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Metal Spinning

William R. Schouten

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An Extended Paper
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Approved:

[redacted]

Head of Department

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Date

Approved:

[redacted]

Advisor

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I

Brief History of Metal Spinning

Metal spinning is a technique by which three-dimensional shapes are made from sheet metal. It consists of rotating a flat disk, a cone or a cylinder together with a form of the desired shape, and gradually working the metal against the form by pressure of blunt tools.

If a tool is pressed hard against a soft piece of metal, it makes a dent. With the tool held against this dent, when the metal is rotated about a center, the dent will turn into a groove, extending around the object. It may then be said to have been "spun" into a changed form.

In other words, metal spinning is the making of such articles as bowls, trays, saucers, vases, and many other objects from flat pieces of sheet metal by pressing them over forms which turn on the lathe.

Metal spinning is used extensively in industry today to produce such articles as hub caps, spun drinking containers, salt shakers, bowls and airplane shells.

"Our present-day knowledge of the metal spinning craft has come from the Greeks and the Romans, who spun many of their household utensils from pewter."[1]

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[1] Harold V. Johnson, _32 Metal Spinning Designs_ (Milwaukee: Bruce Publishing Company, 1941), p. 11.

The next trace of spinning was the development of the trade by a small group of artisans in Europe, particularly in France, Germany and Sweden. They jealously guarded their trade, formed their own trade guilds, and set up a seven years apprenticeship for spinners. The boys started their apprenticeship at the age of fourteen or fifteen and were required to serve a year at observing before they were allowed to use any of the spinning tools.

Metal spinning was first introduced in the United States by a man named Jordan in about 1840. He started a small shop in New York City and tried to enlarge his business by teaching it to several apprentices. After they became experienced enough in the art, they started in business for themselves. Most of them became specialists in some line of work. Some of the best and most expert sterling silver spinners learned their trade in these shops.

In the United States the metal-spinning industry is centered in the larger cities. Chicago is probably the largest center.

Though metal spinning has been replaced to a great extent by pressing and stamping, they can never take its place entirely, as there are many cases when the form to be produced cannot be made in one piece except by spinning. If stamped or pressed, they would have to be produced in part and then soldered, riveted, or welded together. This is not desirable in many cases from either a standpoint of art or strength.

Metal spinning, one of the oldest of metalworking arts, is now helping to build the age of space. Many spun parts are used in modern missiles, high altitude balloons, and atomic power plants. In much of this type of work the metal is spun while it is hot. Spinning has kept pace with modern metallurgy and our need for huge, difficult to make shapes in the missile age is being met by hydraulic powered lathes.

Because hydraulic power multiplies the tool pressure while affording precision control, aluminum alloys, stainless, and chrome-molybdenum steel, all vital in missile work, are now spun with the aid of automation to tolerances and in gauges formerly impractical.

"So versatile is the process that the same plant may turn out stainless steel dog dishes and missile bulkheads, TV tubes and rocket-fuel tank heads."[1]

It is very unlikely that pressing and stamping will replace spinning because the stamping equipment is so expensive that many pieces would be required to be made to pay for the equipment, while spinning equipment is relatively inexpensive.

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[1]Harry Walton, "Spinning Strange Shapes For The Space Age," Popular Science Magazine, LXXII (May, 1958), p. 91.

II

Equipment Necessary For Spinning

Equipment that is necessary for metal spinning on a small scale is a lathe, faceplate, toolrest, a tail center or spinning center, and spinning tools.

The spinning lathe can be a conversion from an engine lathe, or from a heavy-duty wood lathe with adjustable speeds. For school work, the speed should be from 300 R.P.M. to 1800 R.P.M., depending upon the type of metal and the process being done. In production work, speeds up to 3500 R.P.M. are used.

The standard faceplate may be used to hold the wooden chucks in metal spinning. Another method of fastening the chuck to the lathe is to drill a hole in the wooden chuck and cut screw threads in it, corresponding to the threads on the spindle of the lathe, and then screw the chuck directly on the lathe. Wood chucks can be turned on the wood lathe. Metal chucks are used when there are a large number of shells to be spun. Care must be used not to chip metal chucks. Chucks made of hardwood, such as maple, are preferred for school work.

The tailstock spindle and handwheel located on both metal and wood lathes is satisfactory for spinning, but the dead center must be replaced by a spinning center. The spinning center can be a piece of steel machined with a taper to fit the tailstock with a hole bored in the end, and fitted with a block of wood that will turn freely in the hole. A better spinning center is made with bearings.

The tool rest (Figure 1) is similar to that of a wood lathe except that there are vertical holes at intervals of one half inch for the purpose of inserting a pin that acts as a fulcrum for the spinning tools. The fulcrum pin should be easily removable and have a shoulder so that it does not drop all the way through the tool rest. A tapered pin is sometimes used, but has a disadvantage of becoming stuck in the tool rest.

"Spinning tools are made of hardened steel in many shapes and sizes and are used to press the metals against a form. The spinners hand tools can be placed into three classes: blunt tools, beading tools, and cutting tools."[1]

Under the classification of blunt tools falls the flat tool, point tool, planishing tool, and the backstick.

The flat tool (Figure 2) is used more frequently than any of the others. One side of the tip is flat for smoothing purposes and the other side is flat for bending and forcing the metal to the chuck. Where the two sides join there is a rounded part that is used in the making of fillets. In working with soft metals, such as aluminum and pewter, the flat tool is practically the only tool needed for forming and finishing.

The point tool (Figure 2) is a forming tool for small projects, as a finishing tool for small radii, and for squaring up corners. Its shape at the tip is similar to a cone.

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[1] Oswald A. Ludwig, Metalwork, Technology and Practice (Bloomington: McKnight and McKnight Publishing Company, 1955), pp. 374-375.

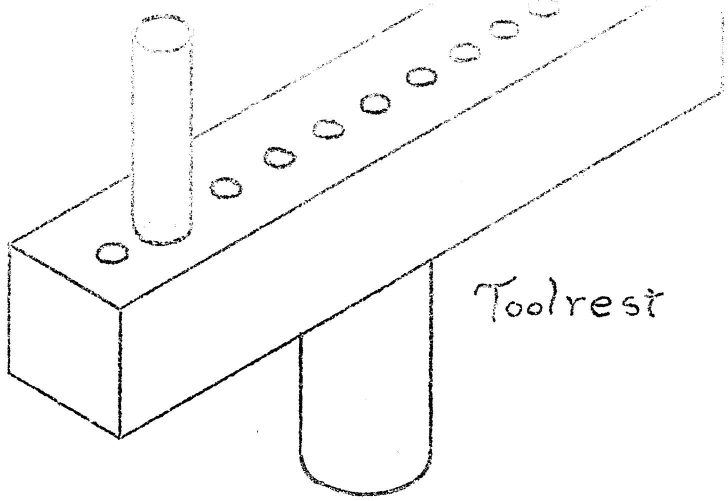
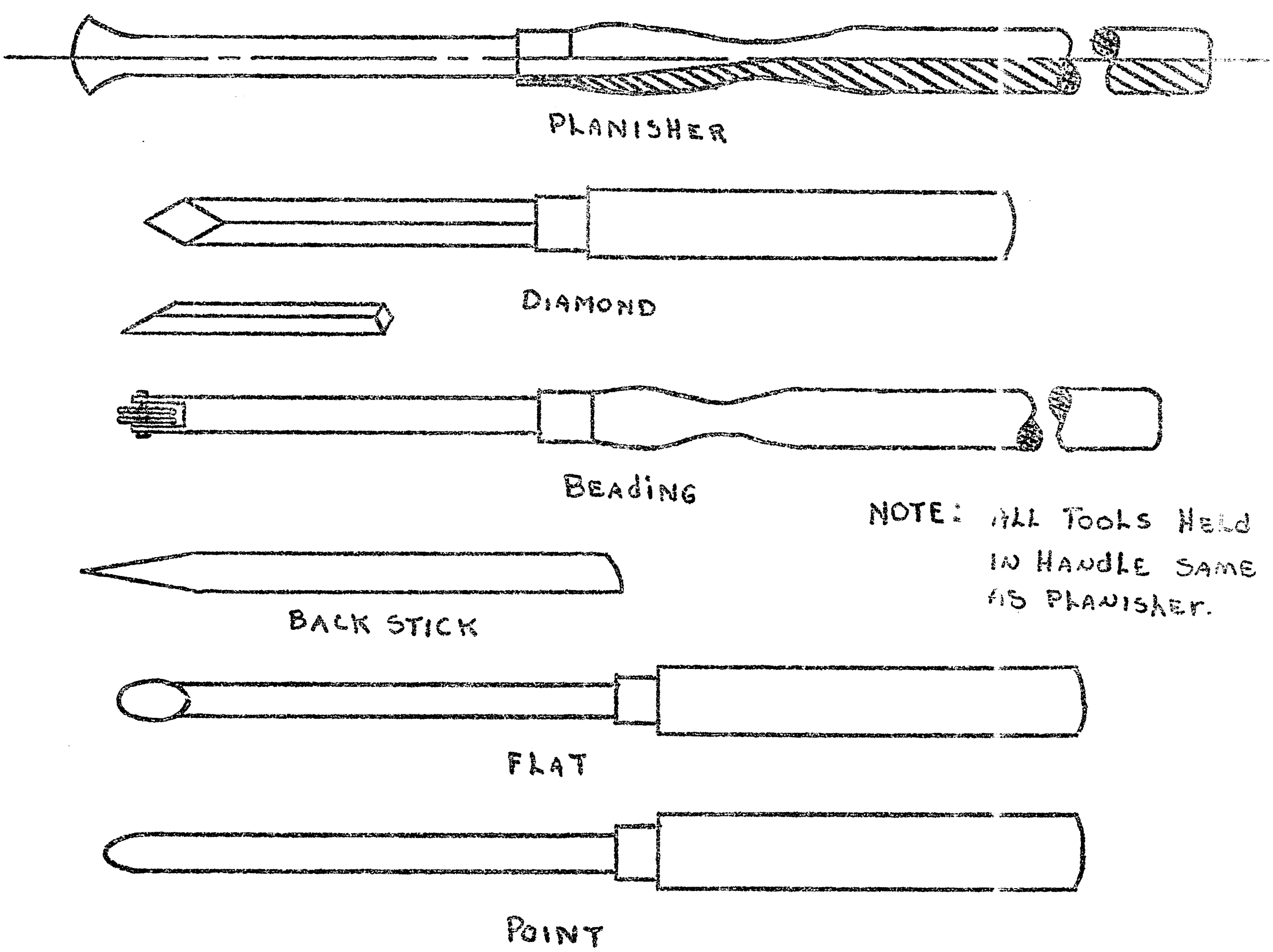


Figure 1



Spinning Tools

Figure 2

The planishing tool or planisher (Figure 2) is used as a finishing tool to remove any marks that are left by the other tools. It is polished to a glasslike finish after it has been forged and ground to a fan shape. The edge of the tool at the point is used to make small grooves or shoulders in the shell.

The backstick (Figure 2) is a piece of hard wood that is shaped like a blunt cold chisel and its primary function is to provide pressure behind the spinning tool in the breaking down process or to prevent edges from wrinkling.

The beading tool or beading roller (Figure 2) has a wheel on the tip that is cupped in the center and rotates on an axis as pressure is applied to the shell. The cupped part on the rim of the wheel produces a bead.

The diamond point (Figure 2) is a cutting tool and is shaped like its name indicates. It is used to cut off and trim edges.

III

Metals And Their Treatment

Metals for spinning can be divided into the three general classes of hard, semi-hard and soft. The soft class is the easiest metal for the beginner to spin and includes aluminum, copper, pewter, zinc, silver, and gold. The semi-hard class consists of nickel and German silver. Iron and the different kinds of steel make up the hard classification. A different treatment is necessary for each type of metal.

Aluminum is a soft silvery metal that is found in clay and rocks. One-sixth of the earth's surface contains bauxite which is aluminum ore. Aluminim is soft and light and is very easy to spin. It is not necessary to anneal aluminum so it is used more frequently by the craftsmen. Most generally, 16 to 22 gauge stock is used. One fault of aluminum in spinning is that it sweats and becomes greasy while spinning. It becomes very bright and shiny when polished.

Copper, one of the oldest metals known to man, is a tough reddish brown metal and has a tendency to turn green when moisture is present. Copper ore is mined in Utah, Michigan, Arizona, and Montana. Copper has many uses, such as a carrier of electricity. It is also used with many other metals in the making of alloys such as brass, bronze, and German silver. It is slightly more difficult to spin than aluminum as it becomes hard and springy from pressure and annealing is necessary. Copper hardens when spun so it must be annealed frequently. This may be done by heating it to an iridescent color and then plunging it into cold water. This metal takes a brilliant polish but must be lacquered or finished to prevent tarnishing. The gauge of copper to use should be about 22 to 26 gauge and should be annealed before it is placed in the chuck. In spinning copper the edge should be kept trimmed because it has a tendency to become ragged, and will begin to crack.

Pewter is a silvery white alloy composed of mainly tin with a little antimony and copper added. The lower grades also have lead which adds a dull appearance to the metal. Pewter is also called Brittania metal because it was first made in Britain. It is mainly used for tableware and ornamental work. In America, manufacturers of pewter have excluded the lead entirely which is responsible for its popularity in this country. It is probably one of the most desirable metals for spinning as it does not require annealing for it remains soft while being worked. Care must be taken not to use too much pressure or the stretching of the metal will put a hole in the piece. Eighteen gauge metal is the approximate size that is satisfactory for spinning.

Zinc is a hard, brittle, bluish white metal. It is used as a coating for iron and steel for protection against rust. Zinc is also used in German silver, brass, and bronze. It is used principally in commercial spinning. Like copper, zinc hardens when it is spun. Great care must be taken when annealing it, and it is not advisable to exceed 375 degrees Fahrenheit before slowly cooling for the softening process. Craftsmen should heat it to 212 degrees Fahrenheit and place it on the lathe immediately and spin it while it is hot.

Gold, a precious, heavy, bright yellow metal is found in rocks in the form of gold ore. Pure gold is too soft for articles of general use and is therefore mixed with copper or other metals. The purity of gold is measured in carats. Pure gold is 24 carats. Gold can be spun very easily but the cost is prohibitive.

Silver is a white shiny metal. It is found in the form of silver ore and is used for ornamental work and jewelry. Sterling silver is silver with a little copper added to make it harder. It can also be spun very readily, but the cost is too high for the average user. In spinning, if the silver is stretched too much, it becomes very weak in strength.

Nickel can be spun, but requires annealing more frequently than copper. It is rather difficult to spin because of its hardness. This metal is a hard, tough, shiny silvery metal, that is found in the form of ore. It does not rust and a very highly polished finish is possible. It is used for plating other metals to improve their appearance.

German silver has about the same spinning characteristics as nickel. The higher the percentage of nickel in German silver, the harder it is to spin. It is composed of nickel, copper and zinc.

Steel is a manufactured metal. It is a gray metal which, when broken, looks like fine crystals. There are many different kinds and uses of steel. In spinning steel, it is more difficult to work than any other metal. As far as spinning is concerned, steel is for commercial use where it can be turned with hydraulic power. Some craftsmen have spun 24 to 26 gauge steel satisfactorily by using bronze spinning tools and keeping the metal well annealed. "Steel is annealed by heating to a bright red and cooling slowly in powdered lime."[1]

The following table provides information concerning the annealing temperatures and color characteristics of the more common metals.

Annealing Table[2]

	Degrees	Color and Character
1. Aluminum	650	Will just char white pine sawdust
2. Pewter	0	No annealing required
3. Copper	1000	Iridescent, very dull red
4. Brass	1000	Very dull red when oil burns off
5. Zinc	212	Boiling water, spin hot
6. Lead	0	No annealing required
7. Steel (C.R.S.)	1700	Bright yellow (cool slowly)

[1]Ludwig, op. cit., p. 120.

[2]Sam Brown, "Try Your Hand at Metal Spinning," Popular Mechanics Magazine, CI (June, 1954), pp. 187-191.

IV

Lubricants Used In Spinning

A lubricant is a substance used to make the metal smooth and slippery. Friction, causing heat, is set up by the pressure of the spinning tool against the metal disk being spun. To reduce the heat and prevent the tearing of the metal disk by the tools, a lubricant is used. There are many different lubricants used for the different kinds of metals being spun, the temperature of the shop, and the preference of the operator. "A very good lubricant to use on copper, aluminum and pewter is Johnson's No. L 40 Stikwax. For harder grades of metal, Naptha soap is a good lubricant."[1]

The following table provides information concerning lubricants for the more common metals.

Chart of Lubricants[2]

Steel	Laundry soap; sheep's tallow
Aluminum	Sheep's tallow and oil mixture, heavy oil
Copper	Soap and oil mixture; soft soap, tallow and oil

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[1]Harold V. Johnson, "Planters Lamp," Industrial Arts and Vocational Education Magazine, VL (September, 1956), p. 228.

[2]James E. Reagan, Metal Spinning (Milwaukee: Bruce Publishing Company, 1936), p. 41.

Chart of Lubricants (Cont'd)

Monel metal	Sheep's tallow
Brass	Tallow and oil mixture, tallow candle
Pewter	Soap and oil mixture, tallow candle
Lead	Tallow candle, tallow and oil mixture
Zinc	Tallow candle, tallow and oil mixture
Silver	Tallow candle
Gold	Tallow candle

"For the tallow and oil mixture the correct mixture is two pounds of tallow to one-half pint of oil."[1]

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[1] *Ibid*., p. 42.

V

Fundamentals Of Metal Spinning

To prepare the lathe for metal spinning a chuck or form has to be placed on the headstock. The disc is then centered between the chuck and the follow block. "The radius of the disc needed can be determined by adding the radius of the largest diameter to the height of the form."[1] The next step is to lubricate the disc. After this, the tool rest is placed parallel to the bed of the lathe so that it just clears the disc. Now the blunt nose of the spinning tool is placed against the disc, fairly close to the smallest diameter of the chuck, and then pressure is exerted on the fulcrum pin on the tool rest. This action is like the action of a lever and will cause the metal disc to bend where the point of the spinning tool makes contact with the disc. This will cause the outer edge to start to decrease in diameter because of the bending of the metal towards the chuck. At this point, the spinning tool is moved under pressure toward the outer edge of the spinning disc. This operation is repeated over and over again, until the disc takes the shape of the chuck. In some metals it is necessary to alternate spinning from the middle out to the outside in to keep the thickness of the metal the same.

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[1] Johnson, 32 Metal Spinning Designs, op. cit., p. 21.

The amount of pressure applied to the spinning tool will vary with the different speeds and kinds of metal. This will be learned with experience. The beginner should start slowly with little pressure. If too much pressure is applied to the disc, it will wrinkle, tear, or break. In case wrinkles appear soon after beginning to spin the disc, the best way to remove them is to anneal the disc and then proceed with gentle pressure of the spinning tool with the point of the backstick being held directly opposite the point of the spinning tool. The spinning tool should be kept continually in motion, otherwise rings will be worn on the surface of the metal. The flat tool is used to start the spinning operation.

Before the outer edge of the disc is flat against the chuck, the disc should be trimmed with the diamond point tool. To do this, the toolrest is moved closer to the edge of the spinning disc and the cutting edge of the diamond point brought in contact with the metal. After the edge is trimmed, it is then spun until the disc conforms with the chuck. While trimming the spinner should stand to one side so that he is out of the way of flying chips. When a bead is to be put on the outer edge, the disc is turned down to completely fit the chuck before trimming. Then the edge of the disc is turned into a bead with a beading tool or the backstick and the flat tool.

The disc should not be spun too tightly on the chuck because the metal sometimes sticks to the form. When it sticks solid it is necessary to go over the entire surface of the shell lightly with a planishing tool. This enlarges the shell slightly so that it may be removed.

The following are a few safety precautions to be followed.

1. Chucks and discs both must be centered true.

2. Do not lubricate the spinning center where it makes contact with the disc.

3. Never stand in front of the revolving disc when first starting the lathe.

4. Be sure the spinning center is tight.

5. Never insert a disc when the machine is running.

6. A height of one third of the diameter of the finished shell may be spun with one operation.

7. It is advisable to wear goggles.

A student that follows these fundamentals and safety rules should have very little trouble in spinning his first article. A person needs to give thought and study to the work and do a little experimenting, but the satisfaction of producing the spun article will amply repay him for the time spent.

VI

Summary

Metal spinning is the art of turning three dimensional objects from flat pieces of sheet metal. Metal spinning was used by the Greeks and Romans in making their household utensils and has advanced to the space age of today. It has been replaced in industry somewhat by pressing and stamping, but due to the cost of the pressing and stamping equipment, it is unlikely that spinning will be eliminated.

The minimum equipment necessary for spinning is a lathe, faceplate, spinning center, a special tool rest, a form or wooden chuck, and spinning tools. The forms can be turned from maple on a wood lathe. Spinning tools are made of steel and are used to press the metal against a form. The flat tool, planishing tool, diamond point, beading tool, and a back-stick are the commonly used spinning tools.

Friction caused by the pressure of the tool against the disc being spun develops heat. To reduce this heat and protect the spinning disc, a lubricant must be used. Different kinds of lubricants are used, depending upon the kind of metal being spun, the speed of the work, and the amount of pressure being applied.

There are many different metals that can be spun. Aluminum and pewter are among the best for the first attempt at spinning, because they are soft and require no annealing. Twenty gauge is the approximate thickness that should be used.

Metal spinning is an interesting subject, demanding skill and judgment while at the same time introducing a variety of metals not commonly used by the craftsman. The idea of doing something new appeals to the student and metal spinning opens a new field that is fairly inexpensive.

VII

Appendix

Suppliers of Metal Spinning Equipment:

1. The Atlas Press Company
   Kalamazoo, Michigan

2. The Boyer-Campbell Company
   6540 St. Antoine Street
   Detroit 2, Michigan

3. Brodhead-Garrett Company
   4560 East 71st Street
   Cleveland 5, Ohio

4. English and Miller
   6560 Epworth Boulevard
   Detroit 10, Michigan

5. Howard and Smith, Inc.
   Detroit 20, Michigan

Suppliers of Metal:

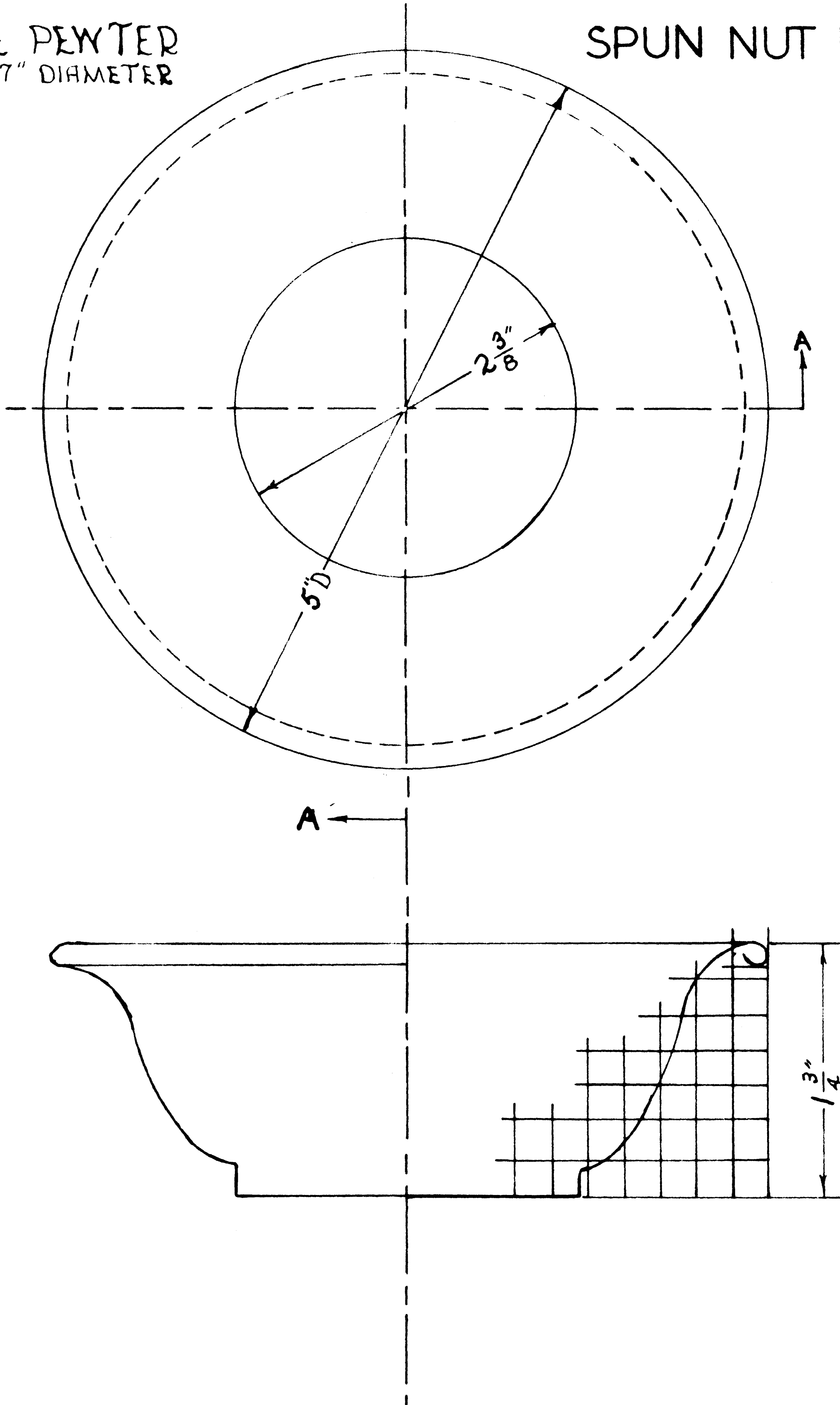
1. Retco Alloy Company
   Chicago 19, Illinois

2. Monahan Bronze Company
   Flat Rock, Michigan

The following five pages are examples of the type of projects which can be spun.

SPUN NUT DISH

20 GAGE PEWTER
7" DIAMETER



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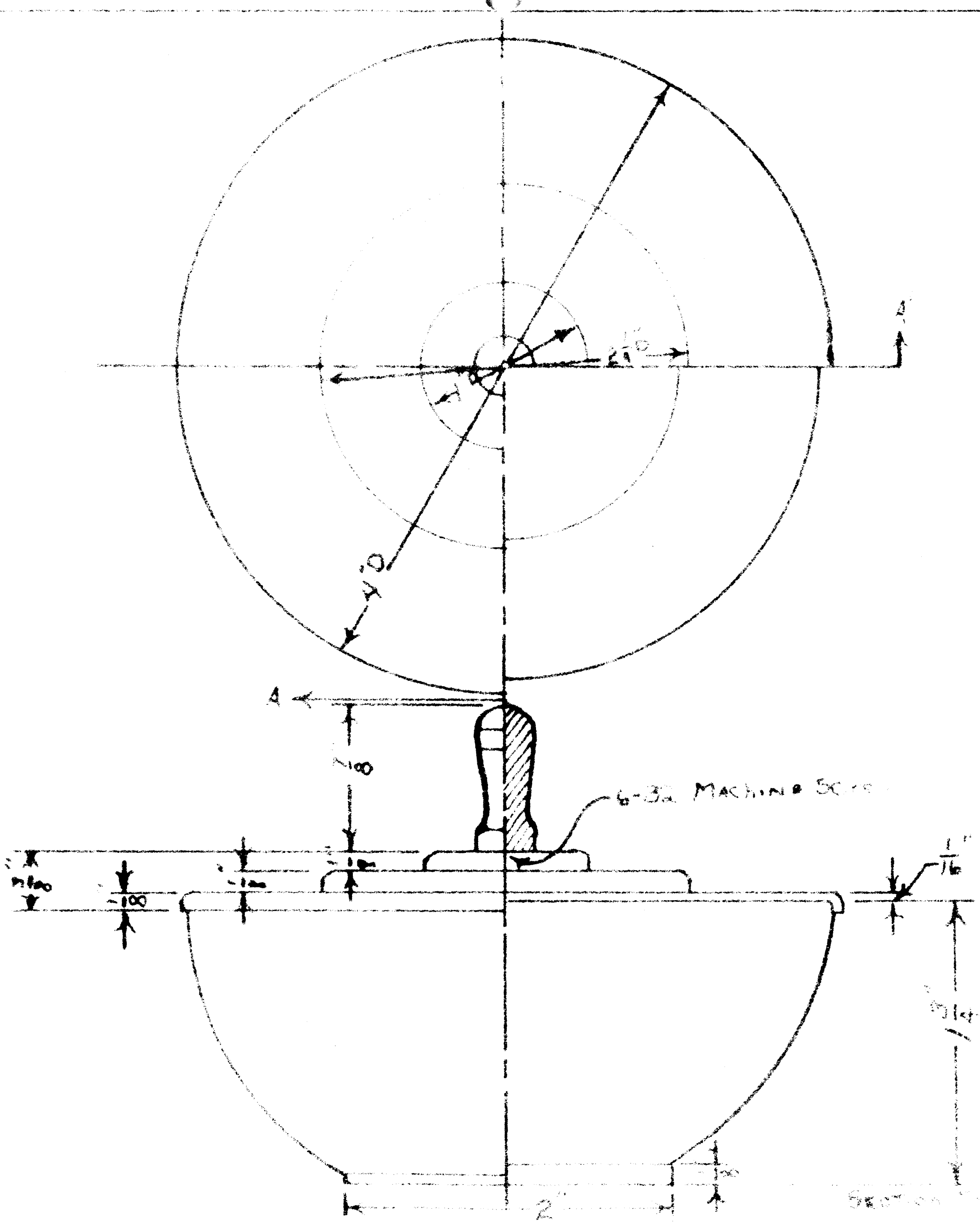

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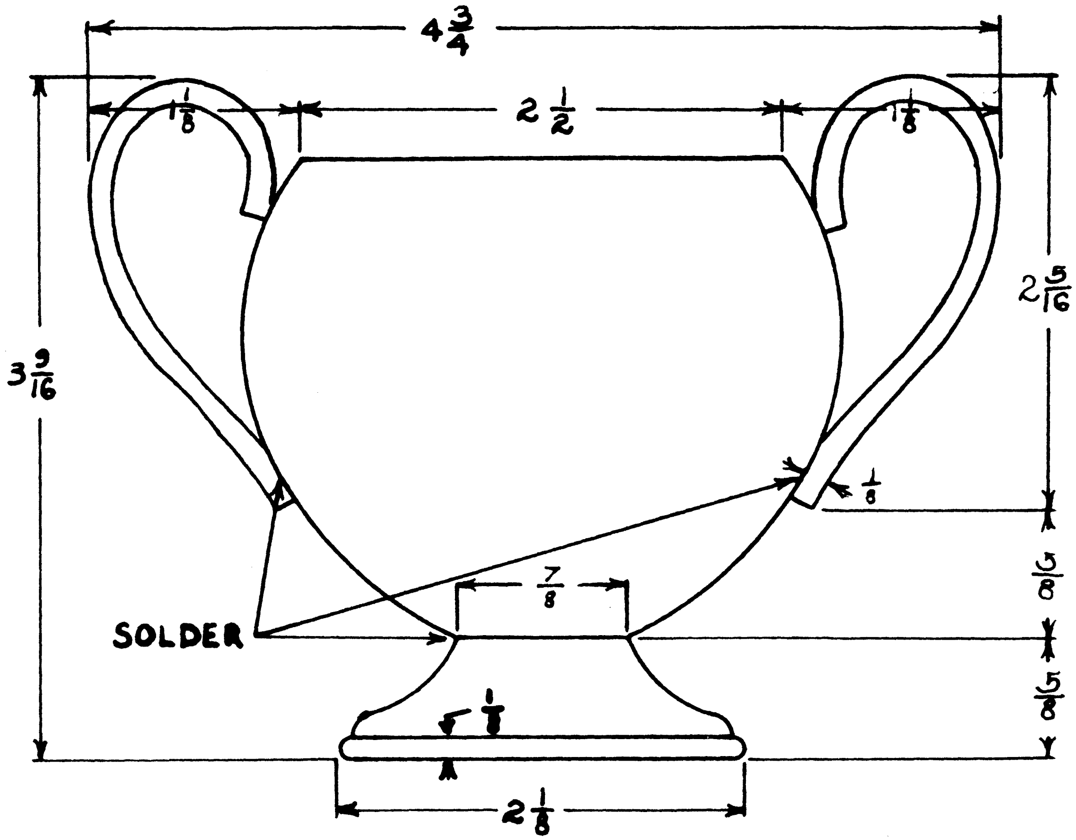
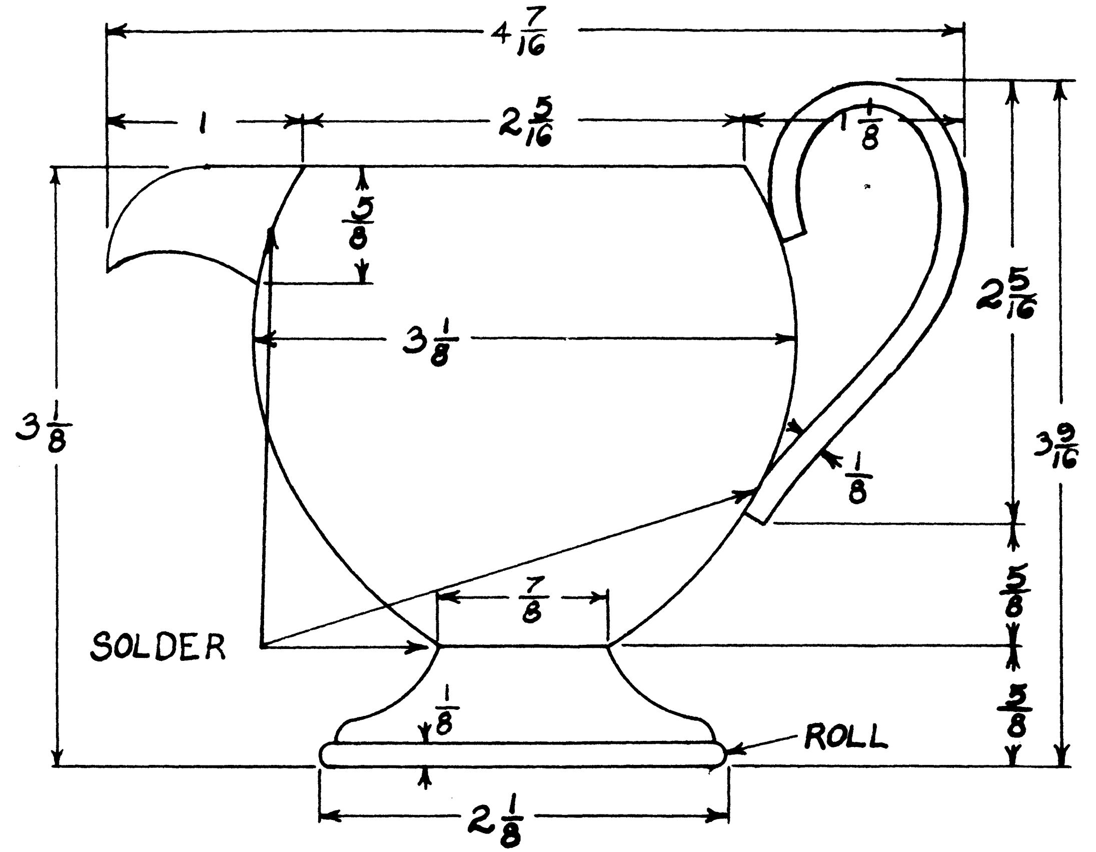
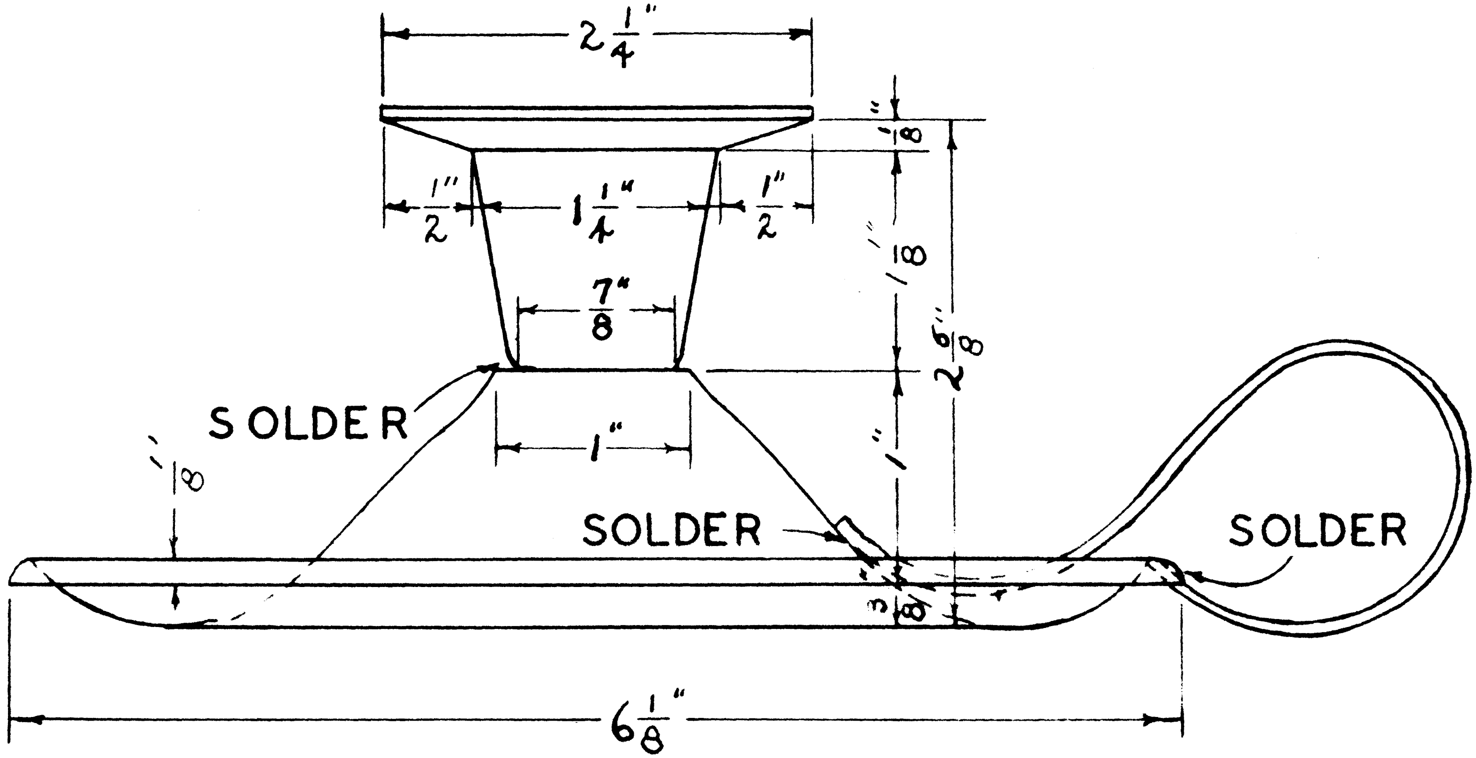


FLAT ROCK HIGH SCHOOL FLAT ROCK, MICH.	SUGAR BOWL SCALE 1" = 1" 3/22/60	DRAWN BY CARL ROMACK APPROVED BY



FLAT ROCK HIGH SCHOOL FLAT ROCK, MICH	CREAMER SCALE 1" = 1" 3/25/60	DRAWN BY CARL ROMACK APPROVED BY

COLONIAL CANDLESTICK



DRAWN BY JIM BASS

IX

Selected References

"Articles in Magazines"

1. Beal, Harold S. "Metal Spinning Projects," Industrial Arts and Vocational Education Magazine, XXXVI (January, 1947), pp. 39-40.

2. Beal, Harold S. "Pewter Candy Dish," Industrial Arts and Vocational Education Magazine, XXXVII (May, 1948), pp. 200-201.

3. Brown, Sam. "Try Your Hand at Metal Spinning." Popular Mechanics Magazine, CI (June, 1954), pp. 187-191.

4. Hardeman, Bryce. "Planters Lamp," Industrial Arts and Vocational Education Magazine, XXXVIII (January, 1949), pp. 27-29.

5. Hardeman, Bryce. "Spun Metal Scales, " Industrial Arts and Vocational Education Magazine, XLI (October, 1952), pp. 287-289.

6. Johnson, Harold V. "Planters Lamp," Industrial Arts and Vocational Education Magazine, XLV (September, 1956), pp. 228-231.

7. Manzer, Emerson W. "Project Manual for Spun Bowl," Industrial Arts and Vocational Education Magazine, XL (January, 1951), pp. 21-23.

8. Manzer, Emerson W. "Project Manual for Spun Candlesticks," Industrial Arts and Vocational Education Magazine, XXXVIII (December, 1950), pp. 402-405.

9. Reynolds, James O. "Metal Spinning with Aluminum," Industrial Arts and Vocational Education Magazine, LXXX (October, 1950), pp. 330-331.

10. Walton, Harry. "Spinning Strange Shapes for the Space Age," Popular Science Magazine, LXXII (May, 1958), pp. 88-92.

"Books"

1. Johnson, Harold V. 32 Metal Spinning Designs. Milwaukee, Wisconsin: Bruce Publishing Company, 1941.

2. Ludwig, Oswald A. Metalwork, Technology and Practice. Bloomington, Illinois: McKnight and McKnight Publishing Company, 1955.

3. Miller, John G. Metal Art Crafts. New York: D. Van Nostrand Company, Inc., 1953.

4. Reagan, James E., and Earl E. Smith. Metal Spinning. Milwaukee, Wisconsin: The Bruce Publishing Company, 1936.

5. Smith, Robert E. Units in Etching, Spinning, Raising and Tooling of Metal. Bloomington, Illinois: McKnight and McKnight Publishing Company, 1939.