

T H E S I S

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Submitted by

Earl M. McMahon

In partial fulfillment of the requirements
for the Degree of Master of Science

Colorado Agricultural College

Fort Collins, Colorado

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COLORADO AGRICULTURAL COLLEGE

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GRADUATE WORK

August 18, 1931

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER
MY SUPERVISION BY Earl M. McMahon

ENTITLED A Course in General Metal Shop for Retarded
Youth

BE ACCEPTED AS FULFILLING THIS PART OF THE REQUIREMENTS
FOR THE DEGREE OF Master of Science in Trade and
Industrial Education.

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Advanced Degrees

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INTRODUCTION

Problem:

This study concerns the training of retarded students in metal work, in the city of Tulsa, Oklahoma. Tulsa has a population of 142,000 with a school population of 32,000. Many of these students who are retarded, backward, border-line, problem, truant, and under-privileged, require special training; they are taken care of in the Edison School which was constructed three years ago in one of the best sections of Tulsa.

During the school year of 1930-31, the Edison School had an enrollment of 180 students. Nearly all types of problem cases were represented; one boy, 21 years old, had not been able to complete the fifth grade; one boy from Arkansas who was 17 years old, had been in school only four months during his lifetime; one boy came direct from Germany and could not speak the English language; a few had court records and were there because of disciplinary troubles; many of them were slow and far behind the grade in which they should have been.

These students range in age from 11 years to 21 years; their intelligence quotients range from 55 to 103. The home conditions are often very poor; during the past year, many of the parents were unemployed, and clothing as well as free lunches had to be given to many of the students to allow them to stay in school. Transportation is given

all boys and girls living more than 12 blocks from school.

These students require a special kind of training which is adapted to them. The nine teachers in the Edison School attempt to do this in art, science, home economics, wood work, metal work, and the academic courses. Individual instruction is given. To aid in methods of instruction, the students are divided into eight sections based upon their intelligence quotients and educational achievements.

Purpose:

The objective of this investigation is to work out a course of study in metal work, in detail, which is adapted to this type of student. Projects must be selected which are usable, salable, educational, and inexpensive; they must be adapted to this type of student. It is possible to get instructional material in metal work for junior high, senior high, and trade class students, but there is none available for retarded students. The English and mathematics on the blueprints and job sheets must be simplified so that these special students can understand and use them.

Competence of Author:

This study is the result of five years experience in teaching machine shop practice, acetylene welding, foundry, forging, sheet metal, and ornamental iron. During the first three years, the author had junior and senior high school students, part-time school students, and adults

in evening school classes. For the last two years, he has taught metal work to special school students in the Edison School located in Tulsa, Oklahoma. Previous to his teaching experience, he has had six years of trade experience along metal lines. He has received his bachelor's degree, and at the present time is completing his work for a master's degree.

Method Used in Investigation:

In working out this course of study, it was first necessary to know the students. The students were analyzed as to various characteristics such as: earnestness, application, interest, dependability, physical condition, financial condition, and habits. The instructor's judgment of the students was supplemented by the intelligence quotients and results of such other tests as the testing department could furnish.

From some 300 projects which the author had worked out and used in other classes, he selected those which he felt would be suitable for this type of student. The students were allowed to select certain projects which they wished to make, or to suggest others which they wished to make. With the instructor's permission, the student made the project which he had selected. By experimentation, it was found which projects were suitable for these retarded students. Certain projects which had actually been made, but for various reasons were not satisfactory,

were discarded from this course of study. All of the 50 projects included in this course of study have been made during the past two years by retarded students and are fitted to the needs of these students.

In the spring of 1931, twelve of these projects were entered in a contest held by the Cosmopolitan Club of Tulsa, Oklahoma, in competition with the seven junior high schools of Tulsa. Out of a possible four first prizes in metal work, two of these projects won first place; out of a possible four second prizes, two of these projects won second place. The students in the Edison School actually won more prizes in metal work than those of any junior high school in Tulsa. This was the result of having a definite course of study worked out, and of using blueprints supplemented by job sheets, especially adapted to this type of student.

HISTORICAL REVIEW

One of the leading special schools in the United States is the Thomas A. Edison School of Cleveland, Ohio. This school is described by Mr. C. R. Wise (1) in an article in the National Education Association Journal. In 1921, the superintendent found that Cleveland had a type of boy who was not being properly educated in the existing schools; he was restless, rebellious, and was evidently not receiving the kind of instruction which satisfied his hunger. He was largely a product of bad home and community environment, uneducated, and almost certain to become a burden to society. Thus, the Edison School was established in Cleveland --- "A school for truants which has a minimum of truancy, a disciplinary school whose aim is not punishment, a school for misfit boys, housed and equipped as well as any school in the city."

This school has 1,000 boys of truant and problem type, between 6 and 18 years of age. Their intelligence quotients range from 58 to 138, and their grades in school, from the first grade to the eleventh grade. A considerable percent come from foreign homes; a majority are dull normals whose mental processes seem to function best when accompanied by motor activity.

Another leading special school of this type is the Luther Burbank Intermediate School of Fresno, California.

The Lee Special High School of Okmulgee, Okla-

homa (2) is another school of this type. All pupils from special classes in the elementary schools, who have passed the thirteenth birthday during the past semester, are sent to the Lee Special High School. Also, all children, entering from other towns who are 13 years old but have not passed the fifth grade, are given achievement tests and an individual intelligence test; if results show an intelligence quotient of 80 or below, with achievement-test results and social reactions corresponding, the pupil is sent directly to Lee Special High School. This school, offering three years of work, has the following classifications: Intermediate Ranks I and II, Advanced Ranks I and II, and Superior Ranks I and II. On each grade card is this motto: The pupil who does his best never fails at Lee High.

The need for special schools is being realized more each year. Mr. T. H. Haines (3) in an article in the National Conference Social Work states that there were 586 instructors teaching 9,357 pupils in special classes in 1913; there were 1,321 instructors teaching 23,252 pupils in special classes in 1922.

In a bulletin on "Special Schools and Classes in Cities of 10,000 Population and More in the United States" (4) published in 1930, it was found that 3,247 instructors were teaching 55,154 pupils in special schools and classes.

Miss Barbara H. Wright, Supervisor of Counselors of Minneapolis Public Schools (5) tells of achievements of

boys who were rated as failures in school. "Pupils dull in school are not as a rule unsuccessful in industry according to the standards of their social class. Of 175 special class boys, 151 were working and either paying board, giving all their earnings to families, or supporting families of their own; only 24 were being supported by their families --- not a bad record for boys definitely sub-normal."

Mr. A. O. Heck, Associate Professor of School Administration at Ohio State University (4) states: "American educators like to think that American education is providing at least an equal opportunity to all young Americans to develop to the maximum the abilities they may have. The idea that such equality of opportunity actually exists, however, is being gradually dissipated." Our school program of studies is for the most part keyed to the ability of academically minded children; children who are handicapped physically, mentally, and morally have been provided for very inadequately.

GENERAL INFORMATION SHEETS

Safety First Rules:

1- Never use the electric grinder unless your eyes are safely protected from flying particles, by goggles or by shields placed over the stones.

2- Never fail to report a cut, scratch, burn, or bruise to your teacher; he can protect you from getting blood poisoning.

3- If you notice that the room is stuffy from lack of proper ventilation, report it at once to the teacher.

4- If you are sick in any way, report your condition to the teacher.

5- Avoid throwing small particles of metal in the shop, as this will probably save some boy's eye.

6- Always make sure that the hammer head is tight on the handle; if it should come off while you are using it, some one might be injured.

7- Avoid holding small objects with the hands while drilling holes under the drill press. Hold your work with pliers, tongs, or in the drill press vise.

8- In lighting the gas furnace, make sure that all small valves are closed, and that the main valve is open. Light an oil rag, or piece of paper, and place in the furnace. Open one valve on each side of furnace; then open all valves.

9- Never pick up iron or steel lying on the forge,

or around the forge, unless you investigate to see whether it is hot. Tap lightly with the finger, or sprinkle a little water on the surface of the metal.

10-Never work around a steel lathe with sleeves hanging down, jacket unbuttoned, or with any loose clothing of any kind. These might catch on the lead screw, revolving work, lathe dogs, chucks, belts, or pulleys and cause a severe accident.

11-Always hold your work tightly when grinding metal on the emery stone. Never allow your fingers or hands to get close to the emery stone; be sure you know where they are at all times. By doing this, you can avoid getting finger nails torn off, or getting cuts on the hands.

12-Do not turn the handle of the blower with all your might; this would cause hot coals to blow from the fire which might burn you, or cause your clothes to catch fire. It should be turned at a moderate, even rate of speed. Ask your teacher to show you how.

13-Avoid catching steel cuttings or shavings as they come from your work, in your hands; these cuttings might wrap around your finger and cause a severe cut.

14-When using the squaring machine, make sure that your fingers and hands are at least 3 inches from the blade if possible. Your feet should not be under the foot lever while cutting sheet metal.

15-While forming sheet metal on the forming rolls

never have your fingers or hands touching the rolls while you are turning the handle. It is easy to get your fingers and hands pulled in between the rolls.

16-Always grip your work tightly with tongs while hammering on hot materials; otherwise it might fly out of your tongs and strike you in the face.

17-Never cut on small objects on the anvil or in the vise with a cold chisel unless you are sure these cut-off particles will not fly and hurt some one.

Correct Way to Check Out Tools:

1-To get a tool to work with from the tool room, write your name, and the name of the tool on a slip of paper and hand it to the tool room boy. The tool room boy will read this, hang it up, and hand you the tool.

2-When you have finished using it, clean it, and return it to the tool room boy; he will check off the tools returned, and see that none is missing or broken.

Cost of Materials to the Student:

1-The student who furnishes his own material will not have to pay anything for the finished project.

2-Students may secure the material from the school at the cost price.

3-The student must pay for material which he wastes, through carelessness.

Breakage of Tools:

1-If a tool is broken through carelessness on the

part of the student, he will be required to pay for it.

2-If a tool is broken, and the cause could not be avoided, the school will stand the loss.

Proper Care of Machines:

1-The oiling of bearings of a machine is governed by its use.

2-The main bearings on machines used several hours each day, such as lathes and electric grinders, should be oiled each morning.

3-The main bearings on machines not used very often, such as forming rolls, burring machines, and wiring machines, should be oiled about every two weeks.

4-Each oil cup or oil hole on the lathe and drill press should be oiled once a week, if used every day.

5-Each student who uses a machine will be required to brush and clean it off when he is through using it.

6-Each machine will be given a thorough inspection once a month for worn and broken parts.

7-Each machine should be gone over with an oiled cloth at least once a month.

How to Operate a Steel Lathe:

1-Before you are ready to learn the operations of the lathe, you are required to learn the important parts of the lathe and to locate these parts on the lathe.

2-Next, oil the oil cups and oil holes on the

lathe; have your teacher check to see that you have not missed any.

3-Now you are ready to start adjusting levers and clutches. Stand in front of the lathe and run the cross feed back and forth across the bed of the lathe.

4-Run the carriage toward the head and the tail-stock, to get familiar with its operations.

5-Ask your teacher for a demonstration on running the lathe; watch him very closely.

6-You will now run the lathe under your teacher's supervision.

Drilling Holes with the Drill Press:

1-Center-punch the place where the hole is to be drilled.

2-Place a block of wood on the drill press table; place your work on the block of wood on the drill press table, with the punch mark directly under the point of the drill.

3-Hold your work firm and steady to avoid breaking drills. See that you are holding your work straight and in a horizontal position.

4-Start the motor; then place the point of the drill on the mark.

5-Do not put too much force on the hand lever of the drill press, but just enough so that the cuttings will feed out the top of the hole.

6-Place oil frequently on the part of the drill not in the hole, so it will run down into the hole; this will avoid getting metal cuttings in the oil can.

7-If you notice a squeaking noise, and cuttings are not coming from the hole, the drill is dull. It should be sharpened.

8-The above procedure will be all right for about all the holes drilled in the general metal shop. For very accurate work, the teacher will do the lining up, using V-blocks, dividers, and a surface gauge.

Proper Use of the Electric Grinder:

1-The grinder is used in a metal shop, primarily, for the purpose of grinding cutting edges on tools.

2-The grinder should never be used to remove more than 1/8 inch of surface from any work.

3-Never grind away part of work that can be forged, or removed with a hack saw. It is poor economy to grind away stone that cost several dollars, just to make it easy for the student.

4-The grinder is used for making smooth surfaces on work. Cast iron, carbon steel, cold rolled steel, high speed steel, and ordinary iron can be ground on emery stones without filling up the pores of the stone. Soft metals, such as lead, aluminum, and babbitt should never be ground on the emery stone because these metals stick in the pores of the stone and cause the work to be rough.

Soldering Sheet Metal:

1-Heat the soldering iron to a bright red. File the surfaces of the point bright and smooth.

2-Heat the soldering iron until it will melt solder freely; then rub the point of the iron on a lump of sal-ammoniac to clean it. Now melt a few drops of solder on the sal-ammoniac and rub the point of the iron over it until it is tinned.

3-Smooth the surface of the work to be tinned with emery cloth until bright; give the bright surface a coat of soldering flux, using a small steel brush.

4-Take the heated soldering iron and melt the solder along the seam or surface to be soldered. Melt only a small amount of the solder at a time, and then go over the soldered part with the iron to make it smooth and even.

5-This method can be used on any sheet metal if a flux suitable for all sheet metals is used.

Casehardening Steel and Iron:

1-In casehardening, we mean the taking of iron and low carbon steel and making it hard on the outside surface by adding carbon to it.

2-It is poor practise to take an expensive piece of steel and use it while a cheap piece of iron could be substituted, by casehardening it to stand wear. This method is practised in industry and trade shops.

3-There are several casehardening materials on

the market today but potassium cyanide, a chemical, is by far the best to use for ordinary purposes. It is very easy to handle and use, but the fumes are very dangerous if they are inhaled. Be sure to wash your hands after using it.

4-Take a small piece of iron which you wish to caseharden and heat it red hot in a crucible or pipe; the flame must not come directly in contact with the iron.

5-When it is a bright red, place it in a pan and pour potassium cyanide over it so that all surfaces have been covered.

6-When the powder melts and starts to run, drop the iron in a tank of clear water.

Annealing Steel:

1-It is always practical before machining, filing, or grinding a piece of steel that has been hardened, to anneal it.

2-To do this, heat the metal to a cherry red and cover the surface with lime, dry sand, or ashes; leave it until it cools.

3-You can machine this part, grind or file it; then heat and harden again.

Heating Iron and Steel in a Forge:

1-When heating iron and steel in a forge, you must watch that they do not get too hot. Burning steel removes carbon and makes it soft, so that it will crack;

iron which is burned will become soft and spongy.

2-To avoid burning a piece of metal, watch it closely all the time it is in the forge. Pull it out quickly; if it is a bright red, it is ready to be forged.

3-If it is turning white and a few sparkles are coming from the fire, pull it out and do not heat more than this. Stop the blower.

4-If hundreds of sparkles are coming from the fire, the metal is burned and will have to be cut off.

Welding Iron and Steel in the Coal Forge:

1-Before you can make a weld in a coal forge, you must have a clean fire with no clinkers, dirt, slate, or pieces of iron in the fire. You do not need a large fire to make a weld; as you sprinkle the soft blacksmith coal, in making your coke, tamp the coke in the fire box to form a pocket.

2-There are many kinds of welds, but I shall describe the lap-weld. The principle is the same. You must get the steel or iron to its melting point before the pieces will fuse or join together. We do this in the coal forge, or by electric or acetylene welding methods.

3-In welding two round pieces of iron or steel, first make these ends larger by striking the ends on the anvil; then scarf. Notice very carefully as you heat these ends; the blower should be turned at a moderate, constant

speed.

4-When the ends are bright red cover them with a flux. In welding steel, use powdered lump borax or a welding compound; iron does not need a flux, but one can be used.

5-Continue heating and add more flux; rub off flux in the fire with a poker to see if the metal is at the fusing point. Do not mistake the flux for the running of the metal.

6-When both ends seem to be melting or running, remove ends and lap the scarfs; you must work fast, striking lightly at first.

7-Re-heat and take another welding heat using more flux; draw the weld down to the proper size. A flux is used in welding to keep a scale from forming on the heated ends, and to cover the ends so a higher temperature can be reached without burning the metal.

Proper Way to Build Fire in Coal Forge:

1-Clean out the fire box and remove all ashes; light a small amount of shavings, and add coke gradually as you turn the blower slowly.

2-Add more coke as you increase the speed of the blower to the desired speed. You can start a fire by using coal but it is much slower and more difficult to do.

Proper Metals to Use for Various Projects:

1-Use high speed steel for cutting tools, center drills, and twist drills.

2-Use carbon steel for center drills, twist drills, hot and cold cutters, hammer heads, jaws for vises, cold chisels, punches, center-punches, jaws for forging tongs, and for anything that must cut, stand wear or abuse. Carbon steel can be hardened.

3-Ordinary iron is used to make problems that are to be threaded, twisted, peened, forged cold, bent into various shapes, and for anything that is to be tough, flexible, and unbreakable.

4-Cast iron breaks very easily but has considerable strength and wearing qualities; it is used for vises, emery stands, and bridge lamp bases.

5-Sheet metals, such as brass and copper, are used for ornamental purposes; some examples are pin trays, mail boxes, lamp shades, ash trays, porch lamps, and candle holders.

6-Galvanized iron and sheet iron are used for projects which are not so ornamental; they may be made more ornamental by peening and decorating.

7-Sheet tin is used for projects which are light, wearable and inexpensive, such as biscuit cutters, cooky cutters, lamp shades, mail boxes, seed boxes, cups and buckets.

Tempering and Hardening Steel:

Two methods of hardening steel are used in the Edison School; the method to use will be determined by the purpose for which it is to be used.

1-In hardening tool steel such as butcher knives, paring knives, hunting knives, daggers, meat cleavers, plumb bobs, and ice picks it is best to harden in oil. Heat the part to be hardened to a cherry red and drop into a tank of clean motor oil until cool. This will make the object hard; yet it is flexible and will bend or spring before it will break.

2-The most common method used in hardening steel is by hardening in a tank of clean water. Move the tool up and down slightly, never holding it long in the same place, in the tank of water. If it is held long in one place, it will water-crack and will break at this place.

Tools used for cutting metals, such as cold cutters, cold chisels, diamond points, gouges, capping tools, and hardies should have about the same hardness. The cold chisel may be used as an illustration of the method of hardening for this group. Heat a length of about 2 inches from the cutting edge of a cold chisel to a cherry red. Cool a length of about $3/4$ inch from the cutting edge of the chisel in a bucket of clean water. Shine one flat tapered side of the chisel on wood, cement floor, old file, or on emery cloth. Notice the various colors on the

bright side of the chisel from the cutting edge back to the place where the steel was first heated. Each one of these colors represents a certain hardness. The following colors may be seen: light and dark blue, light and dark purple, light and dark straw, and gray. The gray represents the greatest degree of hardness. The heated part of the chisel that was not cooled will force these colors out through the sharp cutting edge. Continue to rub the bright side, watching for a dark blue color; when this color appears about 3/16 inch from the cutting edge, cool off the chisel completely.

Center-punches, twist drills, and cutting tools must be fairly hard; use the same method as before but cool off when the light straw color reaches the edge.

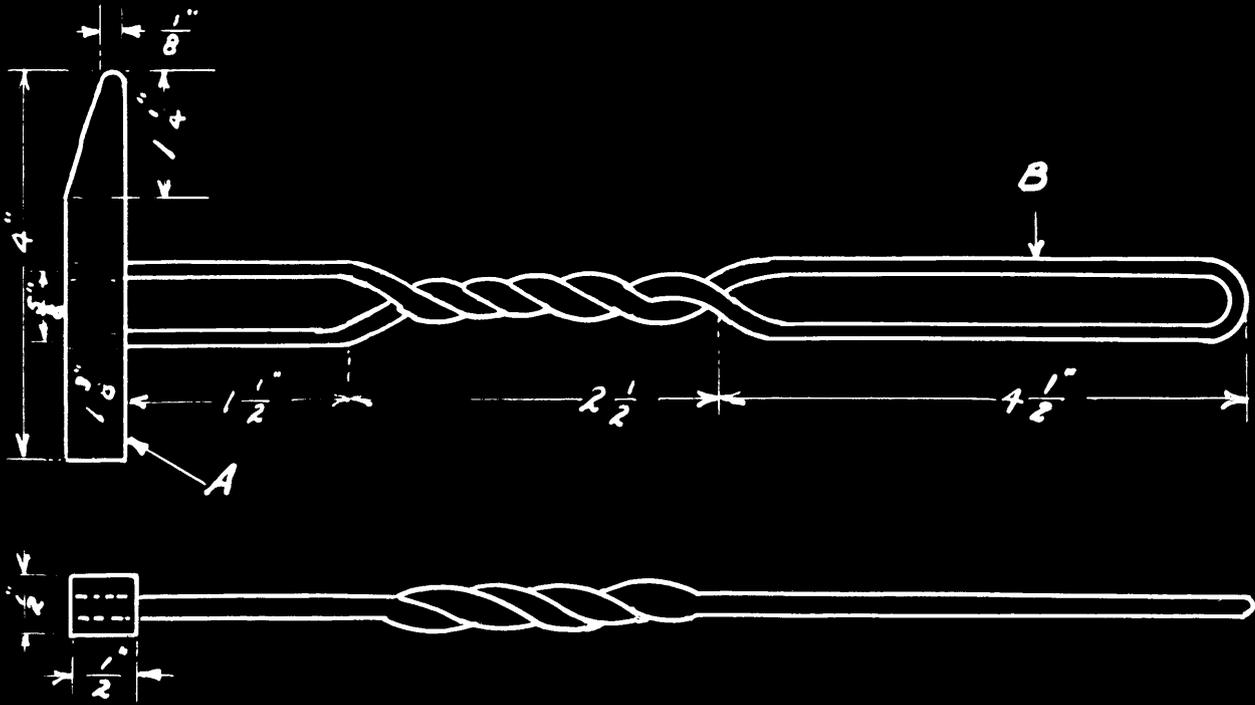
Ordinary punches should never be very hard, so cool them when the light blue color reaches the tapered end.

Screw drivers should be cooled off when the bit end has a color between a light and a dark blue.

All steel hammers used in metal work should be very hard. To harden a double-face hammer made of tool steel, heat to a bright red. Catch the heated hammer in the eye with a pair of tongs; cool off about 1/2 inch of the face. Then reverse ends and cool the same amount on the other end. Keep the water cool and continue this

method of reversing the faces of the hammer. Slide a flat file over the faces; if the file does not cut either face at all, hold the hammer out of the water until the file barely marks or cuts the faces. Cool off and the hammer is hardened. The file test is the older method of telling the degree of hardness.

TACK HAMMER



MATERIALS	
A	1/2" X 1/2" X 4" STEEL
B	3/16" X 22' ROUND COPPER WIRE

JOB SHEET NO. 1

HOW TO MAKE A TACK HAMMER

Part "A"

1-Check out: forging hammer, flat jaw tongs, steel scale, 5/32-inch and 1/2-inch drills, center-punch, and 10-inch flat file.

2-Heat steel in forge until red.

3-Forge a 1 1/4 inch taper on one end, 1/8 inch thick, on edge.

4-Place scale on three sides to see if edges are straight.

5-Let steel cool before working.

6-Grind face, sides, and taper of hammer until all marks are removed; file and finish on buffer.

7-Place drill in drill press chuck.

8-From square end, measure 1 3/8 inches and center-punch in center of hammer; from this end, measure 2 inches and center-punch on the same side.

9-Place work in drill chuck vise and drill holes on center-punch marks, with a 5/32-inch drill.

10-Countersink holes on tapered side with 1/2 - inch drill, slightly.

11-Heat steel in forge to cherry red; remove work from forge with tongs and drop in tank of oil for hardening.

Part "B"

1-Check out steel rule; measure $5/8$ inch from each end of rod and mark with scriber.

2-Grind each end to this mark, down until it fits the hole in the hammer head tightly.

3-Measure from end 11 inches with rule and mark.

4-Bend rod on this mark into a U-shape with sides of rod $3/4$ inch apart, and the ends even.

Assembling

1-Check out: riveting hammer, mallet, and flat file.

2-Place tin around ends held in vise; extend ends $5/8$ inch above face of vise.

3-Place the two holes in hammer over these two ends of rod, with the countersunk side up.

4-Rivet, using cross-peen side of hammer, and then face side for finishing.

5-Smooth rivet heads with file.

6-Extend U-shaped end 7 inches above face of vise.

7-Place board, $1/2$ inch by 4 inches by 24 inches through wire handle.

8-Place handle in center of board with one hand on each end and with board touching part of handle; twist two times to the right.

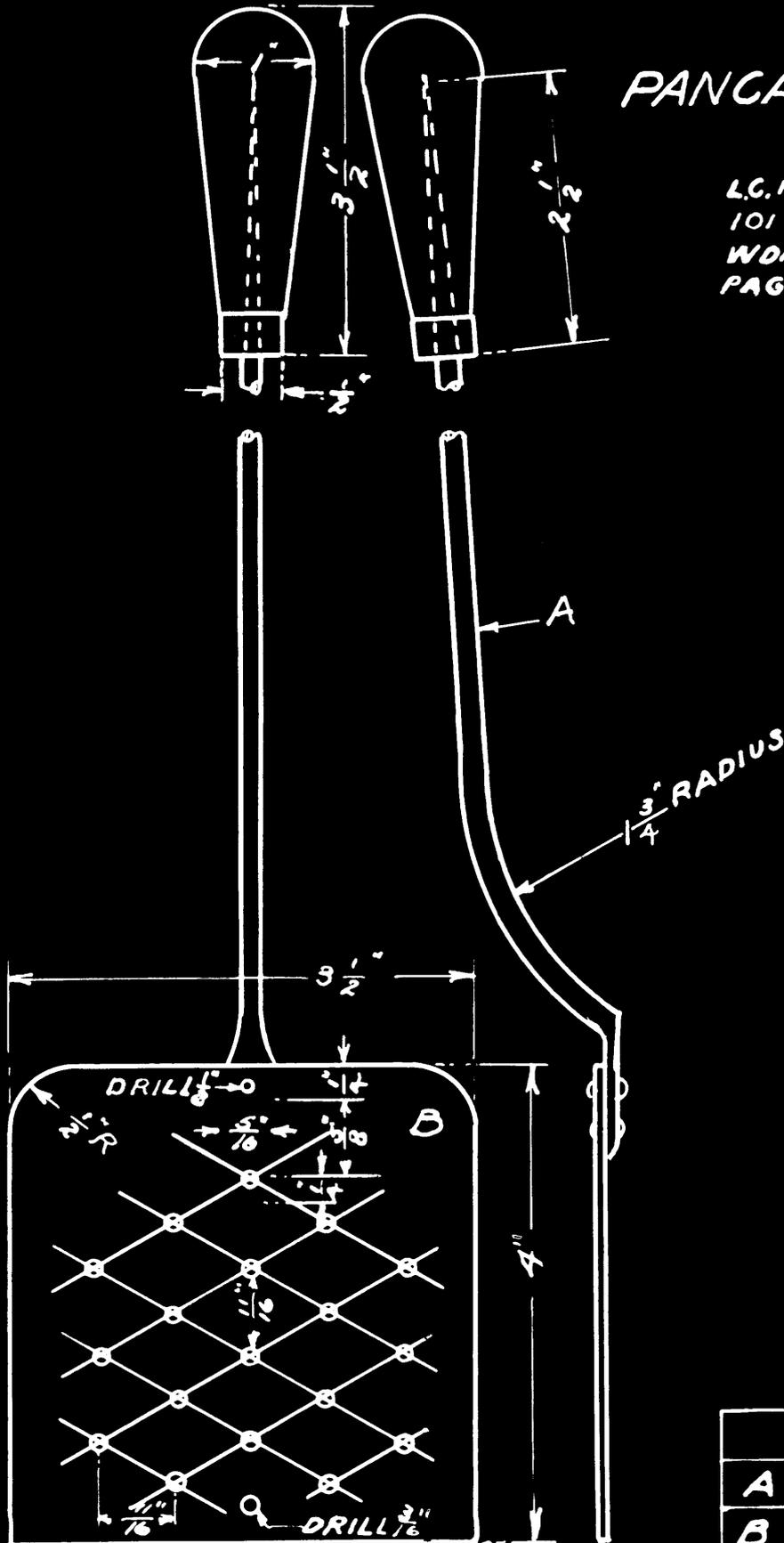
9-Place wire handle on board; using mallet, line

-25-

up handle and remove kinks.

PANCAKE TURNER

L.C. PETERSON
101 METAL
WORKING PROJECTS
PAGE 33



MATERIALS	
A	3/16" X 9 1/2" ROUND IRON
B	3 1/2" X 4" SHEET STEEL
C	1" X 2 1/2" HANDLE
D	(2) RIVETS 1/8" X 1/4"

JOB SHEET NO. 2

HOW TO MAKE A PANCAKE TURNER

Part "A"

- 1-Check out: rule, hammer, and 1/8-inch drill.
- 2-Grind a 2 1/2-inch point on one end of rod.
- 3-Flatten the other end 5/16 inch wide and 1 1/4 inches long.
- 4-Measure 1/4 inch, and 7/8 inch, respectively, from flat end and center-punch in the center.
- 5-Drill a 1/8-inch hole on each mark, and slightly countersink on one side.
- 6-Grind extreme flat end, slightly round.

Part "B"

- 1-Check out: pattern, snips, 1/8-inch and 3/16-inch drills, scriber, emery cloth, and file.
- 2-Place pattern over material and mark each hole and around edge of pattern with scriber.
- 3-Cut out lines with tin snips.
- 4-Smooth edges with file.
- 5-Drill holes according to blueprint.
- 6-File burrs from holes and smooth both sides with emery cloth.

Assembling

- 1-Check out a small hammer and rivet set.

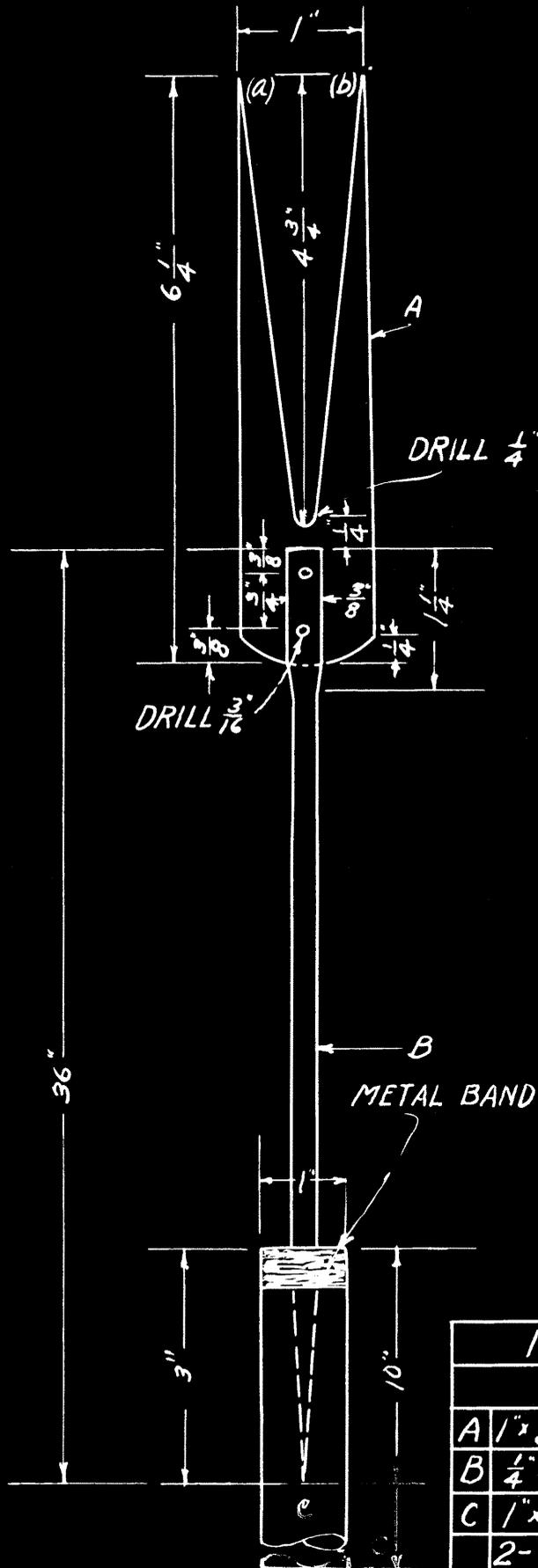
2-Notice blueprint to see how parts go together; if in doubt, consult your teacher.

3-Hit straight down very easily on rivet to form a head. Slightly slant face of hammer and hit around edge of rivet head; place rivet set over head and finish.

4-Bend rod to shape shown on blueprint.

5-Wooden handle will be made in wood shop, or furnished by the school shop.

WIENER FORK



MATERIALS	
A	1" x 1/8" x 6" STEEL
B	1/4" x 36" ROUND IRON
C	1" x 10" ROUND WOOD
	2- 3/16" x 1/2" R. H. RIVETS

JOB SHEET NO. 3

HOW TO MAKE A WIENER FORK

Part "A"

1-Check out: center-punch, hammer, flat file, rule, tongs, scriber, hack saw, and 3/16-inch, 1/2-inch and 1/4-inch drills.

2-Lay out work according to measurements on blueprint.

3-Square one end; slightly round the other end, and smooth all surfaces.

4-Chalk one side of work.

5-Measure from one end 4 3/4 inches, center-punch, and drill hole with 1/4-inch drill.

6-Place edge of rule on one side of hole and on point "a"; use a scriber and scratch a line between these points. Do the same on other side of hole to point "b".

7-Catch in vise with lines above vise jaws.

8-Start at squared end with hack saw and saw out each line to each side of 1/4-inch drilled hole.

9-Go over these sawed edges with file to smooth; finish with emery cloth. File the points sharp.

10-Measure from flat end 3/8 inch, and 1 1/8 inches, respectively, and center-punch. Drill 3/16-inch holes.

11-Grind marks from work on emery stone.

12-Place on buffer to finish.

13-Heat to cherry red and drop in tank of oil.

Part "B"

1-Check out: hammer, rule, 3/16-inch drill, and center-punch.

2-Grind 3 inches of one end to a round, sharp point.

3-Forge the other end flat, 3/8 inch wide and 1 1/4 inches long.

4-Measure from end 3/8 inch, and 1 1/8 inches, respectively; center-punch and drill 3/16-inch holes.

5-Smooth the flat end on emery stone and finish.

Part "C"

1-Check out: hack saw, lathe tools, drill chuck, 1/4-inch drill, and sandpaper.

2-Place work in universal chuck with jaws slightly tightened. See your teacher.

3-Place chuck in tailstock with the drill in place.

4-Drill hole about 3 inches deep.

5-Heat pointed rod several times and burn hole in Part "C" about 5 inches deep.

Assembling

1-Check out riveting hammer and rivet set.

2-Notice blueprint very carefully.

3-Place rivets through Parts "A" and "B" with heads on fork side.

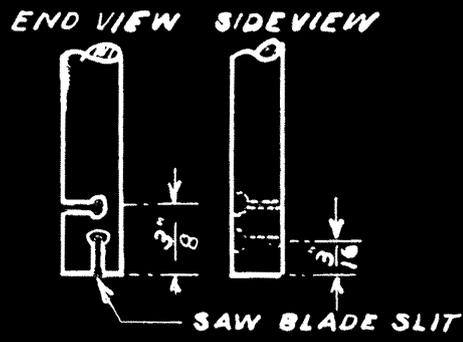
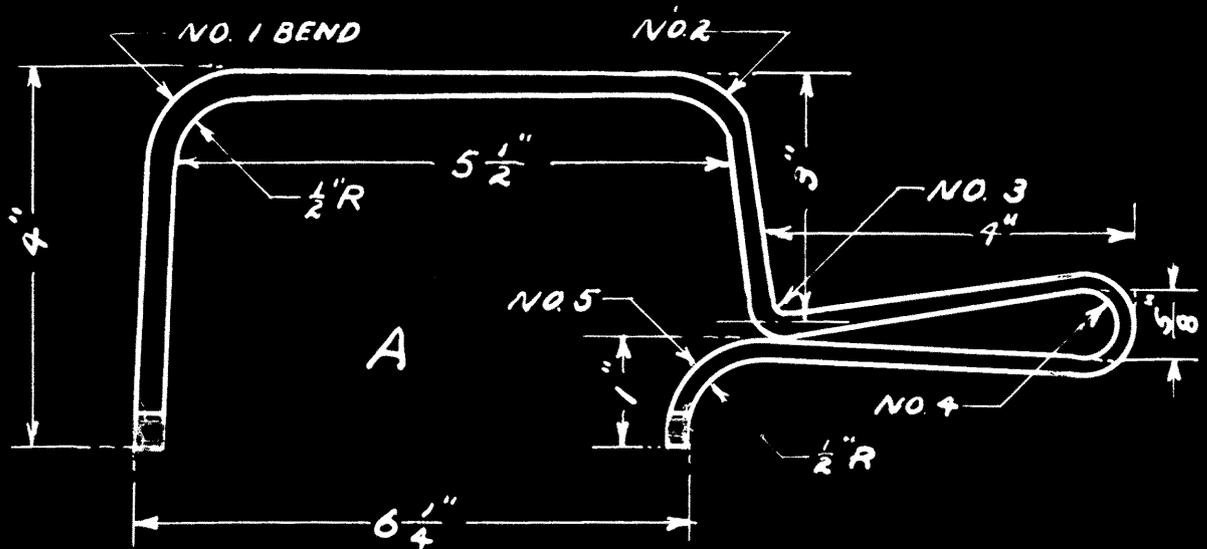
4-Let rivets extend through holes $3/16$ inch.

5-Hit straight down on rivet about five times, fairly hard. Hammer around edge, raising center of head.

6-The metal part can be painted if desired, or placed in flame to cause metal to turn blue.

7-A metal band can be placed over end of wooden handle, by cutting $1/2$ inch of $1/2$ inch pipe, and forcing it over the end.

COPING-SAW FRAME



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MATERIALS	
A	$\frac{1}{4}" \times 22"$ ROUND STEEL

JOB SHEET NO. 4

HOW TO MAKE A COPING SAW FRAME

1-Check out: hack saw, rule, 1/8-inch drill, hammer, scriber, and tongs.

2-Check blueprint closely as to the dimensions, bends, and general shape of the frame.

3-Measure with rule from one end 4 inches and mark; measure from this, 5 1/2 inches and mark; measure from this, 3 inches and mark; measure from this 5/8 inch and mark; measure from this 4 7/8 inches and mark; measure from this 1 inch which is the end.

4-Heat all marks to a cherry red.

5-Use a block of wood to hammer the rod in making the bends.

6-Make the first and second bend over the horn of the anvil; bend the third in the vise; bend the fourth over the needle stake.

7-The part measuring 1 inch will be bent by placing the mark on top of the horn of the anvil; with a block, hit the extended part until the bend is as shown on the blueprint.

8-The ends will be 6 1/4 inches apart, outside measurement.

9-Ask your teacher for a coping saw.

10-Notice how the blade is held in the frame.

11-Measure $3/16$ inch from each end on front and back, and drill $1/8$ -inch holes about $1/8$ inch deep. Saw down to holes through center of ends. See your teacher.

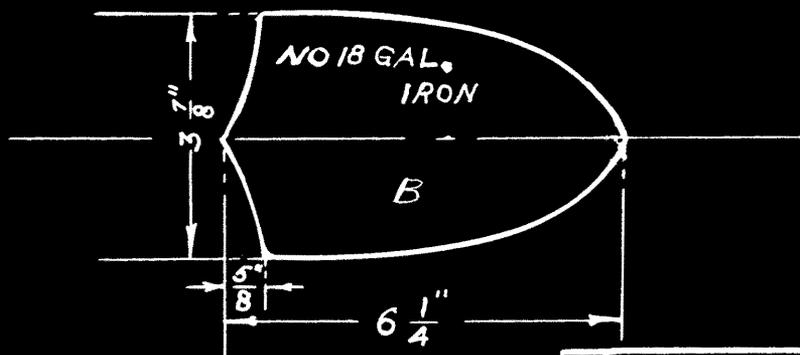
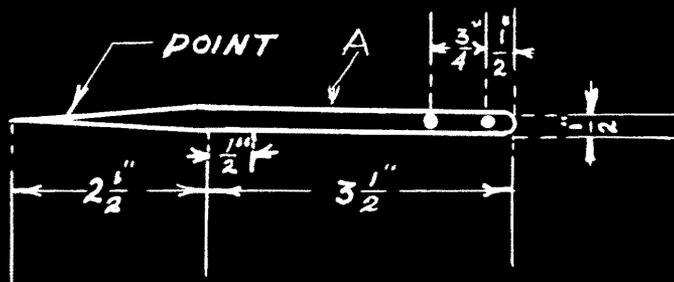
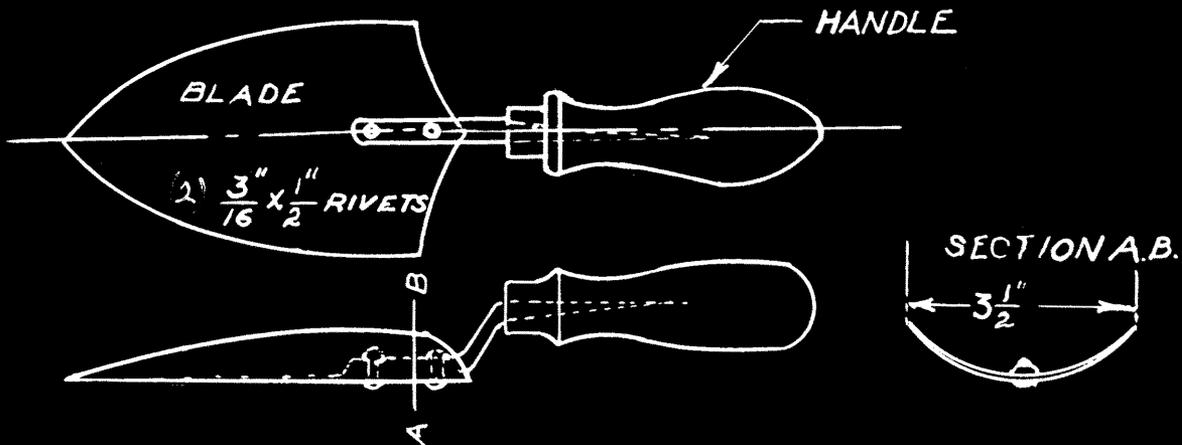
12-Measure up from ends $3/8$ inch on side and drill $1/8$ -inch holes, $1/8$ inch deep. Slit with a hack saw.

13-Heat entire frame to a cherry red.

14-Drop in a tank of oil until cool.

15-Hold on cloth or felt buffer until bright, using a polish on felt wheel if possible.

GARDEN TROWEL



TAKEN FROM A COURSE IN SHEET METAL
INDUSTRIAL EDUCATION MAG.
PEORIA, ILL.

MATERIALS	
	HANDLE $5' \times \frac{3}{8}$ "
B	BLADE $6\frac{1}{2}$ " \times 4"
A	TANG $\frac{3}{16}$ " \times $\frac{1}{2}$ " \times 6

JOB SHEET NO. 5

HOW TO MAKE A GARDEN TROWEL

Part "A"

1-Check out: tongs, hammer, 3/16-inch drill, center-punch, and rule.

2-Heat and forge a tapered point on one end 2 1/2 inches long.

3-Measure from the square end 1/2 inch, and 1 1/4 inches, respectively, center-punch, and drill 3/16-inch holes.

4-Measure from the square end 1 3/4 inches, and 2 3/4 inches, respectively, and mark.

5-The distance between these marks will be 1 inch which is the part to be bent.

6-Place one mark even with the top of the vise.

7-Hit the part above the vise with the hammer until it is bent as shown on the blueprint.

8-Reverse ends with the other mark even with the top of the vise.

9-Bend ends in opposite directions.

Part "B"

1-Check out: snips, scriber, rule, 3/16-inch drill, riveting hammer, rivet set, file, and pattern.

2-Place pattern on work and mark around edges with scriber.

3-Cut out lines with snips.

4-File all edges blunt except the cutting edge.

5-Grind a cutting edge 2 inches each way from the extreme point.

6-Draw a center line connecting the two points.

7-From the blunt end, measure $5/8$ inch, and $1\ 3/8$ inches, respectively, mark on center line, and drill $3/16$ -inch holes.

8-Place center line of blade lengthwise over the horn of the anvil.

9-Strike each side of the work over the horn with a mallet and shape as shown on the blueprint.

Assembling

1-Rivet the tang on the inside of the blade.

2-Place rivet heads on the bottom.

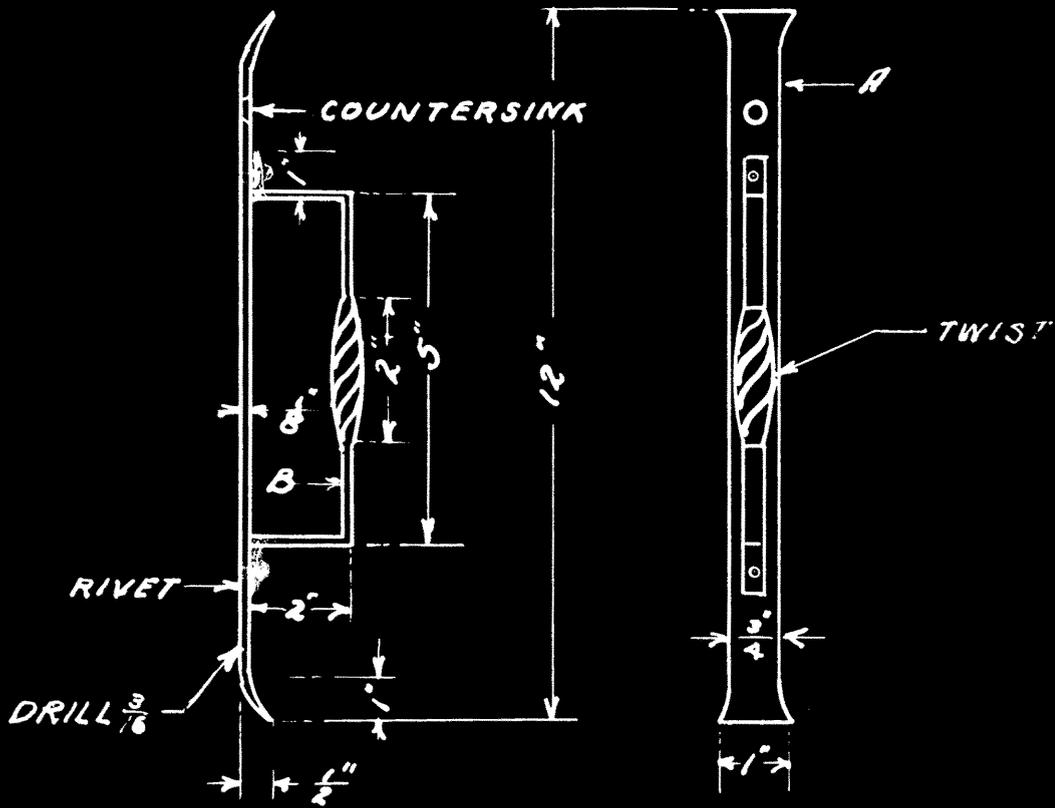
3-Smooth and finish all metal parts with emery cloth.

4-Wooden handle will be made in the school wood shop or furnished by the school.

5-Give the trowel a coat of black lacquer.

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TIE RACK



MATERIALS

A	$\frac{1}{8}$ " X $\frac{3}{4}$ " X 12" (1)
B	$\frac{1}{8}$ " X $\frac{3}{8}$ " X 11" (1)
	RIVETS $\frac{3}{16}$ " X $\frac{1}{2}$ " (2)

JOB SHEET NO. 6

HOW TO MAKE A TIE RACK

Part "A"

1-Check out: rule, ball-peen hammer, 3/16-inch drill, tongs, and center-punch.

2-Forge each end 1 inch wide to a blunt chisel edge.

3-Grind the extreme ends blunt and straight.

4-Peen one side by placing the work flat on the anvil and hammering with peen of hammer.

5-Do not hit in the same place, but hit at intervals; hammer on one entire side.

6-Measure from each end 3 inches, center-punch, and drill 3/16-inch holes.

7-Buff the entire surface on a wire buffer.

8-Bend 1 inch of each end slightly, over the horn of the anvil. Notice the blueprint.

9-Countersink the holes on the back side.

Part "B"

1-Use the same tools as in Part "A".

2-Measure from one end 5 1/2 inches and mark the center of the work.

3-From this line, measure 1 inch, 2 1/2 inches, and 4 1/2 inches, respectively, in each direction and mark.

4-The ends will be forged to a width of 1/2 inch.

similar to the ends of Part "A".

5-Peen one side as before.

6-Measure from the ends 1/2 inch, center-punch, and drill 3/16-inch holes.

7-Use a wire buffer and smooth the peened side.

8-Extend one end 1 inch above the vise and hammer until the end lies flat, or straight across; make a square bend.

9-Extend work 2 more inches above face of vise and bend in opposite direction. See your teacher.

10-The twist in the center of the work will be made by having one line even with the face of the vise, with the 2 inches extending above the vise.

11-Catch above the line, with 2 inches between the tongs and vise, and twist three times in the same direction.

Assembling

1-Check out riveting hammer.

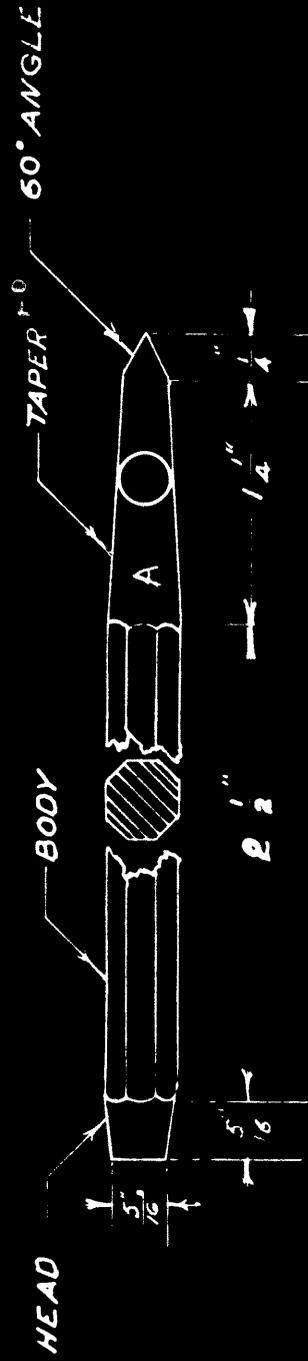
2-Notice blueprint carefully. Place heads of rivets on outside through Part "B" and then Part "A".

3-Rivet on back side only; grind formed heads smooth with surface.

4-Buff the entire surface to finish.

5-Give the tie rack a coat of black lacquer; blow gold bronzing powder at intervals on the wet lacquer.

CENTER PUNCH



MATERIALS
HEXAGON STEEL
4 1/2" LENGTH

JOB SHEET NO. 7

HOW TO MAKE A CENTER-PUNCH

1-Check out: forging hammer, rule, flat file, and tongs.

2-Heat one end red.

3-Hold the punch in tongs with the heated end on the anvil so that the end held between the jaws will be about 1 inch higher than the end on the anvil.

4-Turn the punch slowly, as you forge the end on the anvil down to a diameter of 5/16 inch. The length of this round taper will be 5/16 inch.

5-Heat the other end.

6-Hold the end in the tongs 3/4 inch above the end on the anvil.

7-Turning the punch with the tongs, forge this end down to a diameter of 1/4 inch; this taper will be 1 1/2 inches long.

8-Let the punch cool.

9-Chuck the head end in a universal chuck and, while turning, file the other end until all hammer marks are removed.

10-While work is turning on the lathe, smooth with emery cloth.

11-Change ends and smooth and finish in the same way.

12-Grind the head on the emery stone, resting

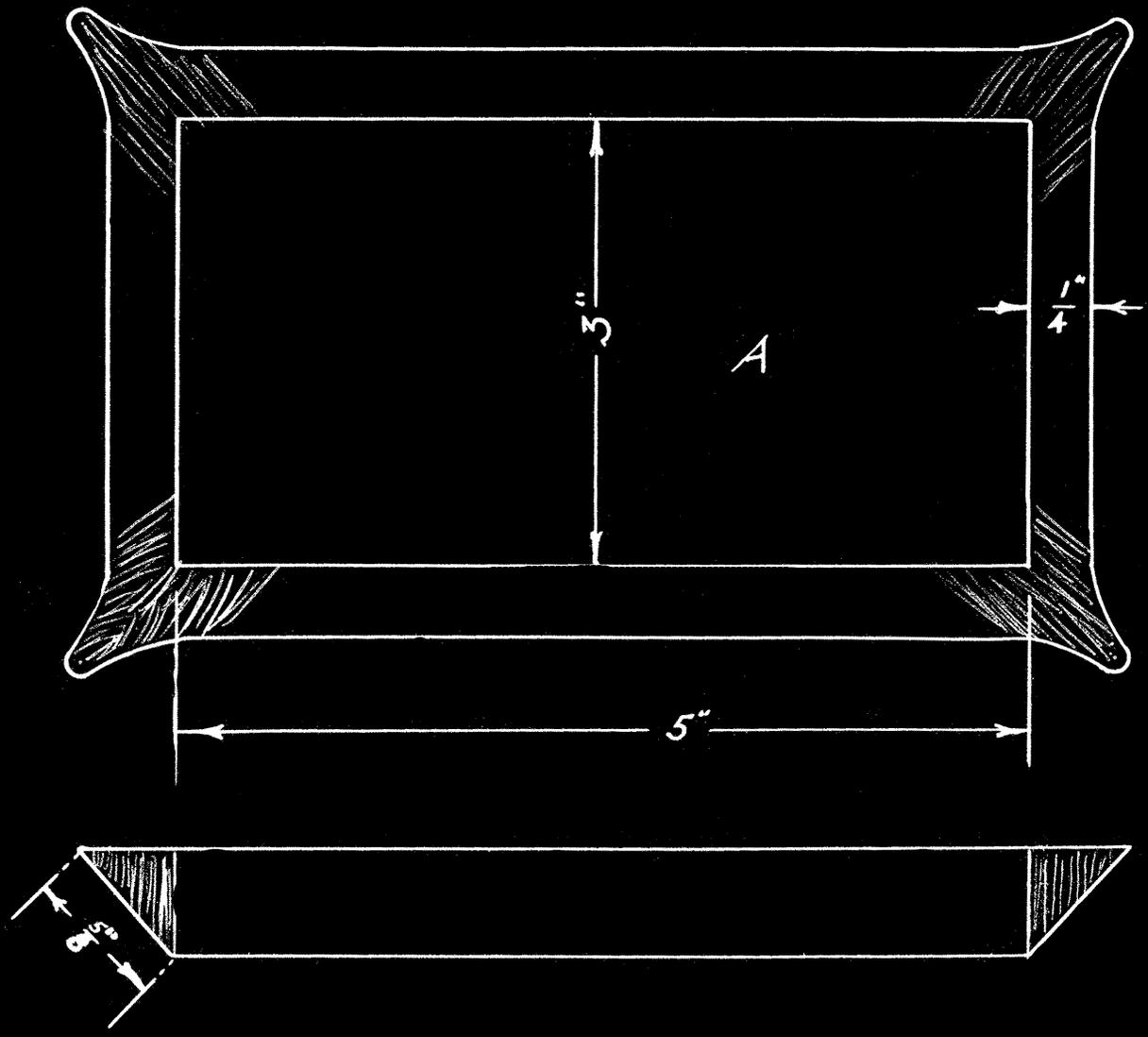
it on the guard with the end against the stone; hold the work in the right hand and turn it with the left.

13-Grind a slight taper on the head of the punch by holding the punch at an angle of 30 degrees with the face of the stone.

14-Grind the other end to a sharp point.

15-Temper the center-punch. Check out the general information sheet for tempering.

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PIN TRAY



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MATERIALS	
A	NO. 24 SHEET BRASS
	5 3/4" x 3 3/4"

JOB SHEET NO. 8

HOW TO MAKE A PIN TRAY

1-Check out: Mallet, rule, tin snips, fine emery cloth, fine steel wool, flat file, and a block of wood (1 inch thick, 3 inches wide, and 5 inches long).

2-Lay the brass flat on the bench and place block of wood on top of it.

3-Measure with the rule until the block of wood is $1/4$ inch from each edge of the tray; mark with pencil.

4-Cut the four corners slightly round.

5-Catch work in the vise with the wooden block in place on one side and tin on the other side.

6-Bend on the line with a mallet; the edges will not be hammered down flat but should be about $3/16$ inch from the block.

7-File the burrs from the corners with a flat file.

8-Shape the corners with your hands.

9-The bottom of the tray should be 3 inches wide and 5 inches long.

10-Smooth the surface with emery cloth; finish with fine steel wool.

11-The tray may be left this way, or it may be given an antique color by dipping it in oil and heating in a gas furnace.

JOB SHEET NO. 9

HOW TO MAKE A GATE HOOK

1-Check out: hammer, tongs, and rule.

2-Heat 1 1/4 inches of one end and forge it round to a diameter of 1/4 inch.

3-Heat 1 3/4 inches of the other end and forge it to a diameter of 1/4 inch.

4-Cool work in water.

5-Hold round ends against emery stone and turn slowly. This will remove marks and smooth work.

6-Heat the shortest end red and make a square bend. Notice the dotted lines above the eye of the hook on the blueprint.

7-Heat the bent part again and place it over the extreme point of the anvil. Gradually extend the round end over the horn of the anvil, striking the extended part lightly on top of the work. Keep work red at all times.

8-Form an eye on this end of the hook 1/2 inch in diameter on the inside of the circle.

9-Heat the other end red and make another square bend in the same direction as before.

10-Heat again and place over the smallest part of the horn. Bend as before but do not close this end. About 1 1/2 inches will be straight, in the direction opposite the first bend on this end. The width inside the

hook is 1/2 inch.

11-Measure 1 inch from the eye on the square part and mark.

12-Measure 1 inch from the square bend on the hook and mark.

13-Heat the part between these two marks red and place in vise with lower mark even with top of the vise.

14-Grip with tongs on the upper mark and twist three times in the same direction.

15-Hold the hook against a wire buffer to finish.

16-Give the hook a coat of black lacquer.

JOB SHEET NO. 10

HOW TO MAKE A TREE CLIMBER

Part "A"

1-Check out: rule, hammer, center-punch, and 3/32-inch and 3/16-inch drills.

2-Measure from each end 3/8 inch, 1 3/4 inches, and 2 1/8 inches, respectively, and mark.

3-Make a square bend on each of these marks, from the same side of the work. See your teacher. Make these bends over a piece of iron, 3/16 inch thick and 1 inch in width.

4-The inside measurement of these ends must be 3/16 inch in width and 1 inch in length.

5-Measure from one end 6 inches, and 9 1/2 inches respectively, and make a square bend to the inside.

6-Measure from the last bend on the inside of the stirrup 3/4 inch, and 1 1/2 inches, respectively, and center-punch. Drill 3/16-inch holes. Countersink these holes on the inside.

7-Measure from the inside stirrup bend 5 3/16 inches and drill a 3/32-inch hole.

Part "B"

1-Check out: rule, 3/16-inch drill, and round jaw tongs.

2-Forge a round tapered point 1 3/4 inches long.

Bend the point $7/8$ inch to the inside.

3-Measure from the point $3\ 3/4$ inches and cut off.

4-Square this end on the emery stone.

5-Grind the point sharp and smooth the entire surface.

6-Measure from the square end $3/4$ inch, and $1\ 1/2$ inches, respectively, and drill $3/16$ -inch holes.

7-Heat the work red and drop in a tank of oil.

Assembling

1-Check out a riveting hammer and a flat file.

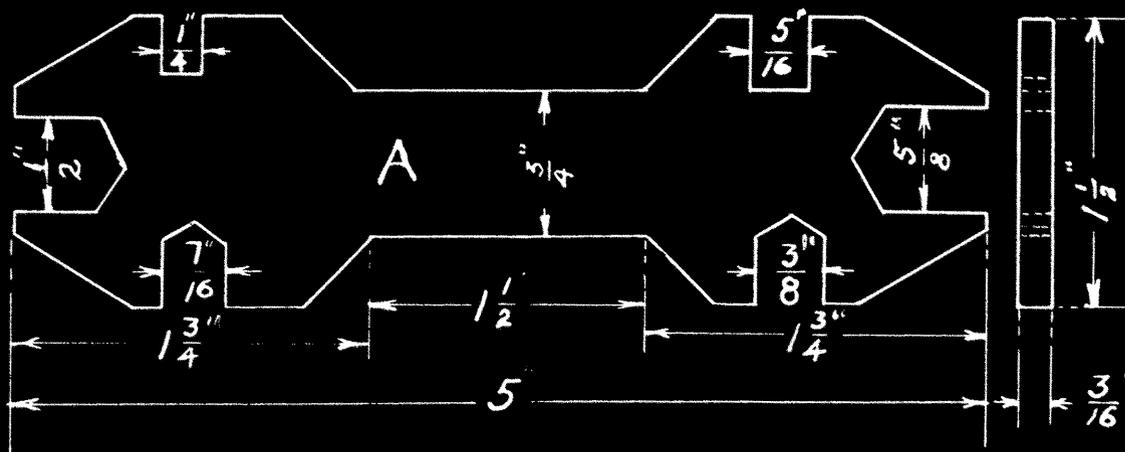
2-Rivet Part "B" to Part "A" with the rivet heads on the outside. Notice the blueprint.

3-Rivet the heads on the inside and file them down even with the inside of the climber.

4-Rivet the bottom strap on the outside of the $3/32$ -inch hole with a $1/8$ -inch brass rivet.

5-Lacquer the metal surface black.

POCKET WRENCH



L.C. PETERSON
101 METAL
WORKING PROJECTS
1947

MATERIALS	
A	$\frac{3}{16} \times \frac{1}{2} \times 5$ Steel
	TOOL STEEL

JOB SHEET NO. 11

HOW TO MAKE A POCKET WRENCH

1-Check out: wrench; pattern; hack saw; hammer; cold chisel; scriber; three corner file; 6 inch, and 10 inch flat files; 3/16-inch, 1/4-inch, 5/16-inch, 3/8-inch, 7/16-inch, 1/2-inch, and 5/8-inch drills.

2-Chalk one side and place the pattern on the material.

3-Mark around the edge of the pattern with the scriber.

4-Catch the wrench in the vise and saw out all lines, except the part for the nuts.

5-Center-punch the center of each square part for a nut and drill out with 3/16-inch drill. Drill one end with a 5/8-inch drill, and the other end with a 1/2-inch drill.

6-On one side drill a 1/4-inch hole, and a 5/16-inch hole.

7-On the other side drill a 3/8-inch hole, and a 7/16-inch hole.

8-Catch the work in a vise and cut out the lines with a hack saw for the different size nuts.

9-With the wrench held in the vise, file the jaws to fit the various nuts with a 6-inch flat file and a three cornered file. Notice the blueprint for the correct shape of jaws.

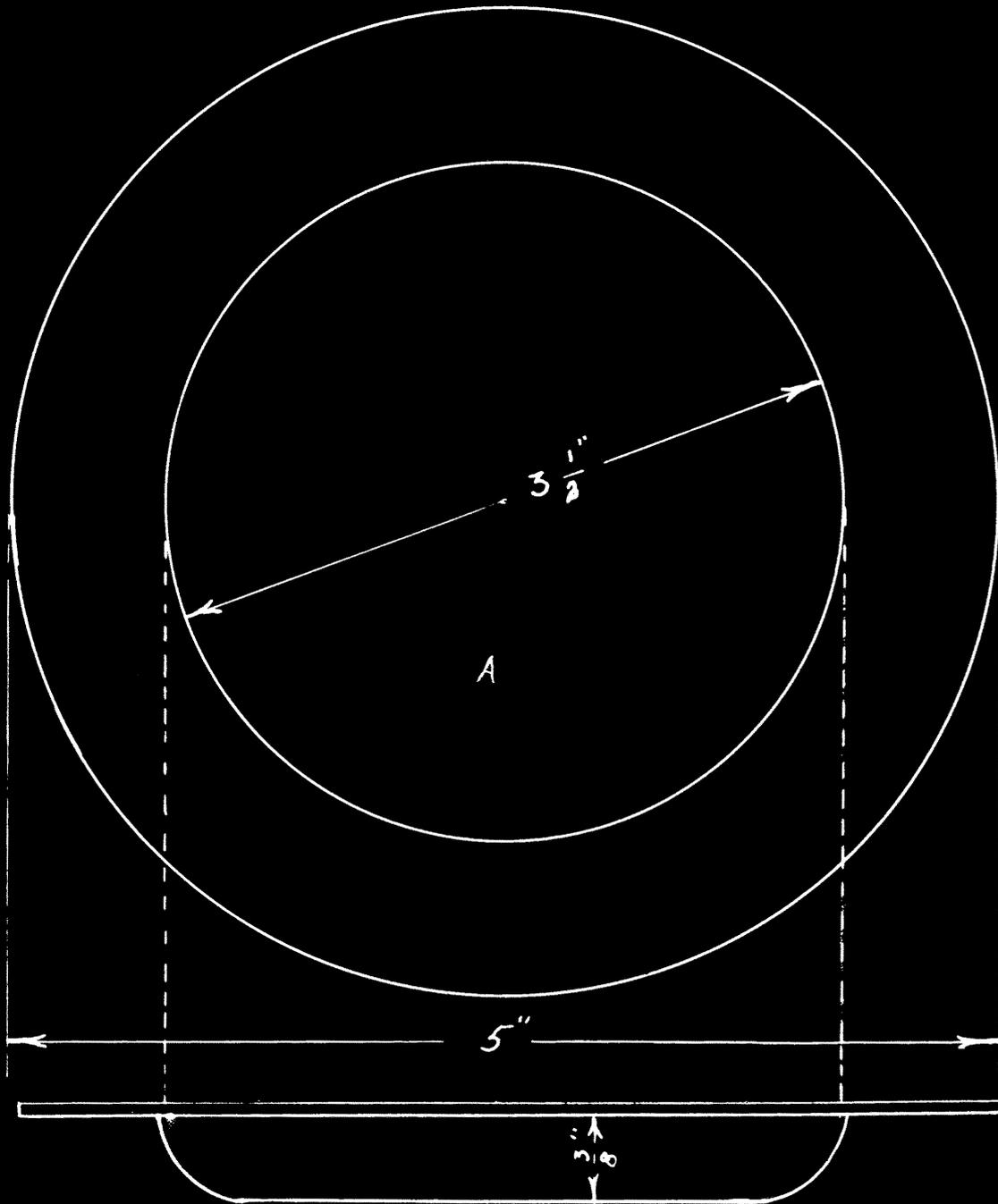
10-File the edges of the wrench blunt with a 10-inch flat file.

11-Grind each flat side smooth; remove all marks with a file.

12-Heat the wrench red and drop in a tank of oil for tempering.

13-Remove from the oil, clean, and hold on the cloth buffer for the finish.

CARD⁵⁶-SALVER



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MATERIALS	
A	NO. 22 SHEET COPPER 5" DIAM.

JOB SHEET NO. 12

HOW TO MAKE A CARD SALVER

1-Check out: small ball-peen hammer, rule, 6-inch dividers, flat file, hardwood block, fine emery cloth, mallet, round jaw tin snips, and steel wool.

2-Set points of dividers 2 1/2 inches apart.

3-Place one point in the center of the material and slightly tap dividers with the hand.

4-With one point in the center, turn the dividers to form a circle.

5-Set the points of the dividers 1 3/4 inches apart.

6-Place one point in the center of the work and turn to form another circle.

7-Cut out outside circle with the snips.

8-Place the hardwood block in the vise. (The block is 3 1/2 inches in diameter with one side cut away.)

9-Holding the brass flat on top of the block in a horizontal position, hammer on the edge of the inside of the circle with the peen of the hammer; turn the work as you hammer. Continue until the center of the circle is reached.

10-Start again on the inside of the small circle about 1/4 inch or 3/8 inch from the mark. Hold your work slightly vertical and continue hammering and turning until

the correct depth has been reached.

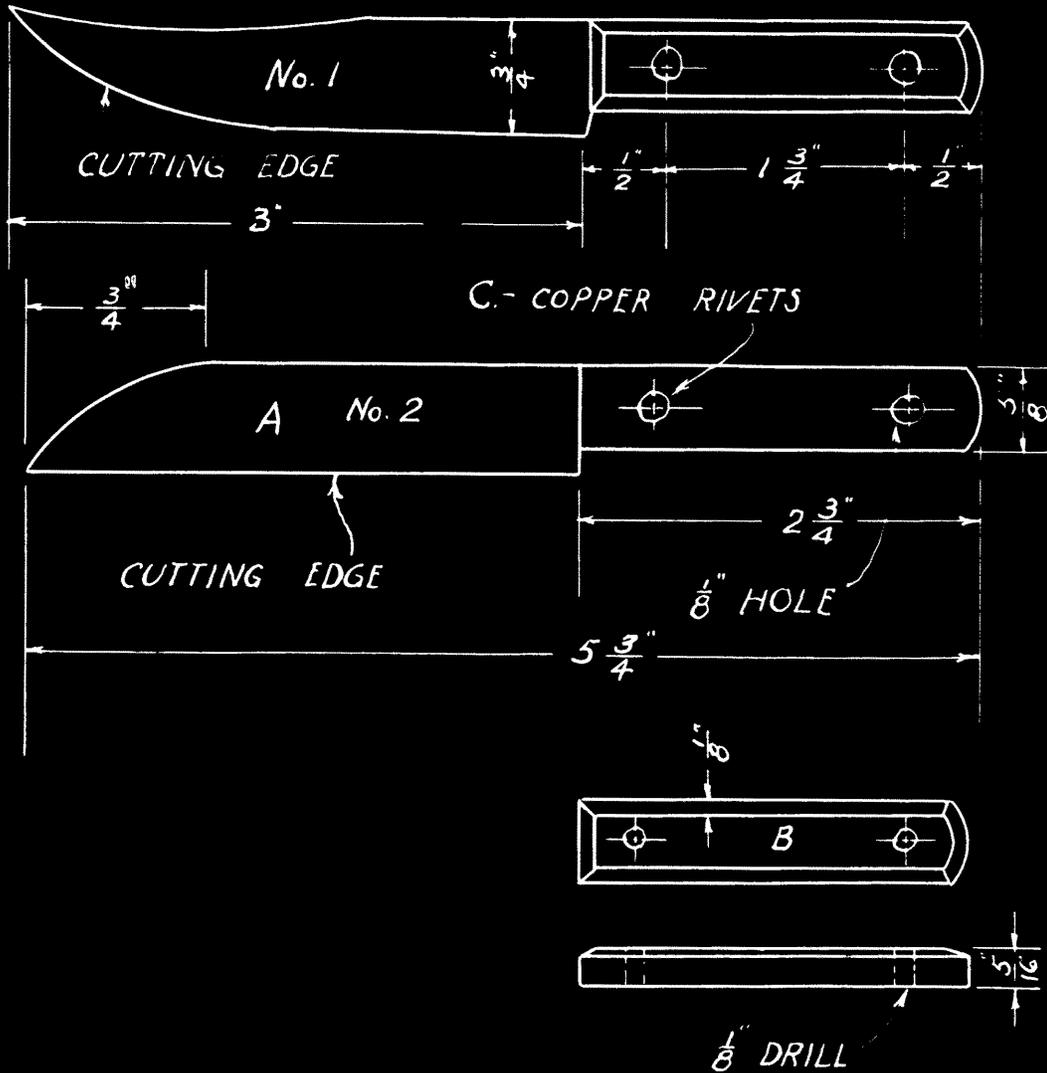
11-Remove all hammer marks by hammering with the face of the hammer; then place work on a flat surface and use a smooth face mallet.

12-Go over the edge with a flat file to remove burrs and sharp edges.

13-Smooth with emery cloth and fine steel wool.

14-The card salver may be given an antique finish by dipping it in oil and heating it in a gas flame.

PARING KNIFE



MATERIALS	
A	$\frac{1}{16} \times \frac{3}{4} \times 5 \frac{3}{4}$ " STEEL
B	2 - $\frac{5}{16} \times \frac{5}{8} \times 2 \frac{3}{4}$ " SOFT PINE
C	2 - $\frac{1}{8} \times 1$ " COPPER RIVETS

JOB SHEET NO. 13

HOW TO MAKE A PARING KNIFE

Part "A"

1-Check out: 1/8-inch drill, center-punch, and rule.

2-Square your work; make sure that your work is exactly 5 3/4 inches long and 3/4 inch wide.

3-Measure from one end 2 3/4 inches and mark. Grind this distance on one side until work is 5/8 inch wide and the end is slightly rounded.

4-Grind the cutting edge on a fine emery stone; keep the knife cool all the time you are grinding it often putting it in water.

5-Make either the No. 1 or the No. 2 knife. Shape the back of the knife on the emery stone.

6-Sharpen the cutting edge on one edge only, but from both sides of the steel. It should be ground from the extreme back as the starting point and tapered by grinding until the cutting edge has been reached.

7-Place on buffer to finish.

8-Measure from handle end 1/2 inch, and 2 1/4 inches, respectively, center-punch, and drill 1/8-inch holes on the center line.

Part "B"

1-Check out 1/8-inch drill.

2-Measure from each end 1/2 inch on each piece,

center-punch, and drill 1/8-inch holes on center line.

Assembling

1-Check out: rivet set, riveting hammer, oil stone, emery cloth, hack saw, wood file, walnut stain, brush, and flat file.

2-Place the rivets through one side of the handle, through the steel, and then through the other side of the handle.

3-Place the washers over the ends of the rivets.

4-Place the hole in the end of the rivet set over the end of the rivet and hit rivet set with hammer. The washers will force the handles tight against the steel.

5-Cut off all copper ends of the rivets extending through the washers, except 1/8 of an inch.

6-Hit straight down with the face of the riveting hammer; then hit around the outside of the rivet head.

7-File the rivet heads flat and smooth.

8-File the 1/8-inch bevel on the handle, or it can be ground if you are very careful.

9-Smooth the handle and blade with fine emery cloth and remove all marks.

10-Heat the blade red and drop in a tank of oil.

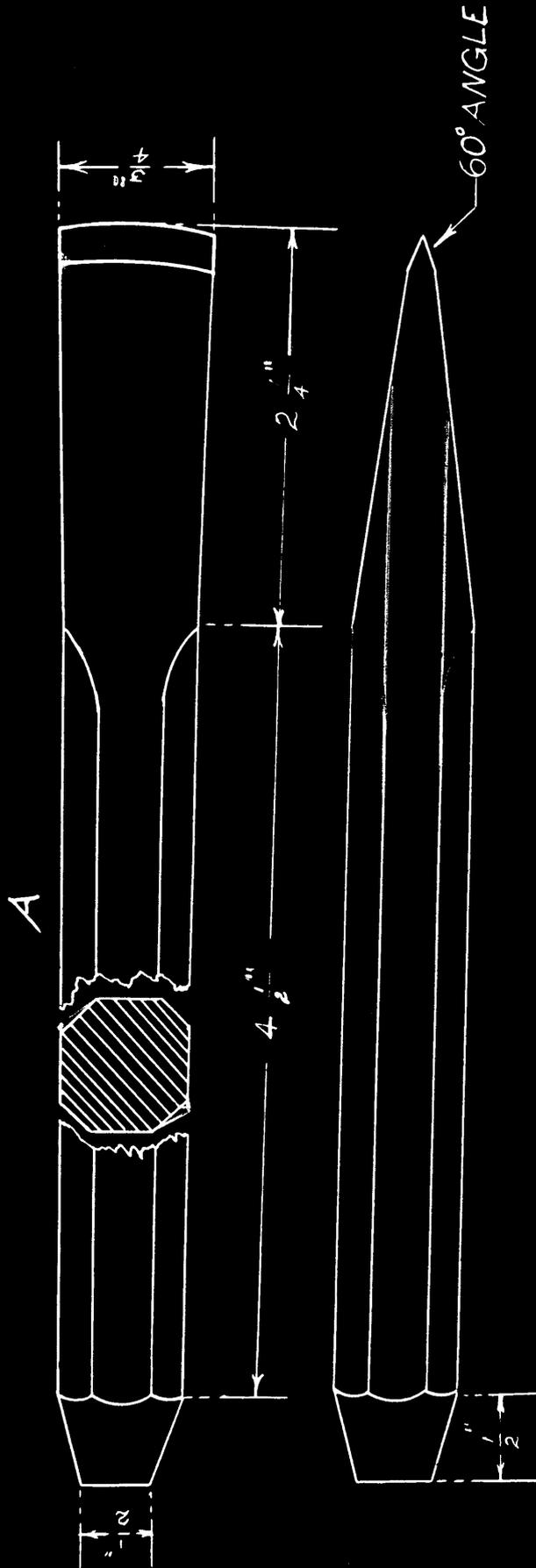
11-Place a little oil on the smooth side of an oil stone; lay one side of the blade flat on the stone and move in a circular motion. Continue to do this on both sides of the blade until the oil color, dark spots, bluish

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color, and scales have been removed and the cutting edge is sharp.

12-Stain the handle with walnut stain.

COLD CHISEL



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A

MATERIALS
 $1\frac{1}{2}$ " X 7 " HEX TOOL STEEL

JOB SHEET NO. 14

HOW TO MAKE A COLD CHISEL

1-Check out: rule, flat file, center gauge, forging hammer, 3/4-inch bolt tongs, and 6-inch outside calipers.

2-Heat one end in a coal forge to a bright red.

3-Hold work in the tongs and place about 1 1/2 inches of work on the face of the anvil; hold the end of the tongs about 3 inches higher than the heated part on the anvil.

4-Strike with the hammer so as to draw this heated part to a tapered sharp cutting edge. The extreme cutting edge should be 1/8 inch wider than the main body of the chisel; the cutting edge should be 3/4 inch wide.

5-Notice the blueprint; you will see that the cutting edge is slightly rounded to keep the corners from breaking.

6-The flat tapered part on this end should be 2 1/4 inches long.

7-Heat the end of the chisel; place on the anvil with the chisel end held about 3 inches higher than the part on the anvil.

8-Turn the tongs as you strike with the hammer to form a round taper on the head. Measure with a rule to see that the taper is 1/2 inch long.

9-Set the jaws of the calipers $1/2$ inch apart and measure the small end of the head with the calipers.

10-Let the work cool.

11-Smooth the head on the emery stone by turning the chisel with one hand while the tapered part is held against the emery stone.

12-Hold the extreme end against the stone and grind it flat.

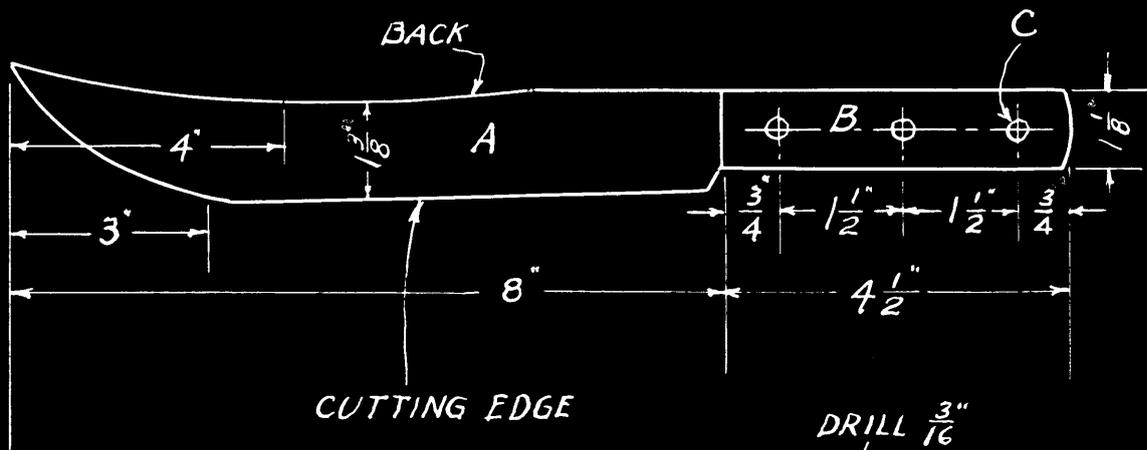
13-Grind the cutting edge on both sides to a 60 degree angle.

14-See your teacher to find out how to use the center gauge.

15-Grind the flat tapered end on both sides to a smooth finish.

16-Heat about $1\ 1/2$ inches of the chisel end to a cherry red. Check out the general information sheet on hardening. Harden the chisel.

BUTCHER KNIFE



CUTTING EDGE

DRILL $\frac{3}{16}$ "



$\frac{1}{8}$ " BEVEL



MATERIALS	
A	$\frac{1}{8}$ " \times $1\frac{3}{8}$ " \times $12\frac{1}{2}$ "
B	$\frac{5}{16}$ " \times $1\frac{1}{8}$ " \times $4\frac{1}{2}$ " - 2
C	3 - $\frac{1}{8}$ " \times 1" COPPER RIVETS

JOB SHEET NO. 15

HOW TO MAKE A BUTCHER KNIFE

1-Check out: flat jaw tongs, riveting hammer, oil stone, rivet set, 3/16-inch twist drill, flat file, fine emery cloth, fine sandpaper, and center-punch.

2-Grind 4 1/2 inches of one end of Part "A" to a width of 1 1/8 inches; do all the grinding on one side.

3-Chalk one side of the steel blade.

4-With a pencil, connect the point with the 3-inch mark on the cutting edge with a curved line and grind to this line.

5-On the back measure 4 inches from the point and grind a slight dip between these points.

6-Sharpen the blade by grinding from each side of the steel, starting at the back of the knife, and gradually taper off to a sharp cutting edge.

7-Tack emery cloth about 2 inches wide around a wood cylinder 3 inches in diameter and 12 inches long.

8-Chuck in a steel lathe. While lathe is running at its fastest speed, hold both sides of blade lightly on buffer.

9-Clean the oil stone and add a few drops of oil. Place blade flat on the stone and move knife in a circular motion. Reverse sides and repeat.

10-Measure 3/4 inch, 2 1/4 inches, and 3 3/4 inches, respectively, from the handle end and center-punch.

11-Drill holes on these marks with a 3/16-inch drill.

12-Heat the blade red and drop it in a tank of oil to cool.

13-Drill the wood handles as you did the steel blade.

14-Place three brass rivets through holes in one side of the handle, through the holes in the steel, and then through the other side of the handle.

15-Place washers over ends of rivets with about 1/8 inch extending through the washers, and rivet.

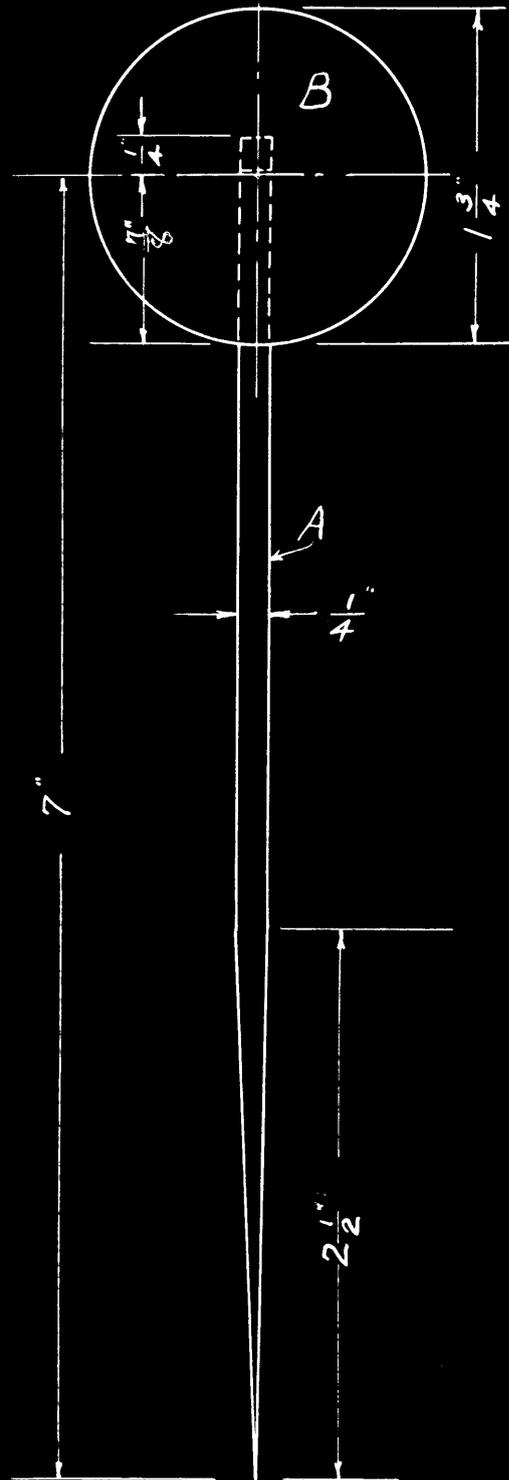
16-File these formed heads flat with the flat file.

17-File a 1/8-inch bevel on the handle.

18-Smooth handle with fine emery cloth; stain the handle, walnut or lacquer it black.

19-Hold the knife blade on the buffer on the lathe for a few minutes to put a bright steel finish on each side of the blade.

ICE PICK



MATERIALS	
A	1/4" x 6 1/2" DRILL ROD STEEL
B	2" DIAM ROUND IRON
	BY 3" LONG C.R.
	C.R. = COLD ROLLED

JOB SHEET NO. 16

HOW TO MAKE AN ICE PICK

Part "A"

1-Check out: rule, hammer, lathe tools, flat file, fine emery cloth, and bolt tongs.

2-Heat and forge a 2 1/2-inch round tapered point on one end of the round rod.

3-Chuck about 3 inches of the part not tapered in a universal chuck.

4-Adjust the lathe for a fast speed.

5-While work is turning in the lathe, file this taper smooth and to a sharp point.

6-Hold emery cloth against work until all marks are removed.

7-Reverse ends in the lathe with about 2 inches extending from the face of the chuck.

8-While work is turning in the lathe, file a slight taper on one inch of this end.

9-Heat the pointed end to a cherry red. Temper as given on the general information sheet.

10-Place in chuck again and with lathe running at high speed, polish the steel with fine emery cloth.

Part "B"

1-Check out: lathe tools, outside calipers, rule, 5/32-inch drill, flat file, emery cloth, drill

chuck, and mallet.

2-Chuck work in a universal chuck with 2 inches extended. Oil the lathe well.

3-Set the point of the cutting tool the same height as the dead center.

4-Have the tool holder pointed slightly toward the head stock.

5-Square the end, or take a fine cut to make it true.

6-Set the calipers at 1 3/4 inches.

7-Cut the material down to a diameter of 1 3/4 inches.

8-Have your teacher show you how to cut a round ball on the lathe.

9-File the ball; smooth with emery cloth.

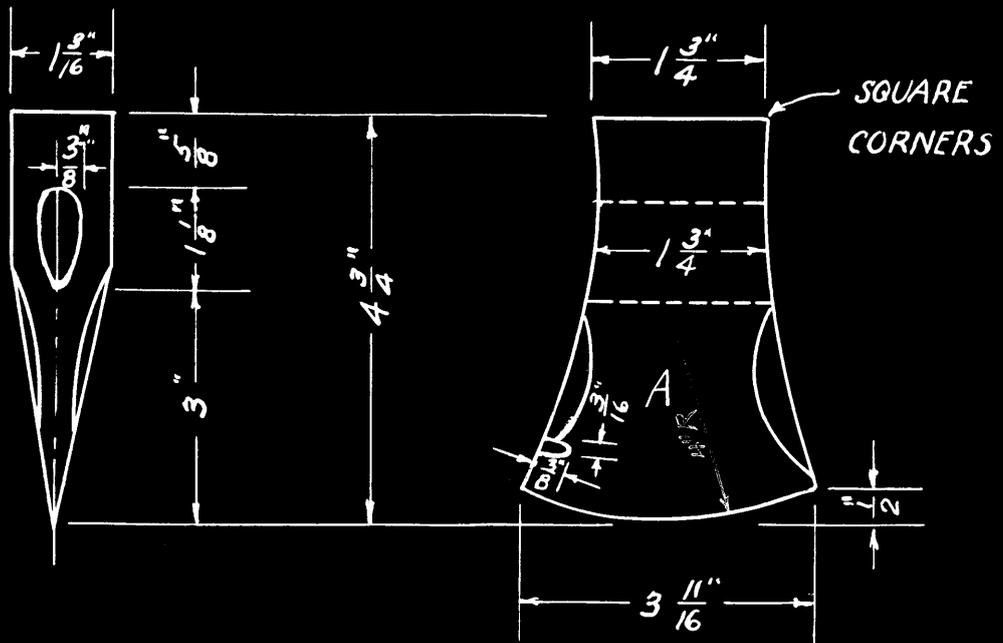
10-Remove tail stock center; place 5/32-inch drill in drill chuck and place in tail stock. Drill hole in center-drill hole 1 1/4 inches deep.

11-Place tin around the center of Part "A" and catch it in a vise; have the blunt end above the vise.

12-Place hole in ball over the blunt end of Part "A". Hit the ball with a mallet or block of wood several times, to make a tight fit.

13-Give the ice pick a coat of oil to prevent rusting.

HUNTING AX HEAD



MATERIALS	
A	1 3/16" x 1 3/4" x 4"
	TOOL STEEL

JOB SHEET NO. 17

HOW TO MAKE A HUNTING AX HEAD

1-Check out: flat jaw tongs, rule, center-punch, flatter, 8-inch flat file, hot cutter, rat-tail file, 8-pound sledge, 2-pound forging hammer, 5/16-inch and 1/2-inch drills, hack saw, and outside calipers.

2-Heat 3 inches of one end of a bar of steel red, but not white-hot.

3-Place the heated end on the anvil and forge it down to a sharp cutting edge similar to that of a cold chisel.

4-Forge this tapered end down until it is 3 inches long, and the extreme cutting edge is 3/16 inch wide.

5-Place the flatter on the tapered end and strike it with the sledge. Do this several times until all the marks are removed on each side.

6-Measure on the edge of the stock 3 1/4 inches from the cutting edge and center-punch; drill 5/16-inch hole.

7-Similarly measure from the cutting edge 3 3/4 inches and center-punch; drill 5/8-inch hole.

8-Measure a line 4 3/4 inches from the cutting edge and center-punch the line.

9-Heat red on this line; place the hot cutter on this line and striking it with the sledge, cut on each side of the steel until it is cut off.

10-Let cool before working.

11-Catch the ax in a vise with tin placed around it to keep from scarring it.

12-Take the blade out of the hack saw frame and put it through the 5/8-inch hole. Now connect the blade to the frame again.

13-Saw out the steel between these holes; ^{also (?)} saw two slits so you will have the eye for the handle about completed. See your teacher.

14-Set the calipers so they will barely slide over the part between the hole and the sides of the ax.

15-If calipers do not slide tightly over the outside, catch ax in a vise and file out the inside of the hole with a flat file until calipers do slide over the sides.

16-Each end of this eye for the handle should be slightly rounded.

17-Grind the head of the ax until it is exactly flat on top. The corners are left square.

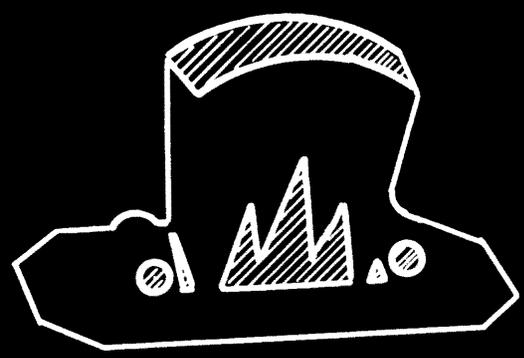
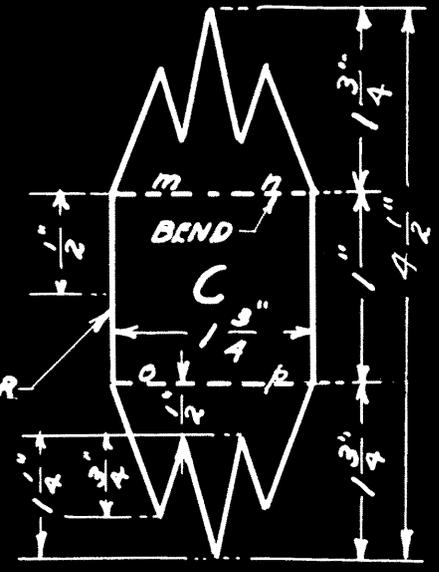
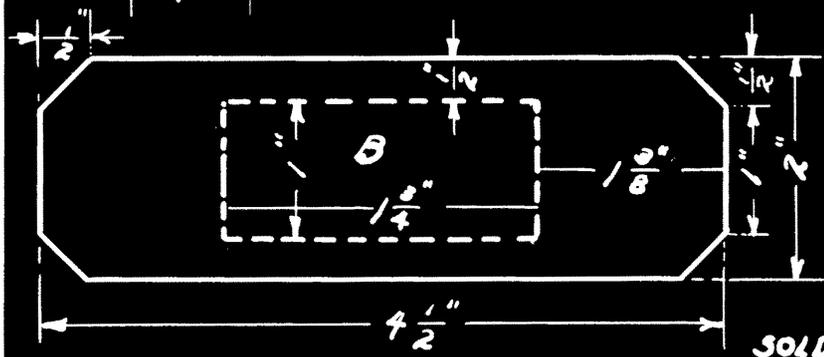
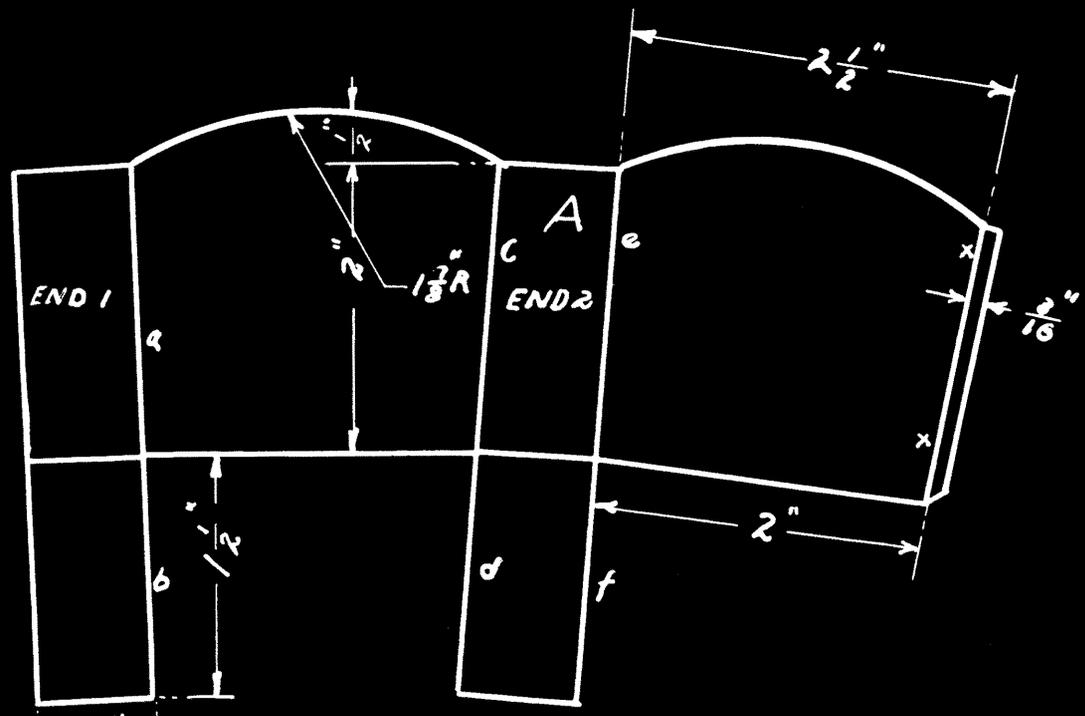
18-Grind the ax until all the marks have been removed.

19-Place fine emery cloth on the buffer and place on the lathe; hold the ax on this buffer until all the surface has been smoothed.

20-Grind the cutting edge until sharp.

21-Heat the ax to a cherry red and harden as directed on the general information sheet.

MATCH BOX



MATERIALS	
A	6 1/2" X 4 1/2" GALV IRON
B	2" X 4 1/2" " "
C	1 3/4" X 4 1/2" " "

JOB SHEET NO. 18

HOW TO MAKE A MATCH BOX

Part "A"

1-Check out: pattern, soldering iron, solder, paste, tin snips, scriber, flat file, fine emery cloth, and mallet.

2-Place pattern over galvanized iron and mark around the edge of pattern with a scriber.

3-Cut out the line with snips.

4-Go around the cut edges with a flat file to remove all burrs and sharp edges.

5-Smooth both sides with fine emery cloth.

6-Make square bends on the lines ab, cd, ef, and xy on the same side of the work. It should resemble a rectangular box.

7-Force the 3/16-inch lap to the inside so a square corner will be formed on the outside.

8-Solder this seam. Check out information sheet on soldering.

9-Remove all high spots, lumps, and rough places on the outside soldering job with a flat file.

10-Bend the ends extending out from the main body 1 inch wide and 1 1/2 inches long, over the round end of the needle stake.

11-Hammer these ends round, using the mallet until they are 1/2 inch in diameter. These ends are on

the outside of the main body of the box.

Part "B"

1-Check out: pattern, tin snips, scriber, emery cloth, and flat file.

2-Place pattern on material and mark around edges.

3-Cut out lines with snips and file off sharp edges and burrs.

4-Smooth each side with emery cloth.

Part "C"

1-Check out: pattern, rule, snips, scriber, mallet, emery cloth, and flat file.

2-Place pattern on material and mark around edges with scriber.

3-Cut out lines with snips and file off burrs and sharp edges.

4-Smooth each side with emery cloth.

5-Measure from the longest point on one side $2 \frac{1}{4}$ inches; this is the center.

6-Measure each way from this center mark $\frac{1}{2}$ inch. See your teacher.

7-Make square bends over the flat ends of the needle stake on the lines mn and op.

Assembling

1-Check out: solder, soldering iron, flux, emery cloth, lacquer, brush, gold bronzing powder, and rule.

2-Measure $1 \frac{3}{8}$ inches from each end of Part "B"

and mark.

3-Measure $1/2$ inch from each side and mark.

4-Place Part "C" in the rectangle; solder Part "C" to Part "B" at the place shown on the blueprint.

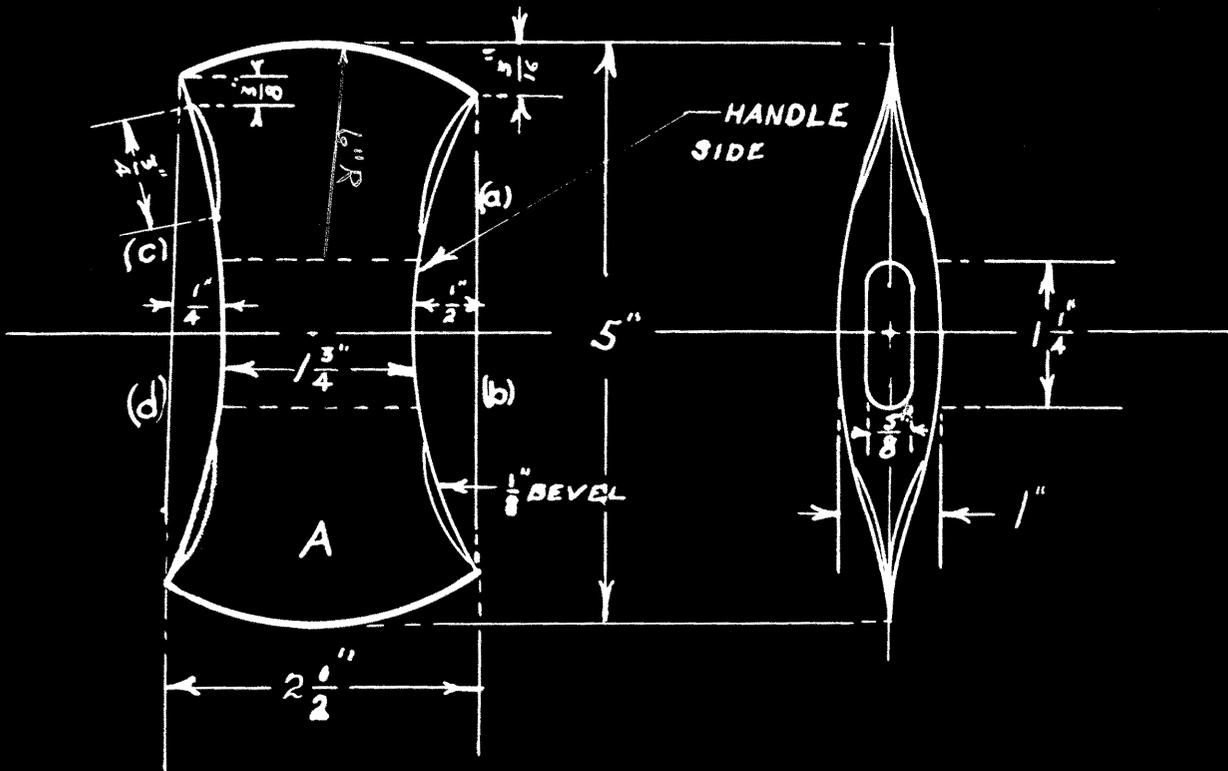
5-Place Part "A" between the points on Part "C". The bottom of Part "A" must fit snugly on the bottom of Part "B" with no open space at the bottom.

6-Solder each corner of Part "A" to Part "B".

7-Wipe the box clean with a cloth; smooth with emery cloth.

8-Give the match box a coat of black lacquer. While the lacquer is wet, blow gold bronzing powder through a folded sheet of paper at intervals on the box.

DOUBLE BIT AX HEAD



MATERIALS	
A	$1" \times \frac{3}{4}" \times 4$ LONG
	TOOL STEEL

JOB SHEET NO. 19

HOW TO MAKE A DOUBLE BIT AX

1-Check out: steel rule, flat jaw tongs, oil stone, forging hammer, 8-pound sledge hammer, 10-inch flat file, 5/16-inch, and 5/8-inch twist drills, center-punch, hack saw, coarse and fine emery cloth, hot cutter, and flatter.

2-Measure from one end 5 inches and mark but do not cut material from stock until one cutting edge has been forged.

3-Heat one end of bar hot.

4-Forge a 2 1/2-inch taper on each side of one end, finishing with a sharp cutting edge 2 1/4 inches wide.

5-Heat and cut off on the mark.

6-Heat the end, cut off, and forge to a taper as on the finished end.

7-Measure 2 1/2 inches on the edge of the ax and center-punch on the center line.

8-Measure each way from this mark 1/2 inch and center-punch on the center line.

9-Drill out the three marks with a 5/16-inch drill.

10-Drill out the center hole with a 5/8-inch drill.

11-Place the ax in the vise.

12-Remove the blade from the hack saw and extend it through the 5/8-inch hole. Adjust the frame of the

hack saw so the blade can be put in from the side.

13-Cut out the material on each side of the 5/8-inch hole to the 5/16-inch holes. See your teacher.

14-File the inside of the eye smooth and to the correct width and length.

15-File the eye until the material on each side is the same thickness.

16-From the handle side of the ax, the curve should measure 1/2 inch from the eye up to line ab. See your teacher.

17-The distance on the other side of the handle should measure 1/4 inch from the eye in the ax to the line cd.

18-Grind the ax on the emery stone until all marks and scars have been removed.

19-File the four bevels on each side of the ax. Notice the blueprint carefully.

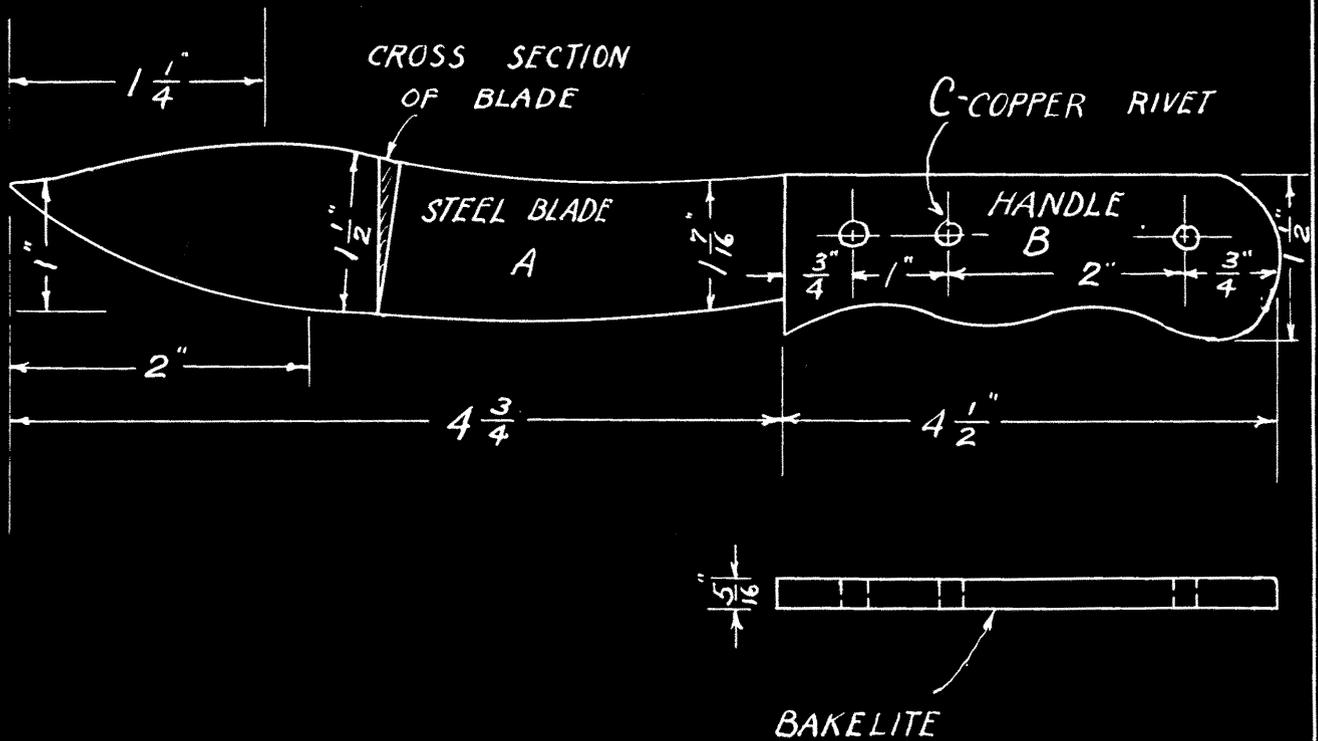
20-Hold the surface of the ax on a buffer covered with coarse emery cloth; then, on a buffer covered with fine emery cloth.

21-File a sharp cutting edge on each bit of the ax from each side of the blade.

22-Heat the ax and temper as given on the general information sheet.

23-Put a smooth sharp edge on the ax on the oil stone. Then hold on a felt buffer to brighten.

HUNTING KNIFE



MATERIALS	
TOOL STEEL	
A	BLADE $\frac{5}{8} \times 1\frac{1}{2} \times 9\frac{1}{4}$ "
B	HANDLE $\frac{3}{8} \times 1\frac{1}{2} \times 4\frac{1}{4}$ " - 2
BAKELITE HANDLES	
C	$3 - \frac{1}{8} \times 1$ " COPPER RIVETS

JOB SHEET NO. 20

HOW TO MAKE A HUNTING KNIFE

Part "A"

1-Check out: rule, forging hammer, flat jaw tongs, center-punch, and 5/32-inch drill.

2-Forge 4 3/4 inches of one end sharp on one edge.

3-Chalk one side of this end for about 3 inches.

4-Measure 2 inches from the end on the cutting edge and mark.

5-Measure on the back of the knife from the point 1 1/4 inches and mark.

6-Measure 1 inch on this end, from the cutting edge across the end.

7-Connect this last point with the point on the cutting edge; slightly curve the line between these points to the outside.

8-Draw a straight line from the mark on the cutting edge to the mark on the extreme tip end.

9-Cut on the mark just made.

10-Forge the part just cut on the cutting edge, sharp.

11-On the handle end of Part "A" measure from the end 3/4 inch, 2 3/4 inches, and 3 3/4 inches, respectively; center-punch in the center and drill 5/32-inch holes.

12-Grind this end slightly round from corner to corner.

13-Grind each side of the cutting edge until all marks have been removed.

14-Hold on buffer covered with coarse and then fine emery cloth for a good finish.

15-Heat the blade to a cherry red and drop it in a tank of oil, to harden.

Part "B"

1-Check out a rule and 5/32-inch drill.

2-Place the drilled end of the steel blade over the handles and mark through the holes with a pencil.

3-Drill out these marks with a 5/32-inch drill.

Assembling

1-Check out a hack saw and rule.

2-Place the three rivets through one side of the handle, through the steel, and through the other side of the handle.

3-Place washers over the ends of rivets.

4-Place the hole in the end of the rivet set over these rivets and force washers up against the handle.

5-Saw off ends of rivets until only 1/8 inch extends through the washers.

6-Hit lightly with riveting hammer and form a good head.

7-Shape the handle as shown on the blueprint

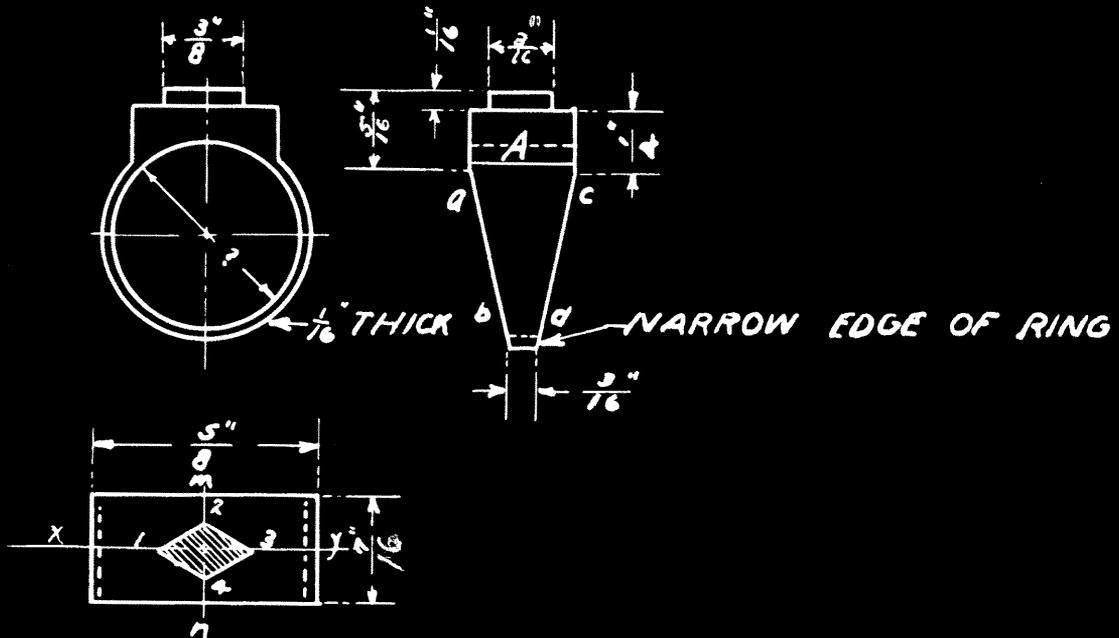
on the emery stone.

8-File the edges of the handle and smooth with emery cloth.

9-Lacquer this edge black; leave the sides the original color.

10- Buff the blade again to remove all stains and colors. This buffing will give the blade a bright steel finish.

MONEL RING



MATERIALS	
A	$\frac{5}{8}$ " X $1\frac{1}{2}$ " ROUND
	$\frac{5}{8}$ " THICK $1\frac{1}{2}$ " ROUND
	MONEL METAL

JOB SHEET NO. 21

HOW TO MAKE A MONEL RING

1-Check out: round file, 1/2-inch tapered punch, fine flat file, hack saw, fine steel wool, fine emery cloth, center-punch, hammer, rule, 6-inch dividers, and 1/4-inch and 1/2-inch drills.

2-Locate the center with the dividers, and center-punch.

3-Drill out mark with a 1/4-inch drill.

4-Drill out this small hole with a 7/16-inch drill.

5-Catch work in a vise and file out the hole to fit the desired finger.

6-Drive the punch in this hole until tight.

7-Grind one side flat, 7/16 inch wide and 5/8 inch long.

8-Grind the balance of the ring to a thickness of 1/16 inch, keeping the punch tight in the hole.

9-Notice the side view of the ring on the blueprint.

10-Measure 5/16 inch from the flat surface on each side and mark.

11-From this mark, draw lines ab and cd to the narrow edge. The narrow edge is 3/16 inch wide.

12-Remove the punch and catch the ring in a vise; saw out these two lines.

13-Place punch back in the hole; catch the punch in a vise with the flat surface of the ring up.

14-Draw the line xy through the center of the flat surface.

15-Draw the line mn.

16-Measure $3/16$ inch each way, on the line xy from the line mn.

17-Measure $3/32$ inch each way, on the line mn from the line xy.

18-Connect the points 1, 2, 3, and 4 to form a diamond; do not file inside these marks.

19-Catch the punch in the vise with the flat surface of the ring up.

20-File around the lines making the diamond, until a depth of $1/16$ inch has been reached.

21-Go over the outside surface of the ring with a flat file to remove any rough places.

22-Place a buffer covered with fine emery cloth on the lathe; hold the ring against this buffer until a smooth finish is obtained.

23-Drive a round punch in the ring and catch the punch in a universal chuck.

24-While the ring turns very fast, hold fine steel wool against the surface until all marks are removed.

25-Remove the ring from the punch.

26-Tack fine emery cloth around a piece of broom stick 12 inches long, one end of which is 1/2 inch in diameter.

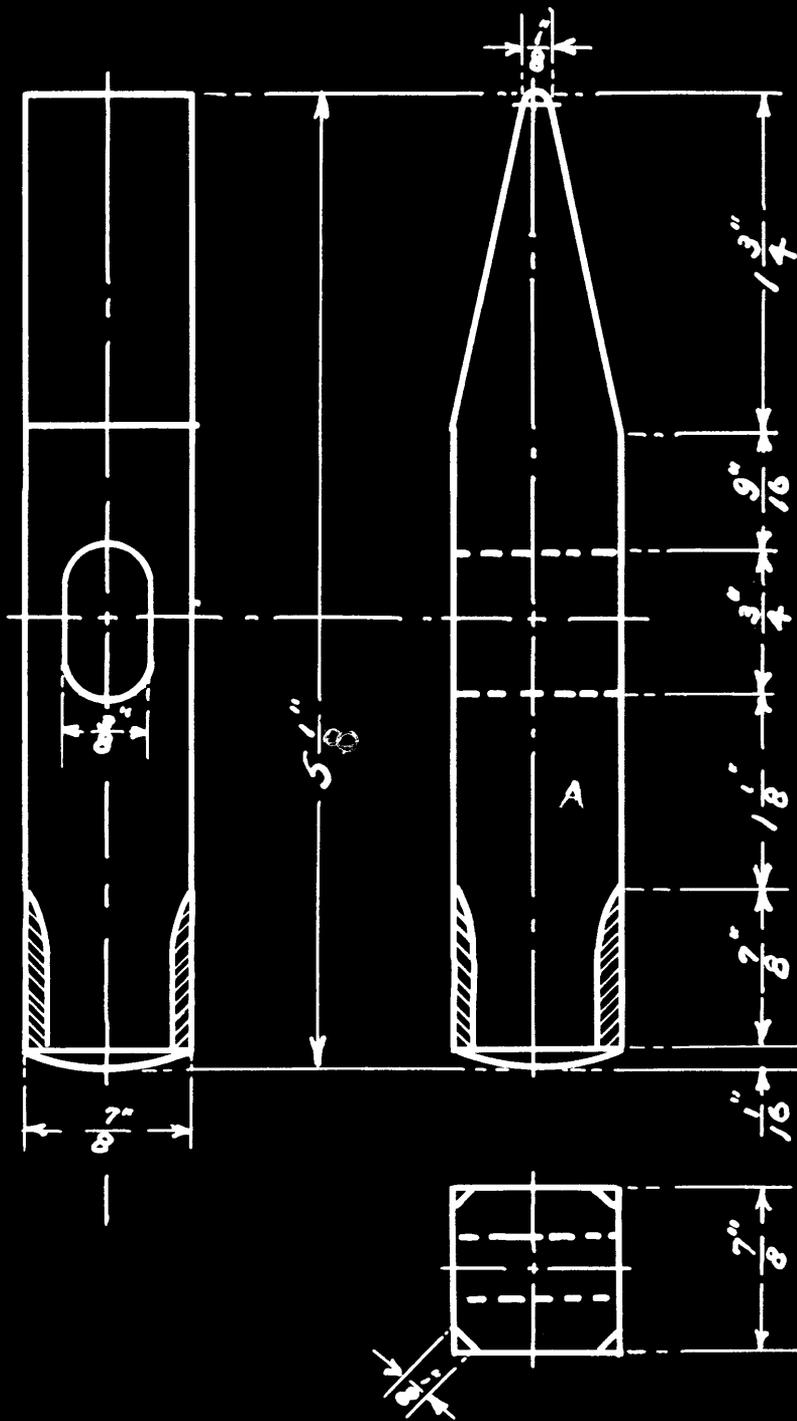
26-Catch the large end of the stick in the universal chuck.

27-While turning very fast on the lathe, slide the ring over the small end of the buffer.

28-Hold the ring in the hand over this buffer until all marks are removed and the ring is very smooth.

29-Hold the ring against a felt buffer to give it a bright, silver finish.

SHEET METAL HAMMER



MATERIALS	
A	TOOL STEEL
	$\frac{1}{2}$ " X $\frac{7}{8}$ " X $4\frac{1}{2}$ " SQ.

JOB SHEET NO. 22

HOW TO MAKE A SHEET METAL HAMMER HEAD

1-Check out: rule, steel brush, fine emery cloth, hack saw, center-punch, round file, 2-pound forging hammer, 10-inch flat file, and 3/8-inch drill.

2-Heat one end in a forge before the work has been cut from the stock.

3-Forge a flat taper on this end 1 3/4 inches long and 7/8 inch wide.

4-The extreme tapered edge must be 1/8 inch across the edge and slightly round.

5-Measure on tapered side from tapered end 2 11/16 inches and mark.

6-Measure 1/4 inch each way from this mark on the center line and center-punch.

7-Drill out the center-punch marks with a 3/8-inch drill.

8-Saw out the material between these holes.

9-File the eye, 3/8 inch wide and 3/4 inch long. File until each side of the hole has the same thickness.

10-Measure from the tapered end 5 5/16 inches and saw off.

11-Measure 1 inch from each corner of the face of the hammer.

12-Grind 1/8 inch from the flat surface, up to the marks, 1 inch from the face.

13-Grind all surfaces smooth.

14-Grind the face slightly rounded --- about 1/16 inch higher in center.

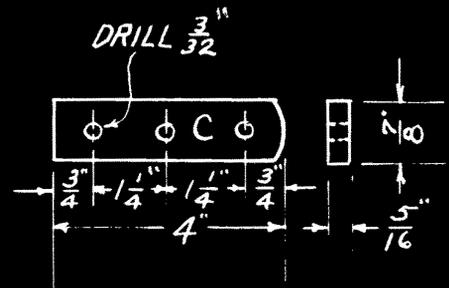
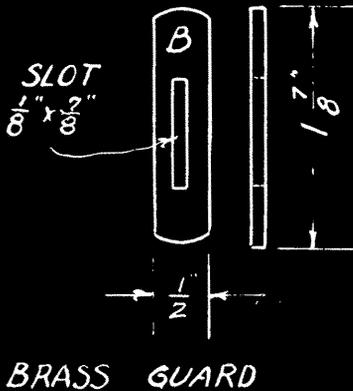
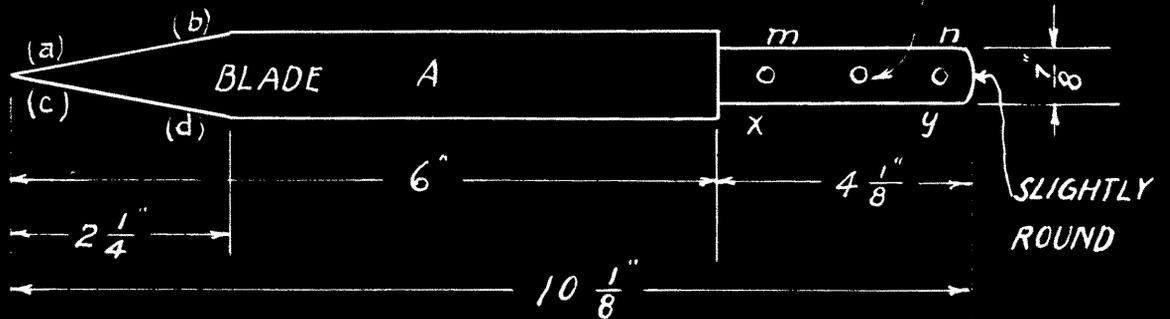
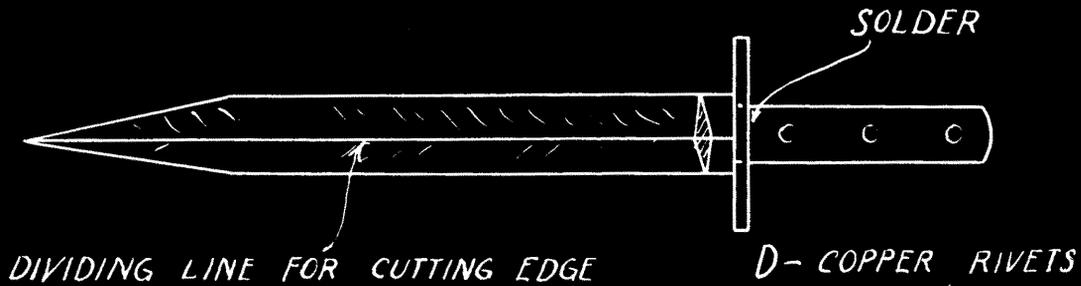
15-Catch the hammer in a vise and go over the entire surface with a flat file.

16-Hold the hammer against a buffer covered with fine emery cloth.

17-Heat red and drop in a tank of oil.

18-You may leave the hammer a dark blue, or hold it on the buffer to remove stains and colors.

DAGGER



HANDLES:

1. BAKELITE
 2. WALNUT
 3. ALUMINUM
 4. COW HORN
- OPTIONAL

MATERIALS

A	1/8" x 1/4" x 10 1/8" STEEL BLADE
B	1/8" x 1/2" x 7/8" BRASS GUARD
C	5/16" x 7/8" x 4" HANDLE - 2
D	3 - 1/8" x 1" COPPER RIVETS

JOB SHEET NO. 23

HOW TO MAKE A DAGGER

Part "A"

1-Check out: rule, 3/16-inch drill, flat jaw tongs, forging hammer, outside calipers, 10-inch flat file and center-punch.

2-Measure from one end 2 1/4 inches, and 6 inches, respectively, for the blade end.

3-Draw the lines ab and cd and connect them with the extreme point or center of the end.

4-Heat this end to a cherry red and cut out these lines on the hand lever.

5-Draw a dividing line as shown on the blueprint.

6-Forge a cutting edge each way from the dividing lines to the 6-inch mark.

7-Put knife blade in lime and allow to cool.

8-Grind all hammer marks from the blade.

9-Grind a cutting edge from the dividing line each way, on each side.

10-Catch the handle in the vise with the blade horizontal. See your teacher.

11-File each way on each side of the blade, from the dividing line to the cutting edge; keep the dividing line straight as you file.

12-Measure from the handle end 4 1/8 inches and mark.

13-Measure $7/16$ inch each way from the center line, on this end.

14-Connect the points m and n, and the points x and y; this makes the handle $4 \frac{1}{8}$ inches long and $7/8$ inch wide.

15-Heat this end red and cut out marks on a hand lever.

16-Set jaws of the calipers $7/8$ inch apart.

17-File the handle end on each side until the calipers just slide over.

18-Measure from the handle end $3/4$ inch, 2 inches, and $3 \frac{1}{4}$ inches, respectively, and center-punch.

19-Drill out marks with $3/16$ -inch drill.

20-Heat the blade red and cool in a tank of oil.

Part "B"

1-Check out: 6-inch flat file, small chisel, rule, hammer, soldering iron, solder, soldering paste, $1/8$ -inch drill, old flat file, and center-punch.

2-Draw a center line through the brass.

3-Measure from each end $1/2$ inch on this center line and mark.

4-Center-punch between these marks on the center line about $3/16$ inch apart.

5-Catch the brass in a vise and cut out each side of the holes making a slot $1/8$ inch wide and $7/8$ inch long.

6-Make the slot exactly $1/8$ inch by $7/8$ inch by filing.

7-Hold brass on a fine emery cloth buffer until it has a good finish.

8-Slide the guard over the handle end, up against the square shoulder; solder the guard to the steel.

9-File soldered part with an old flat file; then smooth with emery cloth.

Part "C"

1-Check out: hack saw, $3/16$ -inch drill, fine steel wool, oil stone, and riveting hammer.

2-Saw out bakelite handles, $7/8$ inch wide and 4 inches long.

3-Measure from each end $3/4$ inch and mark; measure from the end 2 inches and mark.

4-Drill these three marks with a $3/16$ -inch drill.

5-Rivet handles to steel with washers on one side and the rivet heads on the other side.

6-File the rivet heads smooth.

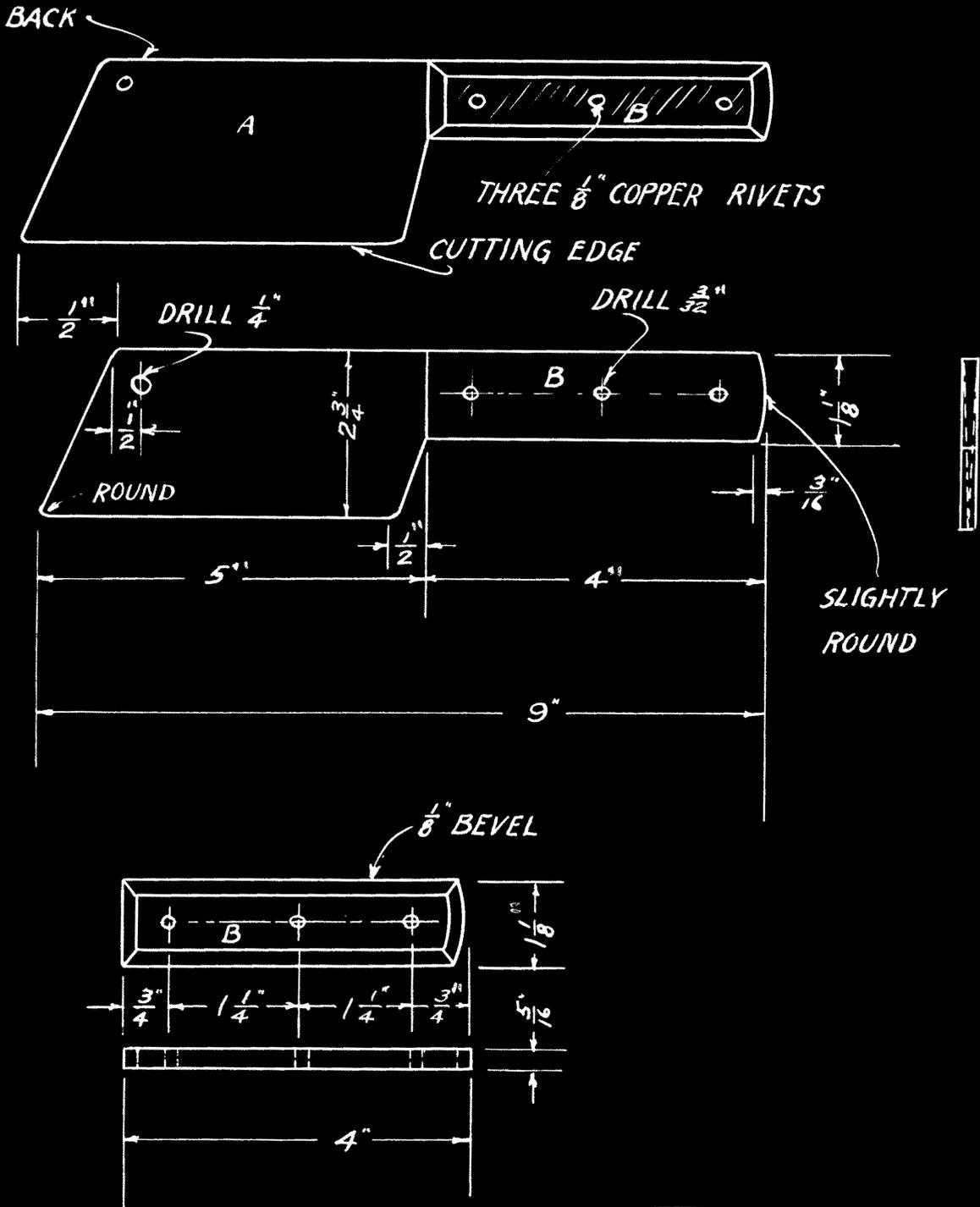
7-File the edge of the handle slightly rounded.

8-Grind the end of the handle slightly rounded.

9-Hold the blade against a fine emery cloth buffer until the blade is smooth and all stains are removed.

10-Go over each side of the blade with steel wool. Put a sharp cutting edge on knife on the oil stone.

MEAT CUTTER OR CLEAVER



MATERIALS	
A	$\frac{3}{32} \times 2\frac{3}{4} \times 9$ STEEL
B	$\frac{5}{16} \times \frac{1}{8} \times 4$ HANDLE SOFT PINE WOOD
	3- $\frac{1}{8} \times 1$ COPPER RIVETS

JOB SHEET NO. 24

HOW TO MAKE A MEAT CLEAVER

Part "A"

1-Check out: rule, 3/32-inch and 1/4-inch drills, flat jaw tongs, forging hammer, flat file, pattern, scriber, and center-punch.

2-Chalk one side of the steel white.

3-Place the pattern over this side and mark around the edge; center-punch the holes.

4-Heat the lines red and cut them out on the hand lever, or with a cold chisel.

5-Start forging about 1 1/2 inches from the cutting edge and gradually taper down to the cutting edge.

6-Drill out the holes for the handle with 3/32-inch drill.

7-Drill out the hole to hang it by, with a 1/4-inch drill.

8-Grind each side of the cleaver starting at the back and gradually tapering down to a fine cutting edge.

9-Catch the work in a vise and go over each side of the cleaver with a flat file to remove the marks.

10-Place on a buffer to finish.

11-Heat red and drop into a tank of oil.

Part "B"

1-Check out: 3/32-inch drill, riveting hammer, rivets, flat file, fine sand paper, walnut stain, brush,

and buffer.

2-Measure from each end $3/4$ inch and drill on center line, $3/32$ -inch holes; measure from one end 2 inches and drill $3/32$ -inch hole on the center line.

3-Rivet these handles to the steel; the rivet head must be on one side and the washer on the other.

4-File a $1/8$ -inch bevel around the corner of each side of the handle.

5-File the edges of the handle slightly rounded.

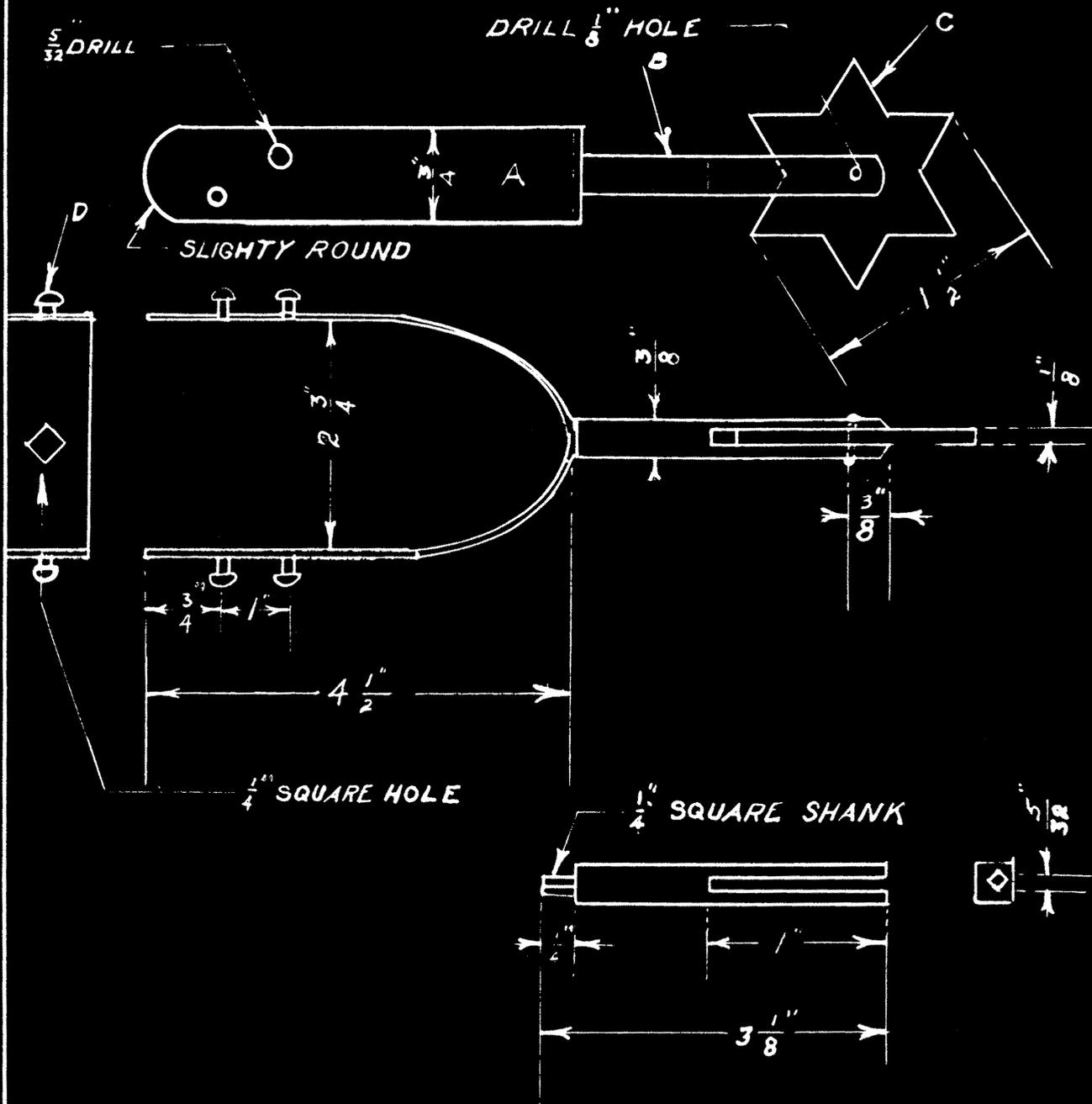
6-File the rivet heads flat.

7-Smooth wooden handle with fine sandpaper.

8-Place steel cutting edge on fine emery cloth buffer to remove colors and stains.

9-Stain the handle, or lacquer it, black.

- 98 -
SPUR



MATERIALS	
A	$\frac{1}{8}$ x $\frac{3}{4}$ x 9" (1) PIECE
B	$\frac{3}{8}$ x $\frac{1}{2}$ x 3" SQUARE
C	$\frac{1}{8}$ x $1\frac{1}{2}$ ROUND STEEL
D	$\frac{3}{8}$ x $\frac{1}{2}$ RH. RIVETS (4)
E	$\frac{1}{8}$ x $\frac{1}{2}$ RH. RIVET (1)
RH.: ROUNDHEAD	

JOB SHEET NO. 25

HOW TO MAKE A SPUR

Part "A"

1-Check out: rule, 3/16-inch square punch, tongs, hammer, and 5/32-inch and 3/16-inch drills.

2-Grind the ends half-round as shown on the blueprint.

3-Measure from each end 3/4 inch and drill 5/32-inch holes, 1/4 inch from the bottom edge; countersink on the inside.

4-Measure from each end 1 inch and drill 5/32-inch holes, 1/4 inch from the top edge; countersink on the inside.

5-Measure from the end 4 1/2 inches, drill 3/16-inch hole, and countersink on one side.

6-Heat at the center hole and punch it to a 1/4-inch square hole. See your teacher.

7-File off burrs on each side of the punched hole.

8-Bend each way from this center hole on the countersunk side, until it fits around the back of the shoe. Make sure that the ends are even and the same length.

9-Smooth and finish on a fine emery cloth buffer.

Part "B"

1-Check out: rule, 1/8-inch and 5/32-inch

drills, center-punch, hammer, hack saw, and 6-inch flat file.

2-Measure 1 inch from one end and drill a $5/32$ -inch hole.

3-Saw a slot $5/32$ inch wide from this same end to the hole.

4-Smooth the inside of the slot with a flat file; the slot must be of uniform width.

5-Measure from the same end, but on the side not sawed, $3/8$ inch and drill a $1/8$ -inch hole.

6-File a square shank on the other end, $1/4$ inch square and $1/4$ inch long.

7-Smooth all surfaces on a buffer.

Part "C"

1-Check out: $1/8$ -inch drill, center-punch, scriber, hack saw, small flat file, pattern, pliers, and hammer.

2-Chalk one side and place the pattern in place.

3-Mark around the edges with the scriber; also mark the center hole.

4-Saw on the outside edge of the lines.

5-File the sawed edges smooth and blunt.

6-Center-punch the mark in the center of the rowel and drill a $1/8$ -inch hole.

7-Smooth the sides on a buffer.

Assembling

1-Heat the square shank on Part "B" and quickly place it in the square hole on Part "A" from the outside and rivet.

2-Place Part "C" in the slot with the holes in line.

3-Place a 1/8-inch rod, 1/2 inch long, through the holes and form a head on each side.

4-Take four 3/16-inch round head rivets, 1/2 inch long, and file about 3/16 inch of the small end round until these ends fit the 5/32-inch holes.

5-Rivet them from the inside with the heads on the outside.

6-File rivet heads smooth.

7-Place the finished spur on a buffer until smooth.

8-Place spur in a gas flame until various colors appear; then, cool.

JOB SHEET NO. 26

HOW TO MAKE A GROCERY REMINDER

Part "A"

1-Check out: 12-inch rule, scribe, pattern, straight jaw tin snips, curved jaw tin snips, solder, soldering iron, paste, 6-inch flat file, mallet, 1/8-inch and 1/4-inch drills, small cold chisel, and fine emery cloth.

2-Place the pattern on the galvanized iron and mark around the edges with the scribe. Do not let the pattern slip. Mark the 1/4-inch hole and each slot.

3-Cut out the lines with the snips.

4-Drill the two 1/8-inch holes and the three 1/4-inch holes according to the blueprint.

5-Place work over a block of wood and cut out the slots with a cold chisel.

6-Catch the work in a vise and file each inside edge of the slot until it is 1/8 inch wide.

7-Bend a 1/4-inch edge on each end and side.

8-Solder the cut-out corners on the inside.

9-Measure from the outside edge of each ear, 3 inches, and draw a line parallel to the center line. See your teacher.

10-Bend on these lines in the opposite direction. The bent ears should measure 2 5/8 inches apart.

11-Go over all cut edges with a flat file to

remove burrs and sharp edges.

12-Smooth one side with emery cloth.

Part "B"

1-Check out: tin snips, rule, scriber, solder, soldering iron, and soldering paste.

2-Cut out a piece of galvanized iron 1/2 inch wide by 3 inches long.

3-Bend a 1/8 inch square edge on each end, on the same side.

4-Solder Part "B" to Part "A". Notice the blueprint carefully.

Part "C"

1-Check out: rule, hack saw, flat file, and emery cloth.

2-Chuck one end in a lathe and round the other end with a file. Reverse ends and repeat.

3-Smooth the work with emery cloth.

4-Measure from each end 5/16 inch.

5-Catch work in a vise and saw around the rod until a smooth round groove 1/8 inch in diameter has been formed.

6-Slide Part "C" through the large end of the slots and line the round sawed grooves up with the 1/8-inch slots.

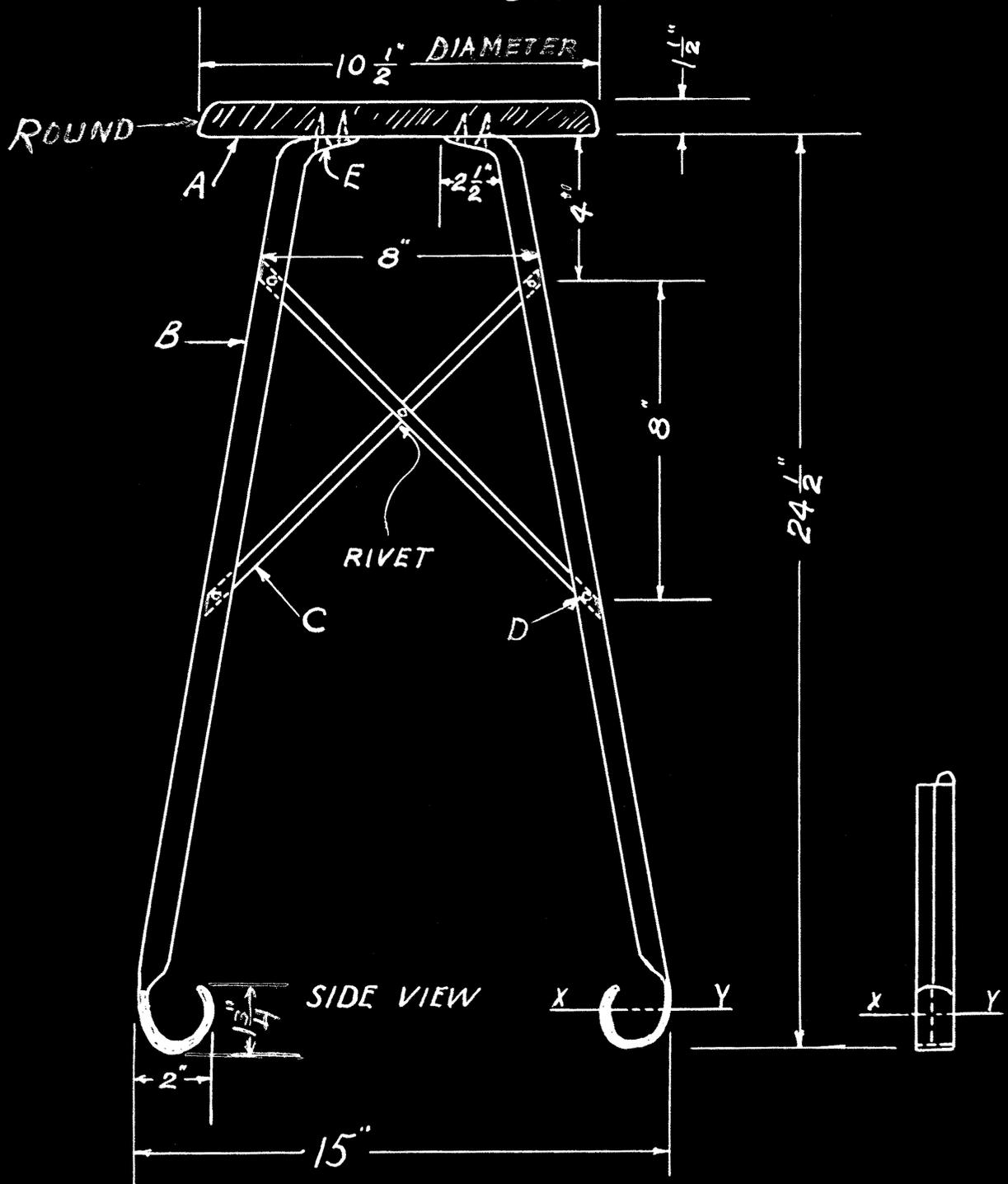
7-Force Part "B" downward with the hands to see

if the rod slides easily in the grooves. If it does not slide easily, file the inside edges of the slot until the grooves on the rod fit.

8-Give the grocery reminder a coat of green lacquer.

9-Place an adding machine roll of paper on Part "C"; the paper is pulled down under Part "B" which has been made sharp to tear the paper off at the desired place.

KITCHEN STOOL



MATERIALS	
A	TOP $1\frac{1}{2} \times 10\frac{1}{2}$ " ROUND
B	4- $\frac{1}{8} \times \frac{3}{4} \times 30$ " ANGLE IRON
C	8- $\frac{1}{8} \times \frac{1}{2} \times 11$ " FLAT IRON
D	20- $\frac{3}{16} \times \frac{1}{2}$ " R.H. RIVETS
E	8- $\frac{3}{16} \times 1$ " WOOD SCREWS

JOB SHEET NO. 27

HOW TO MAKE A KITCHEN STOOL

Part "A"

1-The wood top will be made in the wood shop, or furnished by the school.

Part "B"

1-Check out: hack saw, rule, 3/16-inch drill, hammer, center-punch, flat file, and cold chisel.

2-Saw off four pieces of 3/4 by 3/4 by 1/8-inch angle iron, 30 inches long.

3-Heat one end of each to a cherry red and flatten 3 inches from the end.

4-Trim the end of each, round with a cold chisel.

5-Grind these ends exactly to a half-round shape, and smooth.

6-Bend 3 inches of each end over the horn of the anvil until U-shaped, and 2 inches in diameter.

7-Grind the outside of the U-shaped ends smooth.

8-File the outside of these bends.

9-Heat and flatten 2 1/2 inches of the other ends.

10-Measure from each of these ends 3/4 inch, and 2 inches, respectively, and drill 3/16-inch holes.

11-Countersink these holes on the inside.

12-Make a square bend on the lines, 2 1/2 inches from the end, over the square corner of the anvil.

13-Measure from the square bend of each leg, 4 inches, and 12 inches, respectively, and mark.

14-Measure from the inside corner of the angle iron, $7/16$ inch each way from the marks.

15-Center-punch where the lines cross and drill $3/16$ -inch holes.

Part "C"

1-Check out: $3/16$ -inch drill, rule, and hack saw.

2-Cut off eight pieces of $1/8$ by $1/2$ -inch flat iron, 11 inches long.

3-Round the ends and drill a $3/16$ -inch hole at a point $5/16$ inch from each end.

Assembling

1-Check out: rule, riveting hammer, rivet set, and $5/32$ -inch and $3/16$ -inch drills.

2-Cross the pieces as shown on the blueprint and rivet the ends on the inside of the angle iron.

3-Rivet two legs together at a time, with all rivet heads placed on the outside.

4-Connect these pairs of legs together by crossing the braces on the sides.

5-Draw a 15-inch square on the floor.

6-Adjust the rounded ends of the legs until each leg is inside the square.

7-Center-punch and drill 3/16-inch holes where the braces cross.

8-Rivet from the inside with the heads on the outside.

9-Place the wood top flat on the bench with the bottom side up.

10-Turn the frame of the stool upside down and place the flat bent ends on the wood top.

11-Measure from the edge of the wood top to the outside of bend until the four bends are all the same distance from edge of the wood top.

12-Mark through the holes with a pencil and drill 5/32-inch holes, 1 inch deep.

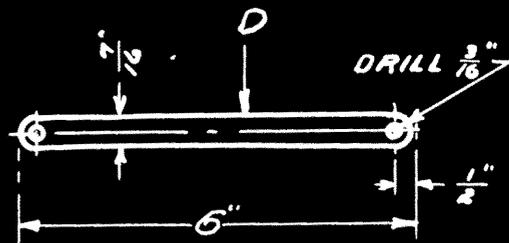
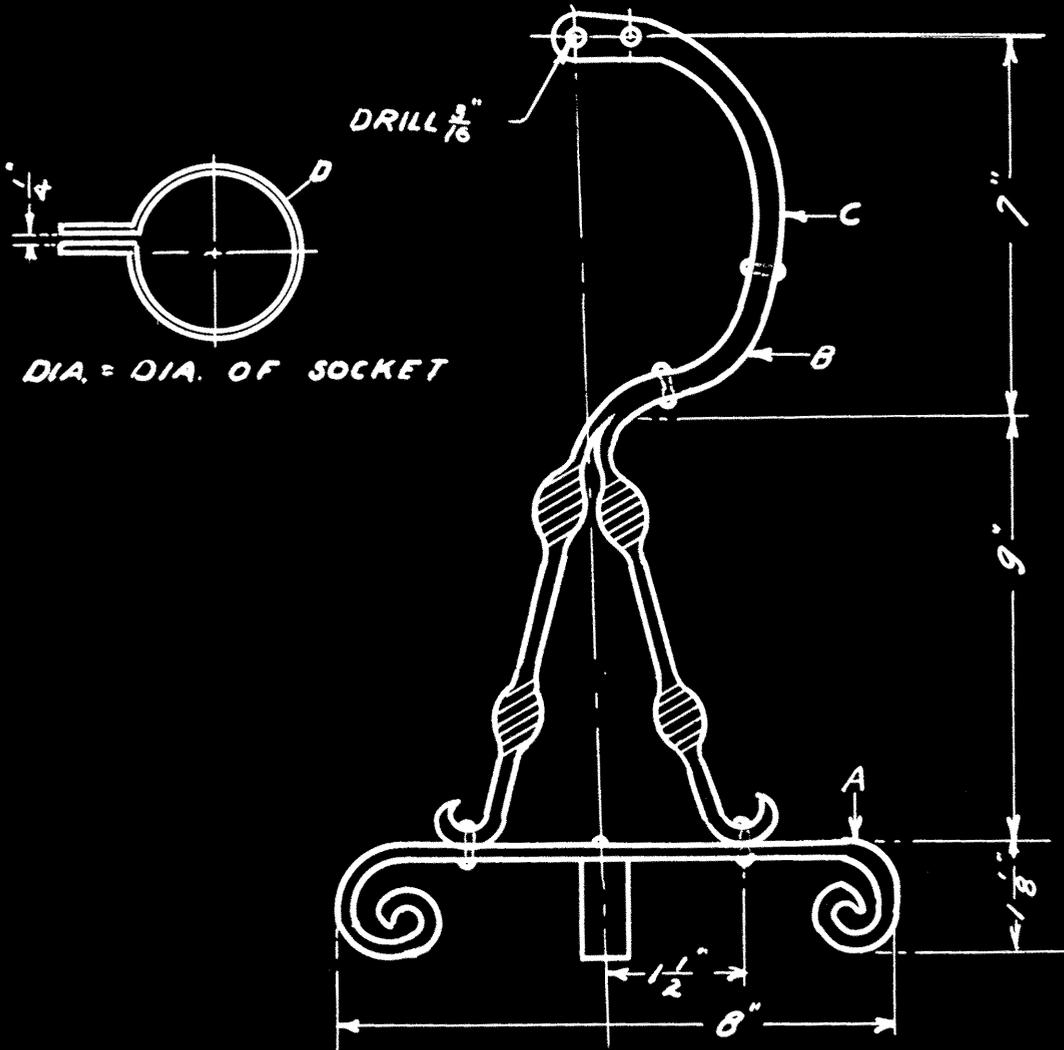
13-Place screws through holes in legs and fasten to the wood top.

14-Part "F" is optional; these braces can be added if desired but they are not necessary. They require more material and add to the cost of the stool.

15-If the stool does not stand level, place the rounded ends of the legs that touch the floor, over the horn of the anvil; bend a little more and try the stool on the floor again.

16-Wipe stool with a cloth and give the stool two coats of white, or green lacquer. The colors are optional but these colors are very popular.

READING LAMP



MATERIALS

A	(2) 1/8" X 3/4" X 12"
B	(2) 1/8" X 1/2" X 22" FLAT IRON
C	(6) RIVETS 3/8" X 1/2" R. H.
D	GALV. IRON 1/2" X 6" CLAMP FOR SOCKET

JOB SHEET NO. 28

HOW TO MAKE A READING LAMP

Part "A"

1-Check out: 3/16-inch drill, riveting hammer, hammer, rule, hack saw, and center-punch.

2-Cut off material and flatten each end to a chisel edge, 1 inch wide at the ends.

3-Grind blunt and straight across at the ends. Smooth each side of forged end.

4-Measure from each end 6 inches, center-punch, and drill 3/16-inch holes.

5-Bend each end over the horn of the anvil and shape as shown on the blueprint.

6-The bend from the top to the bottom should be 1 1/8 inches.

7-Cross the two pieces with the bent ends down and rivet at the center, with the rivet head on top.

Part "B"

1-Check out: rule, 3/16-inch drill, monkey wrench, riveting hammer, and forging hammer.

2-Flatten one end of each piece to a chisel edge, 3/4 inch wide and blunt.

3-Grind these ends square and smooth.

4-Measure from each of these ends 1 1/2 inches

and drill 3/16-inch holes.

5-Bend slightly round as shown on the blueprint, over the horn of the anvil.

6-Measure from the bent end, on each piece, 3 inches and make a one-half turn with the monkey wrench. Measure from the center of the turn, 4 inches, and make another one-half turn.

7-Measure 9 inches from the bent ends and start the large bend for the offset for the shade.

8-Form to shape over the horn of the anvil with the end in the vise. The large bend should measure 7 inches inside the semi-circle.

9-Drill a 3/16-inch hole 3 1/2 inches from the top of the bend and rivet.

10-About 2 inches down from this hole, drill a 3/16-inch hole and rivet.

11-Round the top end slightly. Measure from this end 1/2 inch, and 1 1/2 inches, respectively, and drill 3/16-inch holes.

12-Rivet the hole which is 1 1/2 inches from the end.

Assembling

1-Check out 3/16-inch drill, riveting hammer, black lacquer, and gold bronzing powder.

2-Measure each way from the center of the rivet

head on the base, 1 1/2 inches, and drill 3/16-inch holes. Drill on one cross piece only.

3-Notice the blueprint to see how Part "B" rivets to Part "A". Place the rivet heads on top and rivet from the bottom side of the base.

4-The clamp which holds the socket to the lamp is made from heavy sheet metal as given on the blueprint.

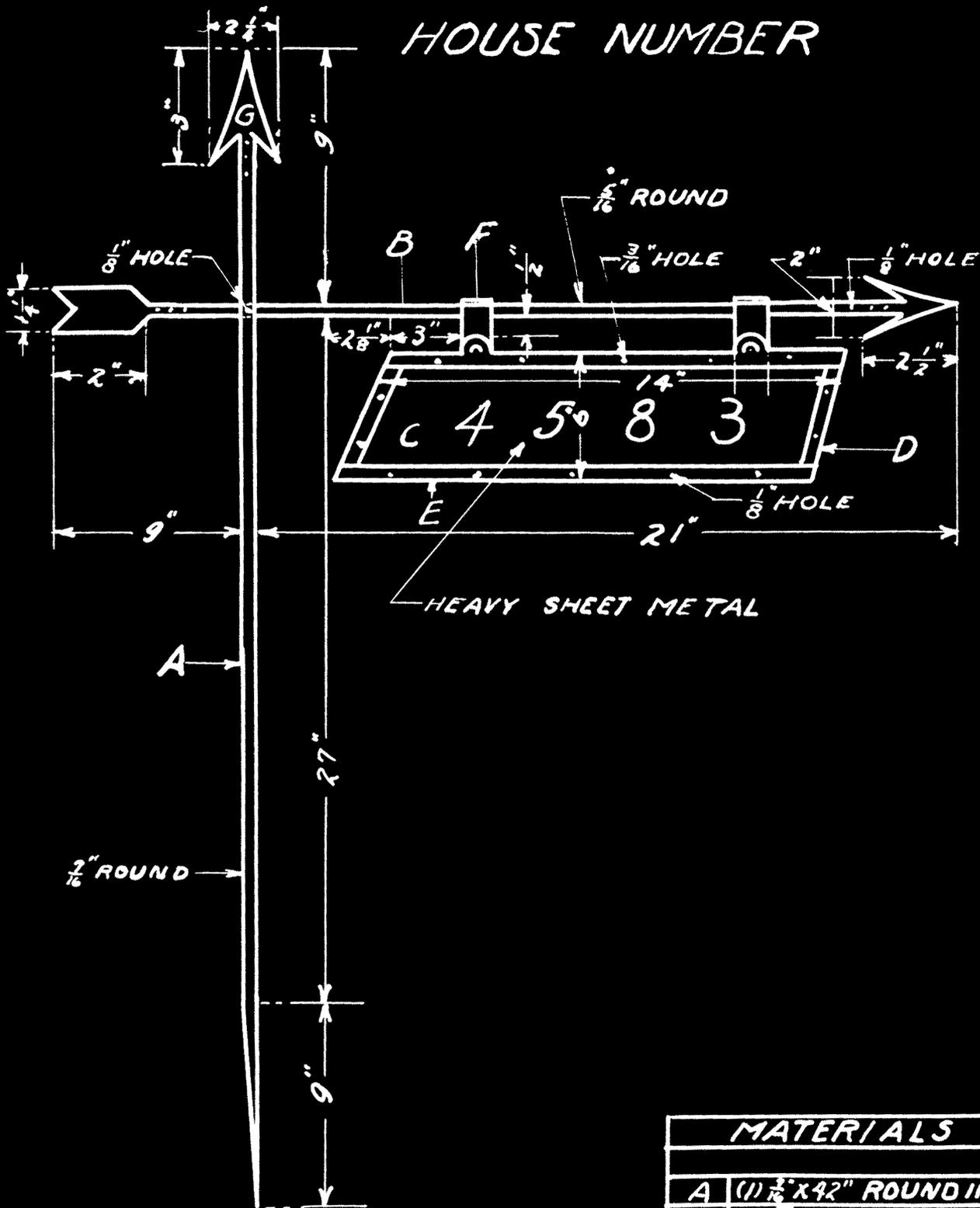
5-Round the ends. Drill 3/16-inch holes, 1/2 inch from each end.

6-Bend this piece round until it fits a lamp socket. Bend about 3/4 inch of each end outward as shown on the blueprint. The ends should be 1/4 inch apart.

7-Place this over the 3/16-inch hole at the top of the lamp and connect with a bolt, 3/16 inch by 1 inch.

8-Lacquer the lamp black and while wet, blow gold bronzing powder on the surface at intervals.

HOUSE NUMBER



MATERIALS	
A	(1) $\frac{1}{2}$ " X 42" ROUND IRON
B	(1) $\frac{1}{8}$ " X 27" " "
C	(1) $6\frac{1}{2}$ " X $16\frac{1}{2}$ " SHEET METAL
D	(2) $2\frac{1}{2}$ " X $5\frac{1}{2}$ " FLAT IRON (4 PIECES)
E	(2) $1\frac{1}{2}$ " X $14\frac{1}{2}$ " " " " "
F	(2) $1\frac{1}{2}$ " X $1\frac{1}{2}$ " " "
G	(1) BRASS SHEET 6" X 10"
	(9) RIVETS $\frac{1}{8}$ " X $\frac{1}{2}$ "

JOB SHEET NO. 29

HOW TO MAKE A HOUSE NUMBER

Part "A"

1-Check out: forging hammer, rule, 1/8-inch and 7/16-inch twist drills, hack saw, riveting hammer, and flat file.

2-Forge a round sharp point on one end, 9 inches long.

3-Split the other end 1 inch with a hack saw.

4-Design and cut from heavy sheet brass, an arrow point, 2 1/4 inches wide and 3 inches long, as shown on the blueprint.

5-Slide the arrow point in sawed end.

6-Drill two 1/8-inch holes through slit and arrow point. The holes should be 3/8 inch, and 3/4 inch, respectively, from the end of the slit.

7-Countersink each side of the holes, and rivet.

8-Measure from the arrow point, 9 inches and center-punch on the round rod. The mark must be directly in line with the sawed end. See your teacher.

9-Drill out this mark with a 5/16-inch drill; be sure to hold the rod horizontal.

10-Grind the pointed end round and sharp; file the rivet heads, on the arrow point end, smooth with the surface.

Part "B"

1-Check out: hack saw, 1/8-inch and 3/8-inch drills, and riveting hammer.

2-Split the ends of Part "B" about 1 inch on the same side so the split ends are in line when finished.

3-Lay out the point, 2 inches wide and 2 1/2 inches long, on heavy sheet brass; cut it out.

4-Lay out the other end of the arrow, 1 1/4 inches wide and 3 inches long, on heavy sheet brass; cut it out.

5-Slide the 5/16-inch rod through the 5/16-inch hole drilled in Part "A".

6-Slide the sheet metal ends in the slits; drill 1/8-inch holes, and rivet as in Part "A".

7-Slide the 5/16-inch rod in until the blunt end is 9 inches from the 7/16-inch rod.

8-With arrow ends in position as shown on the blueprint, drill a 1/8-inch hole through both rods where they cross.

9-Slightly countersink each side of the hole; rivet and smooth down heads.

Part "C"

1-Check out: rule, 1/8-inch and 3/16-inch drills, riveting hammer, hack saw, flat file, and center-punch.

2-Cut out a piece of sheet metal, 6 1/2 inches

wide and $16 \frac{1}{4}$ inches long. Have your teacher help you to cut $2 \frac{1}{8}$ inches off each end, at an angle, as shown on the blueprint.

3-Part "C" is cut $6 \frac{1}{2}$ inches wide so $\frac{1}{2}$ inch of one long side can be used to cut half-circles to fasten the clamps.

4-Measure from each end, at the top, 3 inches, and mark; measure 1 inch from this and mark. Between these marks, make a half-circle starting $\frac{1}{2}$ inch from the edge.

5-Drill a $\frac{3}{16}$ -inch hole in the center of each half circle.

6-Cut off the surplus sheet metal, following the marks made for the half-circles.

7-Drill holes in the four pieces of flat iron, as shown on the blueprint; rivet these strips, one on each side of Part "C" as shown on the blueprint, at both top and bottom.

8-Cut the ends of the four short pieces of flat iron at a slight angle to fit the strips riveted on the long sides.

9-When these fit, drill $\frac{1}{8}$ -inch holes and rivet these strips in place.

10-Round the ends of Part "F" slightly, and drill $\frac{3}{16}$ -inch holes, $\frac{3}{8}$ inch from the ends.

11-Heat both pieces to a bright red and bend them over the flat side of a 5/16-inch rod; the holes in each end must be in line and the sides 5/16 inch apart.

12-Slide the two clamps over Part "B" as shown on the blueprint, and rivet them to Part "C".

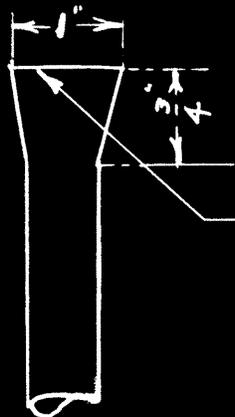
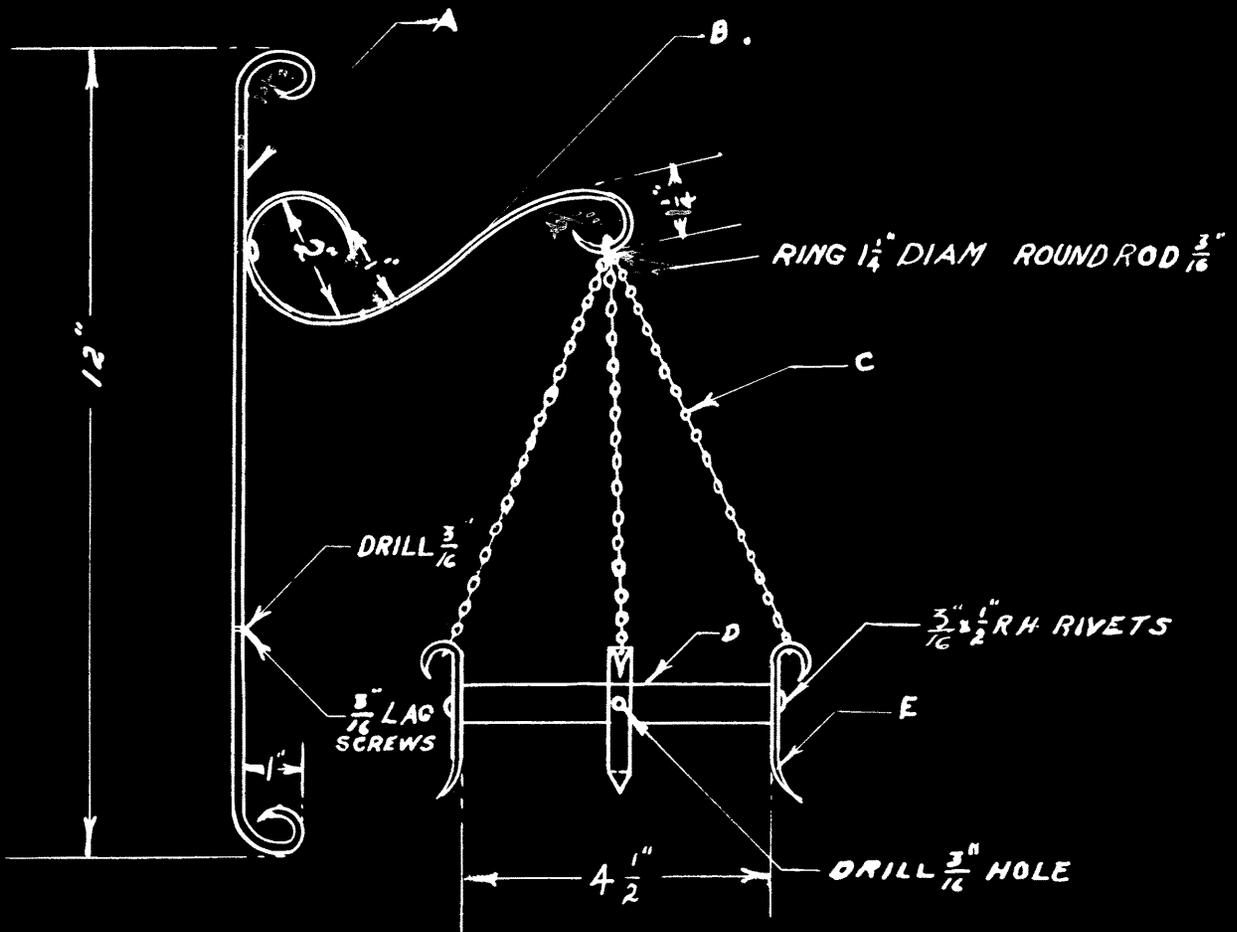
13-The numbers can be made or be purchased; in either case, they should be of brass so they can be seen easily. The numbers should be about 3 inches high; the same set of numbers should be riveted on each side.

14-Lacquer the project, black except the arrow points and numbers.

15-While the lacquer is still wet, blow gold bronzing powder on at intervals.

16-Polish the numbers and arrow points with fine emery cloth or steel wool.

FLOWER POT HOLDER



END VIEW OF A & B CHISEL EDGES

(A) ROUND HEAD RIVETS $\frac{3}{16} \times \frac{1}{2}$

MATERIALS	
A	$\frac{1}{2} \times \frac{3}{4} = 14$ BAND IRON
B	$\frac{1}{2} \times \frac{3}{2} \times 12$ " "
C	3) PORCH SWING CHAIN
D	$D \frac{1}{2} \times \frac{3}{4} \times 14$ BAND IRON
E	$\frac{1}{8} \times \frac{1}{2} \times 3$ " " (3)

JOB SHEET NO, 30

HOW TO MAKE A WALL FLOWER POT HOLDER

Part "A"

1-Check out: forging hammer, 3/16-inch drill, center-punch, and rule.

2-Measure from each end, 3 inches; center-punch and drill 3/16-inch holes. Countersink these holes on one side.

3-Measure from one end 4 1/2 inches, center-punch, and drill a 3/16-inch hole; countersink on opposite side from first countersunk holes.

4-Heat ends to a cherry red and sharpen similar to a cold chisel. When finished, the chisel edge should be 1 inch wide on the extreme end and the flat tapered part should be 3/4 inch long.

5-Grind the ends blunt and straight across; also smooth the part forged on the grinder.

6-Turn the curves on the same side that you countersunk the two holes; notice the blueprint and you will see that the chisel ends do not come together to form a circle, but are separated 1/2 inch. The outside diameter should be 1 inch.

Part "B"

1-Check out: forging hammer, rule, 3/16-inch drill, and center-punch.

2-Measure from one end 2 1/2 inches, center-

punch, and drill a 3/16-inch hole.

3-Make a chisel edge on each end 1 inch wide and 3/4 inch long; grind and polish as before.

4-Over the horn of the anvil, form a circle 2 inches inside diameter with the chisel edge lacking 1 inch of closing the circle.

5-Over the horn of the anvil, form a circle on the other end, 1 1/4 inches inside diameter, but in the opposite direction from the first circle; the chisel edge should lack 1/2 inch of closing the circle.

Part "C"

1-The chain will be purchased by the teacher from a local hardware store.

2-Cut three chains, each 12 inches long, being sure that each chain has the same number of links.

Part "D"

1-Check out: rule, 3/16-inch drill, and hammer.

2-Measure from each end 4 11/16 inches, center-punch, and drill 3/16-inch holes.

3-Form this part into a circle over the horn of the anvil; the outside diameter should be 4 1/2 inches.

4-Make the ends blunt, and when in line solder them together.

5-Drill a 3/16-inch hole in the center of this weld.

Part "E"

1-Check out: forging hammer, 3/16-inch drill, rule, and hack saw.

2-Forge a sharp tapered point 1 inch long on each end of the three hooks.

3-Grind the forged ends smooth and the opposite ends slightly blunt. Be sure the three pieces are all the same length and the points taper the same amount.

4-Bend the blunt end of each over the small needle stake to form a slight circle; the ends should not meet.

5-Bend the sharp end slightly in the same direction as before, but do not form a circle. Notice the blue print carefully.

6-Place the three hooks on the face of the anvil and see if they are bent and shaped exactly the same.

7-Drill one 3/16-inch hole in each hook an equal distance from each end.

Assembling

1-Check out: riveting hammer, rivet set, lacquer, and bronzing powder.

2-Rivet Part "B" to the hole drilled in Part "A" 4 1/2 inches from the end. Place the rivet head on the countersunk side.

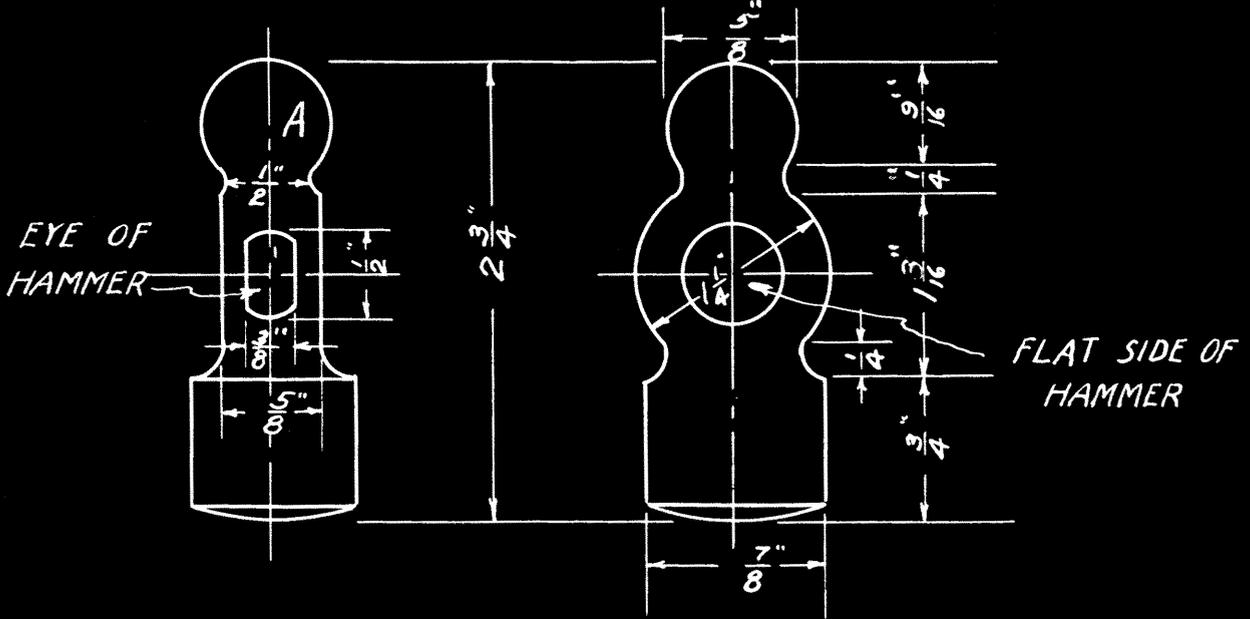
3-Rivet Part "E" to the outside of Part "D". Be sure that the three hook ends are on one side.

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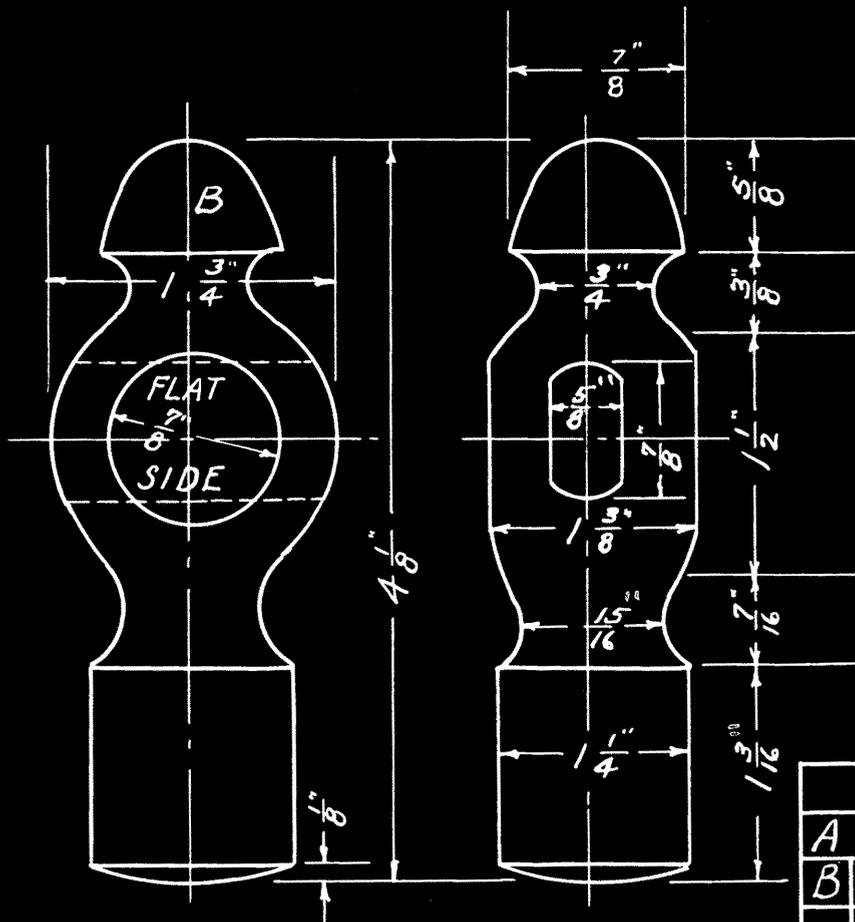
4-Place one end of each chain over a hook; slip the other three ends over the small circle of Part "B".

5-Lacquer the project black and blow green bronzing powder on while the lacquer is still wet.

BALL-PEEN HAMMER NO. 1



BALL-PEEN HAMMER NO. 2



MATERIALS	
A	1 5/16" ROUND x 4" LONG
B	1 7/8" ROUND x 6" LONG
NO. 1 TOOL STEEL	
OR HAMMER STEEL	

JOB SHEET NO. 31

HOW TO MAKE NO. 1 BALL-PEEN HAMMER

1-Check out: tools for lathe, can of oil, center punch, rule, outside calipers, flat file, 3/8-inch twist drill, center-drill, and 8-inch round file.

2-Center-drill one end of the hammer steel.

3-Chuck 1/2 inch of the undrilled end in a universal chuck with the center-drill hole on the dead center

4-Set the jaws of the calipers 1 1/4 inches apart.

5-Cut the entire length of the steel down to this dimension on the lathe.

6-Lay off the work with a rule by first measuring from the drilled end, 1/2 inch, to cut out drill hole. Measure from the mark 3/4 inch for the face, and mark. From this line, measure 1/4 inch to divide the face from the eye of the hammer. Measure from the 1/4-inch division line, 1 3/16 inches, for the eye of the hammer. From this last line measure 1/4 inch to separate the eye of the hammer from the peen. Measure from this line 9/16 inch for the peen of the hammer.

7-Grind a sharp pointed cutting tool. While work is turning on the lathe, let the point of the tool touch each mark thus forming a circle around the work.

8-Cut the first measurement of 1/2 inch down to

a $\frac{3}{8}$ -inch diameter using a round nose cutting tool.

9-Cut the face of the hammer down to a diameter of $\frac{7}{8}$ inch, setting the calipers for a guide.

10-Cut the first $\frac{1}{4}$ -inch dimension down to a diameter of $\frac{5}{8}$ inch with a half-round cutting tool.

11-Cut the other $\frac{1}{4}$ -inch dimension down to a diameter of $\frac{1}{2}$ inch with a half-round cutting tool.

12-Start in the center of the $\frac{1}{16}$ -inch section laid off for the eye and cut from this point each way to the $\frac{1}{4}$ -inch grooves. Cut this part as near round as you can, to resemble a baseball. See your teacher.

13-Cut the part for the peen down to a diameter of $\frac{5}{8}$ inch; start cutting the peen about $\frac{3}{16}$ inch from the edge of the $\frac{1}{4}$ -inch groove.

14-Shape the peen, but leave a thickness of about $\frac{3}{8}$ inch where it will be cut off later on.

15-Set the compound rest out of line 2 degrees from the zero mark. See your teacher.

16-While the work turns, use the compound rest to face the hammer; take a fine cut off the extreme rim of the face.

17-File the entire surface smooth.

18-Use fine and medium emery cloth to remove all marks and scars.

19-Draw a center line with a pencil from the peen to the face of the hammer through the section for the

hammer handle.

20-Measure on the center line $19/32$ inch and center-punch.

21-Measure each way from this mark on the center line $3/16$ inch and center-punch.

22-Hold your work horizontal in a drill chuck vise, protecting your work from vise jaws with tin.

23-Drill out these marks with a $3/8$ -inch drill.

24-File the part between the holes out with an 8-inch round file.

25-File the eye until it is $3/8$ inch by $1/2$ inch.

26-File the flats on the hammer, one on each side of the hole. Try to make them round, flat and smooth; they should be the same diameter --- about $1/2$ inch.

27-Heat and temper using the general information sheet.

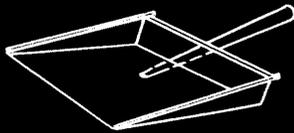
28-Place the work back in the lathe and polish again with fine emery cloth; to prevent rusting, hold an oiled rag on the surface for about 5 minutes.

29-Saw off on lines at each end.

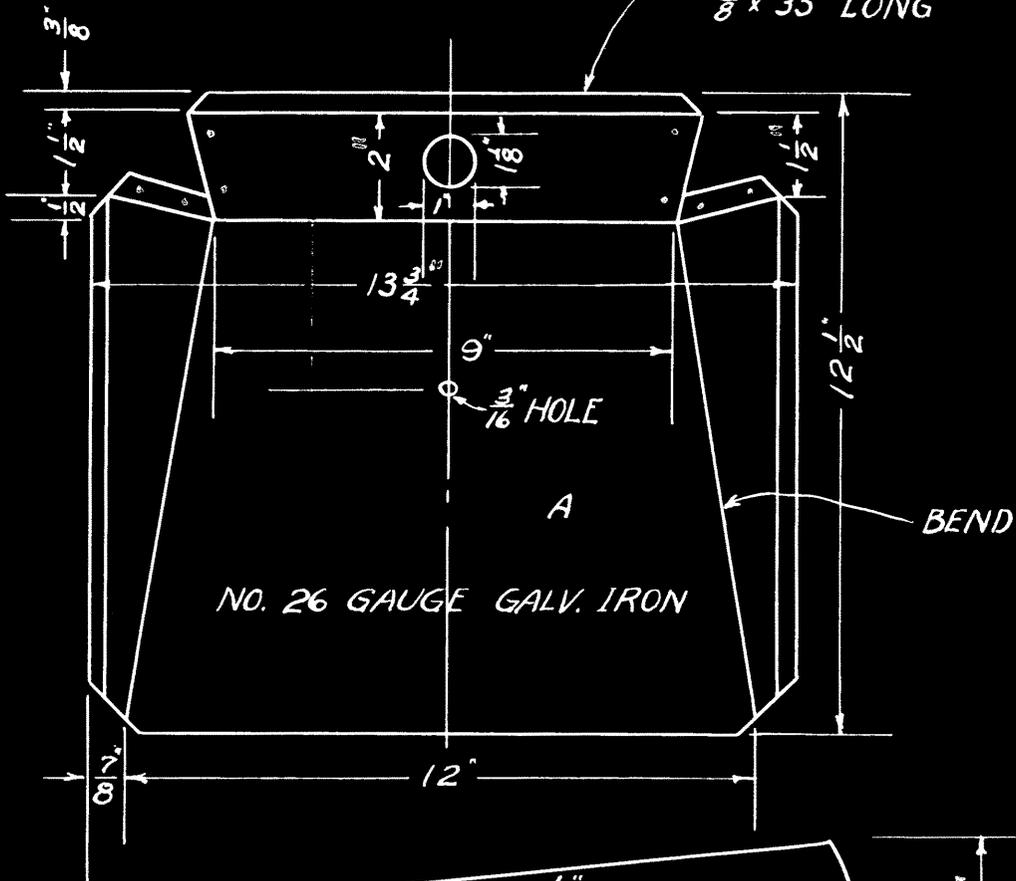
30-Smooth the face and peen ends with a flat file; place on oil stone to remove all marks and scars.

BALL-PEEN HAMMER NO. 2 will be made in a closely similar way.

DUST PAN



WIRE LAP
 $\frac{1}{8}$ " x 35" LONG



NO. 26 GAUGE GALV. IRON

BEND

$\frac{1}{4}$ " DRILL

$\frac{3}{16}$ " DRILL

HANDLE

$\frac{3}{8}$ "

12"

MATERIALS

A	14" x 12 1/2" G.I.
B	4 3/8" x 12" G.I.
	4 - $\frac{1}{8}$ " x $\frac{1}{4}$ " METAL RIVETS
	1 - $\frac{3}{16}$ " x $\frac{1}{4}$ " METAL RIVETS

JOB SHEET NO. 32

HOW TO MAKE A BUST PAN

Part "A"

1-Check out: pattern, snips, mallet, riveting hammer, scribe, pliers, and 1/8-inch, 3/16-inch and 1-inch drills.

2-Place pattern over material and mark around the edge with a scribe.

3-Mark eight small holes and drill them with a 1/8-inch drill.

4- The hole on the center line 3 1/4 inches from the back bend is drilled with a 3/16-inch drill.

5-Drill the large hole for the handle with a 1-inch drill.

6-Form a 3/8 inch lap on the two sides and the back but do not close.

7-Bend on the lines shown on the blueprint until the sides and back are about straight, bending opposite from the folds.

8-Place small rivets in the corners from the inside and rivet.

9-Slide the wire under the lap until the ends are even with the narrow ends of the sides.

10-Force the lap tight around the wire with a pair of pliers.

Part "B"

1-Check out: round jaw snips, rule, riveting hammer, solder, pliers, soldering iron, scriber, mallet, flat file, and pattern.

2-Lay pattern over work and mark around the edges and in the holes with the scriber.

3-Cut out the lines with the tin snips.

4-Drill the hole in the wide end of the handle with a 1/4-inch drill and in the narrow end with a 3/16-inch drill.

5-Form the handle over the blowhorn and needle stake.

6-Shape the handle round using a mallet.

7-When the edges meet, smooth them with emery cloth; place flux on each edge and solder.

8-Smooth soldered joint with a file.

Assembling

1-Check out: riveting hammer, emery cloth, and black lacquer.

2-Place the handle in the 1-inch hole from the outside. If the handle fails to go in the hole 6 inches, file the hole larger with a round file.

3-Place the head of rivet through hole from the bottom and rivet to pan on the inside.

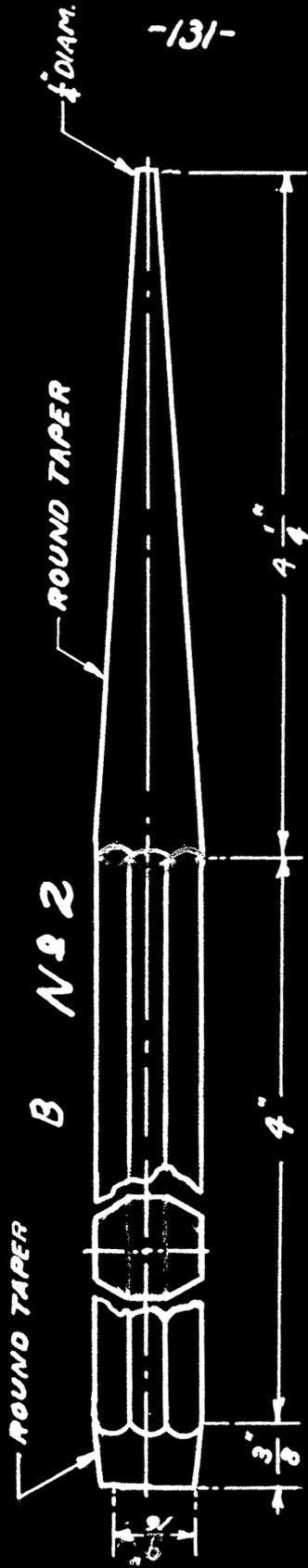
4-Smooth the entire surface with emery cloth; then lacquer for the finish.

STEEL PUNCHES

A No 1



B No 2



-131-

MATERIALS

A	1/4" HEX. STEEL 9" LONG
B	3/8" HEX. STEEL 9" LONG

JOB SHEET NO. 33

HOW TO MAKE A STEEL PUNCH

Straight Punch No. 1

1-Check out: outside calipers, hack saw, forging hammer, round jaw tongs, center-drill, can of oil, lathe tools, rule, flat file, and fine emery cloth.

2-True up about 2 inches of the steel in a four-jaw independent chuck.

3-Center-drill the other end on the lathe.

4-Run the tail stock up so the dead center fits tightly in the center-drill hole; tighten the tail stock bolt.

5-Set the jaws of the calipers $3/8$ inch apart.

6-Measure from the center-drill end $4\ 1/2$ inches and cut the material down to a diameter of $3/8$ inch, or until the calipers will barely slide over the work.

7-Measure $1/2$ inch from the shoulder on the $3/4$ -inch hexagon steel.

8-Cut a round shoulder between these lines, connecting the $3/4$ -inch hexagon handle of the punch to the $3/8$ -inch round part of the punch.

9-File the round shoulder and the round part of punch smooth and follow with fine emery cloth.

10-Saw from the end of the punch the part with the hole; then remove work from the lathe.

11-Square the round part of the punch with a file with the edge of the end filed slightly blunt.

12-Heat the head end in a forge to a bright red and forge a 3/8-inch round taper to a 9/16-inch diameter on the round end.

13-Place the work back in the chuck with the head end out about 2 inches from the chuck face.

14-With work turning at high speed, file and smooth the head with emery cloth.

15-The head and the round part of the punch should be hardened a little. See general information sheet.

Tapered Punch No. 2

1-Check out: forging hammer, round jaw tongs, rule, and flat file.

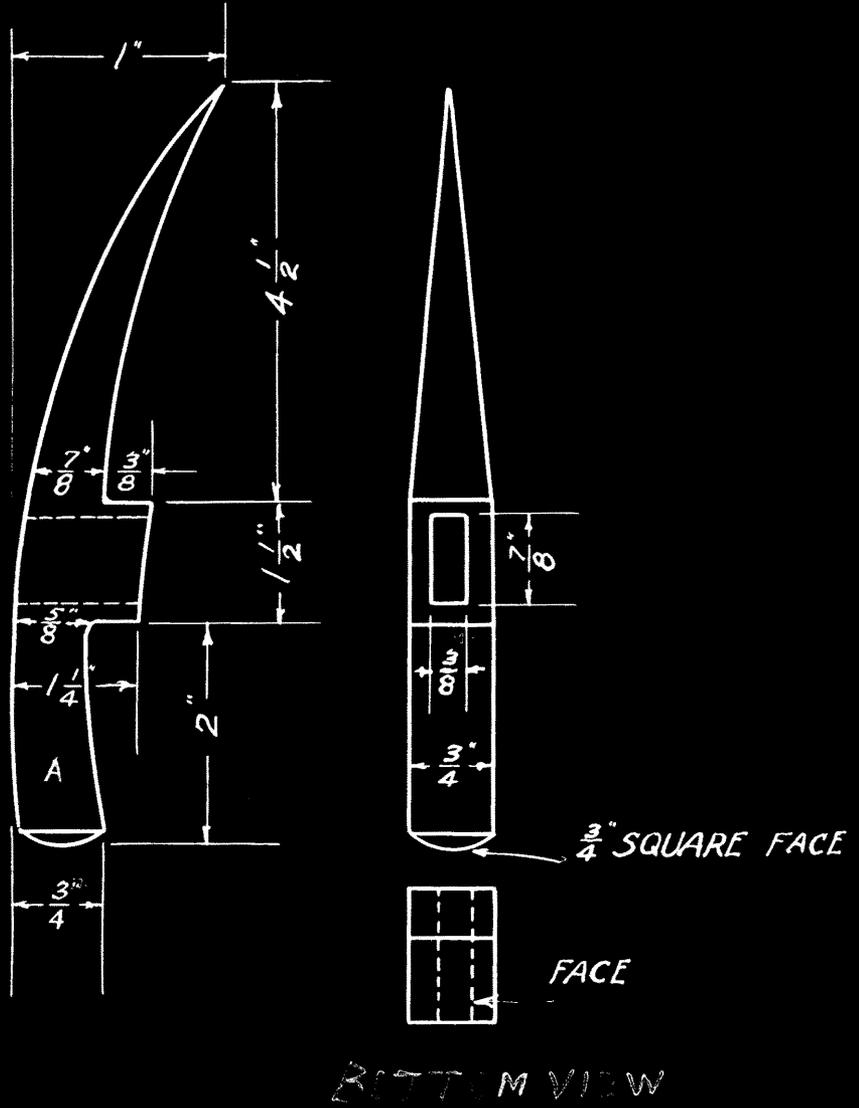
2-Heat one end to a bright red and forge a round taper, 4 1/4 inches long, to a 1/4-inch round point.

3-Heat the other end and forge a head on the punch, 9/16 inch in diameter and 3/8-inch taper.

4-Grind the punch smooth on the emery stone.

5-Temper as given on the general information sheet.

GEOLOGIST PICK



MATERIALS	
A	TOOL STEEL
	3/4" x 1/4" x 6"

JOB SHEET NO. 34

HOW TO MAKE A GEOLOGIST PICK

1-Check out: flat jaw tongs, forging hammer, rule, 3/8-inch twist drill, sledge hammer, flatter, center-punch, and flat file.

2-Measure from one end 2 inches, and 3 1/2 inches, respectively, and mark on the narrow edge.

3-Heat both marks in a coal forge until red.

4-Place the line, 2 inches from the end, flat on the anvil even with the front edge of the anvil.

5-Holding the steel in a horizontal position, strike straight down with a sledge until the steel at this point is 5/8 inch square.

6-At the 2-inch mark on the shoulder, it should be 5/8 inch square; from there to the end, it gradually gets larger; at the extreme face of the pick, it is 3/4 inch square.

7-Heat the other mark and do as you did before; strike straight down with a sledge, following with a hand hammer until it measures 7/8 inch the wide way and 3/4 inch the narrow way. Notice the blueprint carefully.

8-From this point, forge the rest of the steel out to a square tapered point, 4 1/2 inches long.

9-Heat the steel and use a flatter on all surfaces to smooth and remove anvil and hammer marks.

10-Place the steel in a lime barrel and let it cool. Remove and wipe off the lime.

11-Chalk the part of the steel that has not been forged at all ($3/4$ inch by $1\ 1/2$ inches) -- this is the part for the eye of the pick.

12-Draw a straight line from the extreme point to the center of the face, dividing the part for the eye.

13-Measure $3/4$ inch from the shoulder and center-punch.

14-Measure each way from this mark, $3/16$ inch, and center-punch.

15-Drill out these last two marks with a $3/8$ -inch drill.

16-File out the steel between the holes and square up the holes as shown on the blueprint.

17-The extreme back side of the pick is not straight; it is slightly curved and the point of the pick is out of line 1 inch.

18-Place tin around the pick and catch it in a vise with the face up.

19-File the face smooth and slightly round; the center of the face should be about $1/16$ inch higher than the edge.

20-Grind all surfaces to remove all marks; file the square shoulders.

21-Harden the face, using the general information

sheet.

22-Place the pick on a fine emery cloth buffer
to polish.

JOB SHEET NO. 35

HOW TO MAKE A BRIDGE LAMP

Part "A"

1-Check out: lathe tools, outside calipers, rule, forging hammer, flat file, 3/16-inch drill, and 12-inch monkey wrench.

2-Forge a square tapered point 4 inches long, on one end.

3-Grind and file it smooth.

4-Extend the other end of the bar through the hole of the spindle about 1 inch from the face of the independent chuck.

5-True the square iron in the chuck.

6-Measure from the blunt end 3/4 inch and cut it down to a diameter of 1/4 inch.

7-Measure from the pointed end 4 inches, and 13 inches, respectively, and center-punch; drill 3/16-inch holes on the same side of the square iron.

8-Measure from the pointed end, 6 1/2 inches, and 10 1/2 inches, respectively, and mark. Heat red and twist in a vise between these two marks. Line up holes.

9-Measure from the pointed end 18 inches, and 23 inches, respectively, and mark; twist as before.

10-Measure from the round end 3 inches, and 9 inches, respectively, and twist as before.

11-Measure from the round end 26 inches, and 31 inches, respectively, and twist.

12-Straighten bent parts by placing heated part between wooden blocks and striking with a hammer.

Part "B"

1-Check out: forging hammer, rule, and 1/4-inch drill.

2-Forge a chisel edge on the ends of each piece, 7/8 inch wide.

3-Grind the ends blunt, and the hammered part smooth.

4-Measure from the end of No. 1, 1 1/2 inches and drill 3/16-inch hole. Turn a half-circle on the horn of the anvil from the hole to the end.

5-Measure from the other end 3 inches; drill a 3/16-inch hole and bend about three-fourths of a circle in the same direction as before, 1 inch in diameter.

6-Now, on No. 2, measure from one end 1 1/2 inches and drill a 3/16-inch hole; turn a half-circle from the hole to the end.

7-Measure from the other end 3 inches and turn a small curve on the end on the same side as before so that it will hold a 3/16-inch stove bolt.

8-Rivet No. 1 and No. 2 together at the holes drilled 3 inches from the end; use a round head rivet,

3/16 inch by 1/2 inch. The ends of the two pieces should curve in opposite directions.

Part "C"

1-Check out: forging hammer, 3/16-inch drill, rule, and center-punch.

2-Forge each end of the four pieces to a chisel edge, 7/8 inch wide on each end with 3/4-inch taper.

3-Grind the ends blunt and remove hammer marks. Make sure all the pieces are the same length.

4-Measure from one end of each of the four pieces 1 1/2 inches, and drill 3/16-inch holes; bend a slight curve on each of these ends making all about the same.

5-Measure from the other ends of the four pieces, marking points 2 inches from the end of two of them and 2 1/2 inches from the end of the other two; at marks drill holes with a 3/16-inch drill.

6-Slightly curve these ends on the same side as the previous curves made at the other ends.

7-Heat and twist 4 inches in the center of each of these four braces; measure 10 inches from each end before you curve the ends and the distance between these lines will be the amount to twist.

Part "D"

1-Check out: forging hammer, 1/4-inch drill, and rule.

2-Forge a chisel edge on each end , 1 inch taper

and 1 1/4 inches wide on the extreme edge.

3-Measure from the end 15 inches, which is the center, and mark; drill with a 1/4-inch drill.

4-Turn over the horn of the anvil, a circle or scroll in the same direction on each end. The circles must be the same height and the same shape on each end; place the two pieces side by side to check.

5-Measure each way from the center hole on each piece 6 1/2 inches and drill 3/16-inch holes.

Assembling

1-Check out: riveting hammer, rivet set, center-punch, and 3/16-inch drill.

2-Rivet Part "D" to Part "A" by heating the round end red and clamping the bar in a vise with the round end just above the vise jaws.

3-Place the holes in Part "D" over the round end with the curved ends up.

4-Work fast and form a good head on this end of Part "A".

5-Rivet the four braces to these two cross pieces; select the ends with the holes drilled 1 1/2 inches from the end, placing these holes over the holes drilled on Part "D". Have the curved ends out and place the rivet heads on top.

6-Have your teacher to help you line up the other ends of the braces of Part "C" before you mark and drill

holes in Part "A".

7-After you make sure that the long square bar is vertical and straight, mark it through the drilled holes in Part "C".

8-Center-punch these marks and drill out with a 3/16-inch drill.

9-Rivet together, forming round heads with the rivet set.

10-Rivet Part "B" to Part "A" at the holes on each side of the first twist.

11-File all rough places smooth and clean off the lamp with a cloth.

12-Check out the pattern to make the clamp which holds the shade.

13-Mark around edges and in holes; cut out lines with snips and drill center hole with 3/8-inch drill; drill end holes with 3/16-inch drill.

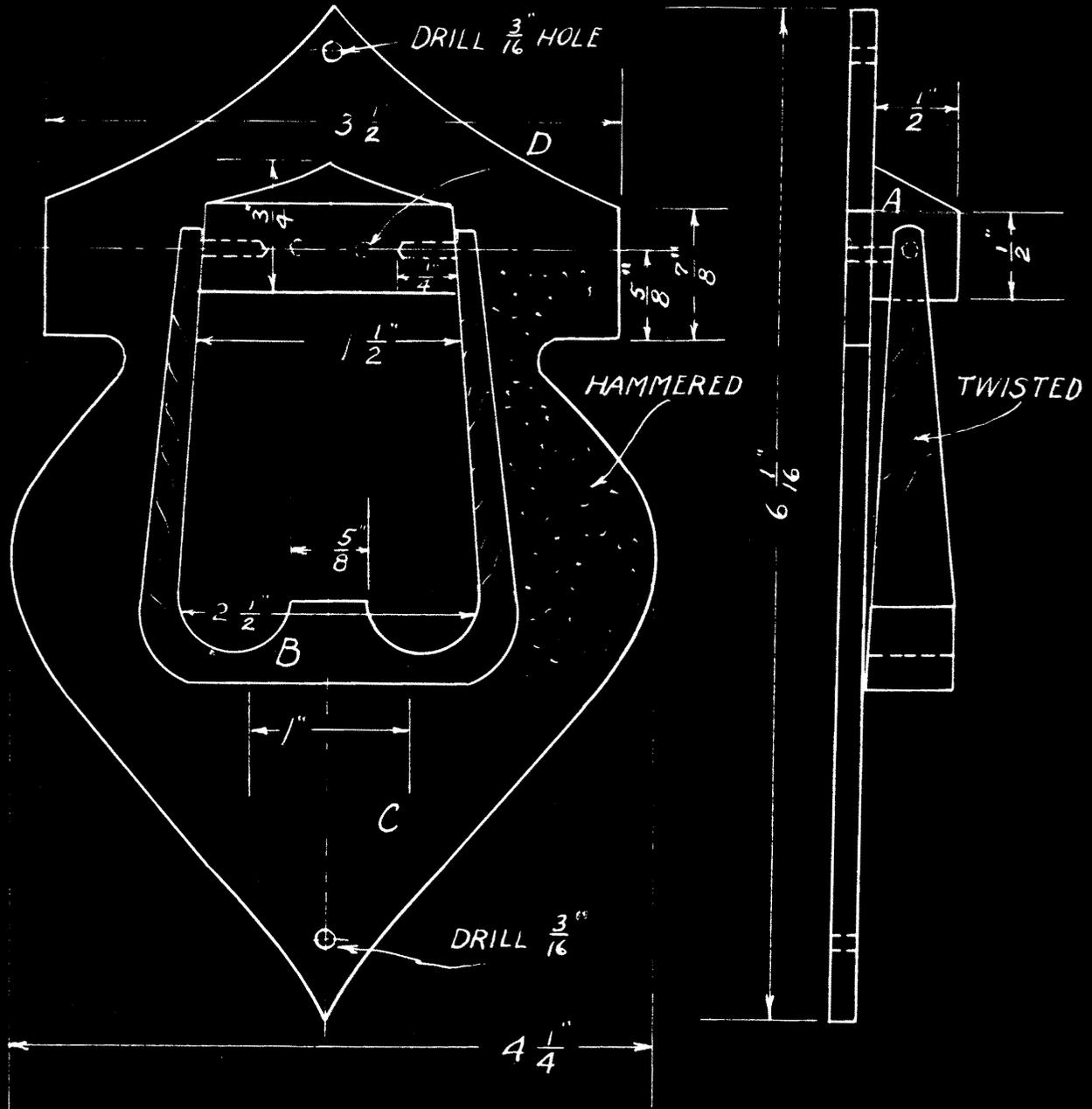
14-Smooth with emery cloth and bend 3/8-inch each way from the center hole.

15-Attach clamp to small curved end of Part "B" with a small stove bolt. Use a wing nut on one end.

16-The shade is held to the lamp with a 3/8-inch S. A. E. nipple, 1/2 inch long, with a nut on one end.

17-Lacquer the lamp black and blow gold bronzing powder on at intervals while the surface is still wet.

DOOR KNOCKER



IND. ARTS AND VOC. ED MAG.
 NOV. 1930 PAGE 445
 BRUCE PUBLISHING CO.
 MILWAUKEE, WISC.

MATERIALS	
A	$\frac{1}{2}$ " x $\frac{3}{4}$ " x $1\frac{1}{2}$ " IRON
B	$\frac{1}{2}$ " x $\frac{1}{2}$ " x 6" IRON
C	$\frac{3}{16}$ " x $4\frac{1}{4}$ " x $6\frac{1}{2}$ " IRON
D	2 - $\frac{3}{16}$ " x $\frac{1}{2}$ " BOLTS
E	1 - $\frac{3}{16}$ " x $\frac{3}{4}$ " LAG SCREWS

JOB SHEET NO. 36

HOW TO MAKE A DOOR KNOCKER

Part "A"

1-Check out: rule, 1/2-inch round file, center-punch, and 3/16-inch and 5/32-inch drills.

2-Measure from the end 3/4 inch and draw a line across Part "A".

3-File a 1/4 inch bevel on one long side; the bevel will start at the center line, which will stay 3/4 inch at the back, and taper down gradually to 1/2 inch in front; it will also gradually taper down to 1/2 inch on the ends. See your teacher.

4-Center-punch the exact center of the 1/2-inch square ends and drill a hole 3/8-inch deep, using a 3/16-inch drill.

5-Measure 3/8 inch each way from the center line on the back, 1/4 inch from the bottom edge and in line with the end holes; center-punch. Drill these marks with a 5/32-inch drill, 3/8 inch deep and tap the holes with a 3/16-inch U. S. S. bottom tap.

6-File, smooth with emery cloth, and buff for a finish.

Part "B"

1-Check out: forging hammer, rule, flat file, outside calipers, scriber, and flat jaw tongs.

2-Measure from each end 2 1/2 inches and mark with a scriber.

3-Heat each end red from the mark to the end and forge a square taper.

4-The first inch each way from the two marks will be drawn down 3/8-inch square; from this, gradually draw down to a 3/16-inch square on the end.

5-Grind all the surfaces smooth and remove marks.

6-Measure with a rule to make sure that each end from the mark is the same length.

7-Measure from each extreme end 1/4 inch and grind each round to 3/16-inch diameter.

8-Heat the previously unheated 1/2-inch square part and the full length of the center and make the piece straight on the lower side.

9-Measure 3/4 inch outward from each of the first two lines made on Part "B" and mark with a scriber.

10-Heat and bend on the side the lines are on; this will be a round bend forged around the horn of the anvil. The bends will leave the sides of Part "B" 2 1/2 inches apart.

11-Heat and bend the round ends 1/4 inch inward so they will be in line to fit in the holes drilled in the end of Part "A".

Part "C"

1-Check out: pattern, hack saw, 3/16-inch and

and 3/8-inch drills, flat file, emery cloth, and scriber.

2-Place pattern over the flat iron and mark around the edges and in the holes with a scriber.

3-Saw out the outside edge of the lines.

4-Go over the sawed edges with a flat file to remove burrs and marks.

5-Center-punch the marks and drill the four holes with a 3/16-inch drill.

6-Countersink the two holes in the center on one side with 3/8-inch drill.

7-Peen one side for finish.

8-Go over all surfaces with a coarse and then a fine grade of emery cloth.

Assembling

1-Check out a screw driver and tongs.

2-Buff every part making the surface smooth and bright.

3-Place the holes in Part "A" over the holes in Part "C". Make sure that you have the top side up and Part "A" is over the opposite side of the countersunk holes.

4-Place the two stove bolts in the countersunk holes of Part "C" and screw them into the threaded holes of Part "A".

5-Heat Part "B" at the 1/2-inch square handle.

6-While red, spring the sides apart until the

round bent ends slide into the holes in the end of Part "A".

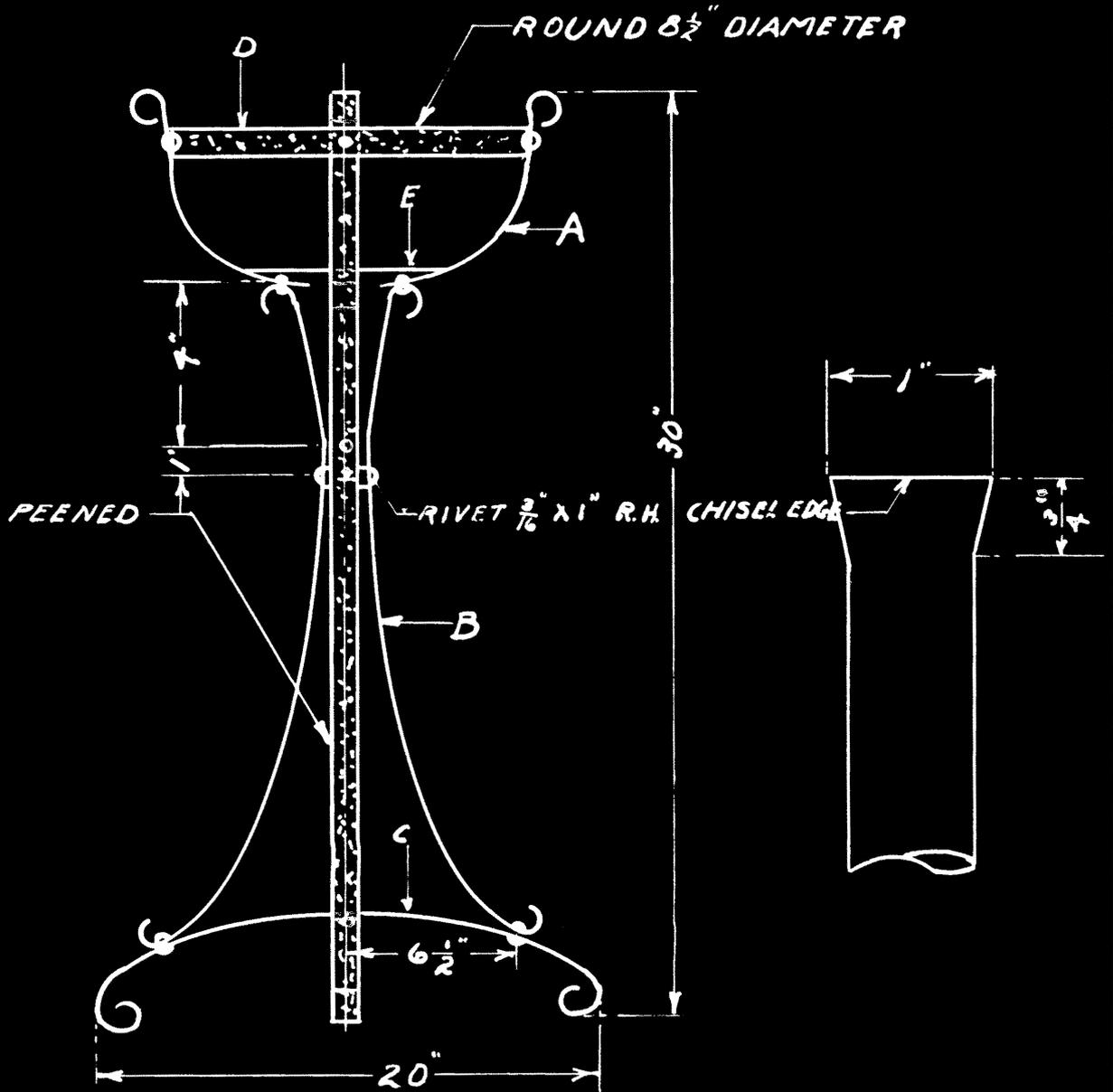
7-Check to see if the sides are straight and if they fit snugly against the ends of Part "A".

8-Shine all surfaces of all parts with fine or worn emery cloth.

9-Hold the knocker with a pair of tongs so the flame of a gas furnace will just touch it; turn the work and do not let it get red or hot.

10-Watch carefully and when you see various colors appear on the surface, remove from the flame and let cool. This finish will not rust.

FLOWER STAND



MATERIALS	
A	(4) $\frac{1}{8}$ " X $\frac{3}{4}$ " X 9" LONG
B	(4) $\frac{1}{8}$ " X $\frac{3}{4}$ " X 24" "
C	(2) $\frac{1}{8}$ " X 1" X 24" "
D	$\frac{1}{8}$ " X $\frac{3}{8}$ " X 26 $\frac{1}{2}$ " "
E	GALV. IRON 6" DIA.
	(13) $\frac{3}{16}$ " X $\frac{1}{2}$ " RIVETS
	(2) $\frac{3}{16}$ " X 1 $\frac{1}{8}$ " "

JOB SHEET NO. 37

HOW TO MAKE A FLOWER STAND

Part "A"

1-Check out: forging hammer, 3/16-inch drill, center-punch, and rule.

2-Forge a chisel edge on each end, 1 inch wide.

3-Grind all ends smooth and blunt; the length of the four pieces must be the same.

4-Measure from one end of each piece 1 1/4 inches, center-punch and drill 3/16-inch holes.

5-Measure from the other ends 1 1/2 inches, center-punch and drill 3/16-inch holes.

6-Turn a round circle on these ends 3/4 inch in diameter but do not have the chisel end touch the flat iron.

7-Slightly curve the four pieces from one end to the other, but in the opposite direction from the small bends on the ends.

8-Open the vise jaws about 1 inch; lay pieces flat across jaws and strike straight down with the hammer. This will make the pieces curve as you want them; slide the pieces slowly over the jaws as you hammer.

Part "B"

1-Check out: forging hammer, rule, 3/16-inch drill, and center-punch.

2-Forge a chisel edge on these ends as before.

3-Grind the ends smooth and blunt; the four

pieces must be the same length.

4-Measure from each end 1 1/2 inches, center-punch and drill 3/16-inch holes.

5-From one end measure on two of the pieces 5 1/2 inches and on the other two of the pieces 6 1/2 inches; center-punch and drill 3/16-inch holes.

6-Slightly round each end so the chisel edge does not meet and so the curve is about 3/4 inch in diameter.

Part "C"

1-Check out the same tools as for Part "B".

2-Forge on the two pieces a chisel edge on each end 1 1/4 inches wide.

3-Grind the ends smooth and blunt.

4-Measure from the ends 12 inches, center-punch and drill 3/16-inch holes.

5-Curve each end as shown on the blueprint; the ends should not meet and the curve should be about 2 inches in diameter.

6-Open the vise jaws about 1 1/2 inches and slide these pieces across the jaws slowly, with the curved ends up, striking with a hammer.

Part "D"

1-Check out: center-punch, 3/16-inch drill, rule, and hammer.

2-Divide this iron into four equal parts and mark.

3-Bend round over the horn of the anvil until the ends meet.

4-Solder or weld this joint.

5-Center-punch the center of this weld or soldered joint; drill this and the other three marks with a 3/16-inch drill.

Assembling

1-Check out: riveting hammer, rivet set, rivets, 3/16-inch drill, black lacquer, and bronzing powder.

2-Form a cross of Part "C" until the center holes meet with the curved ends down; place the rivet through from the top and rivet.

3-Rivet the four parts of Part "B" to the drilled holes on Part "C". (Rivet the holes of Part "B" which are 1 1/2 inches from the end and over 20 inches from the other drilled holes.)

4-Rivet the four pieces of Part "A" to the holes 1 1/2 inches from the ends of Part "B"; the curved ends will be turned out and the other ends riveted to Part "B".

5-Cut a piece of iron 3/4-inch square and 1 1/2 inches long. Drill a hole 1/2 inch from the end and 3/8 inch from the edge.

6-Drill another hole 1 1/2 inches from the same end and at right angles to the first hole.

7-Line up the holes in this block of iron with the holes 5 1/2 inches and 6 1/2 inches from the top ends

of Part "B".

8-Place rivets through Part "B" with the iron block in between and rivet them together.

9-Place Part "D" inside the four upright ends of Part "A".

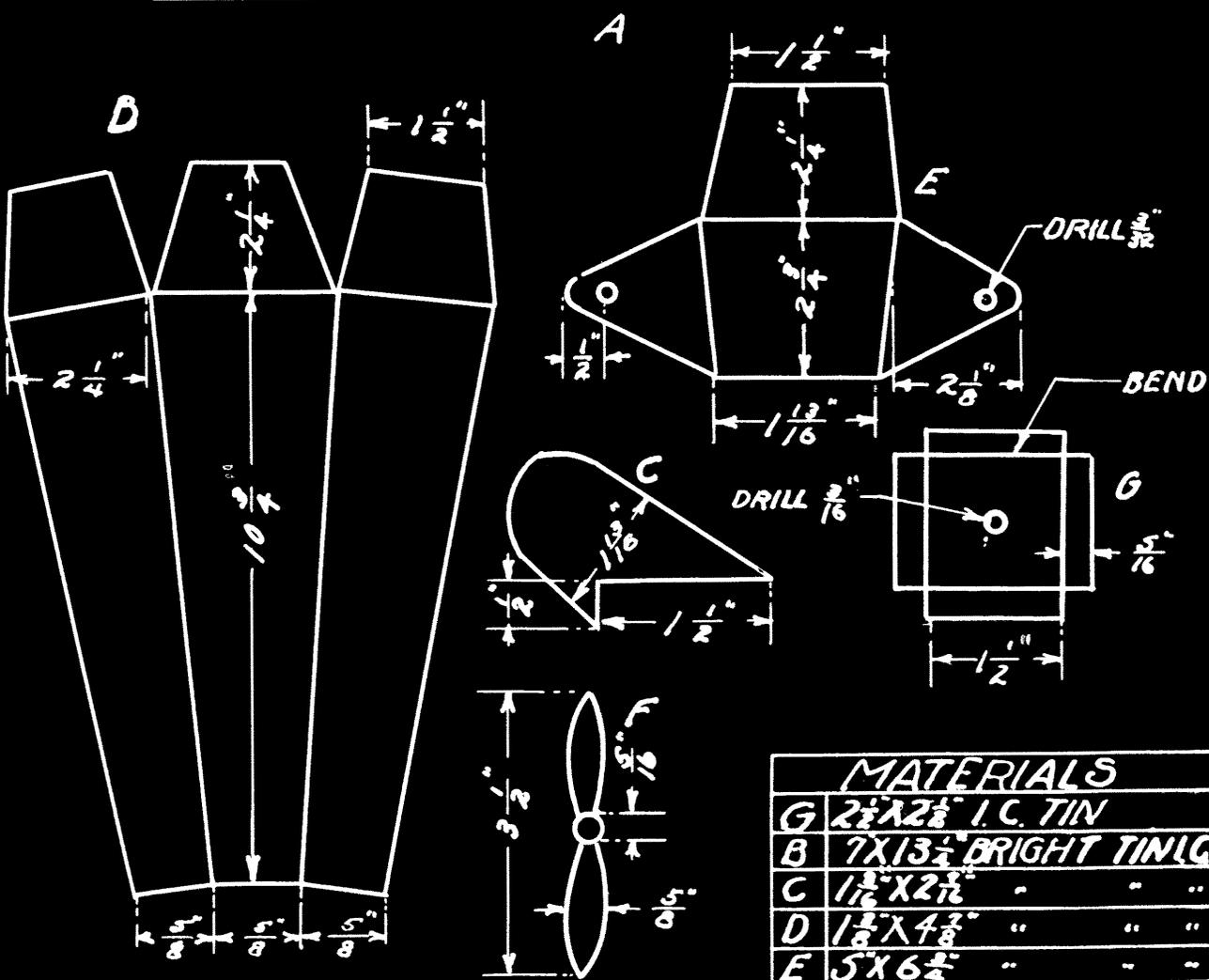
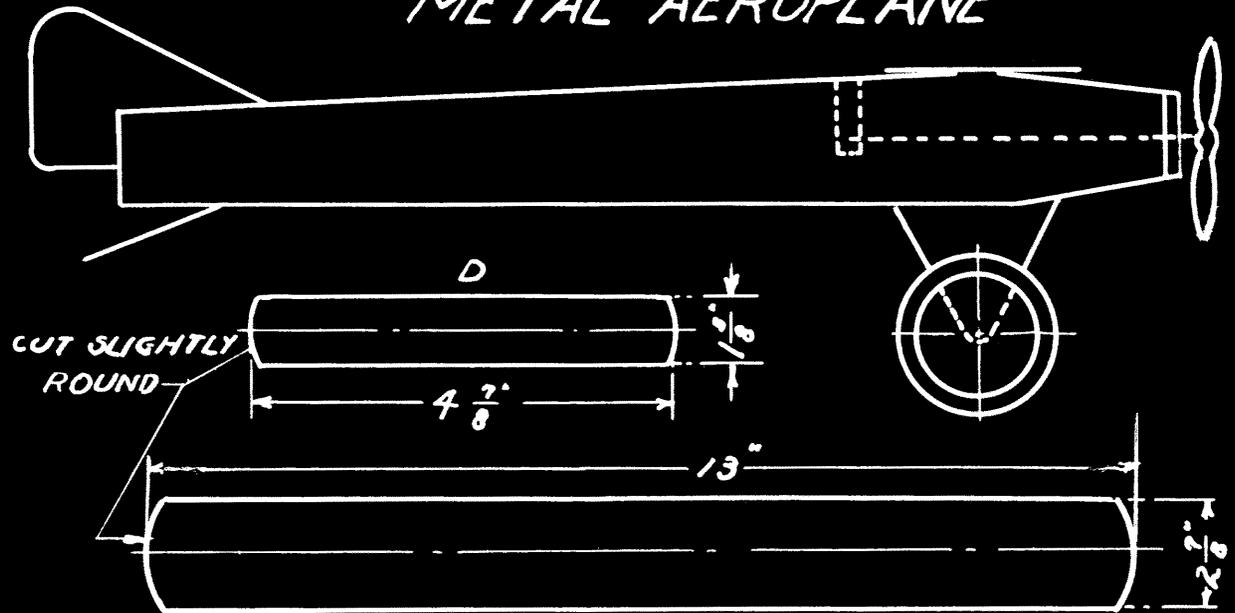
10-Rivet, placing the heads of the rivets on the inside and forming a good head on the rivets on the outside.

11-Cut a round piece of galvanized iron 5 1/2 inches in diameter; you may cut a fancy design around the edge if you wish.

12-Smooth all rivet heads and sharp points.

13-Lacquer the entire surface black and blow bronzing powder on the surface while it is wet.

METAL AEROPLANE



MATERIALS	
G	2 1/2 x 2 1/2" I.C. TIN
B	7 x 13 1/2" BRIGHT TIN LC
C	1 1/2 x 2 1/2" " " "
D	1 1/2 x 4 7/8" " " "
E	5 x 6 1/2" " " "
F	3 x 3 1/2" " " "
A	2 1/2 x 13" " " "
WIRE (2 WHEELS - AXLE)	

JOB SHEET NO. 38

HOW TO MAKE A METAL AEROPLANE

Part "A"

1-Check out: pattern, scribe, tin snips, and rule.

2-Lay the pattern on the tin and mark around the edge.

3-Cut out the straight lines on the squaring machine; cut the end slightly round.

4-Make a 1/4-inch fold on each edge from the same side.

Part "B"

1-Check out the pattern for Part "B" and the same tools as in Part "A".

2-Place the pattern on the sheet metal, mark around the edges and cut out the lines.

3-Bend the lines called for on the blueprint, over the flat end stake making a square bend.

4-Cut out the two V-places on the front end of the body, force the edges together with your hands, and solder on the inside.

Part "C"

1-Check out the pattern and same tools as before.

2-Lay pattern on the metal, mark around the edges and cut out on lines.

Part "D"

1-Check out pattern and same tools as Part "A".

2-Lay pattern on the metal, mark around the edges and cut out on the lines.

Part "E"

1-Check out: pattern, same tools as Part "A", and 3/32-inch drill.

2-Lay pattern on the metal, mark around edge, and cut out on the lines.

3-Make a square bend on the two lines called for on the blueprint.

4-Drill a 3/32-inch hole at the places marked.

Part "F"

1-Check out: pattern, same tools as Part "A", and 1/8-inch drill.

2-Lay pattern on the metal, mark around edge and in the hole, and cut out the lines; drill 1/8-inch hole.

Part "G"

1-Check out: pattern, same tools as Part "A", and 3/16-inch drill.

2-Lay pattern on the metal and mark around the edge; cut out lines and make the bends called for on the blueprint. Drill a 3/16-inch hole in the center.

Assembling

1-Check out: solder, soldering iron, flux, and 3/16-inch drill.

2-Place Part "E" on the bottom side of Part "B"; notice their positions on the blueprint.

3-Have the four tapered ends to form a square with the ends even.

4-Place the bent ends with the holes (Part "E") straight down from the body and bent slightly out.

5-Solder along the edges on both sides.

6-Place Part "G" over the square end of the body and solder around the edge.

7-Draw a line along the center of the top of the body from the front end to the back.

8-Measure 6 1/2 inches from the end of Part "A" and draw a line across.

9-Place this line on the wing over the center line on the body with the front edge of the wing (Part "A") 2 1/4 inches from the front end of the body.

10-Solder on each side of the wing.

11-Draw a line 2 7/16 inches from the end of Part "D" parallel to the ends.

12-Place this center line over the center line on the extreme back end; the back edge of Part "D" will be even with the end.

13-Solder each side of Part "D" to Part "B".

14-Place the 1 1/2-inch dimension of Part "C" over the center line of Part "D" on the back end of the

body; Part "C" is to be soldered to Part "D" on each side.

15-Place a galvanized wire 10 inches long and $\frac{1}{8}$ inch in diameter through the hole in the propeller and solder.

16-Slide the wire through the hole in the front end of the aeroplane so the propeller will extend from the body slightly.

17-Cut a piece of tin 1 inch wide and 3 inches long. Drill a $\frac{3}{16}$ -inch hole in the center.

18-Form a $\frac{1}{4}$ -inch lap on the long edges.

19-Draw a line $\frac{1}{2}$ inch from each end and make square bends on these lines.

20-Place inside the body of the aeroplane with the wire extending through the hole $\frac{1}{2}$ inch.

21-Solder the $\frac{1}{2}$ -inch bent ends to each side of the body.

22-Bend the wire extending through the hole with the pliers.

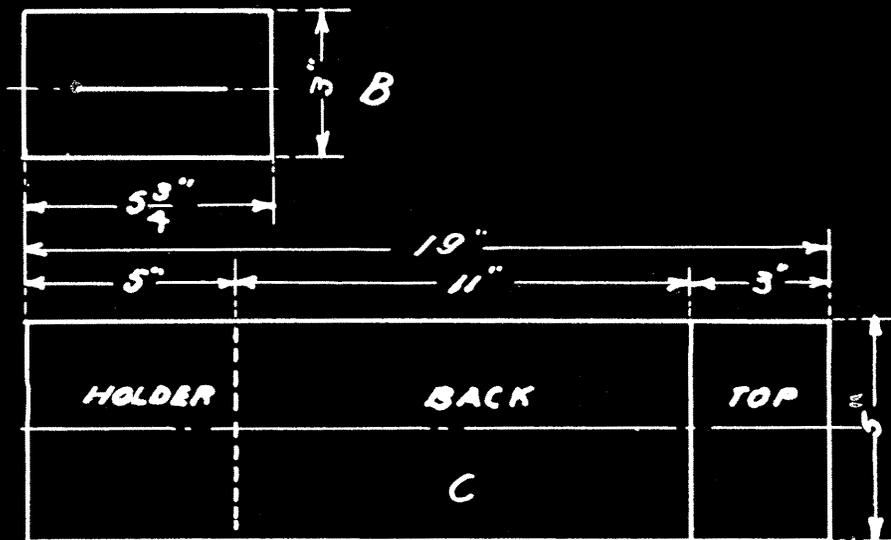
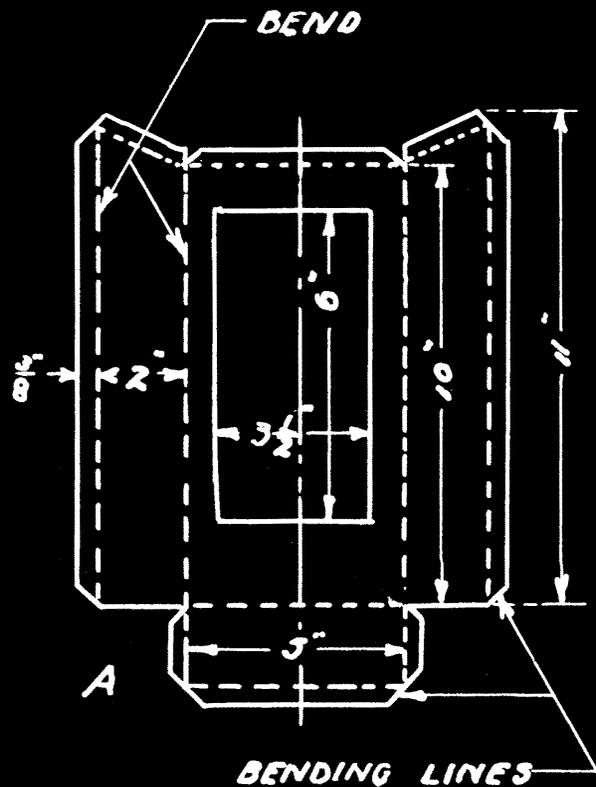
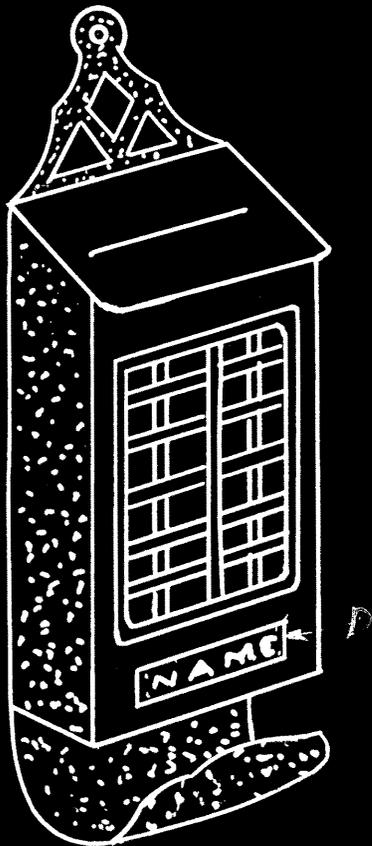
23-Place the axle made of $\frac{3}{16}$ -inch wire, 5 inches long, through the holes in the running gear.

24-Place wheels over the axle.

25-Place $\frac{3}{16}$ inch washers over each end and flatten ends on the anvil with the hammer.

26-Paint the aeroplane some color to represent some large plane you have seen.

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MAIL BOX



MATERIALS	
D	$1\frac{1}{4}$ " X $3\frac{1}{4}$ " BRASS
A	$3\frac{1}{2}$ " X $13\frac{3}{4}$ " BRASS
B	3 " X $5\frac{3}{4}$ " BRASS
C	5 " X 19 " BRASS
	43 SHEET METAL
	RIVETS $\frac{1}{8}$ " X $\frac{1}{8}$ "

JOB SHEET NO. 39

HOW TO MAKE A BRASS MAIL BOX

Part "A"

1-Check out: pattern, scriber, straight jaw tin snips, and cold chisel.

2-Place pattern on the brass and mark around the edges.

3-Cut out the lines with tin snips; cut a slot with a cold chisel for the opening which will be 3 1/2 inches by 6 inches, so you can then cut out the lines with the snips.

Part "B"

1-Check out: pattern, 1/8-inch and 3/16-inch drills, round jaw tin snips, scriber, very sharp cold chisel, and hammer.

2-Lay pattern which is complete, on the sheet brass and mark around the edges.

3-Cut out the lines and drill the four holes with a 3/16-inch drill; cut the corners of one long edge slightly round.

4-Draw a center line connecting the center holes; the distance between these holes will be 4 1/4 inches and will be the slot for placing letters in the box.

5-Place the center line on a hard block of wood and cut a slot or opening between these two holes, 3/16 inch wide with a cold chisel. File sides of slot smooth;

measure with the rule to see that it is the same width all the way across.

Part "C"

1-Check out: pattern, straight jaw snips, 3/8-inch and 3/16-inch drills, round jaw snips, and two sharp chisels with 1/4-inch and 1/2-inch cutting edges.

2-Place the pattern on the brass and mark around the edges; cut out the lines with snips.

3-Cut out the three diamond-shaped openings with the small cold chisels.

4-Drill the large hole with a 3/8-inch drill; be sure that it is exactly on the mark. Drill the other four holes with a 3/16-inch drill.

Assembling

1-Check out: solder, flux, soldering iron, mallet, riveting hammer, ball-peen hammer, 1/8-inch drill, emery cloth, and steel wool.

2-Fold a 3/8-inch lap on all the edges of Part "A", but not flat; form sharp corners with the edges to the inside.

3-Bend 2 inches from the sides and the bottom on the dotted lines over the flat stakes; the bends should be on the same side of the brass.

4-Make sure that all laps are to the inside and the V-places come together to form square corners.

5-Solder from the inside as much as possible as

the colors of solder and brass do not look well together.

6-Bend the holder of Part "C" over a round stake so it forms a half-circle 3 inches across; use your hand or a mallet to shape it.

7-Place Part "A" over Part "C" with the open end of Part "A" coming half way between the four $\frac{3}{16}$ -inch holes.

8-Make sure that the sides of Part "A" fit even with the edges of Part "C"; solder the laps of Part "A" on the inside through the square opening.

9-Bend two half-circles $\frac{1}{2}$ inch in diameter, over the needle stake, from welding iron, $\frac{3}{16}$ inch by $1\frac{3}{4}$ inches.

10-Place one end of each of these in the $\frac{3}{16}$ -inch holes drilled on Part "B"; place the lid on top of the mail box and stick the ends of these hinges in the holes. See your teacher.

11-Raise the lid to see if it opens and closes easily with the hinges in place; adjust hinges and lid if necessary.

12-Solder ends of hinges sticking through Part "C" to the back of Part "C".

13-Cut out a piece of brass $6\frac{1}{2}$ inches by 4 inches; measure to the inside $\frac{1}{4}$ inch all the way around and make a line. Cut out these lines, starting with a cold chisel for an opening and finishing with the straight jaw

snips.

14-Drill 1/8-inch holes in the four corners 1/8 inch from the edge; drill five other holes on the long side and three other holes on the short side. See your teacher.

15-The cross strips on the front are made of brass; three pieces are 1/4 inch by 6 1/2 inches and five pieces are 1/4 inch by 4 inches.

16-Place the strips of brass over the square opening of Part "A" even with the inside; mark holes and drill with 1/8-inch drill.

17-Rivet this strip at the corner with the heads of the rivets on the inside.

18-Slide the cross strips into place on the inside; mark holes, drill and rivet.

19-Place the three long strips in place, mark, drill and rivet. See your teacher.

20-Peen the entire outside surface of the mail box.

21-Smooth and polish the outside surface with emery cloth for the finish.

JOB SHEET NO. 40

HOW TO MAKE A TAP WRENCH

Part "A"

1-Check out: 1/4-inch and 5/16-inch drills, 5/16-inch reamer, flat file, rule, center-punch, hammer, try-square, dividers, and 3-corner file.

2-Place the two pieces side by side with the ends even.

3-Measure 3/4 inch from the ends and through this point draw a line at right angles to the long sides using the try-square.

4-Measure each way from this cross line on the center line 1/2 inch and center-punch.

5-Set the dividers 1/4 inch apart; place one point on the center-punch marks and turn half-circles on the ends.

6-Grind the ends round as shown on the blueprint.

7-Drill a 1/4-inch hole in each end on the mark.

8-Ream one hole in each piece with a 5/16-inch reamer. Tap 1/4-inch holes with a 5/16-inch U. S. S. tap.

9-Measure each way from the center cross line 1/16-inch; using the try-square draw two lines parallel to the center line.

10-File a "V" on each as shown on the blueprint keeping the edge of the file on the center line and not getting out of the two outside lines. The "V" will be 1/16

inch deep.

11-File the ends smooth and finish on the buffer.

12-Check out the instruction sheet on hardening steel; harden these two pieces to a dark blue color.

13-Hold all surfaces of the jaws on a fine emery cloth buffer and smooth.

Part "B"

1-Check out: tools for the lathe, outside calipers, center-drill, rule, flat file, hack saw, knurling tool, and fine emery cloth.

2-Center-drill each end.

3-Chuck one end in a universal chuck and place the other end on the dead center.

4-Face the end and cut the round iron down to 1/2 inch in diameter.

5-Measure from the end 1/2 inch to cut out the center hole.

6-From this mark measure 1 3/16 inches and cut it down to 5/16-inch diameter.

7-Measure from the last mark 1/8 inch and leave it 7/16 inch in diameter. Make sure you have a square shoulder here between the 7/16-inch and the 5/16-inch diameter.

8-Measure from the last mark -- the 1/8-inch measurement -- 2 1/8 inches for a taper.

9-Measure from the tapered mark 2 inches for the

knurled handle. Knurl the handle before cutting the taper.

10-Cut the dimension, $2 \frac{1}{8}$ inches, for the taper to the $\frac{7}{16}$ -inch diameter.

11-Start the taper at the edge of the knurled handle and gradually taper down to $\frac{9}{32}$ inch in diameter, $\frac{1}{2}$ inch from the $\frac{1}{8}$ -inch shoulder.

12-The $\frac{1}{2}$ inch next to the shoulder will be cut down to $\frac{9}{32}$ -inch diameter also, starting on the line next to the $\frac{1}{8}$ -inch shoulder. File and finish the taper, end of the handle and the shoulder.

13-Place tin around the knurled handle and reverse the work.

14-Extend the end not knurled about 1 inch from the face of the chuck.

15-Cut a half-round ball $\frac{1}{2}$ inch long on this end.

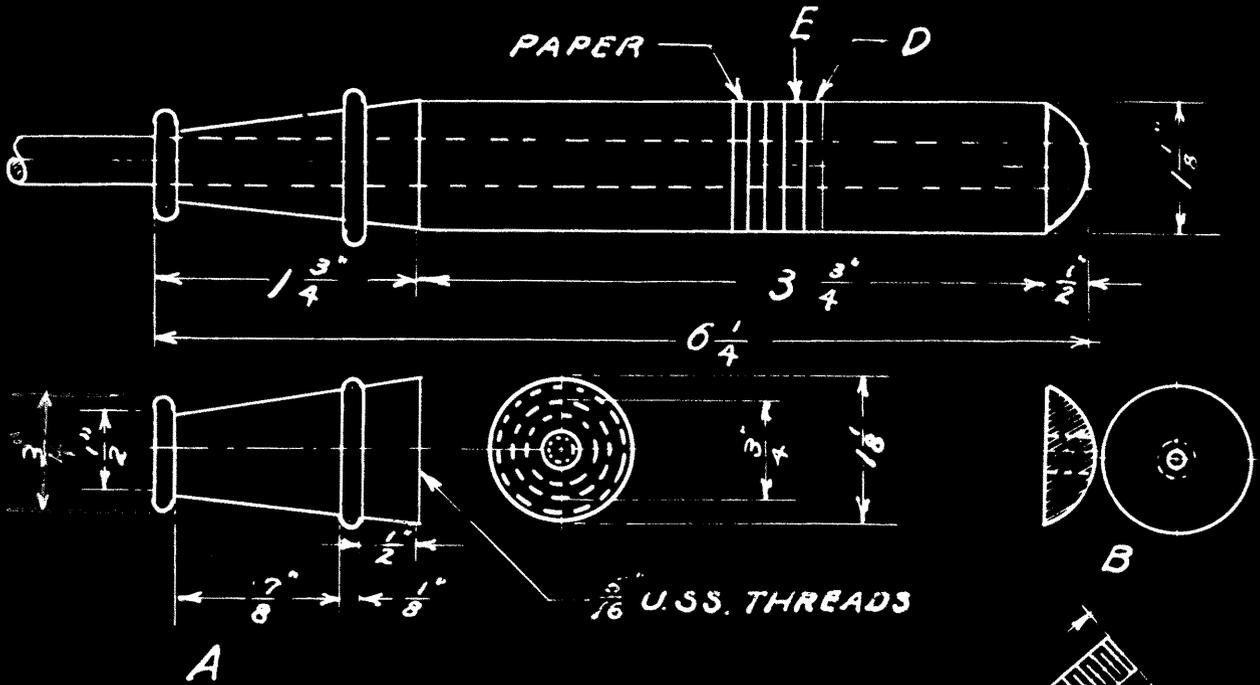
16-Saw the end with the holes from the handles or cut them off on the lathe.

17-Cut $\frac{5}{16}$ -inch U. S. S. threads 1 inch from the small end in a vise.

18-Put the parts together according to the blueprint.

19-Give the wrench a coat of oil with an oiled cloth to keep it from rusting.

SCREW DRIVER



$\frac{5}{16}$ U.S.S. THREADS

MATERIALS	
A	$1\frac{1}{4}$ " X 3" ROUND
B	$1\frac{1}{4}$ " X 1" ROUND
C	$\frac{5}{16}$ " X 13" DRILL ROD STEEL
D	YELLOW PATTERN PAPER
D	RED " "



JOB SHEET NO. 41

HOW TO MAKE A SCREW DRIVER

Part "A"

1-Check out: lathe tools, outside calipers, rule, center-drill, 1/4-inch and 5/16-inch drills, flat file, fine emery cloth, and 5/16-inch U. S. S. tap.

2-Chuck one end of the round iron; center-drill the other.

3-Cut the entire length down to 1 1/8 inch in diameter and face the end.

4-Measure from the end 1/8 inch and cut it down to 3/4-inch diameter, cutting the surface half-round.

5-Measure from the last mark 7/8 inch and cut it down to 3/4-inch diameter.

6-Start the taper 1 inch from the end and gradually taper down to 1/2 inch next to the first 1/8-inch dimension.

7-Measure 1/8 inch from the large end of the taper and cut this distance half-round.

8-Measure from this last mark 1/2 inch and cut a taper in the same direction as the other but leave the small end 3/4 inch in diameter.

9-Drill a 1/4-inch hole through this part on the lathe from the small end.

10-Follow this hole with a 5/16-inch drill for a distance of 1 inch. Tap with 5/16-inch U. S. S. tap.

11-Remove all marks with a file and smooth with emery cloth. Cut off 1 5/8 inches for Part "A".

Part "B"

1-Check out same tools as for Part "A".

2-Chuck the work in the lathe and cut it down to 1 1/8 inches in diameter; face the end.

3-Drill a 1/4-inch hole through the round iron; countersink this side of the hole slightly.

4-Measure 1/2 inch from the end to remove center-drill hole and cut to a diameter of 5/16 inch.

5-Measure from the end 1 inch and cut it half-round to the 5/16-inch diameter end.

6-File and smooth with emery cloth.

7-Cut or saw off 1 inch from the end of the center-drill hole.

8-Face the sawed end in the lathe and tap out the hole with a 5/16-inch U. S. S. tap.

Part "C"

1-Check out: forging hammer, round jaw tongs, and 5/16-inch U.S. S. tap.

2-Heat one end bright red and forge it to a width of 1/2 inch with a 1 1/2 inch flat taper.

3-Grind each side of the flat taper smooth, making the taper the same length on each side.

4-Grind the bit end blunt and 1/16 inch thick, 1/4 inch from this end.

5-Measure from the end 1 inch and grind on each side from a width of $7/16$ inch down to the end which is $5/16$ inch.

6-Heat about 6 inches of the other end red and leave it over night to anneal. See the general information sheet.

7-Place tin around the steel and catch in a vise.

8-Cut $6\ 1/4$ inches of $5/16$ -inch threads on this end with a U. S. S. die.

9-Check out information sheet telling how to temper a screw driver bit and follow instructions. See your teacher.

Part "D"

1-Check out: scissors, $1\ 1/4$ -inch washer, pencil, and $5/16$ -inch drill.

2-Place metal washer over paper and mark around the edge with a pencil; cut out on line.

3-Drill hole with $5/16$ -inch drill through the center.

4-Make about 350 of these paper washers.

Assembling

1-Check out: lathe tools, pipe wrench, flat file, and coarse and fine emery cloth.

2-Screw the small end of Part "A" on the threaded end of Part "C" as far as possible.

3-Place tin around the round bit steel and ex-

tend the threaded end straight up from the jaws of the vise.

4-Slide about 10 paper washers on the threaded end; then slip a 3/8-inch pipe over the end and slide up and down to make the washers go closer together.

5-Do this several times until about 1/2 inch of the threads are sticking out from the paper washer.

6-Screw Part "B" on these threads with the center-drill hole to the outside.

7-Leave in the vise and screw the parts tight together using a pipe wrench on the center-drill hole.

8-Chuck the round bit end in the lathe and the center-drill hole on the dead center.

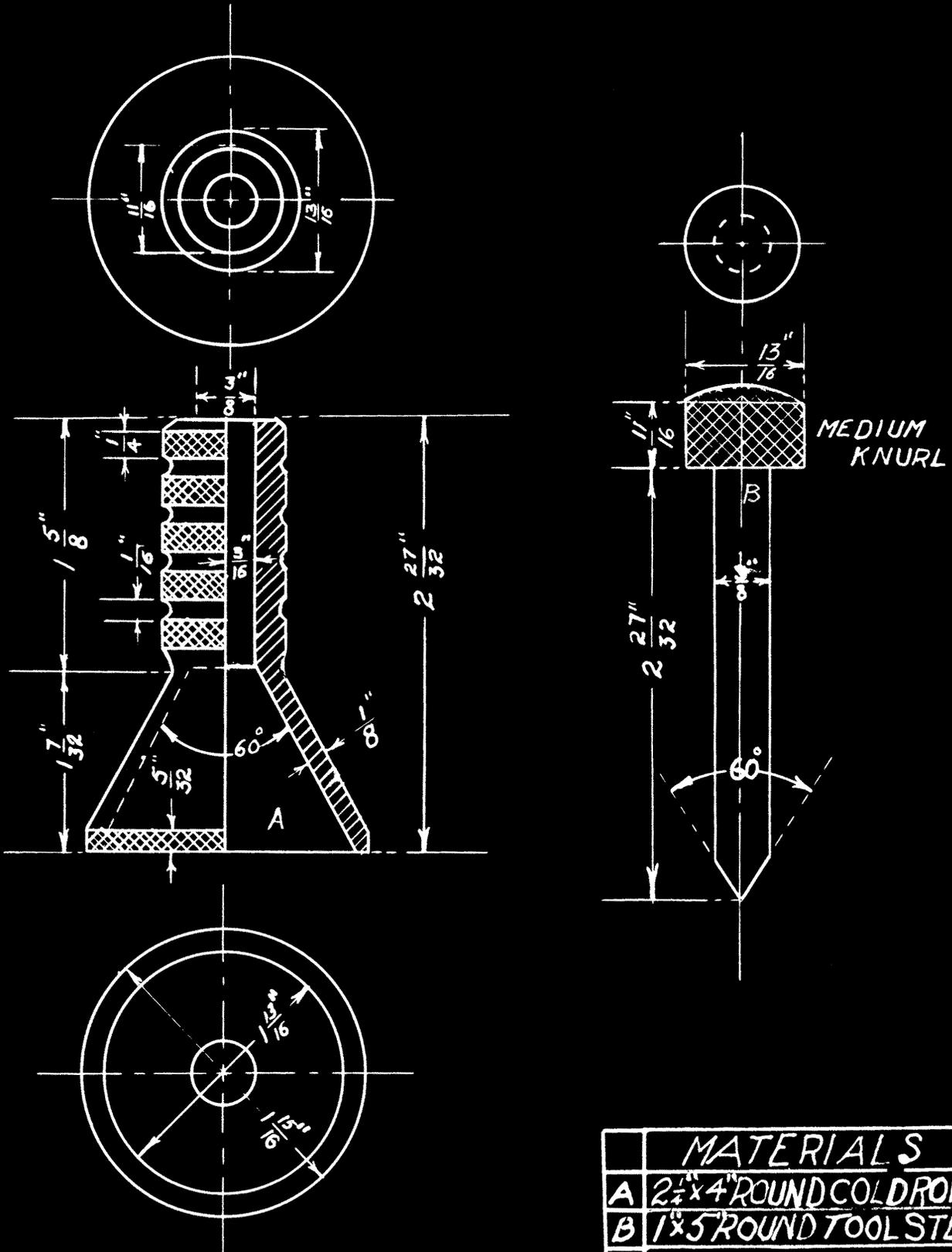
9-Cut the paper handle round and to a diameter of 1 1/8 inches.

10-Hold a flat file, and then emery cloth on this paper handle while the lathe is running at a fast speed.

11-Hold an oiled cloth against the paper to make a smooth finish.

12-Saw off the center-drill hole; file the end and buff the bit end. Catch the paper handle in a chuck and polish the round shank of the bit.

BELL CENTER PUNCH



MATERIALS	
A	2½" x 4" ROUND COLD ROLLED
B	1" x 5" ROUND TOOL STEEL

JOB SHEET NO. 42

HOW TO MAKE A BELL CENTER-PUNCH

Part "A"

1-Check out: lathe tools, center-drill, rule, outside calipers, 3/8-inch drill, knurling tool, drill chuck and wrench, can of oil, flat file, hack saw, and inside boring tool.

2-Chuck 1 1/2 inches on one end and center-drill the other.

3-Slide the tail stock against work with the dead center in the center-drill hole.

4-Square up the end and cut the entire length of round iron down to 1 15/16 inches in diameter.

5-Measure from this end 5/32 inch and mark.

6-Measure from this mark 1 7/32 inches and mark; this is for the taper, or 60 degree angle.

7-Measure from this mark 1 5/8 inches and mark; cut this dimension down to a diameter of 13/16 inch.

8-Set the compound rest 30 degrees to the left of the zero mark. See your teacher.

9-Start cutting 5/32 inch from the end and cut a round taper down to 11/16-inch diameter; stay within the 1 7/32-inch mark.

10-Start knurling at the small end of the work and knurl the 1 5/8-inch distance.

11-Knurl the 5/32-inch width on the large end.

12-Measure from the small end $1/16$ inch and cut a slight bevel. The work will be cut off here later.

13-Measure from the last mark $1/4$ inch; from this mark measure $1/16$ inch and cut a dividing line and a half-round groove.

14-Each of the five knurled sections will be $1/4$ inch wide and each of the four dividing lines or grooves will be $1/16$ inch wide.

15-Place the $3/8$ -inch drill in the drill chuck.

16-Remove the dead center and place the chuck in the tail stock spindle.

17-Drill this hole 3 inches deep through the center-drill hole.

18-Place the inside boring tool in the tool post and bore the inside of the large end at the same angle (30 degrees) or taper, that the outside was cut.

19-Cut on the inside until the wall between the inside and the outside measures $1/8$ inch with the calipers.

20-File the outside parts not knurled and follow with fine emery cloth to remove all marks.

21-Saw off the work $2 \frac{27}{32}$ inches from the large end, or in the center of the first groove made.

22-File the end flat and smooth.

23-Heat in a flame until it turns various colors; then remove and allow to cool.

Part "B"

1-Check out; lathe tools, center-drill, outside calipers, flat file, emery cloth, hack saw, and knurling tool.

2-Chuck one end in a universal chuck and center-drill the other end.

3-Square the end and cut the entire length down to $13/16$ inch in diameter.

4-Measure from the end $1/2$ inch which is allowed for cutting out the center hole.

5-Measure from this mark $2\ 27/32$ inches and cut down to a diameter of $3/8$ inch.

6-Use a side tool and cut a square shoulder where these two diameters meet.

7-Measure from the last mark $11/16$ inch and knurl.

8-Cut outside this last line with a cutting-off tool.

9-Put this knurled end inside the chuck and chuck on the small round part.

10-Extend the $3/8$ -inch round part, $1/2$ inch from the face.

11-Use the compound rest, set out of line from the zero mark 30 degrees, and cut a 60 degree angle on the point. File it smooth. See your teacher.

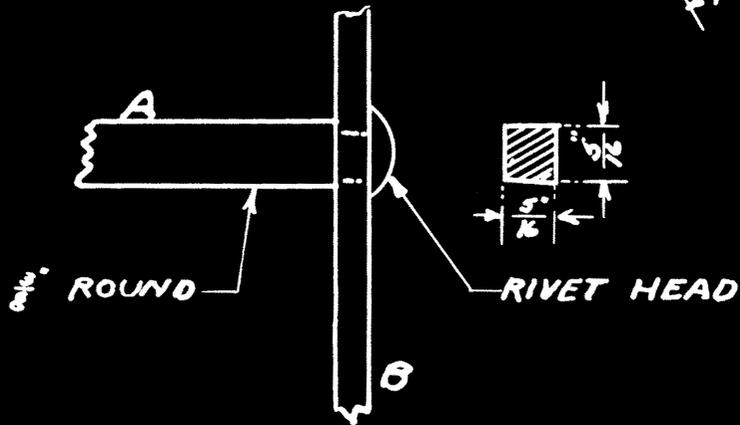
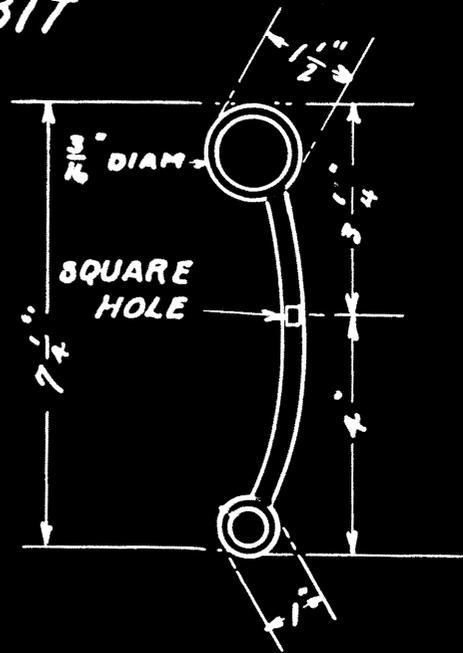
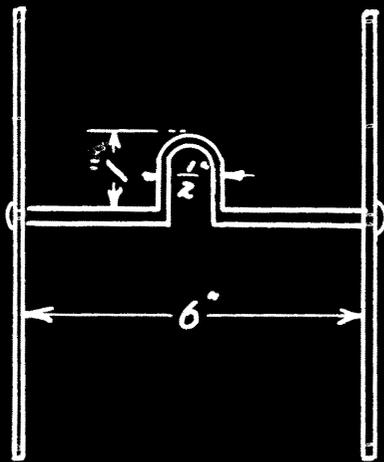
12-Check out the general information sheet on hardening and harden the point very hard.

13-The head or knurled part should be hardened to a dark blue color.

14-Place the point of Part "B" in the hole at the small end of Part "A".

15-Finish by giving the punch a coat of oil with an oiled cloth.

BRIDLE BIT



MATERIALS	
A	$\frac{3}{8}$ " X 9" ROUND STEEL
B	(2) $\frac{3}{16}$ " X $\frac{5}{8}$ " FLAT
	IRON $7\frac{1}{2}$ " LONG

JOB SHEET NO. 43

HOW TO MAKE A BRIDLE BIT

Part "A"

1-Check out: rule, forging hammer, round jaw tongs, and flat file.

2-Measure from the end 4 1/2 inches and mark; measure each way from this center line 1 1/4 inches and mark.

3-Heat the part between these lines and bend as shown on the blueprint. Bend on the center line until the round sides and ends are 1/2 inch apart.

4-Place a piece of 1/2-inch square iron next to the bend between the sides.

5-Catch the work in the vise with the round ends up. Bend out with the hammer in opposite directions.

6-Take work out of the vise, reheat and line up the round ends.

7-File each end 5/16-inch square and 3/8 inch long.

8-Chuck one end in lathe and file the other end, following with fine emery cloth. Repeat on other end.

Part "B"

1-Check out: cold chisel, 1/4-inch drill, center-punch, forging hammer, flat jaw tongs, round punch, and square punch with 3/16-inch square end.

2-Measure from one end $5/16$ inch and center-punch; measure from this mark $1\ 1/2$ inches and center-punch. Connect these two marks with a straight line. Center-punch every $3/16$ inch along the line. Drill out marks with $1/4$ -inch drill.

3-Heat this end red and finish cutting out the holes; you will have a slot $1/4$ inch wide and $1\ 1/2$ inches long.

4-Heat again and open sides with a round punch.

5-Heat and place over the small point of the anvil horn. Hit from the outside to make it round.

6-Continue to heat and forge until the outside diameter of the eye is $1\ 1/2$ inches and the round rim of the ring has a diameter of $3/16$ inch.

7-Measure from the other end $5/16$ inch and then 1 inch from this mark. Along this space of 1 inch center-punch, drill and cut with the chisel; forge it round as before but make the rim $3/16$ inch square on the end with the small eye.

8-Both parts of Part "B" will be made alike.

9-On each part measure from the outside of the small eye 4 inches from the end on the flat iron and center-punch.

10-Drill these holes $1/4$ inch in diameter; punch them to $5/16$ -inch square holes.

11-Measure from the small-eye-end 3 inches and

drill 5/16-inch hole.

Assembling

1-Check out: flat jaw tongs, riveting hammer, small flat file, round file, half-round file, and fine emery cloth.

2-Heat one square end of Part "A" and catch in a vise with the square end extending above the face of the vise.

3-Place the large eye on the top side of Part "B" on the same side on which the U is bent on Part "A". Rivet a round head and make sure it is tight. See the blueprint.

4-Place the other part of Part "B" on the other end of Part "A" while the latter is hot. Be sure that you have the large eyes on the same side of the U and the small eyes on the other side.

5-Go over the entire surface with fine emery cloth, following with steel wool.

6-File all four eyes inside and outside to get the proper shape and thickness of rim.

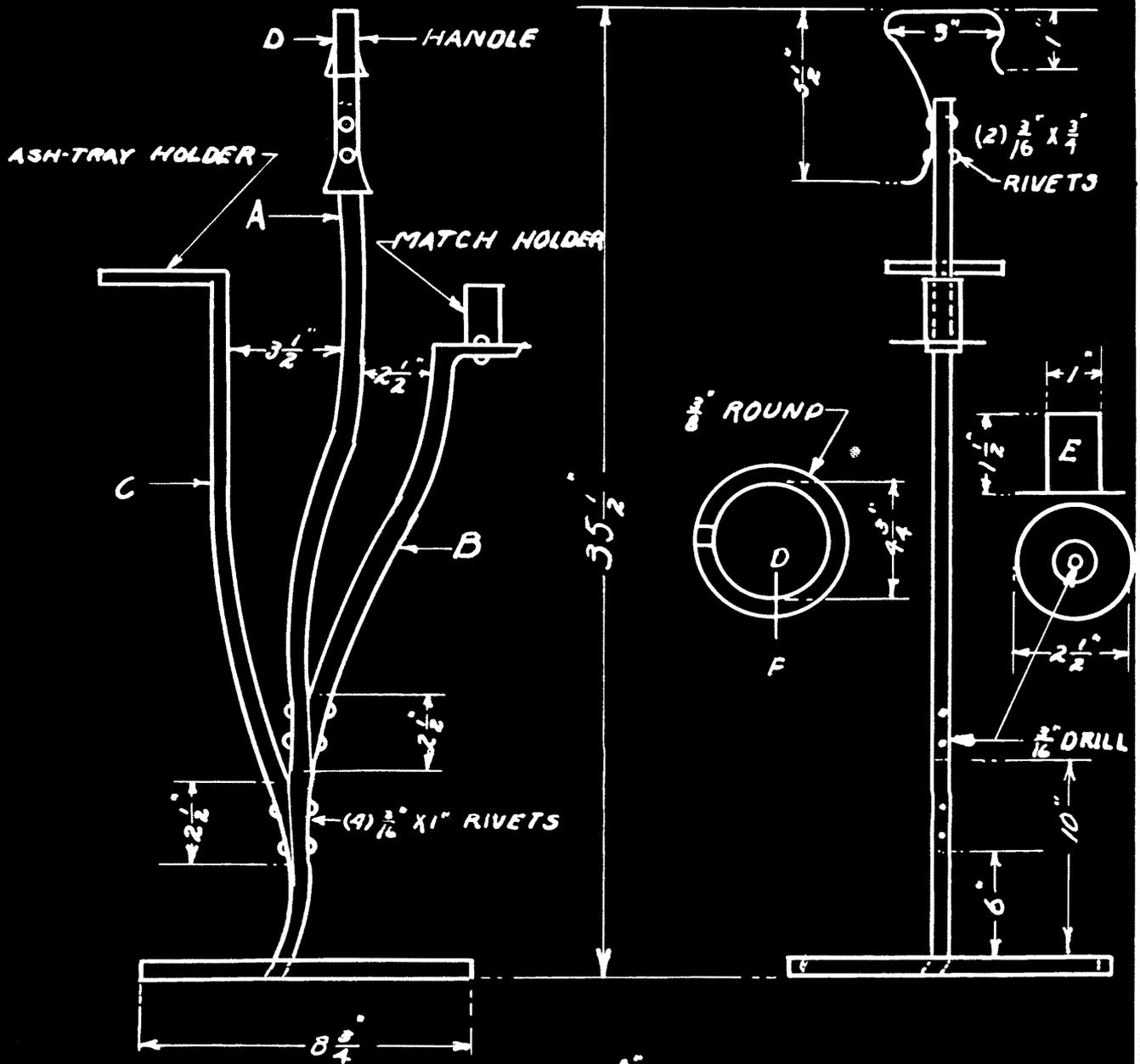
7-Curve the flat part of Part "B" slightly from one end to the other.

8-Heat each side of the square holes and place each side on a block of wood. Use a block of wood for a hammer and shape each side as shown on the blueprint.

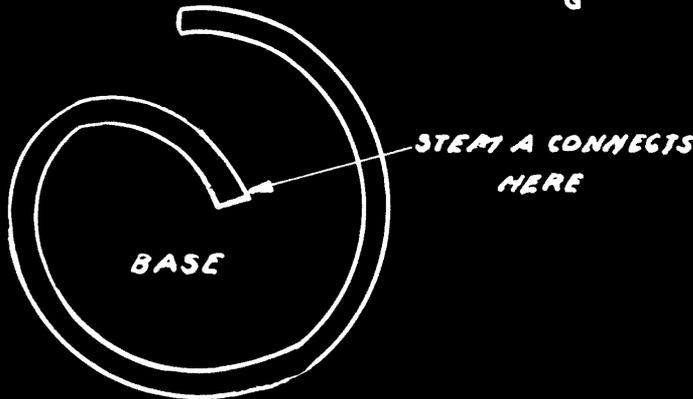
9-Hold all surfaces on a buffer to remove marks.

10-Heat over a gas flame until colors appear.

SMOKING STAND



3/8" SQUARE IRON USED



MATERIALS	
A	3/8" X 3/8" X 6' LONG
B	3/8" X 3/8" X 15 1/2" "
C	3/8" X 3/8" X 33" "
D	1/8" X 1/2" X 9 1/2" "
E	GL. 1'-8 1/2" DIAM. 2-1/2" X 2 1/2"
	(6) 3/16" X 1" R.H. RIVETS
	(1) 3/16" X 1/2" R.H. RIVET

JOB SHEET NO. 44

HOW TO MAKE A SMOKING STAND

Part "A"

1-Check out: forging hammer, 3/16-inch drill, rule, center-punch, and ball-peen hammer.

2-Heat 4 inches at a time on the same end and gradually bend over the horn of the anvil. Form a circle 8 3/4 inches, outside diameter.

3-Notice the blueprint carefully, and particularly the shape of the base; the circle must lie flat and curve gradually.

4-Make a bend straight out from the base on the mark, 2 inches longer than the circle. See your teacher.

5-Gradually start rounding the circle 7 inches from the bend as shown on the blueprint until the stem, or long straight piece of 3/8-inch iron, is in the center of the circle.

6-Place the base on the face of the anvil and hammer it flat so it will set level on the floor.

7-Measure from the other end 1/2 inch, and 1 1/4 inches, respectively; center-punch and drill 3/16-inch holes.

8-Measure from the base 6 1/2 inches, and 7 1/4 inches, respectively; center-punch and drill 3/16-inch holes on the curved sides.

9-Measure from the base 10 1/2 inches, and

11 1/4 inches, respectively; center-punch and drill 3/16-inch holes on the same side.

10-Measure from the top end 10 inches, and 18 inches, respectively, and mark.

11-Place the first mark flat on the anvil over the large hole. Strike straight down with the peen of the hammer. Slide your work back and forth over the hole as you hammer. This will put a slight bend on this side.

12-Turn the work over and do likewise on the other side, starting at the 18-inch mark; slightly curve this side in the opposite direction.

Part "B"

1-Use the same tools as in Part "A".

2-Heat one end and forge it flat, 1/8 inch thick, 1 inch wide, and 1 inch long; the extreme end is round.

3-Measure 1/2 inch from the end and drill a 3/16-inch hole. Measure 1 inch from the end and make a square bend over the end of the anvil.

4-File the end and flat surface smooth.

5-Forge a 2 1/2 inch flat taper on the other end to a chisel edge 3/8 inch wide; this taper will be on the same side of the iron as the other flat end. Grind smooth.

6-Measure from the chisel edge 1/2 inch, and 1 1/4 inches, respectively; center-punch in the center and drill 3/16-inch holes.

7-Notice Part "B" on the blueprint; place the work over the hole on the anvil and slightly curve 10 inches of each end in the opposite direction.

Part "C"

1-Use the same tools as before.

2-Forge 15 inches of one end round with a diameter of $\frac{3}{8}$ inch.

3-Bend on the end of the horn of the anvil, a circle with an outside diameter of $4 \frac{3}{4}$ inches.

4-Heat and bend the part next to the circle so the edge of the circle will be horizontal and the stem will be vertical from the base.

5-Forge a flat taper on the other end $2 \frac{1}{2}$ inches long and $\frac{3}{8}$ inch wide.

6-Drill $\frac{3}{16}$ -inch holes $\frac{1}{2}$ inch, and $1 \frac{1}{4}$ inches, respectively, from the chisel edge.

Part "D"

1-Check out: forging hammer, center-punch, and $\frac{3}{16}$ -inch drill.

2-Forge each end to a chisel edge $\frac{5}{8}$ inch wide and grind smooth.

3-Measure from one end 1 inch, and $1 \frac{3}{4}$ inches, respectively; center-punch and drill $\frac{3}{16}$ -inch holes.

4-Measure from the other end 1 inch and make a round bend. Measure from this mark 3 inches and make another bend on the same side of the iron. From this bend

down to the first hole, the iron will be straight.

5-Measure 2 1/4 inches from the straight end and make a slight bend, opposite the other bends. Notice the blueprint carefully and consult your teacher.

Part "E"

1-Check out: pattern, 3/16-inch drill, solder, soldering iron, flux, round and curved jaw tin snips, and scriber.

2-Place pattern on the metal and mark the hole and around the edge.

3-Cut out the lines and drill the 3/16-inch hole.

4-Fold a 1/8-inch lap on the short edges of the square tin in the opposite direction.

5-Bend round over the needle stake and hook the lap.

6-Solder on the outside to cover up the laps and file smooth.

7-Place one end of the short pipe over the drilled hole; the inside edge of the pipe must be equally distant from the center of the hole.

8-Solder these parts together on the inside.

Assembling

1-Check out: rivet set, riveting hammer, flat file, and ball-peen hammer.

2-Place two rivets in the end holes of Part "C" on the side on which the round ring is bent, 6 1/2 inches

and 7 1/4 inches from the bottom, and rivet.

3-Place the rivets in the two holes on the end of Part "B" and then through the two holes 10 1/2 inches from the base of Part "A"; the flat end of Part "B" will be in the opposite direction from the ring on Part "C".

4-Rivet these parts together as before.

5-Place the 3/16-inch rivet in the hole on the inside of the tin match holder (Part "E") with the head on the inside. Place the end of this rivet in the hole on the bent, flat end of Part "B" and from the top side, rivet these together.

6-Place two 3/16-inch rivets through the holes in Part "D" from the outside and then through the holes at the top of Part "A"; rivet.

7-With the peen of a hammer make dents or round dots on the surface of the smoking stand --- except the tin match holder.

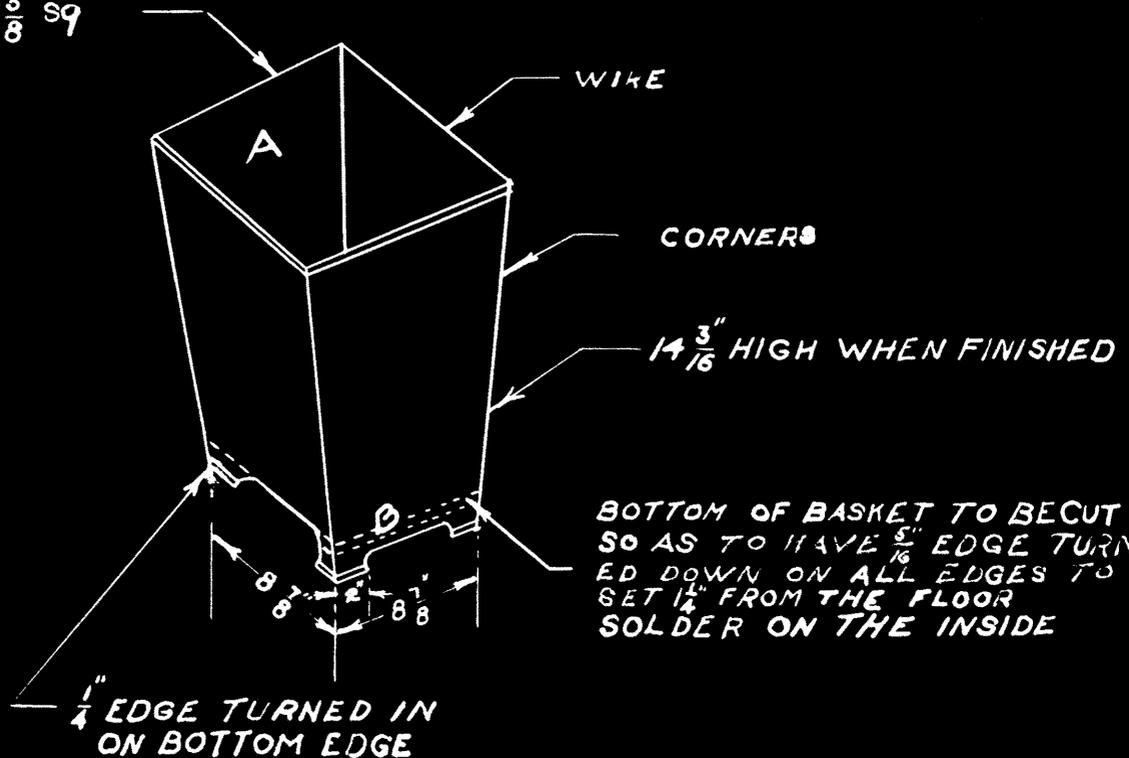
8-Go over all the hammered surface with a flat file to make the marks show up better; go over the hammered surface with an oiled cloth.

9-Lacquer the match holder black. Use a purchased ash tray.

SHEET METAL WASTE PAPER BASKET

TO BE MADE OF # 28 GA.
GALVANIZED IRON

TOP $11\frac{3}{8}$ " sq



BOTTOM OF BASKET TO BE CUT SO AS TO HAVE $\frac{5}{16}$ " EDGE TURNED DOWN ON ALL EDGES TO SET $\frac{1}{4}$ " FROM THE FLOOR SOLDER ON THE INSIDE

COURSE OF STUDY IN SHEET METAL
INDUSTRIAL ARTS MAG.
DEORIA, ILL.

MATERIALS	
A	$14\frac{1}{2}$ " x 46" GALV IRON
B	$9\frac{1}{2}$ " x $9\frac{1}{2}$ " SQ SHEET METAL
	$\frac{3}{16}$ " x 46" WIRE

JOB SHEET NO. 45

HOW TO MAKE A METAL WASTE PAPER BASKET

Part "A"

1-Check out: pattern, scribe, straight jaw tin snips, solder, flux, soldering iron, steel square, mallet, pliers, and snips.

2-Place the pattern over the metal and mark around the edge. Cut out the lines.

3-On the top edge make a 3/8-inch fold on the same side of the metal.

4-On the short edge form a 3/8-inch lap but do not close.

5-On the other short edge form a 3/8-inch lap opposite the first lap. Place a piece of tin the full length and width of the lap, between the fold. Place this lap in the folding machine again, but reverse sides, and form a 3/8-inch lap coming down one-half the way with the handle of the folding machine.

6-Connect corner marks with lines.

7-Form square corners over the square end stake on these lines. Bend on the same side on which laps are formed at the short edges; the bends will be on the side opposite the four laps at the top.

8-Force the laps together at the short edges.

9-Place the inside of Part "A" over a flat stake and hammer down seams with a mallet.

10-Solder this corner on the inside to make it hold in place.

11-Place a wire, $3/16$ inch in diameter, under the top laps; force the tin against the wire with pliers.

12-Turn each way from the bottom corners to the inside, an edge $1/4$ inch by 2 inches. Cut out the corners to form a V so these two edges will come together evenly.

13-Solder these four legs from the inside.

Part "B"

1-Check out: pattern, snips, solder, soldering iron, flux, and scriber.

2-Place the pattern over the work and mark around the edge. Cut out the lines.

3-Turn down $5/16$ -inch edges.

Assembling

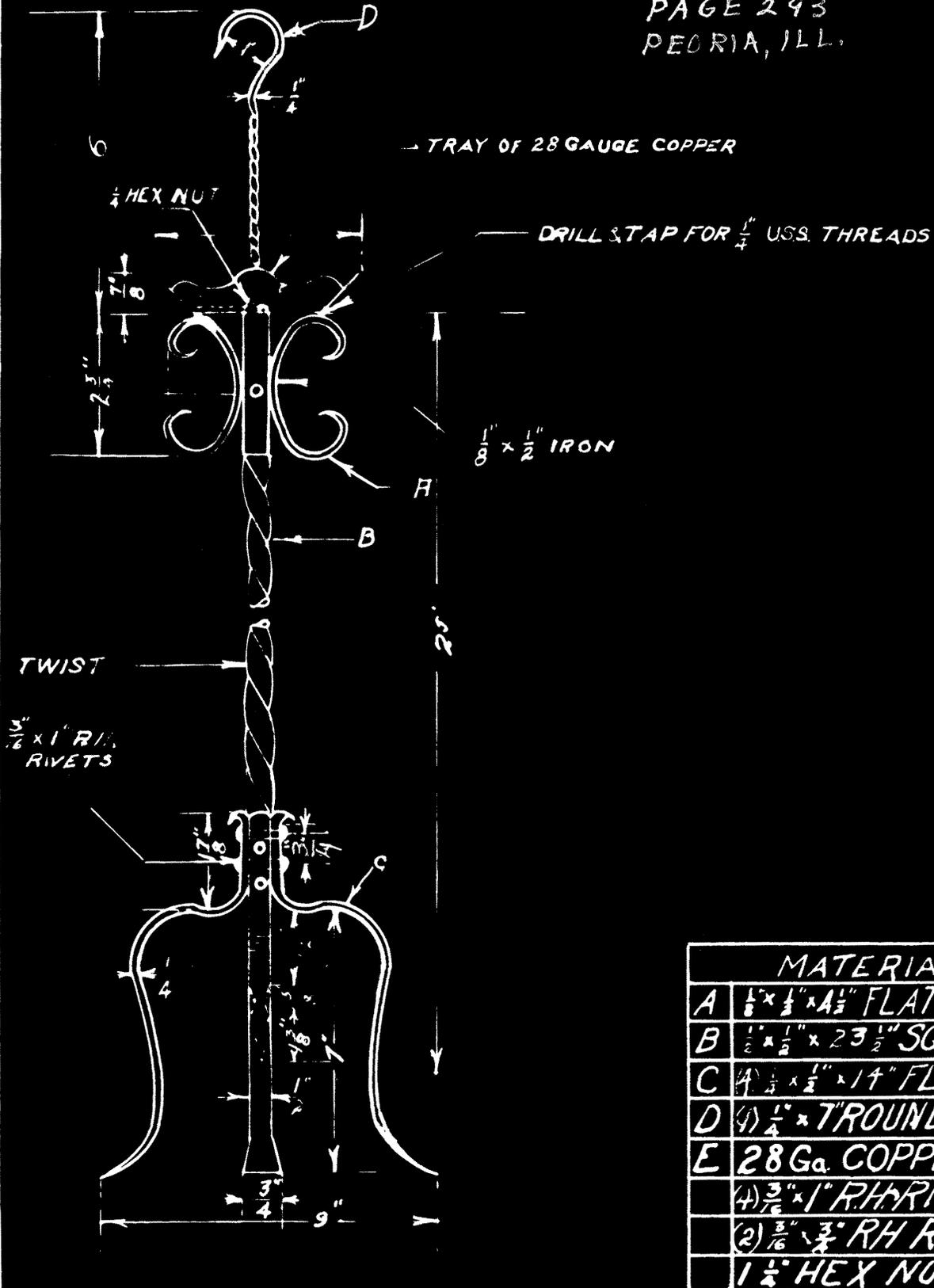
1-Place the metal with the edges down, $1\ 1/4$ inches from the bottom, and solder from the bottom of Part "B" to the sides of Part "A".

2-Smooth all edges with coarse, and then fine emery cloth.

3-Lacquer the basket green. When dry, spray black lacquer on with a spray gun.

SMOKING STAND

IND. ED. MAG.
 FEB. 1928
 PAGE 293
 PEORIA, ILL.



MATERIALS	
A	1/8" x 1/2" x 4 1/2" FLAT IRON (4)
B	1/2" x 1/2" x 23 1/2" SQ IRON
C	4 1/2" x 1/2" x 14" FLAT IRON
D	(4) 1/4" x 7" ROUND IRON
E	28 Ga. COPPER 5" DIAM
	(4) 3/8" x 1" RH RIVETS
	(2) 3/8" x 3/4" RH RIVETS
	1 1/2" HEX NUT

JOB SHEET NO. 46

HOW TO MAKE A SMOKING STAND

Part "A"

1-Check out: center-punch, 3/16-inch drill, forging hammer, and rule.

2-Measure 2 inches from one end of two of the pieces, center-punch and drill 3/16-inch holes.

3-Measure 2 1/4 inches from one end of the other two pieces, center-punch and drill 3/16-inch holes.

4-Bend over the horn of the anvil until the curve is 2 3/4 inches high and 1 3/8 inches from inside the bend to the end. Shape all four pieces in the same way. Forge all ends to chisel edge 5/8 inch wide.

Part "B"

1-Check out: forging hammer, monkey wrench, 3/16-inch drill, tongs, center-punch, 1/4-inch tap, rule, lathe tools, drill chuck, flat file, and emery cloth.

2-Forge a round tapered point on one end, 1 3/8 inches long.

3-From this mark measure 3/8 inch.

4-True this end in an independent chuck with the end 2 inches from the face of the chuck.

5-Use a round nose tool and cut a half-round groove within the 3/8-inch mark; it should not be deep.

6-Measure from the square end 3 1/4 inches, and 9 1/4 inches, respectively. Heat red between these marks

and twist in a vise with a monkey wrench.

7-File the point; then smooth with emery cloth.

8-Change ends and drill a 3/16-inch hole 1 inch deep; tap with 1/4-inch U. S. S. tap.

9-Remove from chuck; measure from the square end 1 3/8 inches and drill a 3/16-inch hole.

10-Measure from the square end 1 1/2 inches and drill a 3/16-inch hole on the side not drilled.

11-Measure from the point 4 inches, and 4 3/4 inches, respectively, and drill 3/16-inch holes; measure from the point 4 1/4 inches, and 5 inches, respectively, and drill 3/16 inch holes on the side not drilled.

Part "C"

1-Check out: hammer, 3/16-inch drill, center-punch, rule, and actual size drawing of the legs of the smoking stand.

2-Forge one end of each piece to a chisel edge, 5/8 inch wide and 1 inch long.

3-Forge the other ends to a square tapered point 1/2 inch long.

4-Grind the ends smooth.

5-Measure from the sharp ends of two pieces, 1 inch, and 1 3/4 inches, respectively; center-punch and drill 3/16-inch holes. Measure from the sharp ends of the other two pieces, 1 1/4 inches, and 2 inches, respectively; center-punch and drill 3/16-inch holes.

7-Have your teacher help you bend one leg as shown on the actual size drawing; bend the other three by yourself.

Part "D"

1-Check out: hammer, 1/4-inch U. S. S. die, flat jaw tongs, and 1/4-inch hexagon nut.

2-Forge a round tapered point on one end 1/2 inch long.

3-Bend a hook over the horn of the anvil until it has an opening of 1 inch. Notice the blueprint.

4-Cut 3/4-inch threads on the other end with 1/4-inch U. S. S. die. Screw the nut on as far as you can.

5-Measure from the end of the threads 1 1/4 inches, and 4 1/4 inches, respectively. Forge the iron between these marks flat and 5/16 inch wide.

6-Heat and twist this forged part.

Part "E"

1-Check out Job Sheet No. 12 and make the tray.

2-Drill a 1/4-inch hole exactly in the center of the tray.

Assembling

1-Check out: riveting hammer, rivet set, and rule.

2-Rivet the two parts of Part "A" that have the holes drilled 2 inches from the end in the hole drilled 1 3/8 inches from the square end of Part "B", placing one

on each side as shown on the blueprint.

3-Similarly, rivet the other two parts of Part "A" in the hole drilled 1 1/2 inches from the square end.

4-Rivet the legs of Part "C" with the holes drilled 1 1/4 inches, and 2 inches, respectively, to the holes on Part "B" drilled 4 3/4 inches, and 4 inches, respectively.

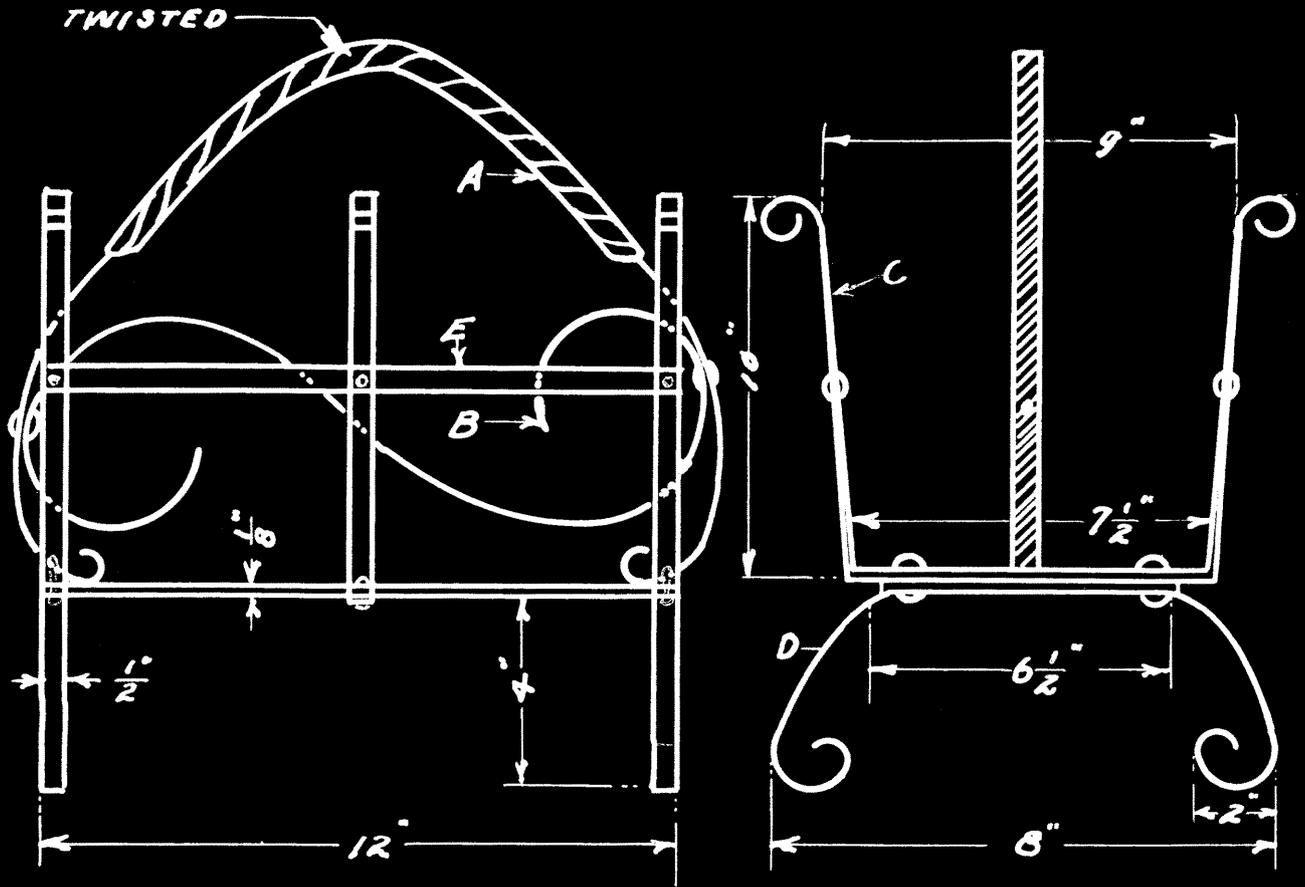
5-Rivet the legs of Part "C" with the holes drilled 1 inch, and 1 3/4 inches, respectively, to the holes on Part "B" drilled 5 inches, and 4 1/4 inches, respectively.

6-Place the hole drilled in the brass ash tray (Part "E") over the threaded hole in the end of Part "B".

7-Screw the threaded end of Part "D" in the threaded hole; tighten the nut to hold the tray.

8-Wipe the smoking stand clean. Lacquer it black and blow gold or red bronzing powder on while it is still wet.

MAGAZINE RACK



MATERIALS

A	(1) $\frac{1}{4}$ " X $\frac{1}{2}$ " X 30" LONG
B	(1) $\frac{1}{2}$ " X $\frac{1}{2}$ " X 24" "
C	(3) $\frac{1}{8}$ " X $\frac{1}{2}$ " X 31 1/2" "
D	(2) $\frac{1}{8}$ " X $\frac{1}{2}$ " X 22" "
E	(4) $\frac{1}{8}$ " X $\frac{1}{2}$ " X 12" "
F	(10) $\frac{1}{16}$ " X $\frac{1}{2}$ " RIVETS-R.H.
C	(6) $\frac{1}{16}$ " X 1" "
	ROUNDHEAD "

JOB SHEET NO. 47

HOW TO MAKE A MAGAZINE RACK

Part "A"

1-Check out: forging hammer, flat jaw tongs, center-punch, 3/16-inch drill, and rule.

2-Forge a blunt chisel edge on each end, 5/8 inch wide.

3-Drill a 3/16-inch hole 1 1/2 inches, and 6 inches, respectively, from each end.

4-Measure from one end to the center which will be 15 inches; measure each way from this mark 7 1/2 inches.

5-Twist the iron between these marks, in a vise.

6-From each end to the hole, form a half-circle 1 inch in diameter. Notice the blueprint carefully.

7-From the hole up to the bend on each side, form a gradual curve from the same side as the half-circles.

8-Make a bend in the center of the twist about 6 inches across so that the handle is about 12 inches from the floor.

9-The distance from hole to hole should be 11 1/2 inches.

Part "B"

1-Use the same tools as in Part "A".

2-Grind the ends blunt and sharp.

3-Notice the blueprint carefully and shape each end the same, over the horn of the anvil and in the vise.

The length of the S should be 13 inches and the inside diameter of the curve at each end should be 4 inches.

4-Place Part "B" inside Part "A" so the center of the curve on each end of Part "B" will be over the holes of Part "A"; mark, center-punch and drill 3/16-inch holes.

Part "C"

1-Use the same tools as in Part "B".

2-Forge a chisel edge on each end 5/8 inch wide. Turn a 1-inch curve on each end on the same side. Check to see that all three pieces are the same length.

3-Measure from one end of each of the three pieces 15 3/4 inches and mark. Drill 3/16-inch holes on two of these marks.

4-Measure each way from these marks 2 3/4 inches, center-punch and drill 3/16-inch holes.

5-Measure from each end 7 inches, center-punch and drill 3/16-inch holes.

6-Measure each way 3 3/4 inches from the 15 3/4-inch mark and make a square bend.

7-The top ends should be 9 inches apart, inside measurement.

Part "D"

1-Use same tools as before.

2-Forge a chisel edge on each end 5/8 inch wide; grind the ends blunt.

3-Measure to the center (11 inches) and mark; drill 3/16-inch holes.

4-Measure each way from these holes 2 3/4 inches, center-punch and drill 3/16-inch holes.

5-Turn a curve on each end from the same side of the iron, 2 inches in diameter; do not close the ends.

6-Measure each way from the center hole, 3 1/4 inches and mark. Bend from the same side of the iron as the curved ends; the bends should be made in the vise but should not be square bends.

7-The distance between these bends should be 6 1/2 inches, while the distance between the outside curved ends should be 8 inches; the distance from the floor to the flat distance between the holes, should be 4 inches.

8-The outside edges of the legs will be straight from the end curves to the 6 1/2-inch bends.

Part "E"

1-Check out: rule, hammer, center-punch, and 3/16-inch drill.

2-Grind the ends blunt and make sure that each piece is exactly 12 inches long.

3-Drill a 3/16-inch hole 1/4 inch, and 6 inches, respectively, from each end of each piece.

Assembling

1-Check out: rivet set, riveting hammer, flat file, black lacquer, gold bronzing powder, and brush.

2-Notice the blueprint carefully to see how parts go together.

3-Place Part "C" on the bench with the ends in an upright position with the two outside pieces 12 inches apart; the other will later be placed half-way between.

4-Place the four parts of Part "E" over the holes on the inside of Part "C"; put the rivet heads through the holes from this side.

5-Rivet the ends of two pieces of Part "E" through holes drilled 7 inches from the small curves of Part "C".

6-Stand the two legs upright; place the holes $2 \frac{3}{4}$ inches from the center of end pieces of Part "C" over the holes drilled in Part "D" $2 \frac{3}{4}$ inches apart.

7-Place the holes in the other two pieces of Part "E" over these holes; place the rivets through these three parts and rivet from the bottom side.

8-Place the central part of Part "C" in position on the outside and rivet to the center holes drilled in the four parts of Part "E".

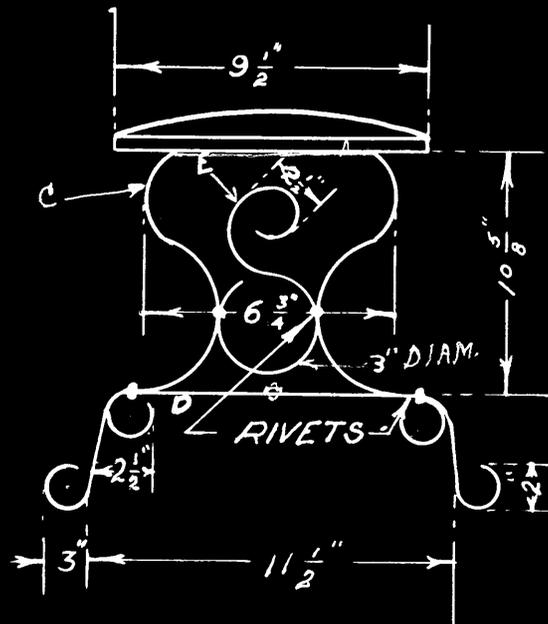
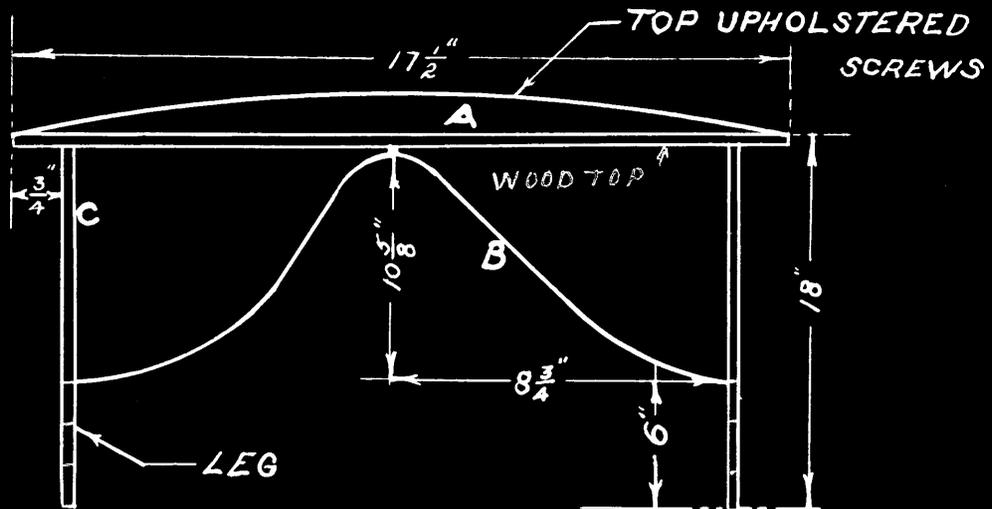
9-Place the holes in the end of Part "A" over the holes drilled on the center lines of the end pieces of Part "C"; the curve for the handle will be in an upright position as shown on the blueprint. Place rivets through holes and rivet.

10-Place the holes in the curves of Part "B" inside Part "A" and rivet. File the rivet heads smooth.

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11-Lacquer the rack black and blow gold bronzing powder on at intervals to make the metal appear spotted.

FIRESIDE BENCH



MATERIALS	
A	$\frac{3}{4}$ " x $9\frac{1}{2}$ " x $17\frac{1}{2}$ " PINE BOARD
B	(1) $2\frac{1}{2}$ " x 8 " x 30 " IRON FLAT
C	2 $2\frac{3}{8}$ " x $2\frac{3}{8}$ " x 60 " " "
D	2 $2\frac{1}{2}$ " x $2\frac{1}{2}$ " x 16 " IRON
E	2 $2\frac{1}{2}$ " x $2\frac{1}{2}$ " x 15 " " "
F	8 $\frac{3}{8}$ " x 1 " RIVETS
G	5 $\frac{3}{4}$ " x 1 " FLAT HEAD SCREWS

JOB SHEET NO. 48

HOW TO MAKE A FIRESIDE BENCH

Part "A"

1-Be sure the board is smooth on all sides and on the end.

Part "B"

1-Check out: center-punch, hammer, 3/16-inch drill, rule, and ball-peen hammer.

2-Measure 5/16-inch from each end and drill 3/16-inch holes. Measure 15 inches from the end, center-punch and drill a 3/16-inch hole.

3-Place material over the large hole on the anvil starting about 3 inches from the end. Strike lightly over the hole as you slide your work back and forth, but do not come closer than 4 inches to the hole in the center.

4-Do the same thing to the material at the other side of the hole.

5-Turn the iron over and place the center hole over the hole on the anvil and strike straight down with the hammer; hammer as far as 4 inches each way from this hole until you have a good curve.

6-Hold the curve in your hand and place the ends on the floor; measure from the floor up to the inside of the curve, springing the work until it measures 10 5/8 inches.

Part "C"

1-Check out: 3/16-inch and 1/2-inch drills, center-punch, and forging hammer.

2-Measure from the end of each piece 30 inches and mark. Measure each way from these marks 2 1/2 inches, center-punch and drill 3/16-inch holes. Countersink these holes slightly.

3-Forge a blunt chisel edge on each end 3/4 inch wide.

4-Curve the four ends over the horn of the anvil; the bends should be on the same side of the work and bent to an outside diameter of 3 inches.

5-Measure from each end 6 inches, and 13 inches, respectively, center-punch and drill 3/16-inch holes.

6-Measure each way from the center line 3 3/8 inches and mark; catch this in the vise on the flat sides, having the marks even with the jaws on the vise.

7-Pull the ends around until they are 6 3/4 inches apart. Do both parts of Part "C" the same.

8-Measure from the bends on each side 9 inches and mark.

9-Place the marks over the horn of the anvil and bend with your hands; the distance between these two holes, 9 inches from the last bend, should be 3 inches.

10-Curve from the inside at the holes drilled 6

inches from the ends on each side; these holes are 6 inches from the floor and 11 inches apart.

11-Separate the legs at the bottom 11 1/2 inches.

Part "D"

1-Check out hammer and 3/16-inch drill.

2-Forge a chisel edge on each end.

3-Drill 3/16-inch holes 1 1/2 inches from each end and in the center which is 8 inches from the end.

4-Slightly curve each end down to the holes from the same side.

Part "E"

1-Check out a hammer.

2-Form an S over the horn of the anvil and in the vise. The larger diameter of the curve will be 3 inches at the bottom while the smaller diameter will be 2 1/2 inches. Notice the blueprint carefully and see your teacher.

Assembling

1-Check out: riveting hammer, 3/16-inch drill, and scriber.

2-Place the holes in Part "D" in line with the holes drilled 6 inches from the ends of Part "C" and rivet them. The curves on Part "D" are turned downward.

3-Place the large curve between the holes on the legs 3 inches apart; mark through holes from the outside, center-punch and drill holes in Part "D".

4-Place head of rivet on the inside and form a head on the outside.

5-Stand the legs on the floor 16 inches apart.

6-Place holes in end of Part "B" over holes in center of Part "D"; have the rivet heads on top and rivet from the bottom. The center curve of Part "B" should be 16 5/8 inches from the floor.

7-Lay the pine board (Part "A") on the bench; turn the legs upside down and place the four countersunk holes over the board; the legs should be 3/4 inch from the end of the board and equally distant from the sides. Place screws in holes.

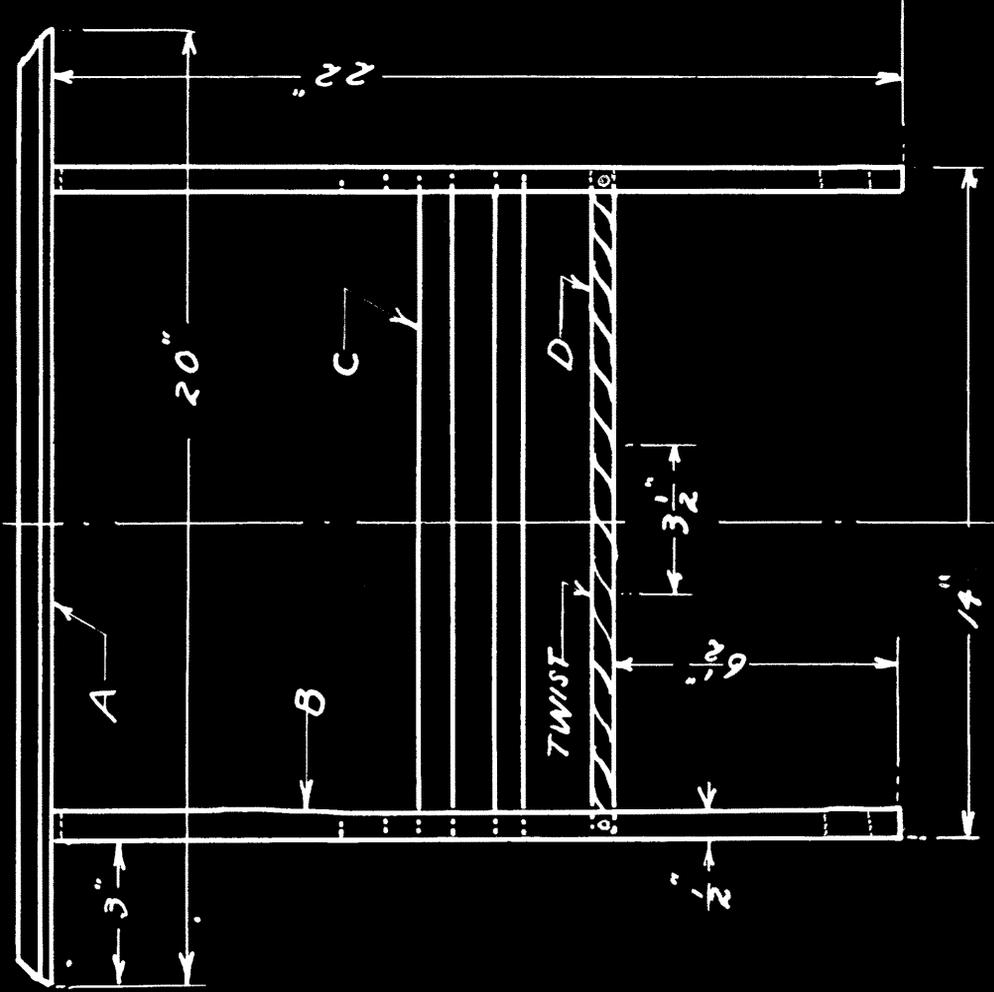
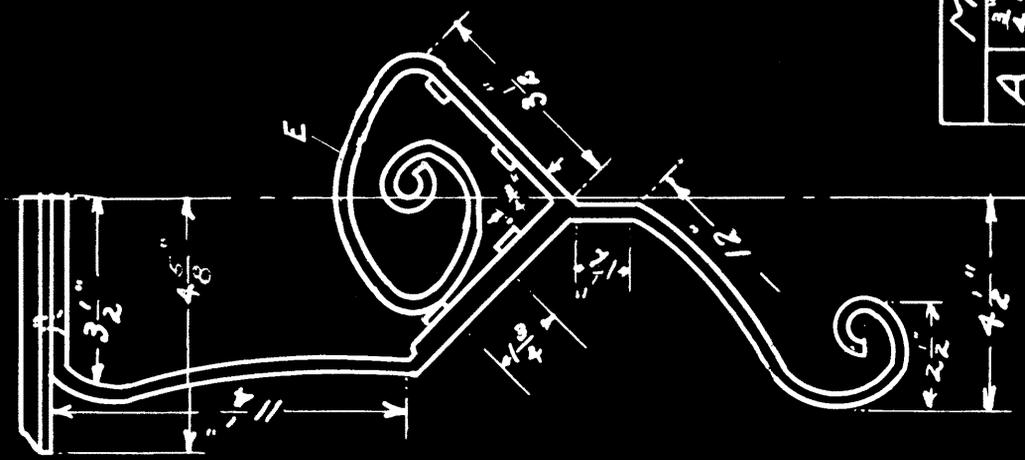
8-Place upholstering hair on top of the bench, pulling it apart and distributing it evenly over the top; cover tightly with burlap and tack underneath.

9-Cover with velvet, or any material desired, holding it in place as you tack around the edge. Then tack fringe around the edge of stool.

10-Lacquer the metal part black; blow gold bronzing powder on at intervals while it is still wet.

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END TABLE

MATERIALS	
A	$\frac{3}{4}$ " X $9\frac{1}{2}$ " X 20" TABLE TOP
B	$\frac{3}{8}$ " X $\frac{1}{2}$ " X 62" LEGS (2)
C	(4) $\frac{1}{8}$ " X $\frac{1}{2}$ " X 14" FLAT IRON
D	$\frac{3}{16}$ " X $\frac{1}{2}$ " X $1\frac{1}{2}$ " " "
E	(2) $\frac{1}{8}$ " X $\frac{1}{2}$ " X 23" RACK
F	(10) RIVETS $\frac{1}{8}$ " X $\frac{3}{4}$ " R. H.
	FLAT HEAD SCREWS



JOB SHEET NO. 49

HOW TO MAKE AN END TABLE

Part "A"

1-The wood top will be cut out, beveled and finished in the school wood shop.

Part "B"

1-Check out: hammer, rule, center-punch, 3/16-inch drill, and an actual size drawing of the end view of the legs on graph paper.

2-Bend the legs on the anvil and in the vise until they have the same shape as shown on the drawing. See your teacher.

3-Mark and drill the holes in all the places called for on the drawing.

4-Draw a line 3 inches from each end of Part "A" parallel to the ends.

5-Place one edge of the top part of the legs even with the lines on the inside. Place wood screws in holes and tighten.

Part "C"

1-Check out: center-punch, 3/16-inch drill, hammer, and rule.

2-Measure 1/4 inch from the ends, center-punch and drill 3/16-inch holes.

3-Grind the end square.

Part "D"

1-Check out: center-punch, hammer, 3/16-inch drill, and flat jaw tongs.

2-Drill a 3/16-inch hole 1/4 inch from the ends.

3-Measure from each end 5 1/2 inches and mark; heat red between these marks and twist in a vise.

4-Place ends of Part "D" between the legs with holes in Parts "D" and "B" in line; rivet together.

Part "E"

1-Use the same tools as before and an actual size drawing of Part "E".

2-Measure from one end 3 1/2 inches and make a square bend to the inside over the corner of the anvil.

3-Measure from this corner 3 1/2 inches and make a square bend to the inside.

4-Bend the curved section of Part "E" until it fits exactly over the drawing.

Assembling

1-Use same tools as before.

2-Rivet the ends of Part "C" to Part "E". Notice the blueprint. File all rivet heads smooth.

3-Lacquer the metal parts black; blow gold bronzing powder on while it is still wet.

4-The wood top will be stained walnut in the wood shop.

JOB SHEET NO. 50

HOW TO MAKE A PLANER JACK

Part "A"

1-Check out: outside calipers, inside calipers, rule, lathe tools, boring tool, knurling tool, can of oil, flat file, half-round file, 3/4-inch U. S. S. tap, 5/8-inch and 1 3/16-inch drills, and center-drill.

2-Chuck your work in a universal chuck and center-drill each end.

3-Face the end and cut the entire length down to a diameter of 2 3/8 inches.

4-Measure from one end 11/32 inch and mark; measure from this mark 2 1/16 inches and mark. Cut the steel between these marks slightly round starting 11/32 inch from the large round end and gradually cut down to a diameter of 1 3/16 inches from the extreme large end. The distance of 2 1/16 inches will not be straight when finished. See your teacher.

5-Measure from the small end 1/16 inch and cut a bevel.

6-Measure from this mark 3/16 inch and knurl.

7-Measure from the last mark 1/8 inch and cut a round groove with a round nose tool, 1/16 inch deep and 1/8 inch wide. Leave your work in the lathe chuck.

8-Place a 5/8-inch drill in the tailstock; start

the hole in the center-drill hole and drill the hole 3 inches deep.

9-Remove the drill and replace with a 13/16-inch drill.

10-Follow the same hole and drill 1 5/8 inches from the large end.

11-Place the inside boring tool in the tool post.

12-Set the compound rest out of line 70 degrees to the right of the zero mark. Have your teacher to help line up your boring tool and demonstrate by taking a few cuts with the boring tool.

13-Cut the inside slightly round to match up with the outside curve; the thickness between these curves should be 11/32 inch.

14-Smooth the inside with emery cloth.

15-Place the surplus material in the chuck.

16-File all marks from the outside of Part "A", following with coarse and then fine emery cloth.

17-Cut off Part "A" with the hack saw on the mark 2 3/4 inches from the large end.

18-Place tin around the large part of Part "A" and catch it in a vise with the small end up.

19-Run a 3/4-inch U. S. S. tap through the hole.

Part "B"

1-Check out: lathe tools, rule, outside calipers,

knurling tool, center-drill, 5/16-inch drill, right hand tool holder, U. S. S. threading tool, thread gauge, dividers, surface gauge, and V blocks.

2-Center-drill each end.

3-Face each end; cut work down to a diameter of 1 3/16 inches.

4-Place one end in a universal chuck and the other end on the dead center.

5-Measure from this end 2 3/4 inches and cut it to a diameter of 3/4 inch.

6-Have your teacher to line up your work; adjust the lathe for cutting 3/4-inch U. S. S. threads on a 3/4-inch round surface.

7-Watch carefully while your teacher demonstrates cutting threads to you; go through the same operations, cutting the threads deep enough so Part "A" will screw over them.

8-Measure from the threaded end 2 9/16 inches; cut a round groove 1/2 inch in diameter between the 2 9/16-inch mark and the 2 3/4-inch mark.

9-Measure from this mark 9/16 inch and knurl.

10-Measure from this line 7/8 inch and cut it down to a diameter of 15/32 inch.

11-Cut a square shoulder on the dividing line between the knurled surface and the 15/32-inch round surface.

12-Measure over half of the knurled part ($9/32$ inch) and center-punch.

13-Clamp the threads in a V block; use the dividers to mark an equal distance from each side of the V block.

14-Keeping the work horizontal, drill a $5/16$ -inch hole.

15-Place the handle (Part "D") in the hole.

16-Turn the threads in the V block $1/4$ turn and clamp.

17-Place the base of the surface gauge on the table of the drill press; adjust the curved point until it touches the top edge of the handle on each end.

18-Place one leg of the dividers against one side of the hole on the knurled surface and place the other leg on the extreme high part of the knurled edge.

19-Repeat on the other side of the hole. Center-punch where these lines meet and drill a $5/16$ -inch hole.

Part "C"

1-Check out: lathe tools, and outside calipers, $5/8$ -inch and $15/32$ -inch drills, rule, center-square, cutting-off tool, and hack saw.

2-Chuck work and face the end; cut it down to a diameter of $1\ 7/16$ inches.

3-Measure from one end $1/4$ inch and knurl.

4-Measure from this mark $5/8$ inch and gradually

cut this part down to a diameter of $1 \frac{3}{16}$ inches, $\frac{7}{8}$ inch from the large end.

5-Drill a $\frac{15}{32}$ -inch hole through the entire work on the lathe.

6-Ream out this hole with a $\frac{5}{8}$ -inch drill, starting at the large end, to a depth of $\frac{5}{16}$ inch. File and finish.

7-On the large end cut two $\frac{1}{16}$ -inch wide circles across the face. See your teacher.

8-Measure from the large end $\frac{7}{8}$ inch and cut off the work with a cutting-off tool.

9-Catch Part "C" in a vise with the large flat end in a horizontal position.

10-With a pair of dividers step the round end off into eight equal parts.

11-Connect opposite marks with the center-square. There will be an angle of 45 degrees between these lines.

Assembling

1-Check out: ball-peen hammer, and center-punch.

2-Place tin around the threads on Part "B" and catch it in a vise with the small end up.

3-Place the hole in Part "C" over this round end with the knurled end up.

4-Rivet the small end of Part "B" inside the reamed hole of Part "C"; swell this head with a center-

punch.

5-Screw the threaded end of Part "B" into the small threaded end of Part "A".

6-Place a rod, $5/16$ inch by 6 inches, in the $5/16$ -inch hole for a handle.

7-Give the planer jack a coat of oil with an oiled cloth.

GENERAL DISCUSSION AND SUMMARY

This study presents a course of study in general metal shop which is adapted to retarded youth. A series of general information sheets have been worked out which give information which the student will need at intervals during the year; at such times he will refer to them to secure such information as he needs at that time. Following this are blueprints of 50 projects, accompanied by job sheets to tell him each step in making each project. These blueprints are not drawn to scale because it is not necessary. All he needs is a true picture of the project, with dimensions; the material he needs is also given on the blueprint and is to be checked out from the teacher. The job sheet tells him what tools he will need, what to do, and the order in which he is to do it.

This study is planned for two years work in general metal shop; the projects are arranged in order of difficulty from the simple to the complex. There is a sufficient variety so that there are projects which will appeal to all types of boys. The cost per project ranges from a few cents to less than two dollars so that any boy can afford to take general metal shop. In some cases of boys who were poor, the projects were made and sold to people who wanted them. The following projects were sold during the past year: knives, screw drivers, ice picks,

SUMMARY

This study presents a course of study in general metal shop which is adapted to retarded youth. A series of general information sheets have been worked out which give information which the student will need at intervals during the year; at such times he will refer to them to secure such information as he needs at that time. Following this are blueprints of 50 projects, accompanied by job sheets to tell him each step in making each project. These blueprints are not drawn to scale because it is not necessary. All he needs is a true picture of the project, with dimensions; the material he needs is also given on the blueprint and is to be checked out from the teacher. The job sheet tells him what tools he will need, what to do, and the order in which he is to do it. This study is planned for two years work in general metal shop; the projects are arranged in order of difficulty from the simple to the complex. There is a sufficient variety so that there are projects which will appeal to all types of boys. The cost of the projects range from a few cents to less than two dollars so that any boy can afford to take general metal shop.

hammers, house numbers, flower stands, lamps, smoking stands, grocery reminders, mail boxes, and fireside benches. In some cases of boys who were furnished food and clothing by the county, a list of projects for which they were unable to pay, was turned in to the county, and the county paid for the material in these projects.

This experiment indicated that many of the subnormal, underprivileged, or retarded youths are really not subnormal; they are merely misfits and need help in becoming adjusted to their normal school life. The regular school subjects will not accomplish this end but such special courses as the type covered in this thesis, if properly taught, will assist in readjusting them. In the Edison School the boy is allowed to select his project; in the junior high schools, he must follow the course of study and does not have as much choice. In the Edison School the classes are smaller and more individual instruction is given while in the junior high schools the classes are larger and the work is given to the class as a whole. Boy psychology is used in the Edison School to good effect to reach the misfit as well as the dullard; such projects as the dagger, hunting knife, monel ring, and aeroplane were included to appeal to certain types of boys.

Interest in the work is secured in various ways. Some days the boys were told that if they worked diligent-

ly during the period they would be allowed to play ball for ten minutes at the end of the period. Others were adult minded or vocationally minded and were appealed to through the medals and prizes offered by the Cosmopolitan Club. When told they might win cash prizes they were interested in completing their projects and wanted to come in and work on them at the lunch hour or after school.

These students are able to evaluate the worth of school subjects; if they are interested in the subject they will work. Under the flexible plan in operation at the Edison School they are enrolled in certain classes and if they are not interested in the work or do not get along well with the teacher, they are immediately transferred to some other class. This could not be done in a junior high school operating under the usual rigid program plan.

Certain cases of students are given here to show that the Edison School is functioning in giving special training to these misfits and helping them to adapt themselves to school life:

Case 1 went to the Edison School one year; then went back to junior high school and is now in senior high school and playing on the football team.

Case 2 came from Germany and was unable to speak the English language; he went to the Edison School one semester and was then able to transfer to junior high school.

Case 3 came to the Edison School because he could barely read and write; he has been there three years now and will go to junior high school next year.

Case 4 , a Greek boy, has been in the Edison School one year because of a language handicap; he will be sent to junior high school next year.

Case 5 is 24 years old; he is retarded in most of his school work but especially in spelling and mathematics. He will transfer to junior high school this next year after spending two years in the Edison School.

Case 6 after attending the Edison School two years transferred to the part-time school, secured a working permit and is now holding down a job.

Case 7 came from the Ozark Mountains of Arkansas although 19 years old he had gone to school only three months during his life. He was placed in the highest group at the Edison School and is allowed to advance as rapidly as he can. A certain woman's club in Tulsa ordered two dozen grocery reminders; this boy made about half of these to earn some money to help pay for other projects. One of these won a medal in the Cosmopolitan Club contest.

Mrs. Griffith of the Denver Opportunity School, in a talk before the Trade and Industrial Club at Fort Collins, Colorado in 1930 told of a boy who was transferred from a senior high school to the Denver Opportunity School. On his card was written the word, "moron". He said, "They

say I'm a m-m-m-me-ron." She told him that it only meant that he stuttered. He took special work there then went on and finished high school; he is now a good Engineering student in the University of Colorado. This is another case of the value of the training given in special schools and bears out the writer's experience with these pupils.

CONCLUSION

Francis N. Maxfield (6) says, "The primary objective in these industrial arts in the special class as pre-vocational training is to cultivate an attitude of work --- following directions, punctuality, dependability, cheerfully sustained effort, interest in the job."

The unskilled or semi-skilled occupations which these boys go into on leaving school are of so varied a character that it is not practicable to attempt vocational training. The work of the special class is therefore, primarily pre-vocational rather than vocational.

The job sheets, blueprints, and general information sheets are not to take the place of the teacher, but are teaching devices that will help the student as well as the teacher.

Out of a possible 300 projects, 50 projects were selected to include in this course of study. Every project has actually been made in the shop by retarded youth, during the past two years.

The students were interested in making these projects and wanted them when they had finished making them. At the close of the school year there was not a single project left on hand in the shop; this shows that the projects were not too expensive. In preceding years there had always been several projects left on hand at the close of school. Furthermore, the Edison Metal Shop made

a profit of \$1.90 this last year on material that went into projects.

The arrangement in the Edison School Metal Shop is comparable to the arrangement of metal shops in other special schools.

It is possible to find specific instructional material which is fitted to the needs of these students; for example, the 50 projects included in this course of study.

In competition, students taught in an organized school by projects selected in this way do secure a rating; for example, the prizes won in the Cosmopolitan Club contest held in Tulsa this last spring.

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