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Some Interesting Projects in Foundry

Paul M. Paulson
Central Washington University

SOME INTERESTING PROJECTS IN FOUNDRY

by

Paul M. Paulson

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CHAPTER I

INTRODUCTION AND PURPOSE OF THE STUDY

Foundry work is one of the largest branches of the metal working industries but still it is ignored by many of our schools today. Numerous reasons are given, such as lack of space, high cost of equipment and the dangers involved. Modern equipment and methods have outmoded these excuses. Jones[1] claims an alert teacher can locate and purchase or even make any foundry equipment and supplies to meet the school budget if he so desires.

The purpose of this study is to acquaint industrial arts teachers with some projects and practices of foundry work as a possible part of their industrial arts program. One of the most persistent problems which faces the industrial arts teacher is the selection of suitable projects for his classes. Students should be encouraged to choose and even design their own projects but experienced teachers know that this is not possible with all students. Wilbur[2] writes that it is therefore necessary the instructor have

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[1]Mervyn T. Jones, "Foundry Work in the Junior High School," Industrial Arts and Vocational Education, 40:414, December, 1951.

[2]Gordon O. Wilbur, Industrial Arts in General Education (Scranton: Haddon Craftsmen, Inc., 1948), p. 87.

on hand a list of "type projects" from which a choice can be made that is suited to the grade level and ability of the students.

Students of the junior high school level are extremely enthusiastic about foundry work and there are almost unlimited possibilities in this field. No student needs to be neglected in this area. Projects can be developed to meet the individual abilities of each student so he may feel some measure of success and accomplishment.

It is gratifying to watch the look of anticipation upon a student's face when he is about to break open a mold that has been recently poured. The entire class is as eager to see the results of the casting as the person who made the mold. Parents are also pleased when their child brings home an attractive and useful project which has been made in the foundry area.

Practical foundry projects and techniques are divided into six areas in the following pages. Descriptive pictures are conveniently located at the end of each project unit. Periodic reference to these pictures will aid the reader in a better understanding of the techniques used to produce the castings.

The terms and their definitions used in this project are contained in Appendix A.

CHAPTER II

RELATED INFORMATION

Patterns. Patterns are constructed of wood or metal and are replicas, except for size, of the objects which are to be cast. Since most metals shrink when they cool, it is necessary to make the patterns a little larger than the castings. The Cast Metals Handbook[3] states that all types of metals do not shrink equally. For example, aluminum shrinks three-thirty seconds of one inch per foot; cast iron shrinks one-eighth of one inch per foot; steel shrinks one-fourth of one inch per foot and copper shrinks three-sixteenths of one inch per foot.

Duddle[4] claims mahogany is generally used for patterns but pine or any other stable soft wood is also satisfactory. To make it easy to draw patterns from the mold, the surfaces of the patterns are polished.

Smith[5] remarked that patterns must be beveled on the

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[3]American Foundrymen's Association, Cast Metals Handbook, Third edition (Chicago: American Foundrymen's Association, 1945), p. 10.

[4]R. S. Duddle, The Craft of the Metalworker (London: The Technical Press Ltd., 1951), p. 112.

[5]Robert E. Smith, Units in Pattern Making and Founding. (Bloomington: McKnight and McKnight Publishing Company, 1939), p. 5.

sides so that they can be drawn from the molding without damaging the mold. The slant of the sides of a pattern is the draft. Thus the part of the pattern farthest down in the sand is slightly smaller than the part at what is known as the parting line or the line along which the division of the mold is made. This is sometimes known as the cope surface. The amount of taper varies with different patterns. Sometimes only a very slight taper is needed. For ordinary work, the common practice is to allow one-sixty fourth of one inch draft per inch of draw face.

Molding sand. Wendt[6] said selecting molding sand for the school shop must be given careful consideration. For small castings, requiring a smooth surface, a molding sand containing sufficient amounts of silica, clay, loam and of a fine grain structure must be used. Sand suitable for the school shop should be cohesive when moistened to the proper degree and rammed to sufficient hardness. It must stick together when the mold is handled and must be tough enough to allow the metal to run over it without washing or cutting into it. Molding sand must be sufficiently refractory to withstand high temperatures as high as three thousand degrees Fahrenheit. It should be porous in order to allow

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[6]R. E. Wendt, Foundry Work (New York: McGraw-Hill Book Company, Inc., 1936), p. 33.

the free escape of all steam and gases that are generated when the mold is poured. The sand should be strong so it will not wear out quickly or crumble when subjected to heat.

Tempering of sand. Wendt[7] claims the tempering of sand means the mixing of the sand with water to the proper degree of dampness. If there is more moisture in the sand than can be driven out when the mold is poured, the metal may be blown out by the steam formed. If the sand is too dry, it may drop out of the flask when the mold is handled, or the metal is likely to cut into the sand and cause sand holes in the castings.

Preparing the sand. Smith[8] said the best method to test for proper temper is to grasp a handful of sand and squeeze it into a lump. Break the lump, and if the edges of the broken surface remains sharp and firm, the sand contains sufficient moisture and is ready for use. If the edges break and crumble, and the lump falls apart, the sand is too dry. If the sand makes the hand muddy or if the sand feels soggy, the sand is too wet. If the sand is too wet, sprinkle a small amount of dry sand over the pile and mix thoroughly. Should the sand be too dry, add a little water and mix thoroughly to eliminate spots in the sand.

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[7]Ibid., pp. 33-34.

[8]Smith, op. cit., p. 33.

Care of the sand. When the sand is in use every day, Wendt[9] said it will become weak, causing trouble in making the mold. After the sand has been used a number of times, the sharp edges have become rounded, partly from wear and partly from the high temperature of the molten metal. New sand, which has never been used before, is stronger than it need be, and when added makes up for the weakening of the old sand. In this manner, sand may be used over and over without replacing the whole amount at any time.

After the sand has been used for a time, it will give better results than when new. Castings from old sand generally will be smoother than those made in all new sand.

Ramming the sand. Stimpson and Gray[10] claim the object of ramming is to make the sand hang in the flask and to support the walls of the mold against the flow and pressure of molten metals. The knack of ramming just right comes with continued practice. Hard ramming closes up the vent, causing blowholes. Soft ramming leaves a weak mold surface and will tend to make the casting larger than the pattern and leave bulges or lumps on the casting.

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[9]Wendt, op. cit., p. 34.

[10]William C. Stimpson and Burton L. Gray, Foundry Work (Chicago: American Technical Society, 1940), p. 26.

Venting the mold. Stimpson and Gray[11] also said there is a considerable amount of air, steam and gas in the molds which must be driven out of the sand when the metal is poured; otherwise, blowholes will occur. It is important that these gases pass off quickly and as completely as possible. If they do not find free escape through the mold they are forced back into the liquid metal in the mold causing the metal to boil or blow. This reaction may cause the metal to blow out through the risers or simply form numerous little bubble-shaped cavities in the casting called blowholes.

The molder cannot depend entirely upon the porosity of the molding sand, but must provide vents or channels for the escape of these gases. For light work, the use of the vent wire through the sand in the cope will serve the purpose.

Stimpson and Gray[12] again said that on castings of medium weight, risers are placed directly on the casting or just off to one side. Gates are connected to the mold from the riser. These risers are left open when the mold is poured and provide for the escape of the air from the mold.

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[11]Stimpson and Gray, loc. cit.

[12]Stimpson and Gray, op. cit., p. 27.

The major reason for risers on castings is to compensate for the liquid shrinkage which occurs while the casting solidifies.

Parting materials. Wendt[13] claims that almost all molds are made in parts, that is to say, one part is made on top of the other. The sand between the cope and drag will stick together unless a parting material is put between the two sections. The most common sand used for this purpose is called parting sand. This sand contains little or no clay. Some molders prefer burned core sand or burned sand that is cleaned from the castings. Any of these sands are suitable. There are also some manufactured parting compounds but they cost more than parting sands. These commercial parting compounds are not used so much commercially but are more convenient for the school shops than parting sands.

Preparing the metal. Smith[14] remarked that metals with low melting points, such as lead and type metal can be melted in an iron pot or ladle over a bench gas furnace. The melting of metals such as aluminum and brass requires a ceramic crucible and a forced draft type of melting furnace. Coal forges and electric furnaces are other ways

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[13]Wendt, op. cit., p. 38.

[14]Smith, op. cit., p. 44.

for melting metals in the school shop.

The temperature of the molten metal may be determined with a pyrometer equipped with a lance or feeler. The lance is inserted into the metal; the temperature registered may then be read on the dial of the pyrometer.

Before the metal is poured into the mold, the operator will notice impurities floating on top of the molten metal. These impurities must be skimmed off preparatory to pouring.

While pouring, flow the metal in a steady continuous stream. Continue pouring until the metal fills the pouring basin or sprue to the top. If the casting is thin, be sure to pour the hot metal rapidly.

Safety. Smith[15] also said the melting pot must be free from moisture, or steam is likely to explode the metal. Safety goggles, asbestos apron and asbestos gloves should always be worn by the individual while pouring molten metals. A further safety precaution is to make sure that the path from the furnace to the mold is clear before any metal is to be poured. Other students should be instructed to stay away from the area while the pouring operation is taking place.

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[16]Smith, op. cit., p. 45.

CHAPTER III

SELECTED PROJECTS

How to Cast a Flower Frog

The flower frog is a unique project which a student can make in a short period of time. This project is popular during the seasons when cut flowers are in abundance. Frog patterns of all shapes and sizes can be easily made.

Procedure for making the pattern.

1. Determine the size and shape of the flower frog.
2. Select a piece of stock, preferably mahogany, pine, or any stable soft wood, to make the pattern.
3. Saw the selected stock to size.
4. Fill all holes with putty or wood filler.
5. Apply one or two coats of shellac.

Procedure for casting a flower frog.

1. Place the pattern and the drag on the molding board with the pins of the drag in a downward position.
2. Dust the molding board and pattern thoroughly with parting powder.
3. Riddle molding sand over the pattern to a depth

of one inch or more.

4. Tuck the sand around the pattern with the fingers into the recesses of the pattern.
5. Shovel sand into the drag until it is heaping full.
6. Ram the sand with a bench rammer.
7. Strike off the excess sand with a strike off bar.
8. With a vent wire, punch a series of holes in the sand over and along the edges of the pattern. Do not punch the holes directly to the pattern, but approximately one-eighth of one inch away.
9. With the help of an assistant, gently turn the molding board and the drag completely over until the drag is facing upward.
10. Remove the molding board.
11. With the bellows, blow all loose sand from the drag and exposed part of the pattern.
12. Place the cope on the drag.
13. Place the sprue pin about one inch away from one end of the pattern and the riser pin the same distance away from the other end of the pattern.
14. Dust parting powder on the surfaces of the molding sand in the drag.
15. Cover the pattern to a depth of one inch or more with riddled sand.

16. Tuck the sand into the recesses of the pattern and around the sprue and riser pins.
17. Fill the cope heaping full of unsifted sand.
18. Repeat the same operations of ramming the cope as was done with the drag.
19. Vent the cope as was done with the drag.
20. Remove the sprue pin and riser pin, and with a slick, cut a pouring basin at one side of the sprue hole.
21. Pack all loose sand around the sprue and riser holes before lifting the cope from the drag.
22. Grasp the ears of the cope with each hand and slowly raise the cope. Lay the cope with its side on the foundry bench.
23. Blow off any loose sand that may be on the mold with the aid of the bellows.
24. Moisten the sand next to the pattern with water. Do not get the sand too wet; otherwise blow holes may occur in the casting.
25. Drive the draw spike into the pattern. Rap on all sides of the pin to loosen the pattern.
26. Draw the pattern from the sand.
27. Patch the mold if necessary.
28. With the gate cutter, cut the gates from the sprue and riser holes to the mold. The gates

should be about three-eighths of one inch deep and one-half of one inch wide.

29. Carefully press brass escutcheon pins or any suitable non-corrosive nails about one-sixteenth of one inch in diameter and one and one-half inches long into the bottom of the mold. Place the pins close together.

30. Remove all loose particles of sand from the mold with the bellows.

31. Place the cope over the drag and lower into place. The cope should be weighted down with a heavy object before pouring. This is to prevent the molten metal from escaping between the cope and the drag of the flask.

32. Pour the mold with type metal or lead and do not disturb the mold for at least twenty minutes before removing the casting from the mold.

FLOWER FROG PATTERN

FINISHED FLOWER FROG

How to Cast a Book End

The book end is another interesting and useful project which appeals to the students. Any book end with the proper draft can be used as a pattern. A variety of patterns, therefore, are always available for the student.

Procedure for making the pattern.

1. Select a pattern.
2. Drill and tap a hole in the heaviest section on the back side of the pattern for a one-fourth inch national coarse bolt.
3. Smooth all surfaces with a fine grade of steel wool or other suitable abrasive.

Procedure for casting the book end.

1. Place the pattern and the drag on the molding board with the pins of the drag in a downward position.
2. Dust the molding board and pattern thoroughly with parting powder.
3. Riddle molding sand over the pattern to a depth of one inch or more.
4. Tuck the sand around the pattern with the fingers into the recesses of the pattern.
5. Shovel sand into the drag until it is heaping full.

6. Ram the sand with a bench rammer.
7. Strike off the excess sand with a strike off bar.
8. With a vent wire, punch a series of holes in the sand over and along the edges of the pattern. Do not punch the holes directly to the pattern, but approximately one-eighth of one inch away.
9. With the help of an assistant, gently turn the molding board and the drag completely over until the drag is facing upward.
10. Remove the molding board.
11. With the bellows, blow all loose sand from the drag and exposed part of the pattern.
12. Place the cope on the drag.
13. Locate and place the sprue pin about one inch away from the pattern.
14. Place a riser over or adjacent to the heaviest section of the casting.
15. Dust parting powder on the surface of the molding sand in the drag.
16. Cover the pattern to a depth of one inch or more with riddled sand.
17. Tuck the sand into the recesses of the pattern and around the sprue and riser pins.
18. Fill the cope heaping full of unsifted sand.
19. Repeat the same operations of ramming the cope as

was done with the drag.

20. Vent the cope as was done with the drag.
21. Remove the sprue pin and riser pin and, with a slick, cut a pouring basin at one side of the sprue hole.
22. Pack all loose sand around the sprue and riser holes before lifting the cope from the drag.
23. Grasp the ears of the cope with each hand and slowly raise the cope. Lay the cope with its side on the foundry bench.
24. Blow off any loose sand that may be on the mold with the bellows.
25. Moisten the sand next to the pattern with the bulb sponge.
26. Screw the one-fourth inch bolt into the pattern. Rap on all sides of the bolt to loosen the pattern.
27. Draw the pattern from the sand.
28. Patch the mold if necessary.
29. With the gate cutter, cut the gates from the sprue and riser holes to the mold. The gates should be about one-half of one inch deep and three-fourths of one inch wide.
30. Remove all loose particles of sand from the mold with the aid of such tools as trowels, lifters,

bulb sponge or bellows.

31. Place the cope over the drag and lower into place.

32. Pour the mold with aluminum and do not disturb for at least fifteen minutes.

UNFINISHED BOOK END

FINISHED BOOK ENDS

How to Cast a Screwdriver Handle

The screw driver is always a favorite project among the students. Handles for a screwdriver can be made from a variety of materials, however, the cast aluminum handle is a popular choice. Design and size of the screwdriver may be altered to meet the student's choice by constructing a split pattern from wood.

Procedure for making the pattern.

1. Select two pieces of stock, preferably mahogany, pine, or any stable soft wood, to make the pattern.
2. Glue a piece of thin cardboard between the two pieces and allow to dry.
3. Shape the screw driver handle to the finished size with the aid of power and hand tools. One method used to determine the size is to compare it with a manufactured screw driver.
4. Drill two one-fourth of one inch holes approximately one inch deep at right angles to the length of the handle for the purpose of pinning the two halves together.
5. Make two pins from one-fourth of one inch doweling and round one end of each pin.
6. Pry the two halves of the pattern apart.

7. Glue the two pins into the half of the pattern which has been drilled completely through with the one-fourth inch drill. Allow one-fourth of one inch of the dowels to protrude from the flat side of the pattern for the purpose of fitting the halves together.
8. Fill all holes with putty or wood filler.
9. Smooth all surfaces with a fine grade of sandpaper or steel wool.
10. Apply two coats of shellac.

Procedure for casting the screwdriver handle.

1. Place the half of the pattern, without the pins, and the drag in the molding board with the pins of the drag in a downward position.
2. Dust the molding board and pattern thoroughly with parting powder.
3. Riddle molding sand over the pattern to a depth of approximately one inch.
4. Tuck the sand around the pattern with the fingers into the recesses of the pattern.
5. Shovel sand into the drag until it is heaping full.
6. Ram the sand with a bench rammer.
7. Strike off the excess sand with a strike off bar.
8. With a vent wire, punch a series of holes in the

sand over and along the edges of the pattern. Do not punch the holes directly to the pattern, but approximately one-eighth of one inch away.

9. With the help of an assistant, gently turn the molding board and the drag completely over until the drag is facing upwards.
10. Remove the molding board.
11. With the bellows, blow all loose sand from the drag and exposed part of the pattern.
12. With a slick, cut a shallow trench for the screwdriver shank to extend from the tapered end of the split pattern. The trench should be at right angles to the pattern and of sufficient depth to cover one half of the diameter of the screwdriver blade.
13. Place the screwdriver shank into the trench with the butt end of the shank extending one inch into the pattern.
14. Place the half of the pattern with the pins on the other half.
15. Lower the cope on the drag.
16. Set the sprue pin approximately one half of one inch from the big end of the pattern.
17. Dust parting powder on the surfaces of the molding sand in the drag.

18. Cover the pattern to a depth of one inch or more with riddled sand.
19. Tuck the sand into the recesses of the pattern and around the sprue pin.
20. Fill the cope heaping full with unsifted sand.
21. Repeat the same operations of ramming the cope as was done with the drag.
22. Vent the cope as was done with the drag.
23. Remove the sprue pin, and with a slick, cut a pouring basin at one side of the sprue hole.
24. Pack all loose sand around the sprue and riser holes before lifting the cope from the drag.
25. Grasp the ears of the cope with each hand and slowly raise the cope. Lay the cope with its side on the foundry bench.
26. Blow off any loose sand that may be on the mold with the bellows.
27. Moisten the sand next to the pattern with water. Do not get the sand too wet; otherwise blow holes may occur in the casting.
28. Draw the pattern and screwdriver bit from the sand.
29. Patch the mold if necessary.
30. With the gate cutter, cut a gate from the sprue hole to the mold. The gate should be about three-

eighths of one inch deep and one-half of one inch wide.

31. Remove all loose particles of sand from the mold with the aid of such tools as trowels, lifters, bulb sponge or bellows.
32. Replace the screwdriver bit back into its original place in the mold.
33. Place the cope over the drag and lower into place.
34. Pour the mold with aluminum and do not disturb for at least ten minutes.

SCREWDRIVER HANDLE PATTERN

UNFINISHED SCREWDRIVER

FINISHED SCREWDRIVER

THREE STAGES OF DEVELOPMENT

How to Cast Accessories for a Modernistic Fireplace Set

Casting the accessories for a fireplace set offers a challenge to advanced students who have better than average abilities in metalcrafts. Not only do the students have to be proficient in foundry practices and pattern making, but they must also have considerable abilities in fields of metals and wood to complete this project.

Procedure for making a split pattern for the handles.

1. Select a file handle of the size and shape desired.
2. Saw off the ferrule, preferably with a hacksaw.
3. Drill two one-fourth of one inch holes approximately three-fourths of one inch deep at right angles to the length of the handle.
4. Carefully cut the handle down the center at right angles to the holes previously drilled.
5. Make two pins from one-fourth inch doweling and round one end of each pin.
6. Glue the two pins into the half of the pattern which has been drilled completely through with the one-fourth inch drill. Allow one-fourth of one inch of the rounded end of the dowels to protrude from the flat side of the pattern for the purpose of fitting the two halves together.

7. Fill all holes with putty or wood filler.
8. Smooth all surfaces with a fine grade of sandpaper or steel wool.
9. Apply two coats of shellac.

Procedure for casting the handles of the fireplace set.

1. Place the half of the pattern without the pins and the drag on the molding board with the pins of the drag in a downward position.
2. Dust the molding board and pattern thoroughly with parting powder.
3. Riddle molding sand over the pattern to a depth of approximately one inch.
4. Tuck the sand around the pattern with the fingers into the recesses of the pattern.
5. Shovel sand into the drag until it is heaping full.
6. Ram the sand with a bench rammer.
7. Strike off the excess sand with a strike off bar.
8. With a vent wire, punch a series of holes in the sand over and along the edges of the pattern. Do not punch the holes directly to the pattern, but approximately one-eighth of one inch away.
9. With the help of an assistant, gently turn the molding board and the drag completely over until

the drag is facing upwards.

10. Remove the molding board.
11. With the bellows, blow all loose sand from the drag and exposed part of the pattern.
12. Place the cope on the drag and fit the pattern together.
13. Set the sprue pin approximately one-half of one inch from one end of the pattern and the riser pin the same distance away from the other end of the pattern.
14. Dust parting powder on the surfaces of the molding sand in the drag.
15. Cover the pattern to a depth of one inch or more with riddled sand.
16. Tuck the sand into the recesses of the pattern and around the sprue and riser pins.
17. Fill the cope heaping full with unsifted sand.
18. Repeat the same operations of ramming the cope as was done with the drag.
19. Vent the cope as was done with the drag.
20. Remove the sprue pin and riser pin, and with a slick, cut a pouring basin at one side of the sprue hole.
21. Pack all loose sand around the sprue and riser holes before lifting the cope from the drag.

22. Grasp the ears of the cope with each hand and slowly raise the cope. Lay the cope with its side on the foundry bench.
23. Blow off any loose sand that may be on the mold with the bellows.
24. Moisten the sand next to the pattern with water. Do not get the sand too wet; otherwise blow holes may occur in the casting.
25. Draw the pattern from the sand.
26. Patch the mold if necessary.
27. With the gate cutter, cut the gates from the sprue and riser holes to the mold. The gates should be about three-eighths of one inch deep and one-half of one inch wide.
28. Remove all loose particles of sand from the mold with the aid of such tools as trowels, lifters, bulb sponge or bellows.
29. Place the cope over the drag and lower into place.
30. Pour the mold with aluminum and do not disturb for at least ten minutes.

FIREPLACE HANDLE PATTERN

UNFINISHED FIREPLACE HANDLE

Procedure for making the pattern for the tip of the poker.

1. Select two pieces of stock, preferably mahogany, pine, or any stable soft wood, to make the pattern.
2. Glue a piece of thin cardboard between the two pieces and allow to dry.
3. Shape the poker tip pattern with the aid of power and hand tools to the finished size.
4. Dowel the two sections together in the same manner used for making the handle.
5. Fill all holes with putty or wood filler.
6. Smooth all surfaces with a fine grade of sandpaper or steel wool.
7. Apply two coats of shellac.

Procedure for casting the tip of the poker.

1. Prepare the mold using the same procedures used for casting the handles.

FIREPLACE POKER TIP PATTERN

UNFINISHED FIREPLACE POKER TIP

Procedure for making the pattern for the brush case.

1. Cut a section from a used or discarded floor brush.
2. Construct a pattern from wood to fit over the wood section of the brush.
3. Fill all holes with putty or wood filler.
4. Smooth surfaces with a fine grade of sandpaper or steel wool.
5. Apply one or two coats of shellac.

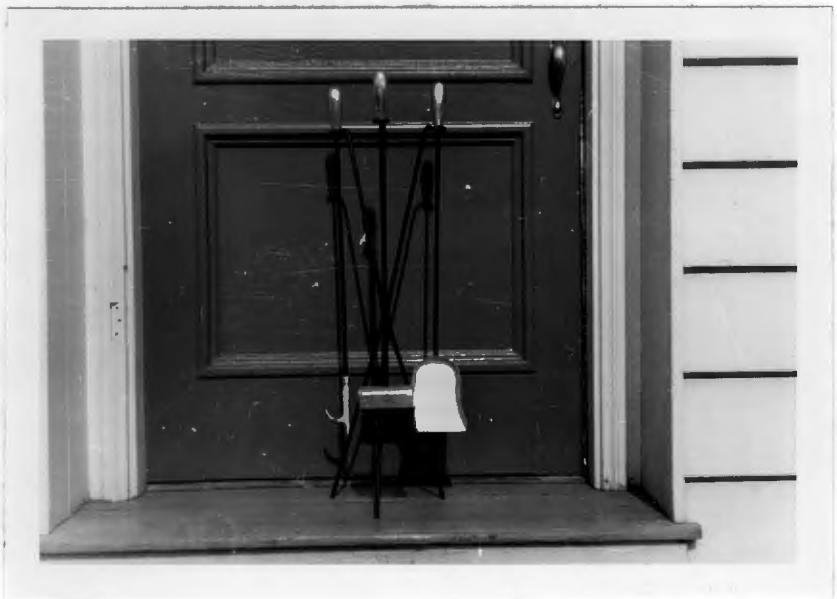
Procedure for casting the brush case.

1. Prepare the mold using the same procedure used for casting the fireplace handles.
2. Cast a permanent aluminum pattern from the original wood pattern.

UNFINISHED FIREPLACE BRUSH CASE

FINISHED FIREPLACE BRUSH CASE

FINISHED FIREPLACE SET



How to Cast House Numbers

An interesting and useful project which appeals to junior high school students is an address bracket with individual house numbers attached. Variations were made by students as to size and design of the finished project.

Casting individual numbers was too slow and painstaking a task, so a pattern was devised where all the numbers, zero through nine, could be cast at one time.

Procedure for making the pattern.

1. Select a piece of three-quarter of one inch plywood free from knots or blemishes.
2. Cut the board two inches longer and two inches wider than the flask.
3. Locate and drill two holes in the plywood so the plywood will fit over the pins of the drag.
4. Locate the house numbers in the circle on the plywood and fasten them to the plywood with small brads.
5. Fasten a half round knob approximately two inches in diameter to the plywood at the center of the circle.
6. Drill a small hole through the center of the hub and the piece of plywood. The hole acts as a guide for centering the sprue pin when the cope

part of the flask is rammed.

7. Make the gates from pieces of one-half inch split dowel and fasten the gates from the individual numbers to the center hub.
8. Fill all nail holes with putty or wood filler.
9. Smooth all surfaces with fine sandpaper or steel wool.
10. Apply one or two coats of shellac.

Procedure for casting the house numbers.

1. Assemble the flask with the pattern board between the cope and the drag.
2. Turn the flask with the drag on the molding board.
3. Dust the pattern board thoroughly with parting powder.
4. Riddle sand over the pattern approximately one inch deep.
5. Tuck the sand around the pattern with the fingers into the recesses of the pattern.
6. Shovel sand into the flask until it is heaping full.
7. Ram the sand with the bench rammer.
8. Strike off the excess sand with a strike off bar.
9. With the help of an assistant, gently turn the flask completely over until the cope is facing

upward.

10. Dust the pattern board thoroughly with parting powder.
11. Place the sprue pin on the mark opposite the knob.
12. Cover the pattern to a depth of one inch or more with riddled sand.
13. Tuck the sand around the sprue pin.
14. Repeat the same operation of ramming the cope as was done with the drag.
15. With a vent wire, punch a series of holes in the sand over and along the edges of the pattern.
16. Do not punch the holes directly to the pattern but approximately one-eighth of one inch away.
17. Remove the sprue pin and cut a pouring basin with a slick at one side of the sprue hole.
18. Pack all loose sand around the sprue hole before lifting the cope.
19. Grasp the ears of the cope with each hand and slowly raise the cope. Lay the cope with its side on the foundry bench.
20. Gently rap the molding board and then carefully lift it off the drag.
21. Patch the mold if necessary. Trowels, lifters and the bulb sponge are good tools to use for this purpose.

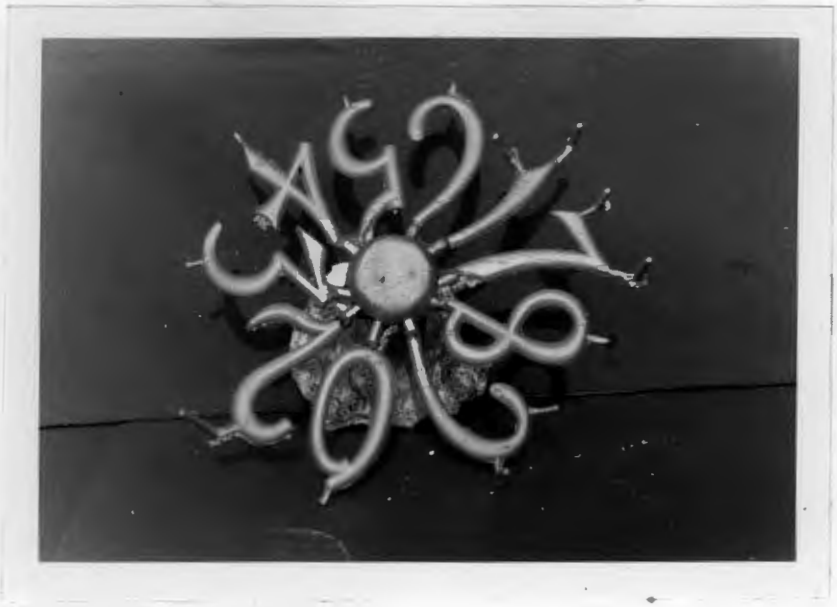
22. Remove all loose particles of sand from the mold.
23. Vent each number individually. This can be easily done by cutting a shallow groove or channel a short distance from each number.
24. With a vent wire, punch a hole at the end of the groove to the top surface of the cope. This is important so each number will fill out completely after pouring.
25. Place the cope over the drag and lower into place.
26. Pour the mold with aluminum and do not disturb for at least fifteen minutes.

HOUSE NUMBER PATTERN BOARD

HOUSE NUMBER PATTERN BOARD ASSEMBLED

BETWEEN THE COPE AND DRAG OF THE FLASK

UNFINISHED HOUSE NUMBERS



ADDRESS BRACKET WITH HOUSE NUMBERS ATTACHED

How to Cast Cane Handles

Not only do the students make projects for themselves, but they often participate in community work. A good example of this was the production of walking canes for disabled Korean veterans. These canes were made in the James Madison Junior High School and the Garfield High School metal shops in Seattle, Washington. The Red Cross furnished the materials, the James Madison Junior High School cast the handles and the Garfield High School machined the handles, turned the cane part itself from wood and assembled the finished product.

Approximately two hundred cane handles were cast, and to so speed up the operation of production, a match plate was devised to cast five cane handles simultaneously.

Procedure for making the pattern.

1. Make a split pattern from wood.
2. Cast a sufficient number of split patterns for handles from the original pattern to make a complete set of five split aluminum patterns.
3. File and polish to the finished size.
4. Drill one half of the pattern with a pass drill.
5. Drill the other half of the pattern with a tap drill.
6. Tap the hole.

7. Cut a piece of plywood, three-fourths of one inch thick and approximately one inch longer and wider than the flask.
8. Arrange the halves of the patterns, which were drilled with the pass drill, in a circle on the plywood board.
9. Carefully mark and drill pass holes through the plywood board.
10. Assemble the respective halves of the patterns on each side of the plywood and secure with machine screws of the approximate size. When assembled, this is called a match plate.
11. Cut off the heads of the machine screws so the surface of the cane pattern is smooth.
12. Use split three-fourths inch dowel for the gates of the five patterns.
13. Attach the gates on each side of the match plate but instead of using machine screws, finishing nails and glue can be used.
14. Fill all holes with putty or wood filler.
15. Smooth all surfaces with a fine grade of sandpaper or steel wool.
16. Apply one or two coats of shellac.
17. Prepare the mold using the same procedure used for casting the house numbers.

18. Pour the mold with aluminum and do not disturb for at least fifteen minutes.

CANE HANDLE PATTERN

CANE HANDLE MATCH PLATE ASSEMBLED

BETWEEN THE COPE AND DRAG OF THE FLASK

UNFINISHED CANE HANDLES

FINISHED WALKING CANE

CHAPTER IV

SUMMARY AND CONCLUSIONS

The topic of this study was to present some techniques and practices in the area of foundry to teachers in the field of industrial arts. Step by step procedures were used along with graphic illustrations to give the reader a better understanding of the study.

The six projects selected for the study were tried in actual school practices with considerable success. The projects selected were a flower frog, book ends, a screwdriver with a cast aluminum handle, cast accessories for a modernistic fireplace set, aluminum house numbers and cane handles for walking canes used by disabled veterans.

The six projects were divided into individual areas with descriptive pictures located at the end of each project unit.

Chapter Two was limited to related information about foundry. The construction of patterns, characteristics of a good molding sand, preparation and care of the molding sand, preparation of metals for casting and other important information was explained in detail.

Appendix A was included to give the reader a better understanding of the technical terms used throughout the study.

The projects and procedures used in the study were from the simple to the complex, suited to meet the individual abilities of each member of the class. It should be kept in mind, however, that the projects included in the study were only suggestive. Teachers, as well as students, should be constantly encouraged to develop projects and designs of their own choosing.

It was not the purpose or intent of the writer to stress foundry more than any other area of industrial arts. All areas are important to meet the needs of the students but foundry should be a definite part.

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APPENDIX

APPENDIX A

SOME FOUNDRY AND PATTERNMAKING TERMS

Tools and equipment used for foundry practices are of a wide variety. Only those tools and equipment which are necessary for a school foundry program will be described.

BELLOWS. An instrument with an air chamber and flexible sides used to blow loose sand from the mold.

BRUSH. A soft bristle brush which is used for cleaning patterns. A wire hand brush or a wire wheel brush is used to clean the castings.

BENCH RAMMER. A tool or device used to pack sand around a pattern.

DRAFT. The taper on a pattern that facilitates its removal from the sand.

DRAW PIN. A draw pin is used for drawing the pattern from the mold. Should the pattern be made of metal, a machine screw is used for this purpose.

DUST BAGS. The dust bag holds the parting compound which is used for the prevention of sand sticking to the pattern.

CRUCIBLE. A vessel of refractory material used for melting purposes.

CRUCIBLE TONGS. A tool used for lifting crucibles.

FLASKS. A wood or metal frame used for holding sand while a mold is made. Rectangular flasks are most commonly used for school purposes. The bottom part of the flask is called the drag and the top section is called the cope. Sections may be added between the cope and drag if necessary. These sections are called cheeks.

GATE. The passageway from the sprue hole to the cavity of the mold.

GATE CUTTER. A gate cutter is a device used to cut a passageway from the sprue hole to the cavity of the mold.

LIFTERS. Lifters are tools used to lift and remove loose sand from deep passages and restricted areas of the mold.

MATCH PLATE. A plate to which patterns are fastened at the parting line. Used for the purpose of increasing production, especially when a large number of castings are required.

PARTING POWDER. A manufactured compound used primarily to prevent two bodies of sand from sticking together.

PATTERN. A replica, except for size, of the object to be cast.

RIDDLE. A device used to remove foreign matter from sand and to deposit a fine layer of sand over the pattern. Riddles are usually round in shape with a wire mesh bottom. The size of the mesh is determined by the number of openings per lineal inch. A twelve or fourteen mesh riddle is the type recommended for average school shop practices.

RISER. An opening in the cope into which the metal rises after the mold is filled.

SPRUE. The solidified metal left in the sprue hole after the mold has been cast.

SPRUE HOLE. An opening in the cope where the metal is poured and from where it runs into the mold.

SPRUE PIN. A tapered pin used for making the sprue hole.

STRIKE OFF BAR. A steel straight edge used to scrape the excess sand from the top of the flask.

VENT WIRE. The vent wire is used to punch holes in the sand from the top surface of the cope to approximately one-eighth of one inch away from the mold. These holes aid in the escape of gases when the metal is being poured.