" X 16 left hand on other
piece 7/8" long. Fig. 5

BLOCK

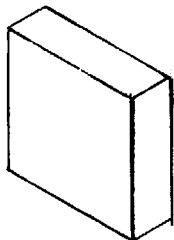


Fig. 1

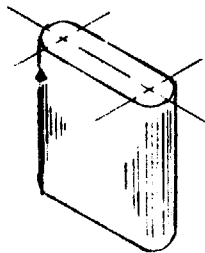


Fig. 2

Shape block to 1/2" X 1 1/2" X 1 5/8".
Allow .015 on all sizes for
grinding. Fig. 1

Mill, 1/2" convex radius with a 1/2"
Concave Cutter, both sides, Layout
from print. Fig. 2



Fig. 3

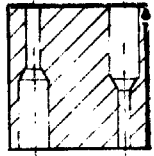


Fig. 4

Center drill at intersections. Drill
5/16" hole thru block at both
locations. Fig. 3

Drill 7/8" deep on opposite sides
(use "W" drill). Fig. 4

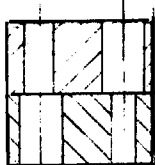


Fig. 5

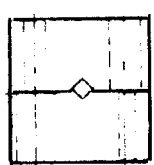


Fig. 6

Use "W" drill and drill 7/8" deep
on opposite sides. Fig. 4

Saw block in half across the holes
then grind parallel to outside
edge. Fig. 5

Use 90° angle mill to mill "W" 3/32"
deep in both parts. Fig. 6

JOB NAME Babbit Hammer

BLUE PRINT NUMBER: 01-A-9

ITEM: Handle.

INFORMATION: This tool is useful for setting down work held in a vise without maring the surface finish.

PRIMARY SKILL LEARNED: 1. Turn taper with tailstock offset.

STOCK: 5/8" Gold Rolled Steel.

OPERATIONS:

1. Cut stock to 7 7/8" length.
2. Face off and center drill in collet.
3. Knurl on centers.
4. Chamfer end.
5. Reverse and turn 1/2" diameter 4 1/8" long.
6. Turn 7/16" diameter 3/4" long.
7. Turn 3/8" diameter 5/8" long.
8. Cut 3/8" - 16 thread.
9. Offset tail stock 5/32" and cut taper.
10. Blend in radius at start of taper.

JOB NAME Rabbit Hammer

BLUE PRINT NUMBER: C1-A-9

ITEM: Head

PRECAUTIONS:

1. Allow stock to stick out at least 5/8" in chuck.
2. Do inside and outside taper in same setup.
3. Set compound rest for cutting tapers.
4. Honl head by ends when drilling for tapped hole.
5. Relieve first thread to get snug fit on handle.

STOCK: 1 1/8" Diameter Hexagon Cold Rolled Steel.

OPERATIONS:

1. Cut off stock to 1 1/4" length.
2. Chuck in 3 jaw chick and turn outside taper.
3. Drill 5/8" hole.
4. Bore inside taper.
5. Reverse piece in chuck.
6. Turn outside taper.
7. Drill 5/8" hole.
8. Bore inside taper.
9. Drill 5/16" hole 7/8" deep.
10. Drill 3/8" hole 1/8" deep to remove first thread.
11. Tap 3/8"-16 thread.

JOB NAME Rabbitt Hammer

BLUE PRINT NUMBER: 01-2-9

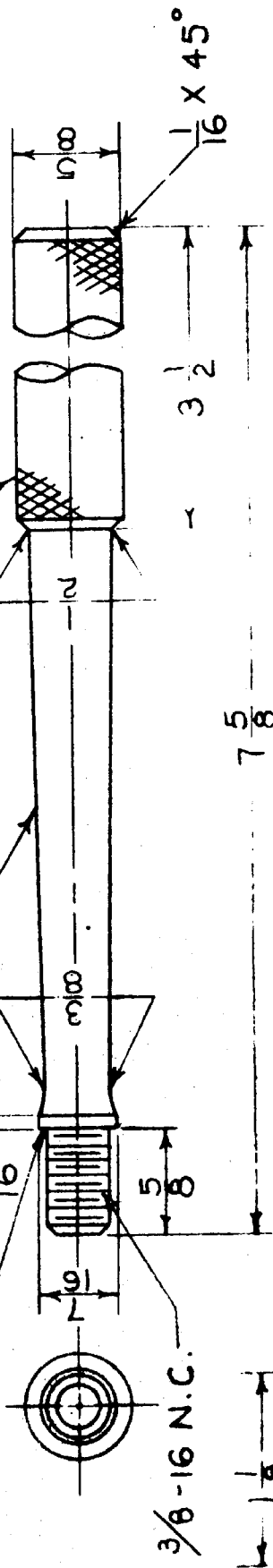
ITX: Mold

- PRECAUTIONS:
1. Outside diameter does not have to be turned.
 2. Have large side of taper facing you when boring so that $1 \frac{1}{16}$ " dimension may be checked.

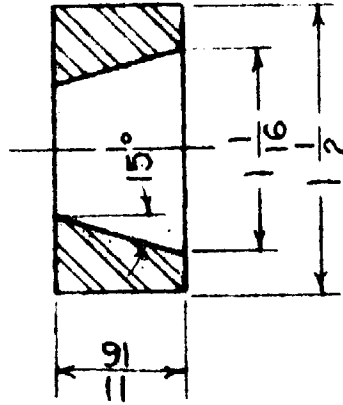
STOCK: Machine steel $1 \frac{1}{2}$ " diameter.

- OPERATIONS:
1. Cut stock to $13/16$ " length.
 2. Remove burrs.
 3. Face off in 3 jaw chuck.
 4. Drill $5/8$ " hole.
 5. bore 15 degree angle.
 6. Reverse piece and face off to $11/16$ ".

5/32 SETOVER OF
TAIL STOCK
SQUARE
SHOULDER

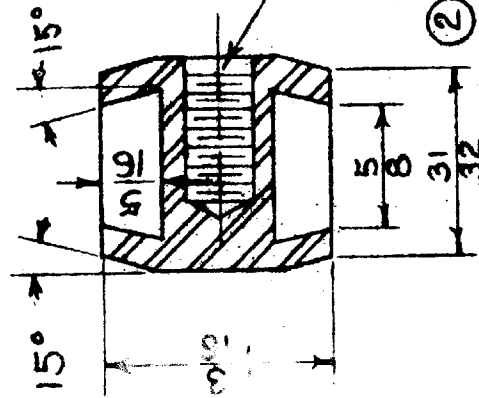


① HANDLE
C.R.S.

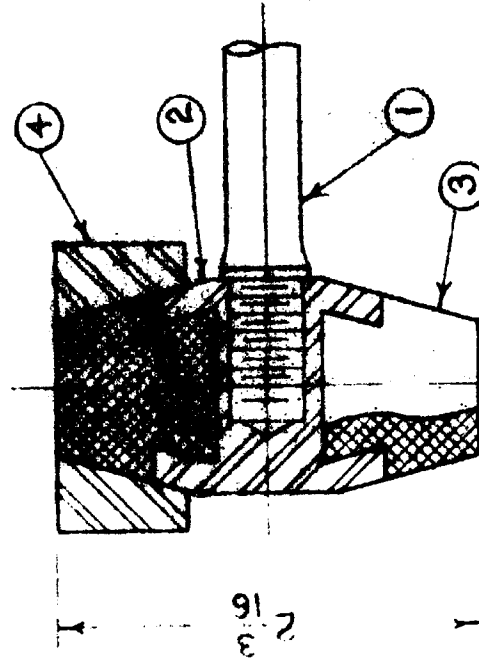


④ MOLD
C.R.S.

3/8-16 N.C.
3/4 DEEP - REMOVE
FIRST TH'D. WITH "W" DRILL



② HEAD
C.R.S.
BREAK ALL UNNECESSARY CORNERS



ASSEMBLY

DO NOT SCALE THIS DRAWING

Material		Part	Name	
Cold Rolled Steel		BABBIT HAMMER		
Heat Treat		Detcs:-	P.W.G. MC.	
		SCALE:-	01-A-9	

ELI WHITNEY REGIONAL VOCATIONAL TECHNICAL SCHOOL

DEMEMSIONAL TOLRANCES Fractional $\pm 1/64$ Decimal $\pm .002$ Angular $\pm 1^\circ$ Concentricity $\pm .001$

BABBIT HAMMER

Use $5/8$ " Cold Roll Steel. Face and center drill both ends in a Spring Collet.

Place the project on centers. Medium knurl one end 4 " long. Chamfer end. Fig. 1



Fig. 1

Reverse piece on centers, protect the knurl with a soft piece of copper.



Fig. 2

From the tailstock end, turn the following sizes:

- a. $1/2$ " diameter $4 1/8$ " long. Fig. 2
- b. $7/16$ " diameter $3/4$ " long.
- c. $.370$ diameter $5/8$ " long. Fig. 3



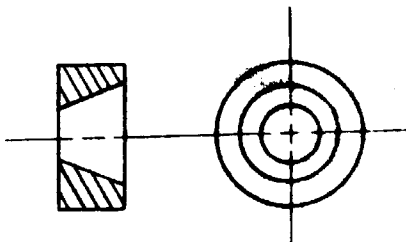
Fig. 3

Turn a $3/8$ " X 16 right hand thread to the shoulder.



Fig. 4

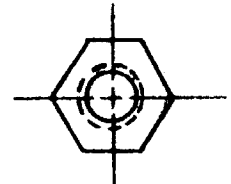
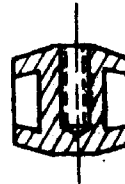
Offset the tailstock $5/32$ " toward the front of the machine and turn the taper. Fig. 4

Mold

Head

Use $1 1/2$ " diameter Cold Roll Steel $13/16$ " long. Place in a 3 jaw chuck, face off and center drill. Use a $5/8$ " drill and drill a $5/8$ " hole thru. Bore a 15° angle to the $1 1/16$ " dimension. Reverse the piece in the chuck and face off to $11/16$ " long. Fig. 5

Use $1 1/8$ " hexagon Cold Roll Steel $1 1/4$ " long. Face off, center drill and drill a $5/8$ " diameter hole $5/16$ " deep. Set the Compound Rest to 15° angle, turn the outside angle to the $31/32$ " dimension. Bore 15° inside angle to the $5/8$ " dimension. Reverse the piece in the chuck, face off to $1 3/16$ " long, and repeat the above operations for this side, Fig. 6



Layout, drill $5/16$ " hole $7/8$ " deep, drill $3/8$ " hole $1/8$ " deep tap $3/8$ " X 16 right hand thread. Stamp name and date.

JOB NAME Thread Tool Grinding Fixture

BLUE PRINT NUMBER: 01-A-10

INFORMATION: This unique tool is extremely valuable in accurately and speedily grinding threading tool bits.

PRIMARY SKILLS LEARNED:

1. Shaping angular work.
2. Milling slots with vise on angle.
3. Mount and dress grinding wheels.
4. Grind surfaces at right angles.
5. Grind thread tool with fixture.

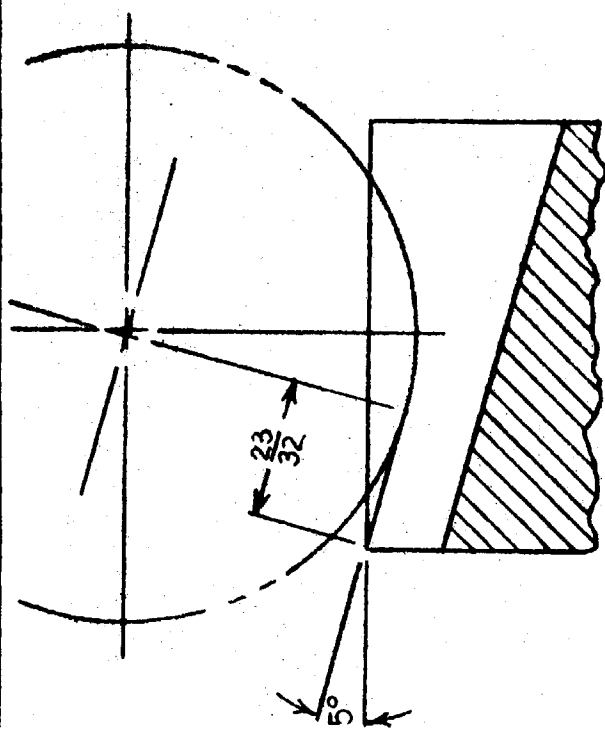
PRECAUTIONS:

1. Drill holes before milling angles.
2. Use sine bar to accurately grind angles.

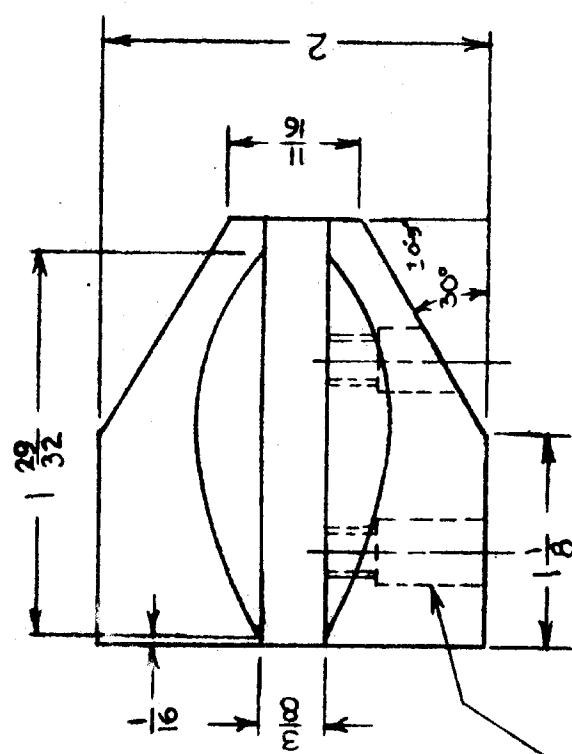
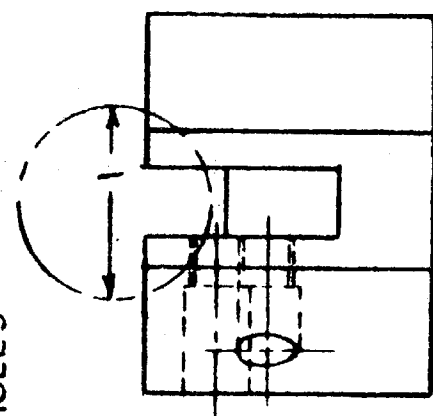
STOCK: 1 5/8" x 2 1/8" Machine steel.

OPERATIONS:

1. Cut off stock to 2 3/8" length.
2. Mill or shape stock to size. (allow .015 on a side for grinding.)
3. Grind piece square.
4. Layout and drill holes.
5. Counterbore holes.
6. Tap holes.
7. Mill or shape 30 degree angles.
8. Mill slot with piece at 15 degree angle.
9. Mill 1" concave finger slot at 15 degree angle.
10. Grind 30 degree angle with sine bar.

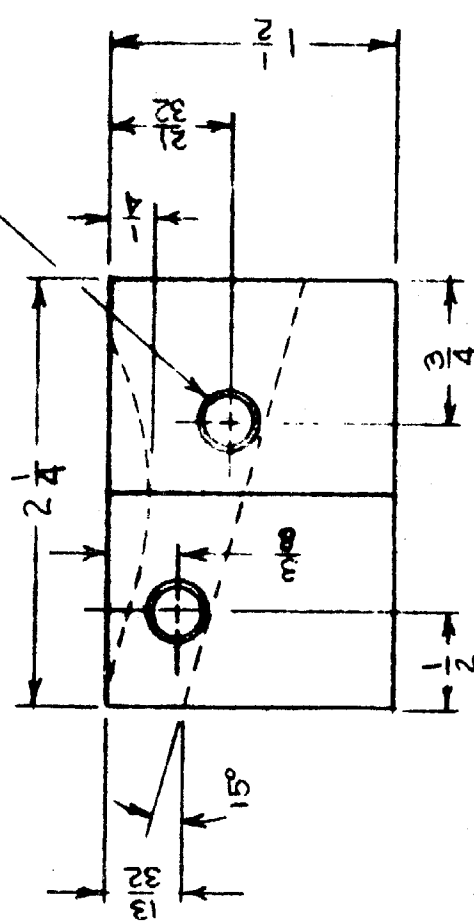


TO COMPLETE USE
TWO SOC. HD SET
SCR 1/4-20 NC-1/4 LG



5/16 C.BORE
9/16 DEEP

1/4-20 NC.-2 HOLES



BREAK ALL UNNECESSARY CORNERS

ELI WHITNEY REGIONAL VOCATIONAL TECHNICAL SCHOOL		Material	PART NAME	THREAD TOOL
DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED:-		Machine Steel	GRINDING FIXTURE	
		Heat Treat	Date:-	D'W'G. No.
			Scales:-	01-A-10

Fractional $\pm 1/64$ Decimal $\pm .002$
Angular $\pm 1^\circ$ Concentricity $\pm .001$

THREAD TOOL GRINDING FIXTURE

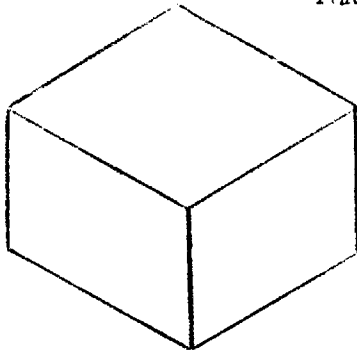


Fig. 1

Shape and grind the block to $1\frac{1}{2}$ " X 2" X $2\frac{1}{4}$ ". All sides must be parallel and square to each other.
Fig. 1

Layout for drilling. Drill two # 7 holes 1" deep, counterbore with a $\frac{5}{16}$ " drill $\frac{19}{32}$ " deep.
Fig. 2

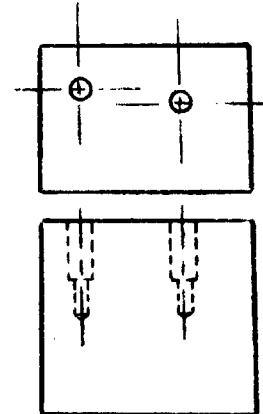


Fig. 2

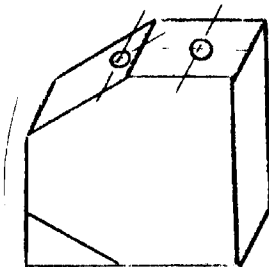


Fig. 3

Mill or Shape 30° angle on both sides, use a Combination Set to locate angle. Fig. 3

Indicate Milling Machine Vise. Mill slot to $\frac{3}{8}$ " measurement at 15° angle. Using the same set up, mill out the finger slot with a 1" Convex Mill.
Fig. 4

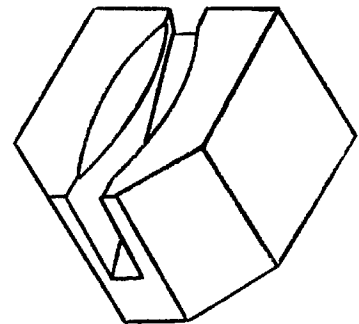
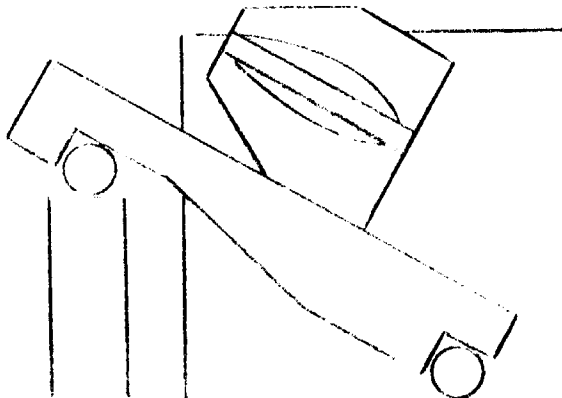


Fig. 4



Grind 30° angle, using a 5" Sine Bar and a 2.500 size block. Secure project to an angle Iron or "U" Iron.
Fig. 5

Stamp name and date

JOB NAME "V" Block

BLUE PRINT NUMBER: 01-A-11

ITEM: Block

INFORMATION: V-blocks are used for holding round or square work, while milling, drilling, grinding or laying out work.

PRIMARY SKILL LEARNED:

1. Shaping work square and to decimal dimensions.
2. Shaping vee shapes.
3. Band sawing stock to a line
4. Surface grind to shoulder
5. Grind steps in vise.
6. Grind angles with magnetic V-block

PRECAUTIONS:

1. Make sure piece is shaped or milled square.
2. Keep base against stationary jaw when milling side slots.
3. Mill $1/4"$ X $1/4"$ slot first, then reverse piece in vise and do same operation on opposite side.
4. Put piece of round stock in "V" when holding block in vise to prevent wing from bending in.

STOCK: $1\ 7/8"$ Square Tool Steel

OPERATIONS:

1. Cut off stock to $3\ 1/8"$ length.
2. Mill or shape to print size. (Allow for grinding.)
3. Layout for milling.
4. Mill or shape 90 degree angles on top and end.
5. Mill $1/8"$ recess in bottom of V's.
6. Saw out corner.
7. Mill grinding recess in corner.
8. Mill slots on sides.
9. Mill $1\ 9/32"$ step on sides.
10. Mill slots on end.
11. Mill $1\ 9/32"$ step on end.

JOB NAME "V" Block

BLUE PRINT NUMBER: 01-A-11

ITEM: Clamp

PRIMARY SKILL LEARNED:

1. True center punch mark with wiggler.
2. Shape to shoulder.
3. Shape to layout.

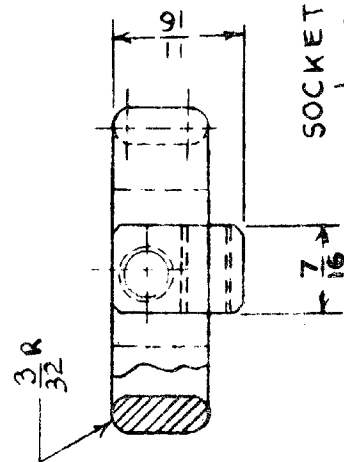
PRECAUTIONS:

1. Notice hub at top of clamp when shaping thickness.
2. Bore hole in 4 jaw chuck.
3. Tapped holes must clear each other at right angles.

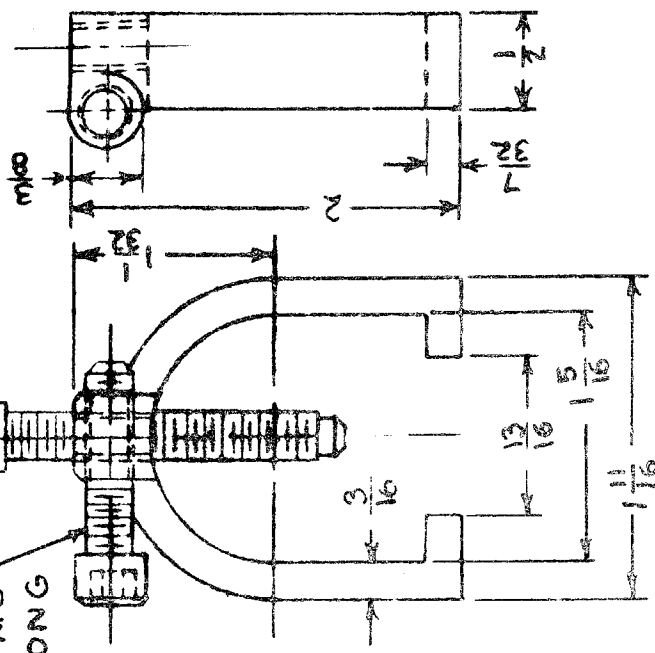
STOCK: 7/8" X 2" Machine Steel.

OPERATIONS:

1. Cut off stock to 2 1/8" length.
2. Shape stock to blueprint size.
3. Layout internal radius.
4. Face off, drill and bore 1 5/16" hole.
5. Layout external radius.
6. Saw outside of clamp.
7. File outside of clamp.
8. Saw inside of clamp.
9. File inside of clamp.
10. Layout and drill for clamping screw.
11. Locate and drill center of hub.
12. Tap holes.
13. File radius on hub.



SOCKET H'D SCREW
1/4-20 N.C.
1" LONG



"V" BLOCK

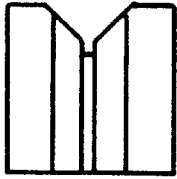


Fig. 1

Shape and grind a tool steel block to $1 \frac{3}{4}$ " X $1 \frac{3}{4}$ " X 3". Indicate the milling machine vise and mill the "V" generally on the top and one end. Use a 90° mill and mill to the print dimensions. Mill a $\frac{1}{8}$ " grinding recess $\frac{1}{8}$ " deep in the bottom of the "V" cuts. Fig. 1

Layout. Bandsaw to the outside of the line. Mill square to the dimensions. Fig. 2
A grinding recess in the "L" may be milled now.

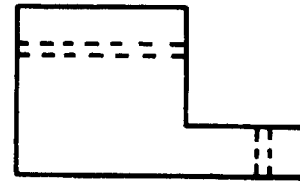


Fig. 2

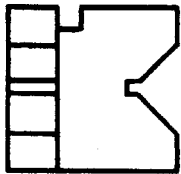


Fig. 3

Place the base of the "V" block against the stationary jaw. Change the cutter to a $\frac{1}{4}$ " wide mill 3" in diameter. Mill a $\frac{1}{4}$ " slot $\frac{1}{4}$ " deep and $\frac{1}{2}$ " from the base. Fig. 3

Reverse the piece in the vise place the base against the stationary jaw. Mill a $\frac{1}{4}$ " slot $\frac{1}{4}$ " deep and $\frac{1}{2}$ " from the base. Fig. 4

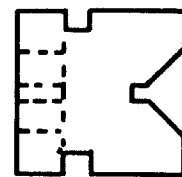


Fig. 4

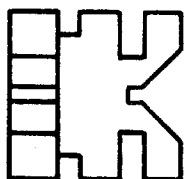


Fig. 5

Mill a $\frac{1}{4}$ " slot $\frac{1}{2}$ " deep $1 \frac{1}{8}$ " from the base. Reverse the piece and repeat the operation on the other side. Fig. 5

" V " BLOCK

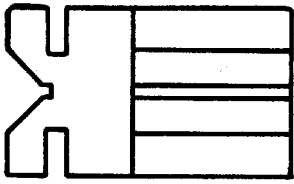


FIG. 6

On the narrow section mill a $\frac{1}{4}$ " slot, $\frac{1}{2}$ " deep and $\frac{3}{8}$ " from the end. Reverse the piece and repeat the operation. FIG. 6

Place the side with the "V" up. Set the edge of the cutter $\frac{15}{64}$ " in from the stationary jaw and mill off one wing. Fig. 7

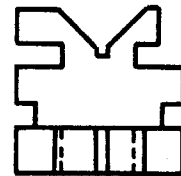


FIG. 7

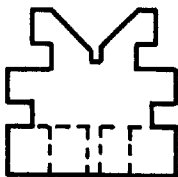


FIG. 8

Place the opposite side against the stationary jaw the "V" up. Mill the other wing. The $1 \frac{9}{32}$ " dimension will be centrally located. Fig. 8

On the narrow section, complete the same operations for FIG. 9 as was completed in the operations shown in FIG. 8. Mill a grinding recess in the "L" section.

Stamp name and date on the bottom. Harden in oil (water), and temper. Finish grind at later date.

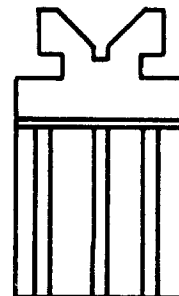


FIG. 9

"V" BLOCK CLAMP

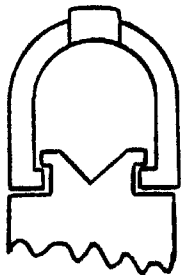


Fig. 2

Consult your blueprint.

Select stock $7/8"$ X $2"$ X

$2\ 1/8"$. Layout as

illustrated in Fig. 1.

Center punch location

at intersection.

Place the piece in

a four jaw chuck and

line up the center

punch mark with the tail

stock center. Face off,

center drill, drill up to $1"$ in

diameter and bore to fit the wings on the

"V" block. Fig. 2. $1\ 5/16"$ Dia.

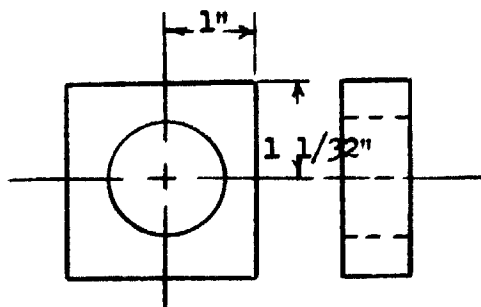
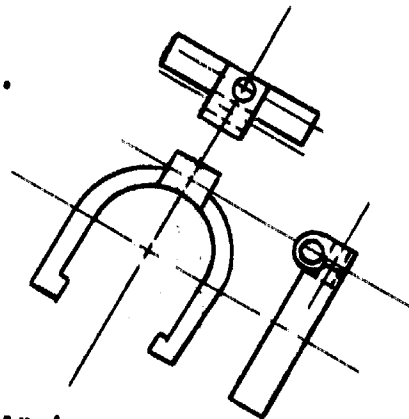


Fig. 1

Layout the outside shape and band saw. Keep the faced off, side down and mill to the $1/2"$ thickness (watch the lug) Fig. 3

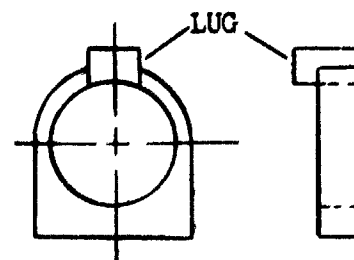


Fig. 3

Layout, drill and tap two $1/4"$ X 20 holes. (Note: tapped holes are at right angles and must clear each other, see blueprint.

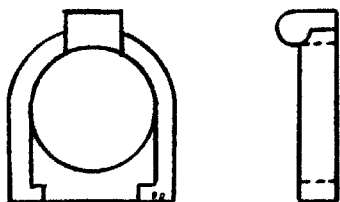


Fig. 4

Layout the inside shape, band saw to the line, file to fit "V" block. Fig. 4

BLUE PRINT NUMBER: 01-A-12ITEM: JawINFORMATION:

Parallel clamps are extremely useful for holding work together while locating holes or machining pieces. The two jaws must be parallel to each other, when clamped on the work in order to hold properly.

PRIMARY SKILL LEARNED:

1. Spotting for transfer of holes.
2. Roughing and squaring stock.
3. Squaring ends on stock.
4. Grind shaper tool bit.
5. Line up work or vise with indicator.

PRECAUTIONS:

1. Mill angle on the 4 jaws together.
2. Clamp pieces together when milling radius.
3. Clamps must be made in pairs so that holes will line up.
4. Clamp jaws together when spotting holes.
5. Make sure tap is perpendicular to top surface of jaw when tapping.

STOCK: 5/8" Square cold Rolled Steel.OPERATIONS:

1. Cut stock to 4" length.
2. Mill ends square in vise.
3. Mill 5/8" radius on ends.
4. Shape or mill angle.
5. Layout and prickpunch holes.
6. Drill letter "I" drill thru two jaws.
7. Clamp drilled jaw to undrilled jaw and spot thru.
8. Drill 1/4" hole 5/16" deep.
9. Drill letter O hole.
10. Mark jaws as a pair.
11. Tap 5/16" holes.
12. Spot 6-32 holes from clip.
13. Tap 6-32 hole.
14. Case harden.

JOB NAME Parallel Clamp

BLUE PRINT NUMBER: 01-A-12

ITEM: Screws

PRIMARY SKILL LEARNED:

1. Cut threads with tool bit.
2. Cut recess in lathe.

PRECAUTIONS:

1. Allow 1/2" extra stock for holding in dog.
2. Note that screws are of different lengths.
3. Knurl before turning thread diameter. (To prevent bending piece).
4. Fit screws to jaws, when threading.
5. Do all operations before cutting off extra stock.

STOCK: 5/8" Cold Rolled Steel.

OPERATIONS:

1. Cut off stock to 4" length.
2. Center drill and face off in collet.
3. Turn 5/8" dia. on centers to true up.
4. Knurl.
5. Reverse piece and turn thread diameter.
6. Turn 1/4" diameter. (on clamping screw only.)
7. Cut 1/16" groove in knurl. (On adjusting screw only.)
8. Thread.
9. Cut off extra stock.
10. Face off in collet.
11. Drill 3/16" hole.

JOB NAME Parallel Clamp

BLUE PRINT NUMBER: 01-A-12

ITEM: Clip

PRIMARY SKILL LEARNED: 1. Drilling thin stock.

PRECAUTIONS:

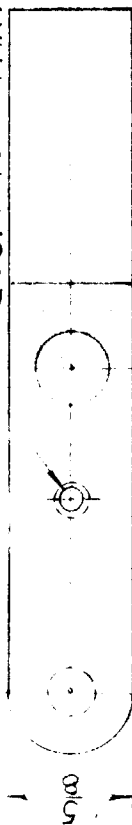
1. Nail stock to a piece of wood while drilling to prevent work from climbing up the drill.
2. Put bend in clip by placing two pieces of 1/16" metal on opposite sides of work and apply pressure in the arbor press.

STOCK: Soft sheet steel 1/16" thick.

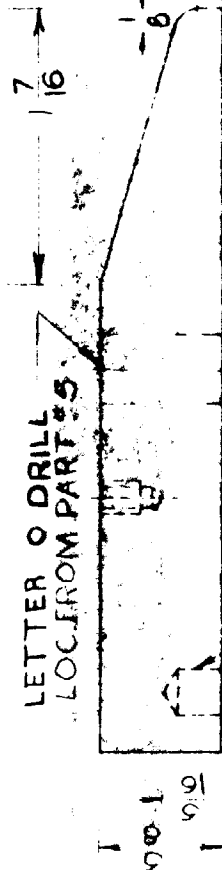
OPERATIONS:

1. Cut stock to length 5/8" x 2".
2. File radius
3. Layout and prick punch.
4. Clamp stock to piece of wood and drill 1/2" hole.
5. Drill #26 holes.
6. Saw piece in half.
7. Bend step in piece.

— "6-32 NC. x $\frac{3}{16}$ DR.
LOC. FROM PART #3

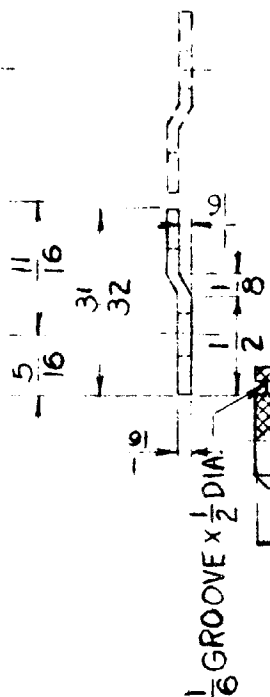
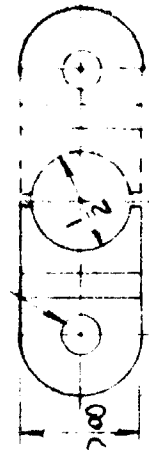


LETTER O DRILL
LOC. FROM PART #3

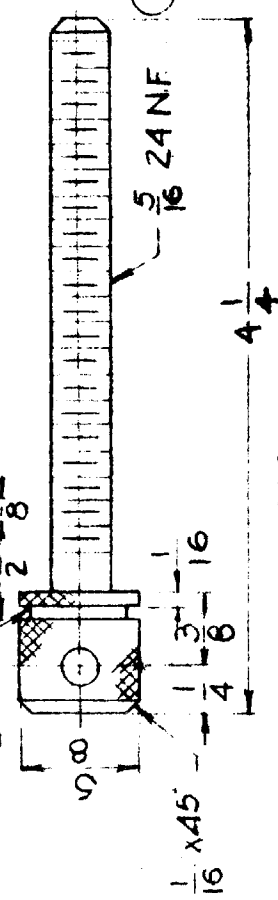


— $\frac{1}{4}$ DRILL LOC. FROM PART #5

— *26 DRILL



$\frac{1}{16}$ GROOVE x $\frac{1}{2}$ DIA



BREAK ALL UNNECESSARY CORNERS

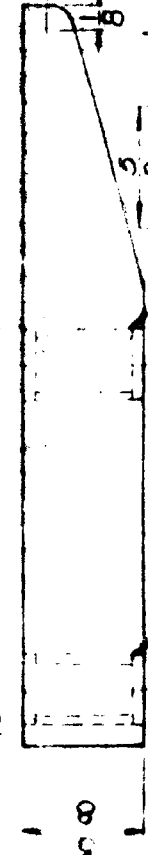
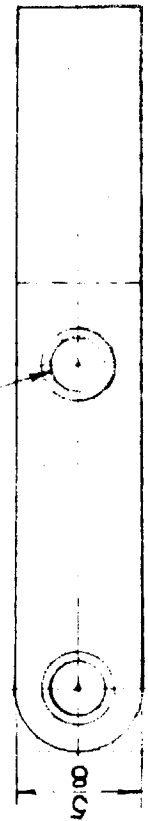
ELI WHITNEY REGIONAL VOCATIONAL TECHNICAL SCHOOL

DIMENSIONAL TOLERANCES
UNLESS OTHERWISE
SPECIFIED: -

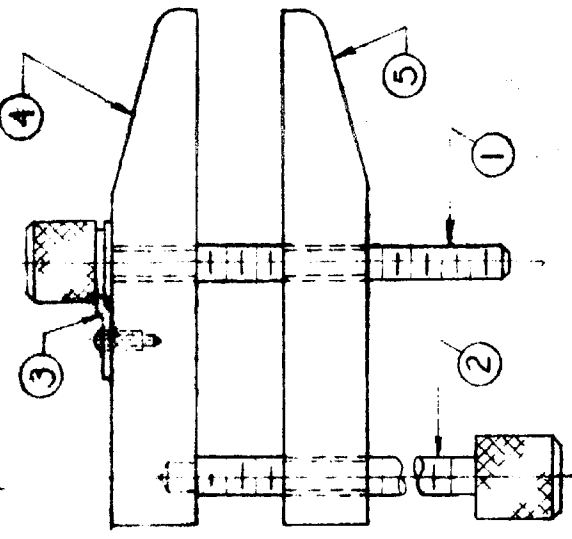
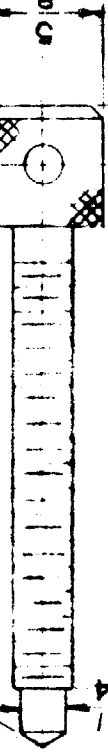
FRACTIONAL $\pm 1/64$ DECIMAL $\pm .002$
ANGULAR $\pm 1^\circ$ CONCENTRICITY $\pm .001$

3 7 8

$\frac{5}{16}$ 24 NF-2 HOLES



REMOVE FIRST THD.



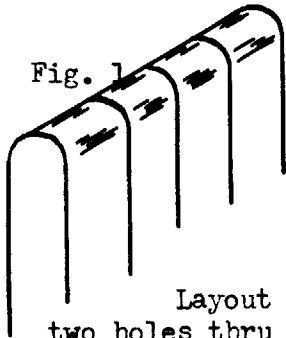
MED
KNURL

PARALLEL CLAMPS		PART NAME	MATERIAL	HEAT TREAT
			Cold Rolled Steel	
		DATE	2-26-64	D'W'G. NO.
		SCALE: -		01-A-22

PARALLEL CLAMPS (2)

Use four pieces of $\frac{5}{8}$ " square cold roll steel, 4" long. Indicate the milling machine vise and mill a $\frac{5}{8}$ " convex radius on all four pieces. Fig. 1

Fig. 1



Use the angle fixture and shape the four pieces at the same time to the $1 \frac{7}{16}$ " dimension. Fig. 2

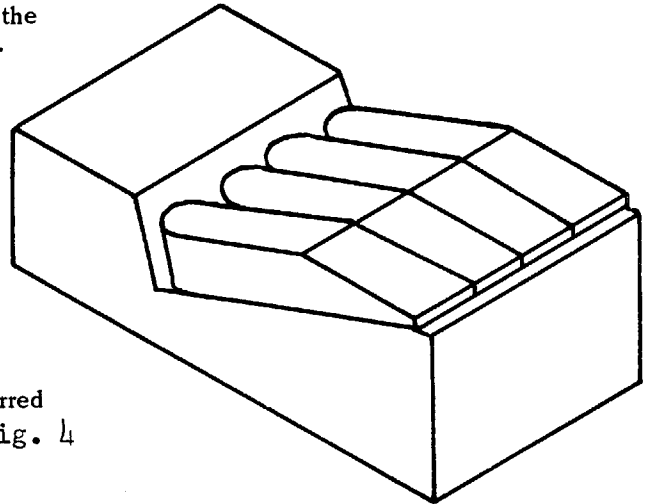


Fig. 2

Layout part #5. Drill two holes thru with an "I" drill in two pieces. Use an "O" drill and counterbore $\frac{1}{16}$ " deep to remove the first thread on both sides of all holes. Fig. 3

Pair up and transfer holes an "I" drill from part #5 to part #4. The transferred holes in part #4 are to be $\frac{1}{16}$ " deep. Fig. 4

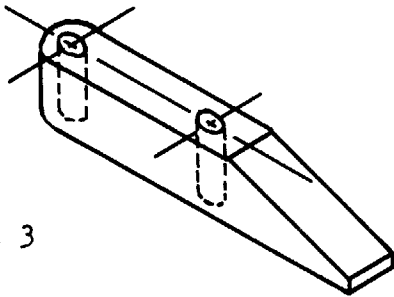


Fig. 3

In part #4, with the transferred holes up, drill a $\frac{1}{4}$ " hole $\frac{5}{16}$ " deep on the end with the radius. Drill the other hole thru with an "O" drill. Remove the burrs. Fig. 5

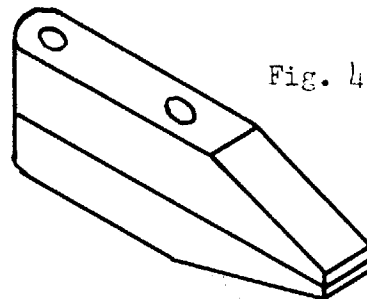


Fig. 4

Tap two $\frac{5}{16}$ " X $2\frac{1}{2}$ holes in part #5.

Stamp name and date.

Transfer the 6-32 threaded hole in part #4 from part #3 at assembly.

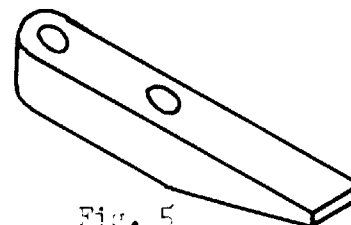


Fig. 5

PARALLEL CLAMPS



Fig. 1



Fig. 2

The screws (part #1 & #2) are made from four pieces of $5/8$ " diameter, cold roll steel, two pieces $4-3/4$ " long, and two $4-1/2$ " long. Knurl the handles $1-1/2$ " long.

Reverse the piece on centers and turn the diameter to $.310$ " and to the proper length. Cut the threads $5/16 \times 24$ to the shoulder.

Note : Undercut the $1/16$ " groove in the knurled area at assembly. Fig. 1.

Turn the $1/4$ " diameter $5/16$ " long on the two pieces that are $4-1/2$ " long. Fig. 2.

Face off knurled end to proper length.

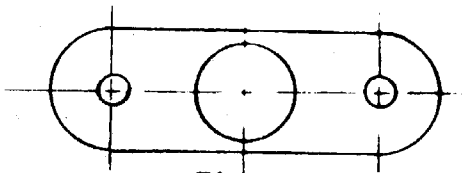


Fig. 3

The hold down spring (part #3) is made from 16 gage sheet metal $5/8$ " wide and 2" long. File the $5/16$ " radius using part #4 or #5 as a guide. Layout center lines and scribe two lines $5/16$ " from each end.

Secure work to a flat piece of wood and drill a $1/2$ " hole in the center and a #26 drill hole at the other two intersections. Fig. 3

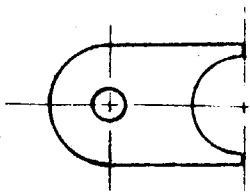


Fig. 4

Saw in half across the $1/2$ " hole and remove the burrs. Fig. 4

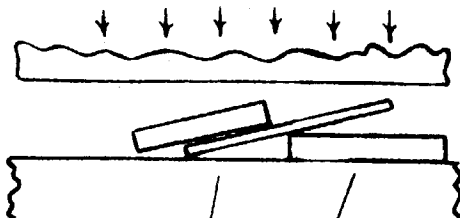


Fig. 5

When bending the spring use two pieces of scrap stock approximately $.070$ " thick.

Place the $.070$ " pieces in such a position so as to provide the proper location for the bend.

Bend in an arbor press.

Figs. 5 - 5a - 6



Fig. 5a

Locate the groove in the screw (part #1) from the spring (part #3) at assembly with the clamp (part #4).

When the groove is made, locate the #6-32 tapped hole in part #4 from the spring.

Tap the hole $1/4$ " deep.

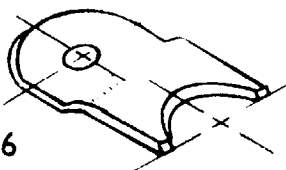


Fig. 6

JOB NAME Planer Jack

BLUE PRINT NUMBER 01-A-13

ITEM: Screw

PRIMARY SKILL LEARNED:

1. Cutting threads, die in tail stock.
2. Cutting threads in vise, stock and die.
3. Straddle milling.

PRECAUTIONS:

1. Make screws as one piece, back to back, allow 1/8" for cutting in half.
2. Thread one end in lathe using die on tail stock and thread other end in vise using stock and die to gain experience in these methods.

STOCK: Machine Steel 3/4" diameter.

OPERATIONS:

1. Cut off stock to length $6\frac{1}{4}$ "
2. Turn 1/2" dia. X 2-1/2".
3. Reverse piece and turn other end to 1/2" dia. X 2-1/2".
4. Undercut head with 1/16" radius.
5. Cut threads.
6. Mill square.
7. Cut in half.
8. File radius on head.

JOB NAME Planner Jack

BLUE PRINT NUMBER: 01-A-13

ITEM: Base

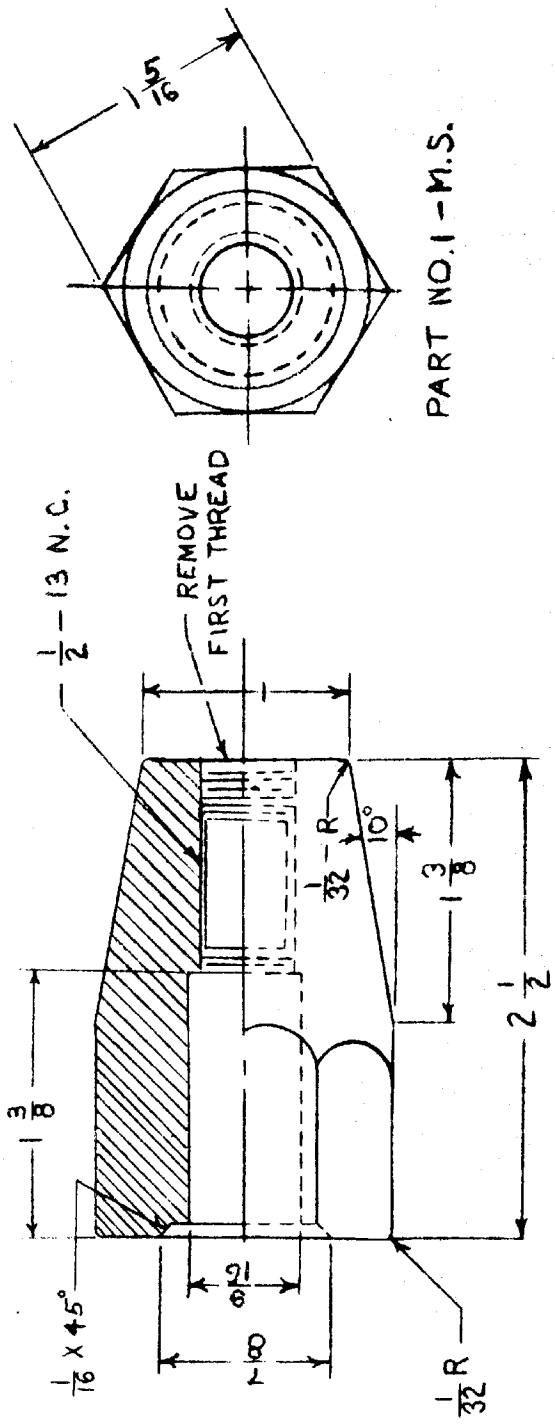
INFORMATION: Planner jacks are used to level work on planer beds and milling machines. They are also valuable in supporting thin shafts during a milling or drilling operation.

PRIMARY SKILL LEARNED: 1. Turn work held in chuck.
 2. Tapping with tail center.
 3. Milling hexagons.
 4. Turn taper using compound rest.

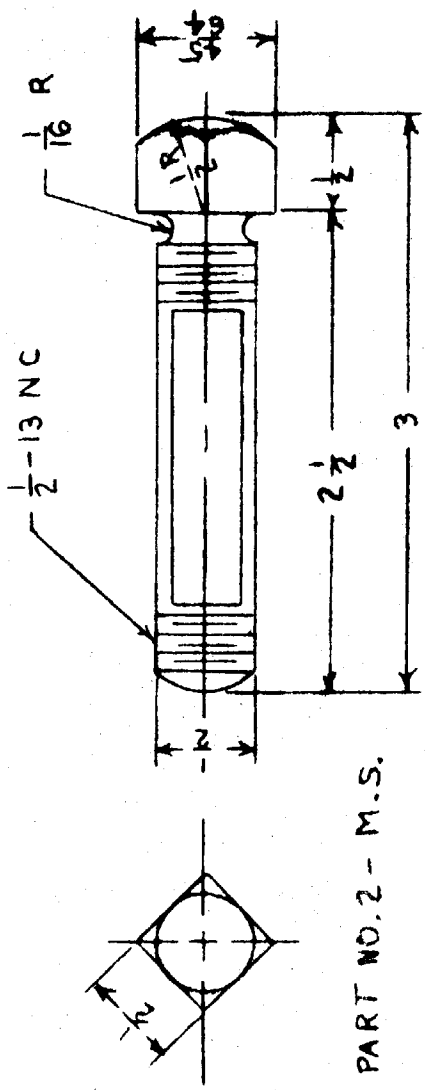
PRECAUTIONS: 1. When reversing piece between index centers use a protractor to line up cut.
 2. Two bases will be milled as one piece, then cut in half.
 3. When tapping in the lathe use light pressure on the tail stock as you advance tap.

STOCK: 1 3/4" Diameter Machine Steel.

OPERATIONS: 1. Cut off stock to length 5 1/4".
 2. Face off and center drill.
 3. Mill hexagon.
 4. Saw piece in half.
 5. Turn taper in chuck.
 6. Drill 27/64" hole.
 7. Drill 1/2" hole 1/8" deep.
 8. Tap in lathe, 1/2"-13 x 1" deep.
 9. Reverse piece in chuck.
 10. Drill 9/16" clearance hole 1 1/2" deep.
 11. Recess undercut.



PART NO. 1 - M.S.



PART NO. 2 - M.S.

BREAK ALL UNNECESSARY CORNERS

DO NOT SCALE THIS DRAWING

ELI WHITNEY REGIONAL VOCATIONAL TECHNICAL SCHOOL		Material	PART NAME	PLANER JACKS	
DIMENSIONAL TOLERANCES		MACHINE STEEL			
UNLESS OTHERWISE SPECIFIED:-		Heat Treat		Date: -	DWG. No.
Fractional $\pm \frac{1}{64}$					01-A-13
Angular $\pm 1^\circ$					
Concentricity $\pm .001$					

PLANNER JACKS

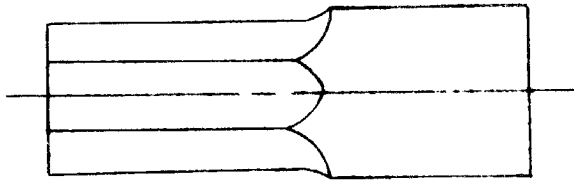


Fig. 1

Stock size $1 \frac{3}{4}$ " diameter, $5 \frac{1}{4}$ " long. Face and center drill both ends, in a three jaw chuck. Adjust the work on the Milling Machine, between the Index Head and the foot-stock. Mill a $1 \frac{5}{16}$ " hexagon, $2 \frac{5}{8}$ " long. Fig. 1

Reverse the work on the Index centers and mill this end to match the completed end. Fig. 2

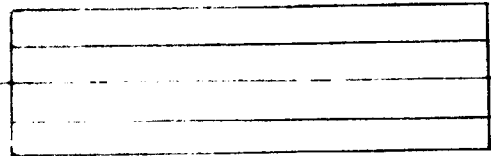


Fig. 2

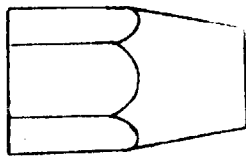


Fig. 3

Saw the piece in half across the hexagon. Use a three jaw chuck in the lathe, face and center drill the sawed end. Turn the 10° angle to the $1"$ dimension. Fig. 3

Drill a $\frac{27}{64}$ " hole thru, counter-bore a $\frac{1}{2}$ " diameter $\frac{1}{8}"$ deep. Tap a $\frac{1}{2}"$ X 13 thread $\frac{5}{8}"$ deep. Fig. 4

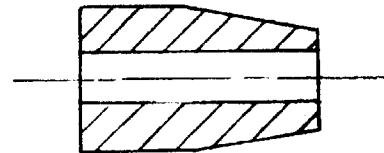


Fig. 4

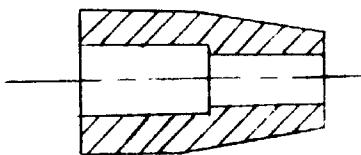


Fig. 5

Reverse the piece in the chuck undercut the bottom to the $\frac{7}{8}"$ dimension. Drill a $\frac{9}{16}"$ hole $1 \frac{3}{8}"$ deep. Fig. 5

Remove the project from the chuck and finish tapping thru. Stamp name and date.

Select $\frac{3}{4}"$ diameter machine steel, $6 \frac{1}{4}"$ long. Face and center drill both ends. Turn one end to $\frac{1}{2}"$ diameter X $2 \frac{1}{2}"$ long. Reverse workpiece on centers and repeat the above operation. Thread one end in lathe using die on tail stock. Thread other end in vise using stock and die to gain experience in these methods. Mill the center section $\frac{1}{2}"$ square in the milling machine. Saw in half and finish by facing off and filing. Fig. 6



Fig. 6

JOB NAME Lathe Center

BLUE PRINT NUMBER: 01-A-14

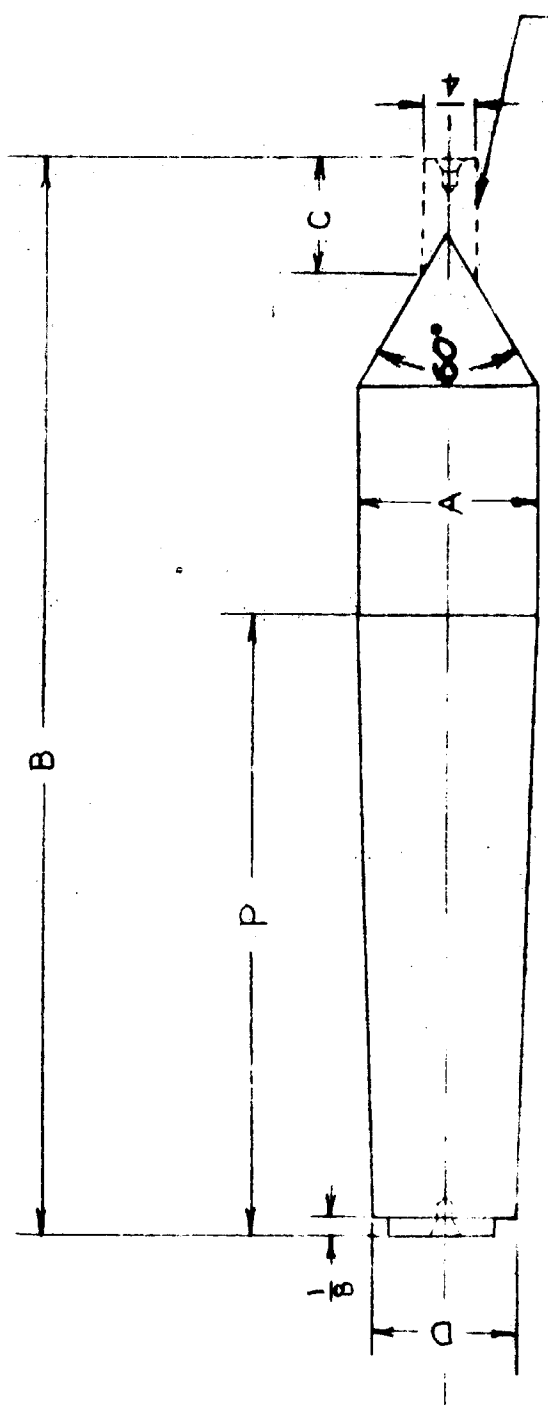
INFORMATION: The accuracy of a lathe center determines the accuracy of the lathe. Always check the center in the spindle end for runout.

PRIMARY SKILL LEARNED: 1. Turn taper with taper attachment.
2. Mount tool post grinder.
3. Grind centers.

PRECAUTIONS: 1. Allow 1/32" for grinding after hardening.
2. Lap center holes before grinding.
3. Check for runout before grinding point.
4. Protect ways on lathe when grinding.
5. Check speed on tool post grinder before turning on grinder.

STOCK: High Speed Steel (Size according to taper required)

OPERATIONS: 1. Cut off stock to size.
2. Face off and center drill.
3. Turn taper to required dimension.
4. Turn "A" dimension.
5. Turn 1/4" diameter.
6. Turn 60 degree angle.
7. Harden.
8. Lap center holes.
9. Grind "A" dimension.
10. Grind taper to fit taper gage.
11. Grind 60 degree angle.



REMOVE
AFTER HARDENING AND
GRINDING

MORRIS TAPER	P	D	A	B	C	T.P.I.
2	2- 9/16	.572	.700	4- 1/2	1/2	04985
3	3- 3/16	.778	.938	5- 3/4	1/2	05019
4	4- 1/16	1.020	1.180	7- 1/8	1/2	05103

BREAK ALL UNNECESSARY CORNERS

DO NOT SCALE DRAWING

ELI WHITNEY REGIONAL TECHNICAL SCHOOL		MATERIAL High Speed Steel		PART NAME	LATHE CENTER	
DIMENSIONAL TOLERANCE		HEAT TREAT		Date	DWG. NO.	
Fractional $\pm \frac{1}{32}$ Decimal $\pm .002$ Ang. $\pm 1^\circ$		Electricity $\pm .001$		Scale	01-A-14	

LATHE CENTERS (2)

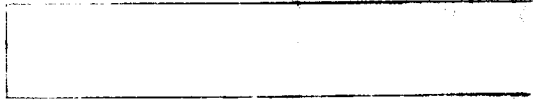


Fig. 1

Use 1 1/8" diameter tool steel, cut off to the proper length. Face and center drill both ends in a three jaw chuck. Fig. 1

Place on centers and turn the taper using the taper attachment. Allow for grinding. Turn the step on the tapered end. Fig. 2

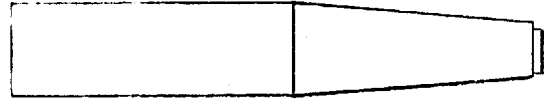


Fig. 2



Fig. 3

Reverse the piece on centers, protect the turned portion with soft copper, and turn the outside diameter. Allow for grinding. Turn the 1/4" diameter, 1/2" long. Fig. 3

Set the compound rest to 30° and turn, from the 1/4" diameter out, the 60° angle. Fig. 4

Harden and temper.

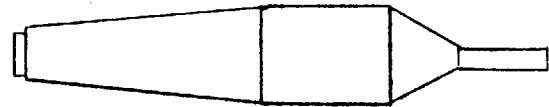


Fig. 4

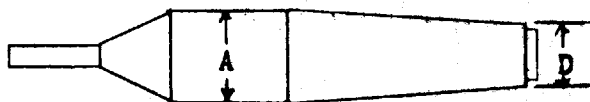


Fig. 5

Grind the "A" dimension to the print size, in the cylindrical grinder. Next, grind the taper to the "D" dimension. To fit the taper gage. Fig. 5

Rough grind the excess metal on the front. Finish grind the point to 60° in the lathe. The point must fit the center gage.



Fig. 6

JOB NAME 1-2-3-Blocks

BLUE PRINT NUMBER: 01-A-15

INFORMATION: These blocks are precision tools and are extremely useful for laying out and checking work. They can also be used as parallels.

PRIMARY SKILL LEARNED:

1. Shape square and to decimals.
2. Layout from drawing.

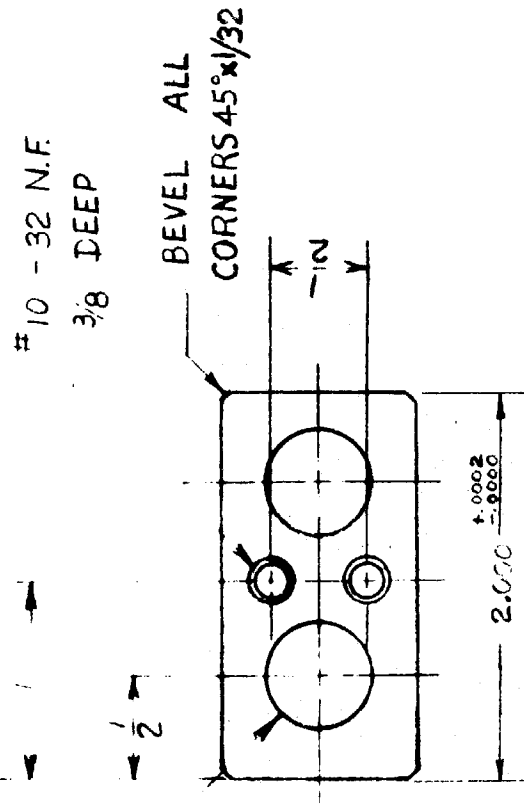
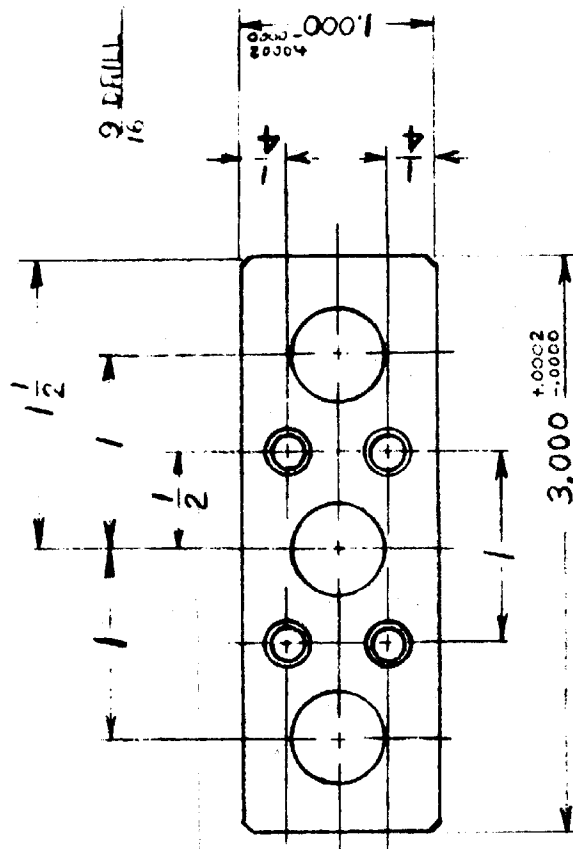
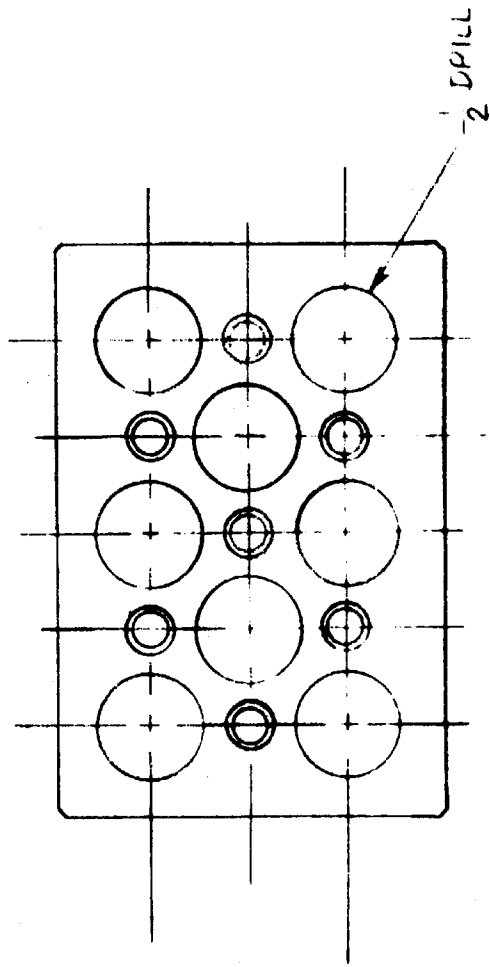
PRECAUTIONS:

1. Allow $1/32$ " overall for grinding before and after hardening.
2. Drill long holes first.
3. Use proper size tap wrench when tapping.
4. Observe safety rules when drilling.

STOCK: 1- $1/8$ " X 2- $1/8$ " Machine steel.

OPERATIONS:

1. Cut stock to length 3- $1/8$ ".
2. Shape stock to dimensions plus $1/32$ ".
3. Grind square. (Allow .015 for grinding after hardening.)
4. Layout holes.
5. Drill holes.
6. Tap holes.
7. Harden and grind.



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ELI WHITNEY REGIONAL VOCATIONAL TECHNICAL SCHOOL	PART NAME
DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED	Heat Treat
Fractional $\pm 1/64$	Date: -
Angular $\pm 1'$	Scale: -
Decimal ± 0.002	DWG. NO.
Concentricity ± 0.01	15

Material	1 - 2 - 3 - 4 - 5
Heat Treat	Date: -
Scale: -	DWG. NO.
	15

1 2 3 BLOCKS

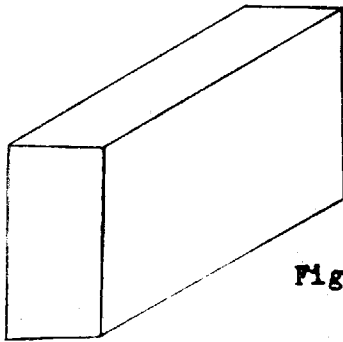


Fig. 1

Two pieces of 1 1/8" X 2 1/8" machine steel, 3 1/8" long. Shape parallel and square to 1 1/32" X 2, 1/32" X 3 1/32".
Remove burrs. Fig. 1
Grind square to 1.015" X 2.015" X 3.015".

Layout hole locations from the center line. Center drill all intersections. The following is a list of holes to be drilled in each block.

2	holes	9/16"	diameter	3"	deep
3	"	1/2"	"	2"	"
8	"	1/2"	"	1"	"
26	"	#21 drill		3/8"	"

Drill two holes 9/16" diameter thru the three inch side. Remove the burrs. Using a 90° countersink, countersink the holes on both sides 1/16" deep.

Fig. 2

Drill three holes 1/2" diameter thru the two inch side. Remove the burrs. Countersink 1/16" deep as above.

Fig. 3

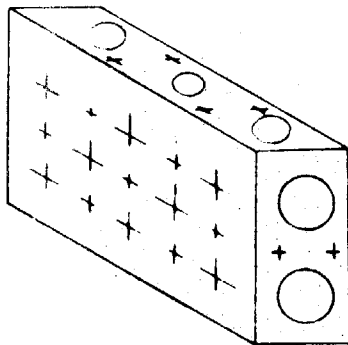


Fig. 3

Drill eight holes 1/2" diameter thru the one inch side. Remove the burrs after each hole is drilled. Countersink 1/16" deep as above.

Fig. 4

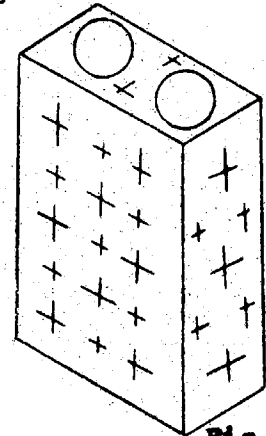


Fig. 2

Drill twenty-six #21 drill holes 3/8" deep. Use a 3/16" drill and counterbore these holes 1/16" deep. Tap all twenty-six holes with a 10/32 tap 5/16" deep. Stamp and date. Fig. 5

Fig. 5

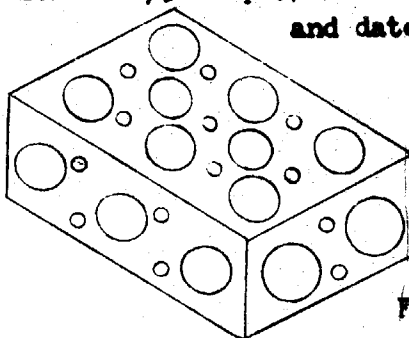


Fig. 5

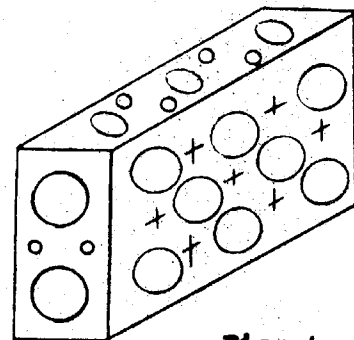


Fig. 4

Pack harden grind and lap.