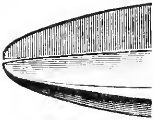
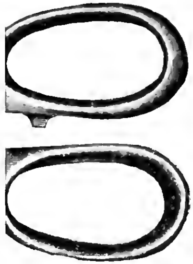
XXth Century Sheet Metal Worker

By

H. E. OSBORNE

THE AMERICAN ARTISAN
CHICAGO
1910





Ever
Snip is a
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retains
No. **27** ... 11
Full L ... 9''
Length ... 2¼''

Combination

DROP FORGED STEEL. HANDY TINNERS' SNIPS.

This Snip is adapted for cornice makers and is an all around combination tool, cutting circular, straight and irregular shapes.

No. **274** "Red Devil"	17	18	19	110
Full Length	14''	13''	12''	11''
Length of Cut	4''	3½''	3''	2½''

XXth Century Sheet Metal Worker

A Modern Treatise on Modern Sheet Metal Work

BY

H. E. OSBORNE

THE AMERICAN ARTISAN
CHICAGO
1910

TO

MY OLD TIME TEACHER

AND FRIEND

GRIFFETH L. JACKSON

THIS LITTLE BOOK

IS

AFFECTIONATELY

DEDICATED

PREFACE

"Waste no time worrying over a mistake, but try to correct it to the best of your ability, with as little loss of time and material as possible."—G. L. Jackson.

And if this book shall prove to be of as much help to just one struggling "tinker" as the above quotation from my old teacher has been to me, then the time spent in its preparation has been well spent.

I have endeavored to give in this work short, concise explanations, which should be easily understood by the young apprentice, and at the same time, sufficiently scientific for the practical use of the journeyman. Some of the items are of so simple a character as to seem to be almost unnecessary, but I have remembered that even the most simple things have to be learned.

H. E. Osborne.

XXth Century
Sheet Metal Worker.

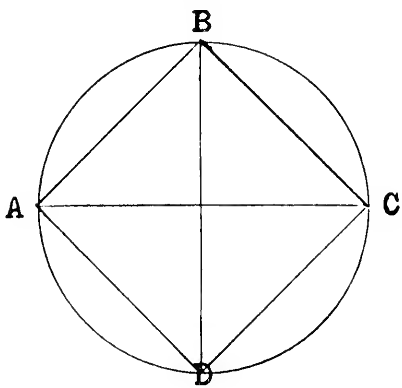
Having a given circle, to find the side of an equivalent square.

Multiply the diameter by the decimal .8862, or, multiply the circumference by the decimal .2821. Either method gives the length of one side of an equivalent square.

Having a given circle, to find the side of an inscribed square.

Multiply the diameter by the decimal .7071, or, multiply the circumference by the decimal .2251.

The first method may also be applied to find the



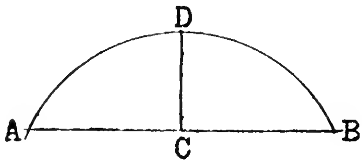
length of the chord of an arc of 90 degrees, a quadrant. Find the radius and multiply it by 2 and then by .7071. Because the side of an inscribed square is the chord of the quadrant.

To inscribe a square in a circle.

Draw the two diameters BD and AC at right angles to each other, and connect the extremities of the diameters by straight lines drawn from A to B, B to C, etc.

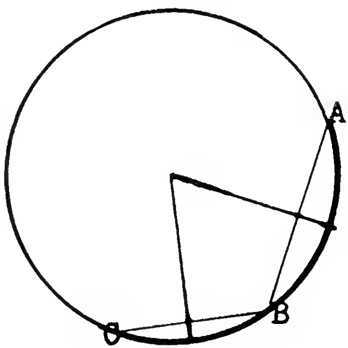
To find the radius of an arc.

To the square of the sine AC, add the square of the



versed sine CD, and divide the result by twice the versed sine.

To make this plain, and dispense with the geometrical terms. Square the length from A to C, and add

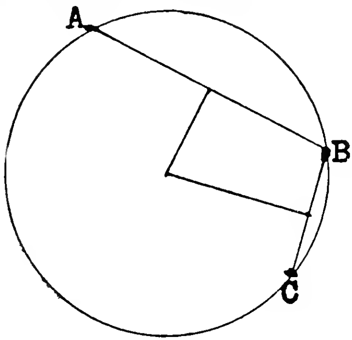


to it the square of the distance C to D and divide the result by twice C D. The quotient will be the length of radius to produce the arc ABD.

To find the center from which a given arc is produced.

Draw any two chords AB and CD, and bisect them, and from the points thus found draw lines perpendicular to the chords, and extending until they meet. The point of meeting will be the center of the circle of which the arc is a portion.

To describe a circle cutting any three points, arranged in any position other than a straight line.



Connect the points by straight lines; then lines drawn perpendicular from the centers of these lines will meet at the center of the required circle.

To find the length of an arc, when the number of degrees it contains and the radius are known.

Multiply the number of degrees by the decimal .01745, and that product by the radius.

To find the area of a sector when the number of degrees and radius are known.

Find the length of the arc by the preceding rule, and multiply this length by one-half the radius.

To find the area of an oval or ellipse.

Multiply the two axes together, and their product by the decimal .7854 and the result will be the required area.

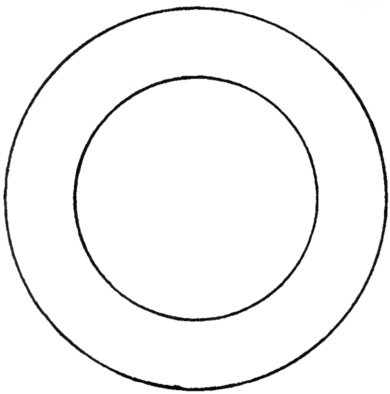
To find the area of a circular ring.

1st. When the circumference and diameter are both known, multiply the circumference by one-half the radius (one-fourth the diameter), or multiply one-half the circumference by one-half the diameter.

2d. When the diameter only is known, square the diameter and multiply by the decimal .7854.

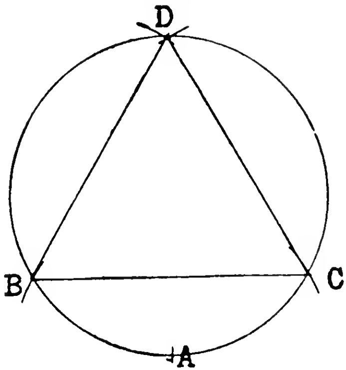
To find the area of a circular ring.

The space between two circles of unequal size, and



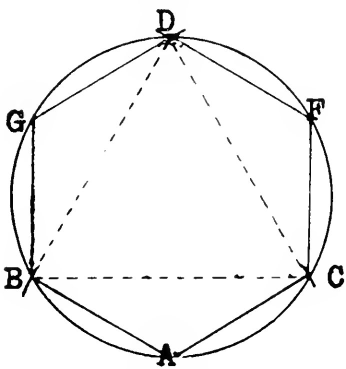
having a common center. Square the diameter of each circle, and subtract the square of the lesser from the square of the greater, and multiply the difference by the decimal .7854.

To inscribe an equilateral triangle in a circle.



With any point (as A) as center, and radius equal to radius of the circle, describe arc cutting the circumference in B and then in C. Then bisect the arc B D C, and connect the points B, C, and D.

To inscribe a hexagon in a circle.

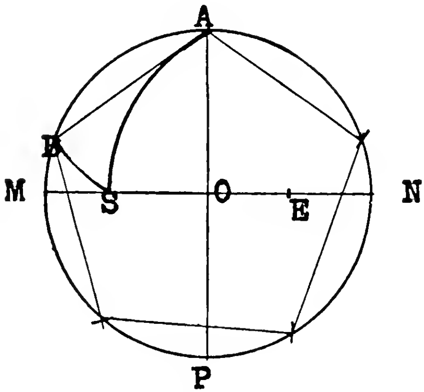


Describe the equilateral triangle as before. Then bisect the arc C D in F, and the arc B D in G, and drew AC, CF, FD, DG, GB, and BA.

Or it may be inscribed by applying the radius six times around the circumference. This is the most common method.

To inscribe a regular pentagon in a circle.

Draw the diameters AP and MN at right angles to each other, and bisect the radius ON at E. From A



as center, and EA as radius, describe the arc SB. Join the points A and B, and the line AB being applied five times around the circle will form the pentagon.

To draw squares whose areas shall be proportionate to the areas of given squares.

Fig. 1. To draw a square ¼ the area of a given square. Bisect one side of the given square, and construct a square upon half its length.

Fig. 2. To draw a square ½ the area of a given square. Draw diagonal lines from corner to corner

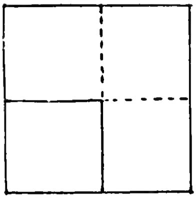


Fig. 1.

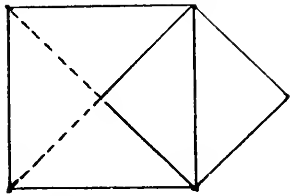


Fig. 2.

of the given square, and construct a square upon half the length of one of the diagonals.

Fig. 3. To draw a square twice the area of a given

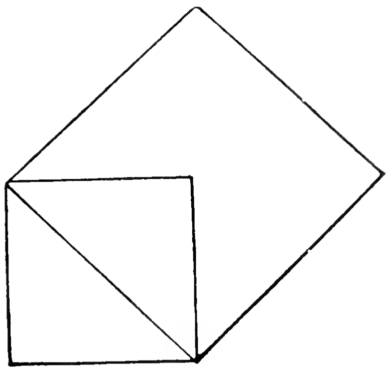


Fig. 3.

square. Draw a diagonal line from corner to corner of the square, and construct a square upon the diagonal.

This is simply the reverse of Fig. 2.

Fig. 4. To draw a square three times the area of a given square. Extend the side of the given square to a length equal to its diagonal, A to B, and from

the extremity of the extension, draw a line to the opposite corner of the square (B to C), upon which construct a square.

Fig. 1. To draw a square four times the area of a given square. Construct a square on a line twice the

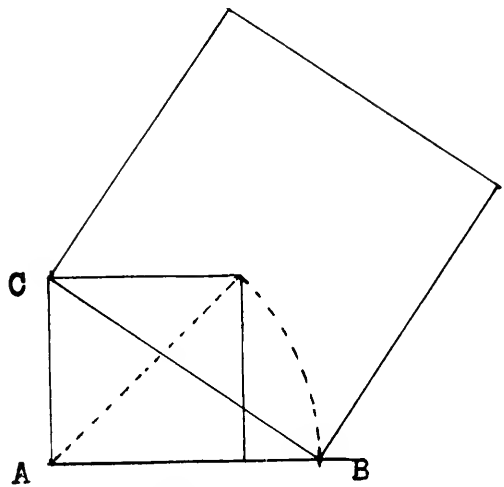


Fig. 4.

length of one side the given square.

Just the reverse of finding one of one-fourth the area.

Fig. 5. To draw a square five times the area of a given square. Extend one side of the square to twice its original length, A to B, and from the extremity of the extension draw a line to the opposite corner of the square (B to C), upon which construct a square.

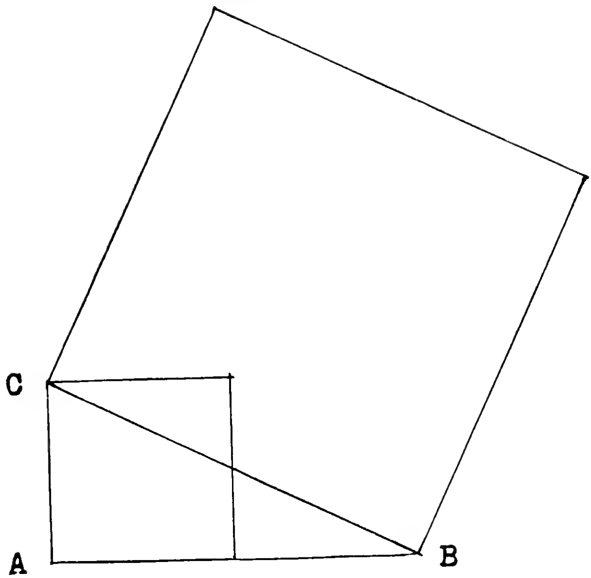
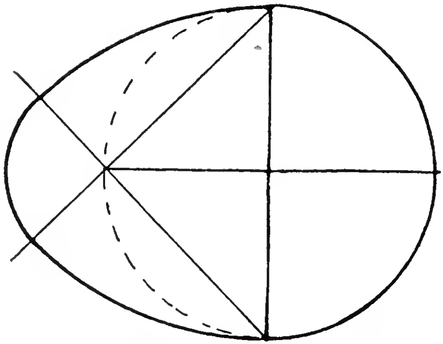


Fig. 5.

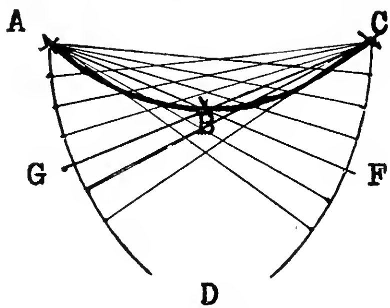
To describe an egg-shaped oval.

Describe a circle the size desired for the round end of the figure, and draw two diameters at right angles, as shown in cut. Then draw a straight line from each end of one of the diameters through the extremity of the other diameter and extending indefinitely. With each end of the first diameter for center, and radius equal to the diameter, strike an arc from the opposite end of the diameter just to the diagonal line. Then with the intersection of the diagonal lines with the other diameter for center, and radius to just meet the previous arcs, or side arcs, draw the small end arc, which completes the figure.



To draw an arc through three points without locating the center.

Let A B and C be the points. Then with A and C as centers, and radius from A to C make arcs from A and C indefinitely towards D. Draw a straight line

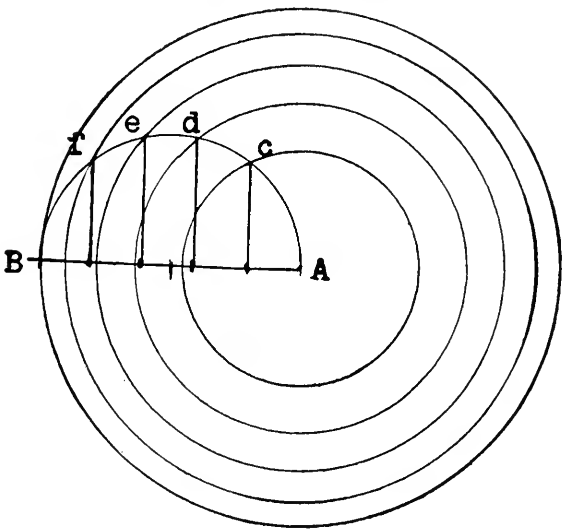


from A through B intersecting the arc C D at F. And another straight line from C through B intersecting the arc A D at G.

Space the arcs between A and G, and between C and F into the same number of equal spaces, continuing one or two of the spaces beyond G and F towards D. Connect the points marked on A D with the point C, and the points marked on C D with the point A, and draw a freehand line through the intersections of these lines.

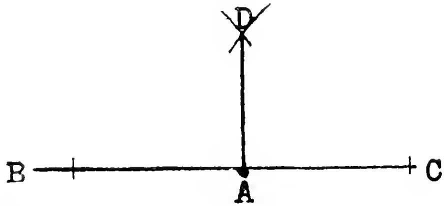
To draw any number of concentric circles, the area of each circular ring thus formed being equal to the area of each of the others and to the circle in the center.

Draw a straight line A B, and space it into the number of equal spaces desired. Bisect A B and draw



upon it a semicircle, and draw a line perpendicular to A B from each of the points to the circumference of the semicircle, as c, d, e, and f. Then with A as center and radius A c describe the inner circle. The next with radius A d, &c., as shown in cut.

To draw a line from a given point in a straight line, perpendicular to the given line.

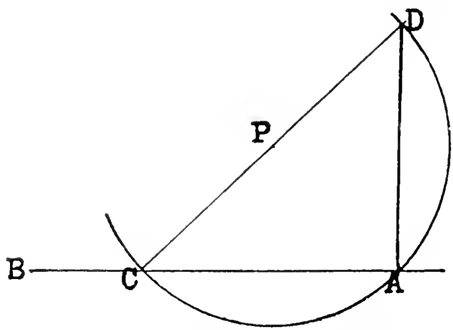


Let A be the given point, and B C the given line.

Place one point of the dividers at A and set off B and C equal to each other. Then with B and C as centers, and with radius greater than A B, describe two arcs intersecting at D. Draw A D and it will be perpendicular to the line B C.

Or, if the point A is near the end of the given line.

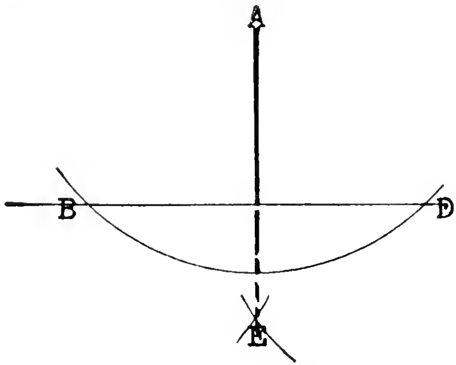
Place one foot of the dividers at any reasonable



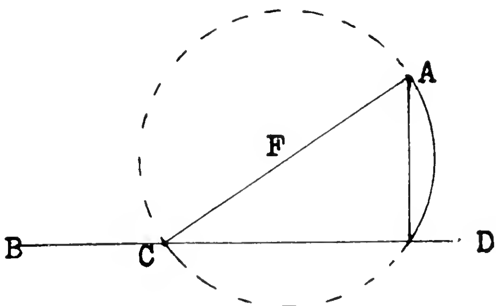
point, as P, and extend the other foot to A. Then with

P as center and radius from P to A, describe a semicircle, or a complete circle would be better, perhaps. Through C, where the circle cuts the line B A, and the point P, draw the line C P D. Then draw A D, and it will be perpendicular to the line B A.

To draw from a given point outside a given straight line, a perpendicular to that line.



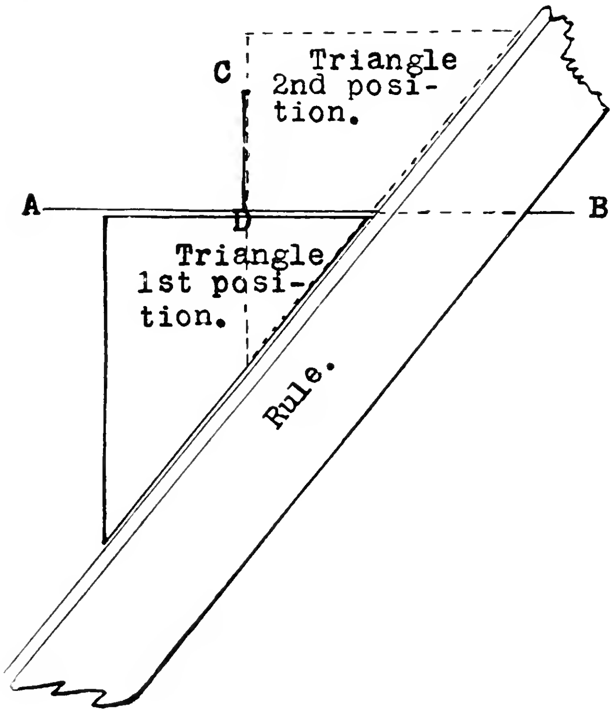
Let A be the given point, and B D the given line. Then from the point A as a center, and with a radius greater than the distance from the line to A, describe



an arc cutting the line B D in the points B and D; then mark the point E, equally distant from B and D, and draw A E, and it will be perpendicular to B D.

Or if the point A is nearly opposite one end of the given line.

Draw the line A C to any point on the line B D, as C. Bisect A C at F. Then with F as center, and F C or F A as radius, describe the semicircle C D A, and draw A D and it will be perpendicular to B D.



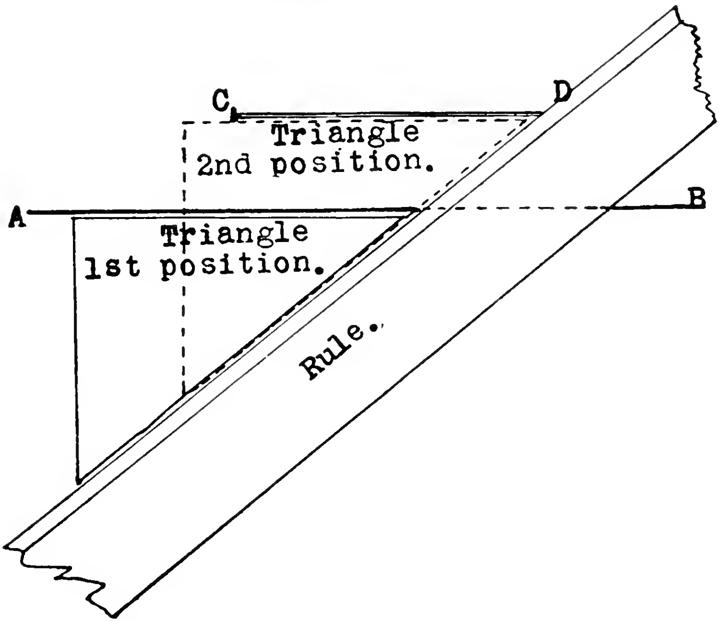
To draw a line to a given point, and perpendicular to a given line, using only a rule and triangle.

Let AB be the given line, and C the given point.

Place the long edge of the triangle against the rule with the other long edge resting on the line AB. Then holding the rule firmly, slide the triangle along until the short side touches the point C. Then draw CD and it will be perpendicular to the line AB.

Of course, only a right-angled triangle, as shown, can be used.

With the same tools, to draw a line to a given point, and parallel to a given line.



Let C be the given point, and AB the given line.

Place the rule and triangle the same as in the previous example, and slide the triangle until the top edge just reaches the point C. Then draw a line along the top edge from C towards D, and it will be parallel to the line AB.

To draw a straight line equal to a given arc, an arc equal to a given straight line, or an arc of different curvature equal to a given arc.

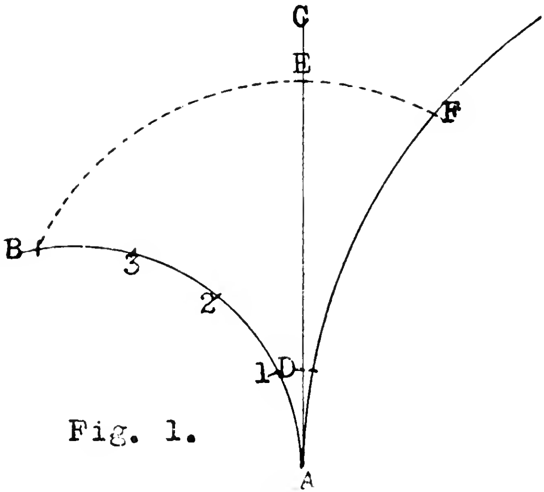


Fig. 1.

Space the given arc, Figure 1, into 4 equal spaces by the intermediate points 1, 2, 3. Draw A C tangent to the arc at A, and with A as center and radius A 1 mark D (the chord of ¼ the arc). Then with D as center and radius D B strike the arc B E, and A F will be the same length as A B.

Or, if the straight line be given, space it into 4 equal spaces, and with the first point of division D as center, strike the arc E B, and A B will equal A E.

Also, let A B be the given arc, and A F an arc of unequal curvature. Space A B, as in the first proposition, and set off D on the straight line tangent to both arcs at A, and with D as center and radius D B, draw the arc B to F. Then A F will equal A B.

To develop, by the latter proposition, the pattern for the envelope of a cone, the slant height and size of base being known.

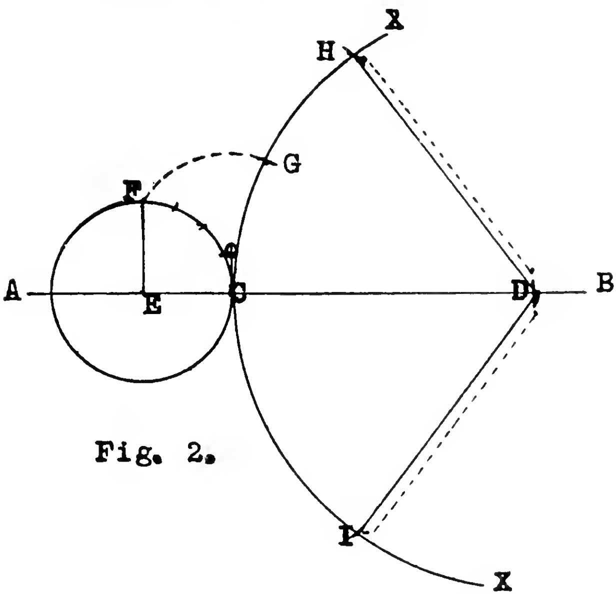


Fig. 2.

On any straight line, Fig. 2, set off the required slant height C D, and with D as center and radius C D, describe the indefinite arc X X. Set off from C, on line A B, the radius of the desired base C to E, and with E as center describe the complete circle. Draw a radius E F perpendicular to A B and space the quarter circle into 4 equal spaces. Erect a perpendicular at C which will be tangent to the circle and to the long arc at that point, and on it set off one of the 4 equal spaces of the quarter circle, marked o. With o as center and radius o F describe the arc from F to the long arc at G. Then C G equals C F, or ¼ the circumference of the base.

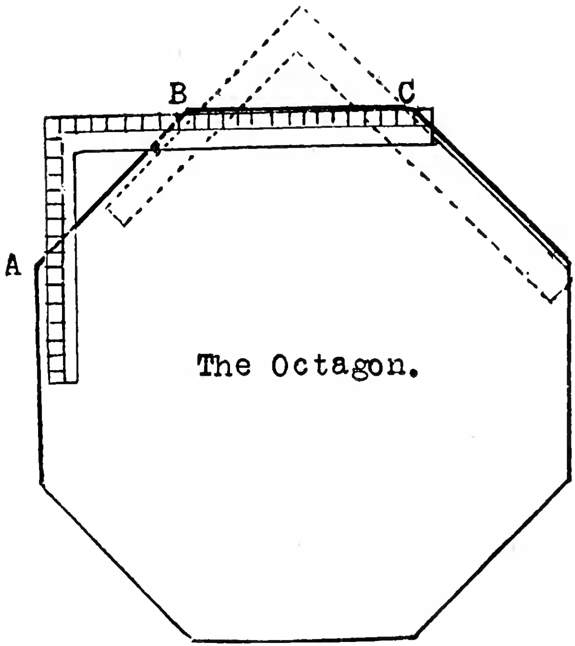
Now span the dividers from C to G, and step this distance from G to H, and two steps from C to I, and connect H and I with D. Allow edges for lock and pattern is complete.

The Octagon.

To lay off an octagon without a circle, or a center, and with no internal lines whatever.

Use the steel square, and after drawing a line the length desired for one side of the octagon, place the square on the line at 12 and 12, or 6 and 6, or any convenient numbers, using the same figure on the blade as on the tongue, and with one of these numbers just at the end of the line, draw the next side along the blade of the square. Continue this process, being careful to make the sides exactly the same length, and to place the square so that the line last drawn crosses it just at the figures selected.

The accompanying cut fully shows the manner of using the square. Here A B is the first side drawn, say 14 inches long, and the square is then placed on A B as shown, with 8 and 8 on the line and the edge of the blade (long side) at the end B of the line. Then draw B C 14 inches long, which would be just to 22 on the blade. Swing the square around onto B C as shown by the dotted outline and draw the next side.



If the work is done accurately the resulting figure will be a perfect octagon.

In the cut the square is shown a little off from the line B C in order to show that line. But if the square was placed so that the 8 inch mark just coincides with end B of the line A B, then B C would just reach the 22 inch mark on the blade.

Of course any size of octagon may be made in this manner, by using smaller numbers on the square for drawing those with shorter sides.

Diam.	Area.	Cir.	Diam.	Area.	Cir.
1/8	0.0123	.3927	16	201.06	50.26
1/4	0.0491	.7854	1/2	213.82	51.83
3/8	0.1104	1.178	17	226.93	53.40
1/2	0.1963	1.571	1/2	240.53	54.98
5/8	0.3068	1.963	18	254.47	56.55
3/4	0.4418	2.356	1/2	268.80	58.12
7/8	0.6013	2.741	19	283.53	59.69
1	0.7854	3.142	1/2	298.65	61.26
1/8	0.9940	3.534	20	314.16	62.83
1/4	1.227	3.927	1/2	330.06	64.40
3/8	1.485	4.319	21	346.36	65.97
1/2	1.767	4.712	1/2	363.05	67.54
5/8	2.074	5.105	22	380.13	69.11
3/4	2.405	5.498	1/2	397.61	70.68
7/8	2.761	5.890	23	415.48	72.25
2	3.142	6.283	1/2	433.73	73.83
1/4	3.976	7.068	24	452.39	75.40
1/2	4.909	7.854	1/2	471.43	76.97
3/4	5.939	8.639	25	490.87	78.54
3	7.068	9.425	26	530.93	81.68
1/4	8.296	10.21	27	572.56	84.82
1/2	9.621	10.99	28	615.75	87.96
3/4	11.044	11.78	29	660.52	91.10
4	12.566	12.56	30	706.86	94.25
1/2	15.904	14.14	31	754.77	97.39
5	19.635	15.71	32	804.25	100.5
1/2	23.758	17.27	33	855.30	103.6
6	28.274	18.85	34	907.92	106.8
1/2	33.183	20.42	35	962.11	109.9
7	38.484	21.99	36	1017.9	113,1
1/2	44.179	23.56	37	1075.2	116.2
8	50.265	25.13	38	1134.1	119.4
1/2	56.745	26.70	39	1194.6	122.5
9	63.617	28.27	40	1256.6	125.6
1/2	70.882	29.84	41	1320.2	128.8
10	78.54	31.41	42	1385.4	131.9
1/2	86.59	32.98	43	1452.2	135.1
11	95.03	34.55	44.	1520.5	138.2
1/2	103.87	36.13	45	1590.4	141.4
12	113.10	37.70	46	1661.9	144.5
1/2	122.72	39.27	47	1734.9	147.6
13	132.73	40.84	48	1809.6	150.8
1/2	143.14	42.41	49	1885.7	153.9
14	153.94	43.98	50	1963.5	157.1
1/2	165.13	45.55	51	2042.8	160.2
15	176.71	47.12	52	2123.7	163.3
1/2	188.69	48.69	53	2206.2	166.5

Diameters and Circumferences of Circles.

To find the circumference of any circle greater than any given in the table, multiply by 2, 3, 4, 10 or any number of times. For instance:

The circumference of 28 is 2 times that of 14. And the circumference of 140 is 10 times that of 14. The circumference of 14 is 43.98, and to find the circumference of 140 multiply 43.98 by 10, which is done by removing the decimal point one place to the right, making 439.8.

A Short Method of Finding Circumferences Without Figures

Draw a line 12 inches long, as A B in Fig. 1. Span dividers to 3 13/16 inches, and with one point at B

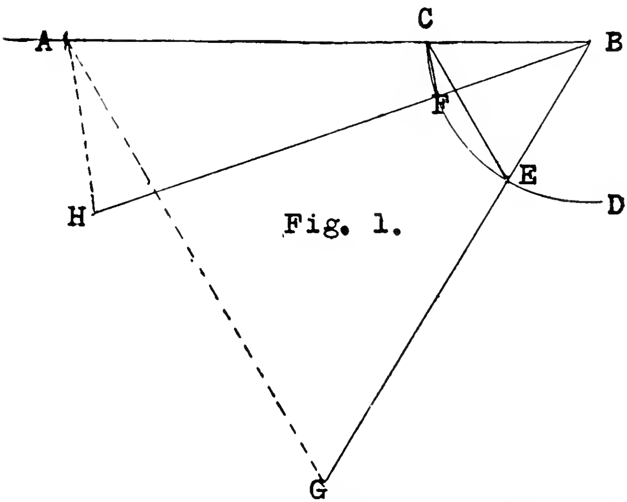


Fig. 1.

strike an arc C D. Set off on this arc from C, the given diameter, as C E or C F. Then draw from B through E or F, another line 12 inches long, and the distance from A to G will be the circumference of the diameter C E, or from A to H will be the circumference of the diameter C F.

This rule is good for all small circles up to 7⅝ inches diameter which, being just 2 times 3 13/16,

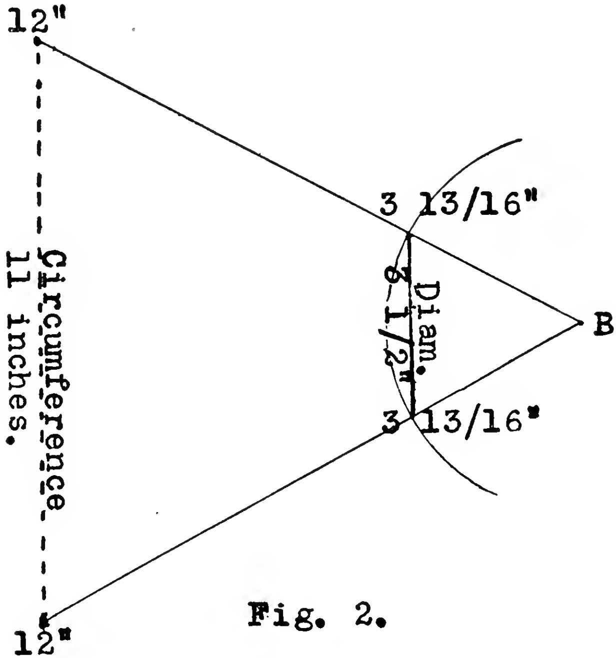


Fig. 2.

would make the arc C D a complete semi-circle, and the line B G would be swung around to form a continuation of A B, thus making the distance from A to G 24 inches, which is just a little more than the true circumference of 7⅝, which is 23.955.

A very convenient way of applying this method is to mark across both legs of a two-foot folding rule, 3 13/16 inches from the center of the rivet in the middle joint, which would be at 8 3/16 on one leg, and at 15 13/16 on the other. Then by opening the two end joints of the rule and spreading the legs so that the marked points at the inside edges will be just the distance apart of the given diameter, the inside corners will be the distance apart equal to the required circumference.

Fig. 2 shows the application of the rule to the same principle. B is the hinged joint, and the lines from B to 12" are the inside edges of the legs of the rule. It is here shown spread to 3½ inches diameter, and measures 11 inches circumference.

Some Remarkable Facts About Circles.

We are taught from our youth up, that the diameter of a circle multiplied by 3.1416 equals the circumference, and that the square of the diameter multiplied by .7854 equals the area. Some of the following facts, however, have not been so generally taught:

That the diameter divided by .3183 equals the circumference.

That the circumference multiplied by .3183 equals the diameter.

That one-half the circumference multiplied by one-half the diameter equals the area. And that the square of the circumference multiplied by .07958 equals the area.

That the area of a circle is greater than that of any other plain figure bounded by an outline of equal length.

That in any circle whose diameter is less than 4 the area is less than the circumference; i. e., the number of square units of area is less than the number of lineal units of the circumference.

That if the diameter is 4 the circumference and area are represented by the same number, each being 12.5664, while in all circles whose diameters are more than 4 the areas exceed the circumferences, and the proportions of one to the other advance by a regular ratio, or progression, as will be seen by the following table:

Table.

Diameter.	
.1	area equals circum. divided by 40.
.4	area equals circum. divided by 10.
.5	area equals circum. divided by 8.
1	area equals circum. divided by 4.
2	area equals circum. divided by 2.
3	area equals circum. divided by 1⅓.
4	area equals circum.
5	area equals circum. multiplied by 1¼.
6	area equals circum. multiplied by 1½.
7	area equals circum. multiplied by 1¾.
8	area equals circum. multiplied by 2.
10	area equals circum. multiplied by 2½.
12	area equals circum. multiplied by 3.
14	area equals circum. multiplied by 3½.
16	area equals circum. multiplied by 4.
18	area equals circum. multiplied by 4½.
20	area equals circum. multiplied by 5.
24	area equals circum. multiplied by 6.
28	area equals circum. multiplied by 7.
32	area equals circum. multiplied by 8.
36	area equals circum. multiplied by 9.
40	area equals circum. multiplied by 10.
44	area equals circum. multiplied by 11.
48	area equals circum. multiplied by 12.

To use the table: Find the circumference by reference to the table of diameters and circumferences given in another chapter, or by any rule, and divide or multiply by the number given in this table opposite the chosen diameter. For example: Diam. 2, the circum. of which is 6.2832, which divide by 2 and the area is found to be 3.1416. Again, diam. 12, circum. of which is 37.6991, which this table shows is to be multiplied by 3. $37.6991 \times 3 = 113.0973$. the required area.

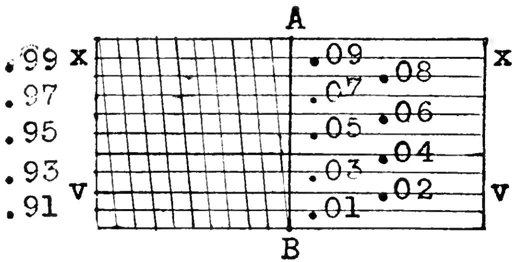
The ratio of increase of the multipliers continues the same indefinitely, increasing ¼ for each unit of increase of diameter, so that this table may be used for finding the area of circles of other diameters than those given. If the diameter is 9 multiply the circum. by 2¼. If 49 multiply by 12¼. If 50, by 12½. If 51, by 12¾, and if 52, by 13. The multiplier continuing to increase one unit for each 4 units of diameter. Hence, to find the area of a circle whose diam. is 400, multiply the circumference by 100. Thus, diam. 400, circum. $1256.64 \times 100 = 125664$.

In other words, multiply the circumference by one-fourth the diameter to find the area of any circle.

Scale of Hundredths.

It frequently happens in making particularly accurate measurements that it is desired to measure a certain number of hundredths of an inch. And sometimes the required number is such that considerable time, and much figuring would be necessary, to reduce it to a common fraction.

A scale of hundredths is a great convenience in such cases, and if the shop square does not contain one, it may be made very accurately, by any one, with a few minutes careful work.

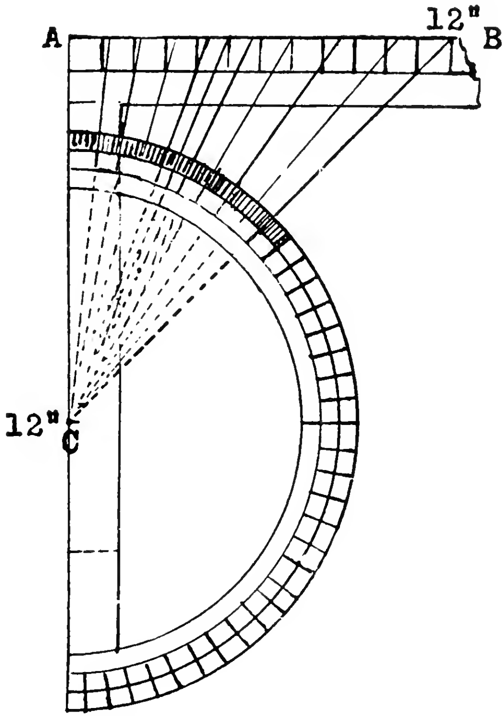


Near one end of a strip of tin, lay off a square inch, and space horizontally into ten equal spaces by parallel lines, and it is a good plan to continue these lines several inches along the tin.

Space it the other way into equal spaces, and draw parallel lines having a slant of one space. That is, draw the first line from one corner of the square to the first space mark on opposite side, thus forming a triangle with one inch perpendicular, and one-tenth inch base. Draw the remainder of the lines exactly parallel to the first, and you will have a similar triangle at the opposite side only reversed.

To use the scale extend dividers the required number of whole inches and place both points on the required line, .01, .02, etc., according to the number of hundredths to be added, with one point exactly on line A B. Then hold the other point firmly and extend the one resting on line A B to the intersection of the diagonal line with the one on which the dividers rest.

For example, to find 2.06", extend the dividers two inches, and place one point on the intersection of the line .06 with the line A B, and holding the other point on line .06, extend the point on A B to the intersection of the first diagonal line.



With this scale any number of hundredths may be readily found. To find 1.99" extend dividers from x to x. Or for 1.92, from v to v, etc.

Measuring Degrees on the Steel Square.

It sometimes happens that it is desirable to find a certain number of degrees when there is no protractor at hand. In such cases the steel square and the following table will be found to answer the purpose with a reasonable degree of accuracy.

Table.

Inches.	No. 1 Deg.	No. 2 Deg.
12	45	45
10 1/16	40	50
8 13/32	35	55
6 15/16	30	60
5 19/32	25	65
5	22½	67½
4⅜	20	70
3 7/32	15	75
2 3/32	10	80
1 1/16	5	85
0	0	90

EXPLANATION OF TABLE.

A line drawn from 12″ on the blade to 12″ on the tongue is 45° to either edge of the square. And a line drawn from 12″ on either edge to any number in the column of inches, on the other edge, will be, at the 12″, the number of degrees indicated in the column of degrees marked "No. 1." And where it intersects the outer edge of the other arm of the square, it will be the number of degrees indicated in the column marked "No. 2."

As the cut shows, the angles given in column No. 1 of Degrees are those at C, and the ones given in column No. 2 are those between A and B.

Chimney Tops.

An article of very general use throughout the country, and yet one which seems to be quite difficult for many tinners to quickly draw patterns for, is the galvanized iron chimney top base. Really this is a transition piece, being an article hav a square or rectangular base, and round top.

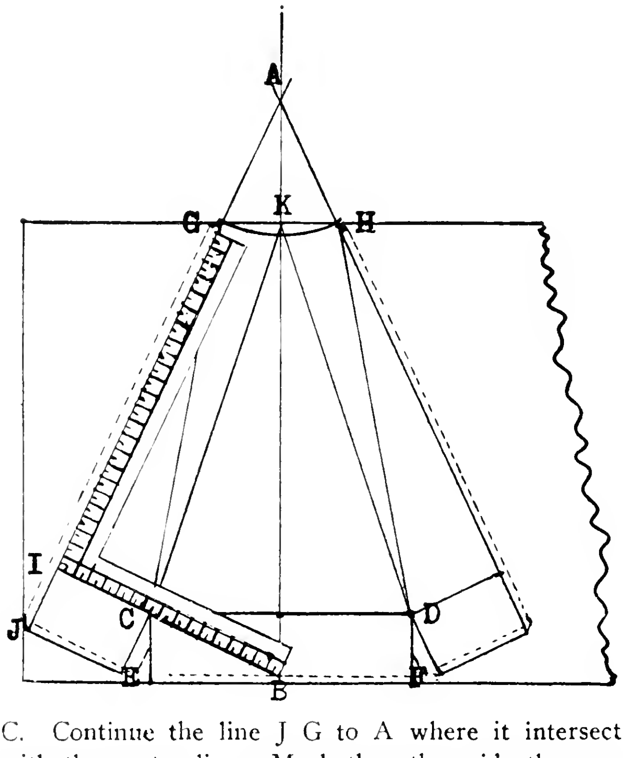
The pattern for this article may e so quickly drawn that it is better to lay it off on the sheet to be used, and if made in two pieces, one only need be drawn, and the other cut by it.

For the purpose of explaining the process we will take definite dimensions, say 13"x17" with 4" perpendicular base, and tapered to fit a 7" pipe, the height to be just what will cut from 30-inch iron. The seams to be in the middle of the narrow sides.

At a distance of 17 inches from one end of the sheet scribe at right angles across it, a line, as A B, letting the line extend indefinitely to A on the floor or bench after reaching the edge of the iron. This line is the center line of the half pattern. Set off from center line at B 8½" to E, and the same distance to F. Then with the square scribe up from F to D 4½", and from E to C 4½", and connect C and D.

From the center line at K set off a little less than ¼ the circumference of top each way to G and H. For 7" pipe about 5 inches each way, making 10 inches for the chord G H. For other sizes of top use about the same proportion—10 to 22, or 5 to 11—which would be about 8⅝ for 6-inch pipe, and about 11⅜ for 8-inch.

Next place the blade of square at G and 6½ inches on the tongue at C, as shown in drawing, and scribe from G to I, and from I to C, then slide the square down 4½ inches, keeping the blade to the line G I, and mark from J to E 6½ inches, and connect E and



C. Continue the line J G to A where it intersects with the center line. Mark the other side the same from H around to D, etc., and continue the line from H to A.

With A as center and radius A G strike the arc G H. Then draw lines from D to H, and from D to K, also from C to G and C to K. Lay off the allowance for lock along each edge as shown by dotted lines, and cut out.

The top should be cut on the arc G K H so the bends can be the more easily made on the lines C K and D K. Notch in from F to D and from E to C, leaving an allowance to rivet. Mark the other half by this, being careful to prick the points K, C, and D. Fold the bottom edge 1/4 inch over flat, and then straight out, to make a good stiff edge at bottom.

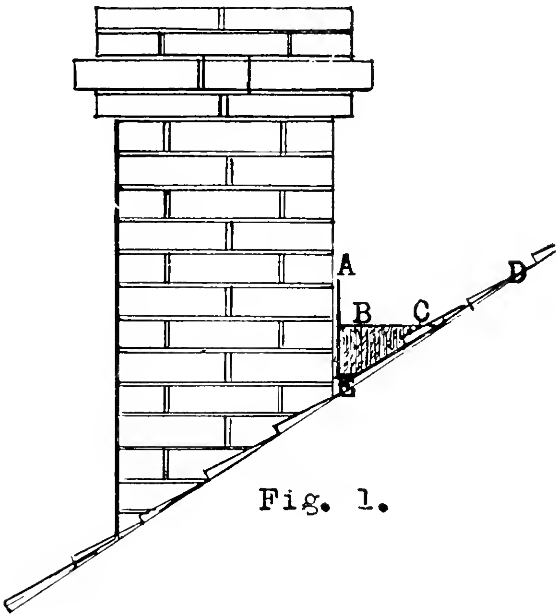


Fig. 1.

Now fold the edge locks, one out and the other in, the same as for stove pipe, and then brake over stake, or in the brake if you have one, on the lines G C, K C, H D and K D, forming about square at C and D, and running out to round at top end G K H. Lock the two halves together and groove down the seams, after which bend on lines I C, C D, etc., to bring the 4-inch base strip to perpendicular, and rivet the corners.

Chimney Saddles.

The chimney saddle is a very important article, and is much better than a plain flashing behind the chimney, because being sloped both ways, it allows the water to all run off quickly, while the flashing usually remains wet for some time, and soon rusts through.

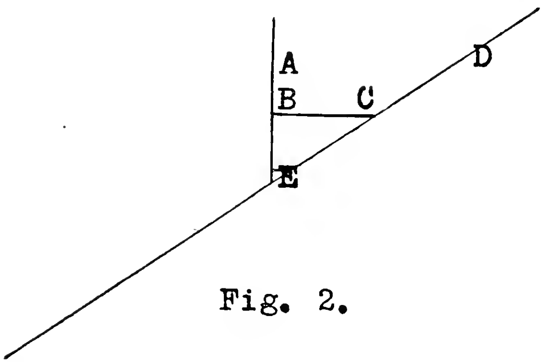


Fig. 2.

Fig. 1 shows the saddle in place behind a chimney on a 1/3 pitch shingled roof. A, B, C, D and E being a side elevation.

To develop the pattern, draw X X, Fig 2, the pitch of roof, A E the perpendicular line of chimney, B C the width desired for high point of saddle, and E the width of ends at low point.

Suppose, for example, the roof is 1/3 pitch, and the chimney is 26 inches wide, and the saddle to be 6 inches wide at high point. Make B C, at right angles to A E, and 6 inches long. And E, 1 inch long, parallel to B C.

Next cut a piece of galvanized iron 16x28 inches and lay it off as shown in Fig. 3. A to B is 4 inches, B to C 6 inches and C to D 6 inches. Cut straight in from A to B, and from D to C. Then bend at right angles on line E E, and to about 1/3 pitch on lines C E and C E. Bend at B C until the line B C is as high

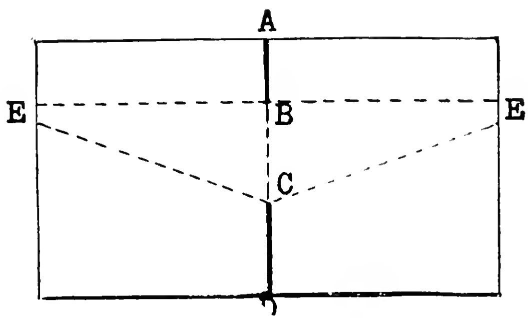


Fig. 3.

above the ends at E as the distance B E in Fig. 2. Rest it on the bench in this position and solder a gore over the V-shaped opening A B. Turn the wide side E D E down flat on bench and solder a gore over the opening D C. These gores should also be riveted to prevent the solder breaking, and they should both be put on the inner side, as they will not leak quite so badly in case the solder does become broken.

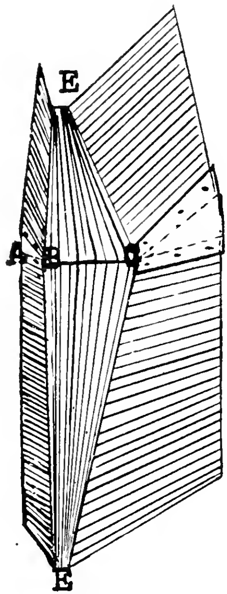


Fig. 4.

Fig. 4 shows the completed article with the riveted gores.

Gutter and Gutter Miters—Octagon and Half Round.

In Figures 1 and 2 are shown square miter patterns for octagon and half round gutter, the inside and outside of miter of each, and each taking the same width of stock, in this case 9 inches.

In Fig. 1 the dimensions are as follows, though these may be varied at will: 0 to 1, ½ in.; 1 to 2, ¾ in.; 2 to 3, ¾ in.; 3 to 4, 1 in.; 4 to 5, 1 in.; 5 to 6, 2½ in.; 6 to 7, 1 in.; 7 to 8, 1½ in.

This takes just 9 inches width of stock, and is a

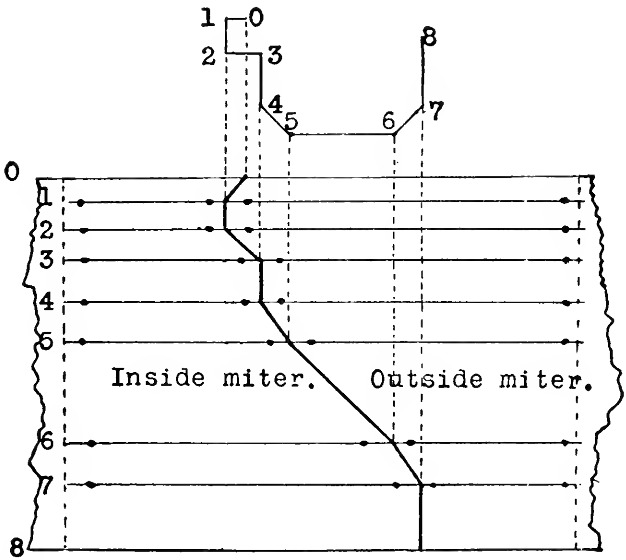
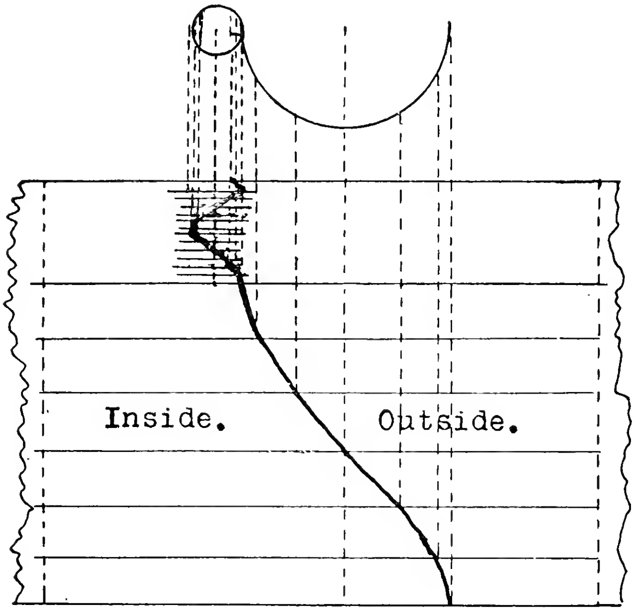


Fig. 1.

very convenient size of gutter to make, as a 36-inch sheet of iron will cut 4 pieces without waste.

To develop the pattern, draw profile as shown, then draw a stretch-out 9 inches from 0 to 8, and any desired length. Space the stretch-out 0 1 2 3, etc., the same measurements as 0 1 2 3, etc., in profile. Draw lines from the points of bend in profile to intersect the space lines in stretch-out as shown, and connect these intersections by straight lines.

Cut on the miter line, and prick both ends of each piece on the space lines, and the two patterns are complete, by which any number of pieces may be



marked and pricked for bending. In cutting out by these patterns one piece of each pair should be cut a half inch longer and notched in at each point of bend, to form a lap, as a much stronger job is made by so doing, than by butting them together.

For marking the long pieces which are to have no miters cut on them, a narrow strip of iron may be prick marked 1 2 3, etc., and cut 9 inches long. Prick each end of the piece by this pattern, and it is then ready to form up in the brake.

In forming up, put the 0 1 2 3 edge of piece into the brake to the third dot (dot 3). Bend square up. Reverse and put the same edge in, the other side up, to dot 2, and bend square up. Pull back to dot 1, and also bend square, this finishes the bead. Turn it around and put in to dot 4, and bend up to 45°, pull back to 5 and bend to 45°, then 6 and 7 each 45°.

It is a good plan to cut a stay the exact shape of profile, and form the gutter to the shape of the stay, as nearly as possible.

In Fig. 2 is shown a very similar development of the half round gutter miter. The bead pattern is a complete two-piece elbow pattern, and the half round part is just half of an elbow pattern, and each part may be laid out by any method of elbow with which the workman is familiar.

The bead in Fig. 2 is shown somewhat out of proportion, but the principle of development is the same regardless of the size.

Box Gutter.

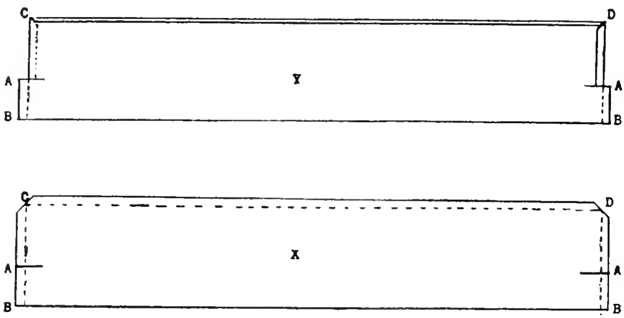
I used to dread a job of box gutter. It seemed to be a hard matter for me to put it in properly, and not spend too much time on the job.

For the benefit of others who may be troubled in the same manner, I will describe my present method. And, by the way, I rather like the work.

We will suppose we have a box gutter job which is to finish over the edge of crown mould with a bead, which is a common style of finish at the present time.

Make up the bead in 28-inch lengths (or in 20-inch if you have only a 20-inch beader in the shop), and of sufficient width to cover the flat or slightly sloped surface between the gutter and outer edge of cornice, and a ¼-inch allowance to turn up to lock the edge of gutter to. For instance, if the deck strip is 2¾ inches, and you have a 30-inch beader which turns a ½-inch bead, cut the tin in 5-inch strips, and cut in with the snips ¾ of an inch deep in each end of each piece, 2 inches from one edge, as shown at A, Fig. 1. Notch

Box Gutter Fig. 1.



the other two corners, being careful to take off corner enough to allow for a ¼-inch fold across the end and along the side also.

Next fold both ends the same as for valley, i. e., in opposite directions, one up and one down, turning clear down so as to lock them together, and fold the edge C D up square, or a little more. Then straighten out the 2 inches of end folds which was previously cut, as shown by dotted lines B A at each end of cut Y in Fig. 1. Hammer these ends down pretty flat with the mallet, so they will slip into the beader readily. Then bead the edge B B, turning the bead on the side opposite to the bend of edge C D.

An end section of the finished piece is shown in Fig. 2, which clearly shows the bead turned *down*, the opposite edge turned *up*, and the up fold of one end, but does not show the down fold of the other end.

Get out enough of these pieces to cover the deck strip, and enough valley (14-inch is wide enough for

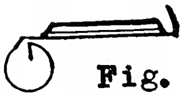


Fig. 2.

most ordinary gutters) being careful that it is well soldered.

Put on the bead first, by putting one in place, then slip the bead of the next over that, and pushing them together far enough to let the fold A C catch over the fold A D, and then pulling back till they lock together.

Nail close to the fold C D, so the heads will be covered when it is hammered down, and put an occasional slim nail through the bead into the edge of crown mould as shown at A in Fig. 3.

When the bead is all in place, measure from bottom of gutter at B to a point about ¼ inch above the turned up edge at C, Fig. 3. Take this measure at the low point of gutter, and again at the high point, and transfer these measurements to the edge of the strip of valley, and bend up with tongs or straight edge and mallet. Then measure the width of gutter B to D, at both ends, as the width often varies as well as the depth, and bend square up.

Next set the tin into the gutter and get into it with one knee, or one foot, to hold it down, and start the edge C over with tongs or plyers, and hammer it down to an angle, and then clinch it tight with cleating tongs

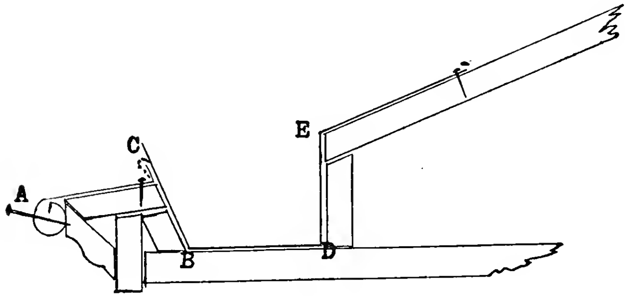


Fig. 3.

or plyers, and finish down flat with the mallet.

Then, still keeping the weight in the gutter, bend the back at E down onto the roof boards, and put in an occasional nail if the roof is to be shingled, but if it is to be tinned, turn up the back edge at F and blind nail, thus leaving it ready to lock the roofing on.

This same method of bead finish may also be used without gutter, if so desired. I have often put on porch roofs with this kind of finish. Using, however, full sheets instead of the narrow strips.

Slit each end of the sheets, and, after folding the two ends and one side, straighten out the narrow part of the end folds, just as described, and turn the bead the same as shown on the narrow strips.

In connection with the box gutter it might be well to mention my way of making the ends. Tinners differ in their manner of doing things, and I do not claim to have the only right way. But I mention these matters, hoping to help some workman who has met with the same difficulties that have hindered me so many times.

I usually cut the tin enough longer than the gutter to equal the greatest depth of both ends, and a little to spare. Then slash straight in at the ends, at each bend, B, D and E, about as far as the height of D E. Bend C B and D E in towards each other, and the bottom, B D, up. Trim off the surplus tin and solder the edges well.

An end may be cut to fit and soldered in, but in most cases this is no advantage, and takes much longer. And in these days of competition, time is quite an object, and the workman who can do things quickly and well, stands a better show than the one who does them ever so well, but works slowly.

The Ellipse or Oval.

A perfectly true ellipse can not be drawn with the dividers and two radii. But there are several methods of drawing them in this manner, which so nearly approximates the true ellipse as to answer the purpose for most tin shop work.

A very accurate method, however, is by the string and nail process. Fig. 1 is drawn in this manner.

Draw A B the length of the major axis and bisecting it at right angles draw C D the length of the minor axis. With C or D as center and one-half the major axis as radius, mark the points E and F on the major axis. Drive nails at E, F and C, and tie a string tightly around the three nails. Remove the nail at C and with a pencil or scriber draw the ellipse, keeping the string tight.

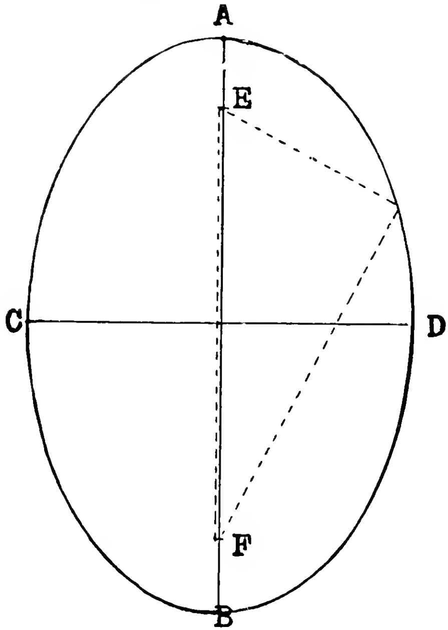


Fig. 1.

If the pencil is held in an upright position and the string is not allowed to slip up or down on it, and does not stretch more in some directions than in others, the result will be a perfect ellipse. In fact, it is in strict accord with the scientific definition of an ellipse—"A figure bounded by a curved line, every point of which is equally distant from two points within, called foci."

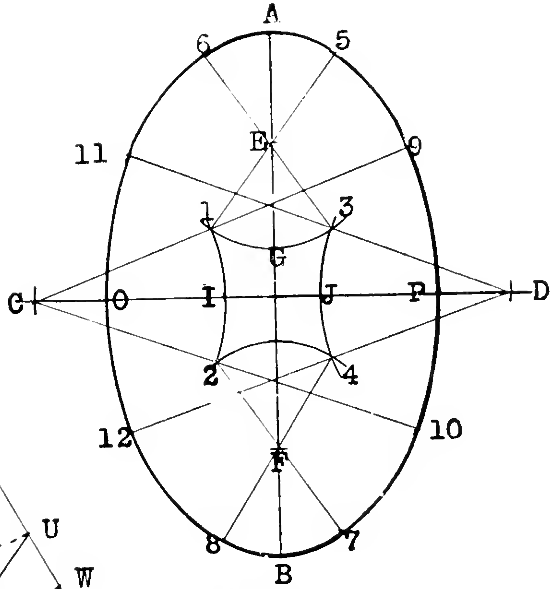


Fig. 2.

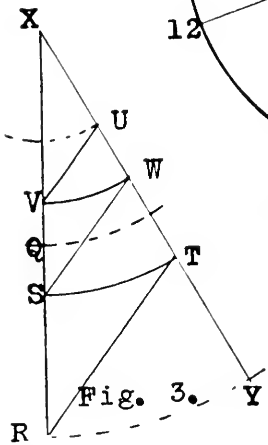


Fig. 3.

In this figure, E and F are the foci, and the distance from any point in the curve to F plus the distance from the same point to E is the same as the combined distances from these two points to any other point in the curve, and is just equal to the length of the major axis.

In Fig. 2 is shown a very near approximate to an ellipse, composed of arcs of circles, having three different radii and eight centers, hence it is called the "eight centered oval."

To draw an oval by this method, draw A B the length of major axis, and bisect it at right angles by C D indefinitely. Mark points O P on C D the length of minor axis.

Now to determine the radii to be used, draw X Y and X Z, Fig. 3, forming any convenient angle at X. With X as center and radius equal to half the short axis strike the arc V W. With same center and radius half the long axis draw the arc S T. Connect W and S, and parallel to W S draw V U and R T. Then X U will be the radius to use for the arcs at the extremities of the major axis, and X R will be the radius for the side arcs at the extremities of the minor axis. For the radius of the arcs to connect the side arcs with the end arcs take the length of the semi-minor axis plus half the difference between the semi-axes, which is (in Fig. 3) the distance X V plus half the distance V S, hence X Q.

On A B of Fig. 2 set off A E and B F, each equal to X U. And A G and B H each equal to X Q. Lay off from O to D and from P to C, each equal to X R and from O to J and P to I each equal to X Q.

With C as center and radius C I draw the arc 1 2, and with D as center and same radius draw the arc 3 4. With E and F as centers and radius E G or F H strike the arcs through G and H intersecting the arcs 1 2 and 3 4 at the points 1 3 and 2 4. Draw a line

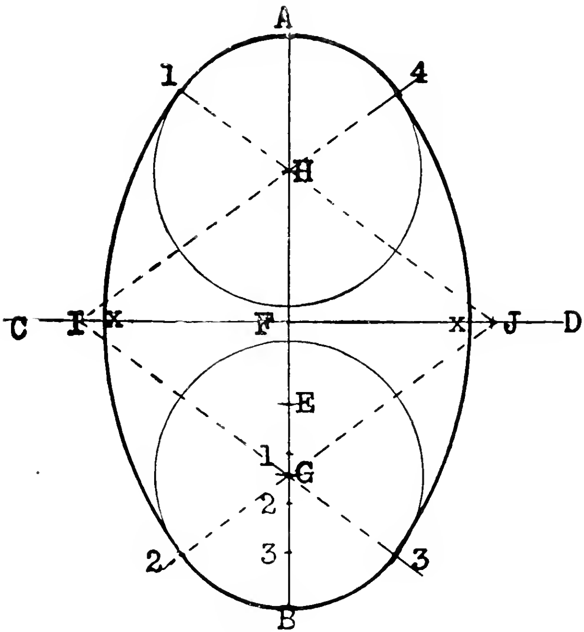


Fig. 4.

through E from 1 to 5 equal in length to X Q, and from 3 to 6 same length, and the same through F from 2 to 7 and from 4 to 8.

From C through 1 and 2 draw lines the length of X R, and from D through 3 and 4 same length, ending at 9, 10, 11 and 12.

With C as center and radius C P (or X R) draw the arc 9 10, and with D as center and same radius draw 11 12. With E and F as centers and radius E A (or X U) draw 5 6 and 7 8. Then with 1, 2, 3 and 4

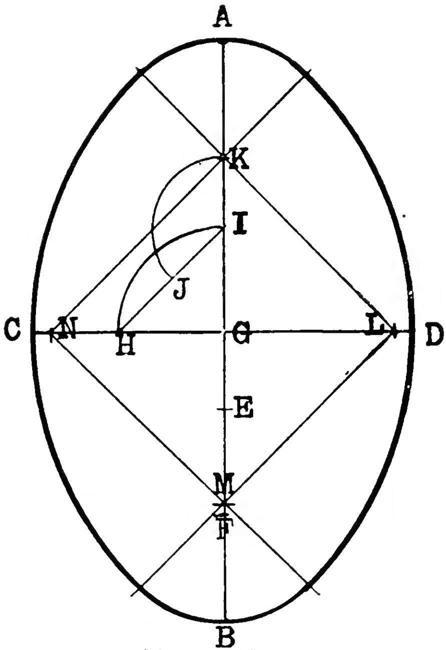


Fig. 5.

respectively as centers and radius 1 to 5 (or X Q) draw the four connecting arcs 5 to 9, 7 to 10, 8 to 12 and 6 to 11. This completes the eight centered ellipse, which is a very near approach to the shape of that in Fig. 1, constructed with the string and nails.

Figures 4 and 5 are of the four centered kind, using only two radii. Either of these will answer very well for small articles. Fig. 4 is, however, slightly nearer to the perfect ellipse than Fig. 5.

To draw Fig. 4 make A B the length of major axis, and bisect it with the indefinite line C D at right angles to it on which mark x x length of minor axis. From A set off the length of required minor axis, marked E, and divide E B into 4 equal spaces. With 3 of these spaces, (which is ¾ the difference of the two axes) as radius, and F as center, mark G and H and describe circles with radius A H or B G. Take the distance from F to the nearest edge of one of the circles and set off from x x marking the points I and J. From I and J draw lines through H and G respectively, as J to 1 and 2, and I to 3 and 4.

With I and J as centers and radius I to opposite x draw the arc 3 4. And with J as center and same radius strike the arc 1 2, completing the figure.

For Fig. 5, draw A B and C D, the length and width desired. From A set off the width, A to E, then E B is the difference of the axis. Take half this difference, which is E F, for radius, and with G as center strike the arc H I. Draw the chord H I and bisect it at J. With I as center and radius I J draw the arc J K. With G as center and radius G K mark L, M and N. Draw lines from L and N both ways through K and M, and use K, L, M and N respectively for the centers from which to draw the four arcs to form the oval.

These four figures are all drawn to the same dimensions, i.e, the same lengths of axes, and the different degrees of variation from the nearest perfect form (Fig. 1) are readily detected.

Oval Flaring Pan.

Having described several methods of drawing elliptical and oval figures, and knowing that many workmen have their own rules for drawing the oval, I will omit that part here, and give an easy short rule for pattern for the body of flaring oval pans.

Around the corner of the square draw indefinitely A B C. Fig. 1. From B mark D the perpendicular depth of pan desired. From D draw D E parallel to A B, and make the distance from D to E the same as the radius I x of the side arc of the oval, Fig. 4. On A B mark F as far from B as the side radius plus the required flare of one side of pan, i. e., make B F just once the flare longer than D E. Then draw from F a line through E, continued to intersect B C at C. The distance from C to E is the radius of curvature of the bottom of the portion of the body to fit a side arc (as 1 x 2) of the oval.

Next, on D E mark e, the length of end radius of oval (A H of Fig. 4), and from B mark f the same distance plus the flare, and draw f e c, which will be parallel to F E C, and gives the radii for end portion of body.

Now draw a center line G H, Fig. 2, and with H as center and radius C E of Fig. 1, describe the arc I J equal in length to 1 x 2 of the oval, measured with a bent strip or by stepping with dividers. With same center and radius C F draw the arc K L limited by lines drawn from H through I and J. Then K I J L is the pattern for one side of pan. Now we will suppose the body is to be made in two pieces, with the

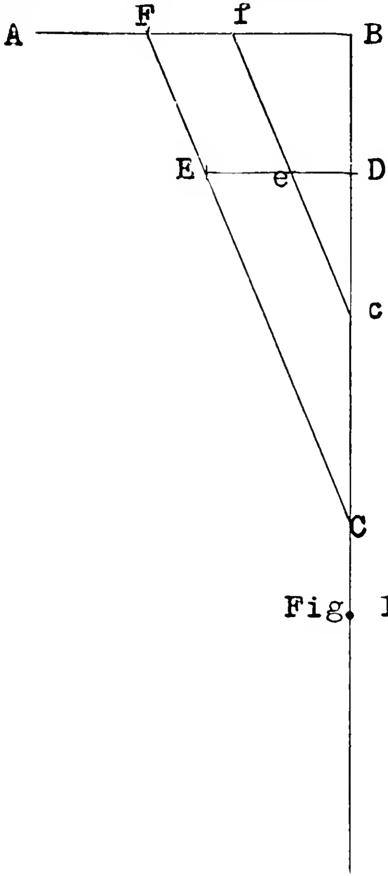


Fig. 1.

seams at the ends. To complete the pattern we must add half the end pattern to each end of K I J L. Set off from K and L, towards H, the distance c f of Fig. 1, here marked h h and with these points as centers and radius c e draw the arcs I i and J j each equal in length to one-half the end arc of oval, as A 1 or A 4 of Fig. 4. From h and h draw lines through i and j

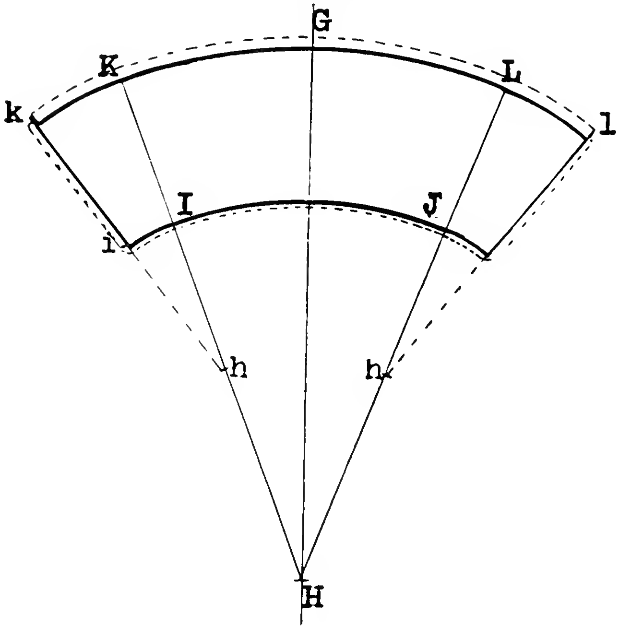


Fig. 2.

to k and l. With same centers and radius c f draw arcs K k and L l. Add allowance for wire, burr and locks, and the pattern is complete for one-half the body.

If the body is to be in four pieces, make lock allowance at K I and L J, and draw the two end halves in one piece, and add locks to both ends of it.

Figs. 1 and 2 are drawn to a smaller scale than the ovals in the other chapter, and the measurements do not exactly correspond with them. For this reason Fig. 4 is here reproduced of a size and shape suitable to illustrate Figs. 1 and 2 of this chapter.

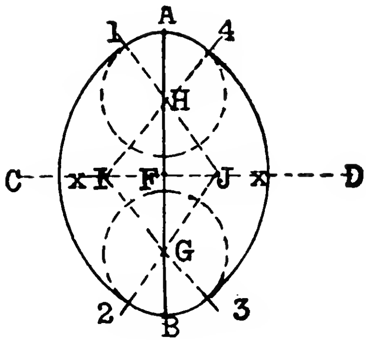


Fig. 4.

Above all things do not use C D and c D of Fig. 1 for radii, as is often done by some, they are not the correct radii, being only the perpendiculars of the triangles the hypothenuse of which are the true radii.

Pan Corners.

There are several ways of cutting a pan corner so that the folded corner will come up true under the wire. And there are many workmen who only guess at it, and make a poor corner in consequence.

In this chapter I will mention three methods, by any one of which the corner may be so quickly laid out that it would not be profitable to use guess work, and they are all accurate methods.

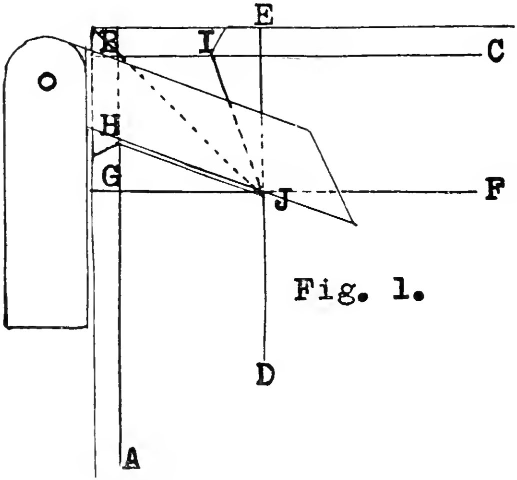


Fig. 1.

The first is the one I most often use, although I do not know that it is any better or quicker than either of the others.

On a perfectly square corner of the sheet to be used, lay off the allowance for wire A B C Fig. 1. Parallel to these lines and far enough in from them for the slant depth of the pan, make D E F. From the points G and E set off towards B the desired flare, one-half the difference between the size of the top and bottom. Draw lines from the points thus found at H and I, to J.

Next place the handle of a bevel against the edge of sheet. and adjust the blade until it coincides with the line H J. Then swing the bevel around till the handle is on H J as shown in Fig. 2, with the inner angle of blade and handle at H, and scribe along the blade from H to the center line J B. Reverse the

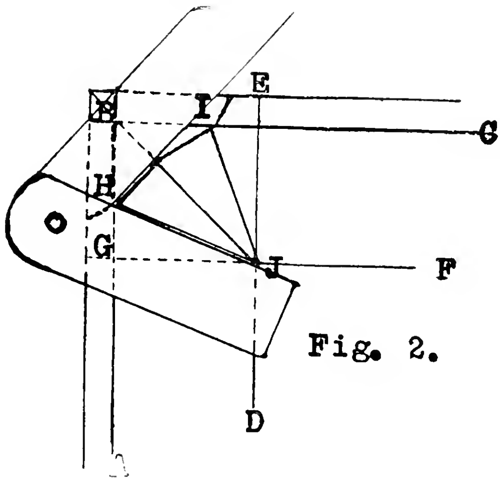


Fig. 2.

bevel, placing the handle on line I J, and scribe from I to the same point on center line as before.

Cut across the wire allowance at any desired angle, or square in to H and I, then through on the lines drawn, being careful to cut accurately when the piece may be used for a pattern by which to cut the other three corners, when you have them located. To do this measure from H along line A B the distance required for width of top, inside of wire. And from I along line B C the length of top, inside of wire. Then place the little corner pattern on with one of its straight edges coinciding with the edge of the iron, and the point H or I at the point found by measure. Mark the cut line and along the farther edge of pattern which will give the point at which to square off the sheet. Square from both the corners thus found, which will locate the fourth corner.

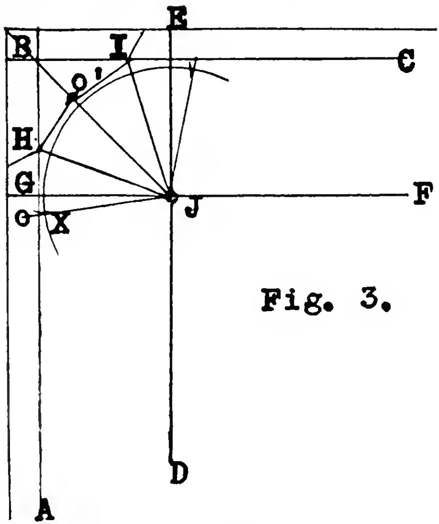


Fig. 3.

The second method is by means of rule or square, and dividers.

Lay off A B C, D E and F G, and locate H and I the same as described in the first method. Then with dividers set at J, Fig. 3, strike a long arc, or semicircle. Span dividers from intersection of arc with line B J to intersection with line H J and swing around to point X. Draw a line from J to X and the point where this line intersects the line of wire allowance is the right height from J for the center line B J, because the line J X is in the position B J will occupy when folded around against end of pan.

Span dividers from J to o and swing around and mark B J at o′.

Scribe from H to o′ and from I to o′, and cut out,

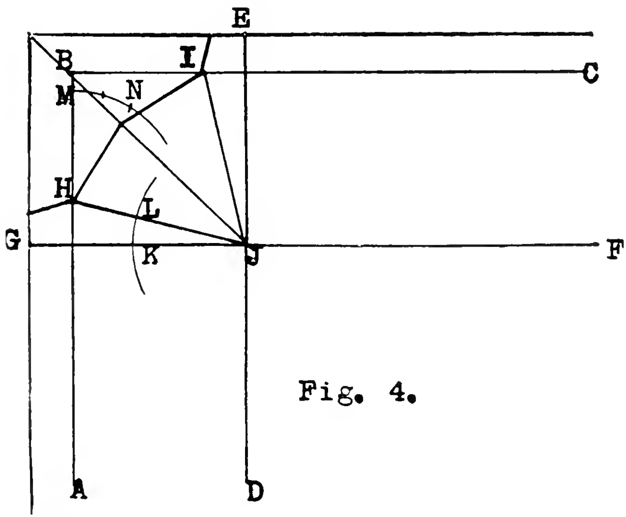


Fig. 4.

cutting wire allowance at any desired angle, thus completing the corner.

The third method is on nearly the same principle as the first, except that the angles are found by means of the dividers instead of a bevel.

After laying off A B C, D E and F G, and locating H and I as before, span dividers from H to a point nearly, but not quite to B, on line A B, and strike on arc downward as shown in Fig. 4. With dividers unchanged set one foot at J and strike an arc cutting H J and G J at K and L.

Then span dividers from K to L, and starting at M step off twice that distance (two steps) to N. Draw by the straight edge from H to N, and from I to the point of intersection with B J, and cut out as before.

In the first method we obtained the angle of H J by means of the bevel and by applying this angle again we produced the line H N (or the line corresponding to H N) at twice that angle with the line A B, and in this case, by stepping twice the distance K to L on an equal arc, we produce H N at just twice the angle of H J.

As before stated, the corner may be cut out and used as a pattern for the other three corners, but in practice I prefer to lay out all the corners first except the lines of cut, and then complete one, and use the piece for pattern for the others. Because the lines H J, B J and I J are needed as guides for making the bends when forming up.

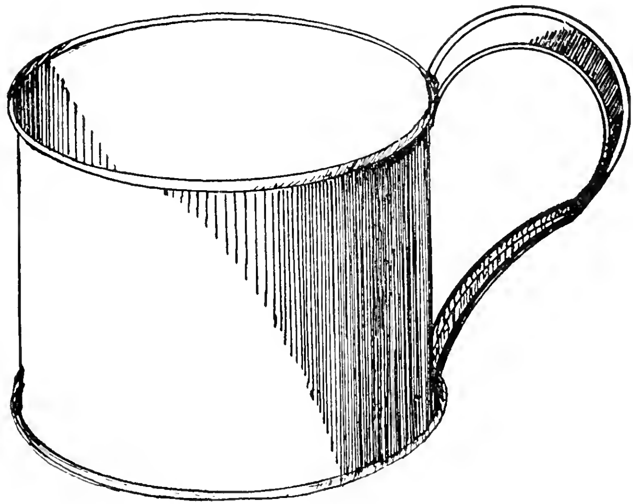
A Deflected Snap Bottom.

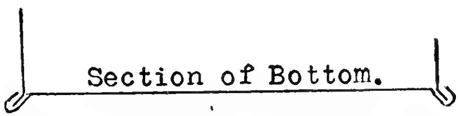
A snap bottom may often be used on small articles of tinware, instead of a double seamed bottom, and given a deflection in the "setting down machine." Cups, dippers, small basins and other small vessels may be made in this manner, quickly and neatly.

Burr the bottom of body out nearly as much as for a double steam, and perhaps just slightly wider. Not too wide, however.

Cut and burr the bottom so it will go on pretty snug, and run it in the setting down machine, holding the article up enough to begin to just start a deflect in the bottom, and continue to raise gradually until the seam is at an angle of about 45 degrees, as shown in the section of bottom underneath the cup, in drawing.

With very little practice, and a good setting down





Section of Bottom.

machine, this can be done very quickly, and makes a neat job.

A double seamed bottom can also be deflected in the setting down machine, if it is a very small seam, and pretty smoothly finished, and not too tight. If the seam is small enough to allow of starting it between the wheels of the machine, and care is used in handling the work, quite a neat looking deflect may be made.

Furnace Pipe Boot by Triangulation.

As triangulation is a more simple and accurate method of obtaining patterns for some of the more irregular and complicated shapes, this second chapter is given for the benefit of those unfamiliar with the process. And I believe, if the reader will carefully study this and the chapter on the "Transition Piece," he will be able to develop the pattern for almost any desired article, by this very useful and simple process.

Figure 1 is a perspective view of a common shape

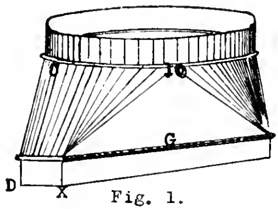


Fig. 1.

of boot for furnace pipe, and is a transition piece, or more strictly speaking, the body between the straight collars is a transition piece, and is the portion for which we will develop the pattern.

This boot is to fit a round pipe at one end 10 inches in diameter, and to fit a "riser" or wall pipe at the other 2x14 inches.

In practice it is unnecessary to draw the perspective. And even the elevations may be omitted, if the workman has the idea, or the picture of the article in his mind, and the work done entirely with the plan shown at the bottom of Fig. 2, the circle and the parallelogram.

Space the circle into any desired number of equal parts, here 10 are used. Construct a diagram of triangles as shown at the right of "side elevation." Make

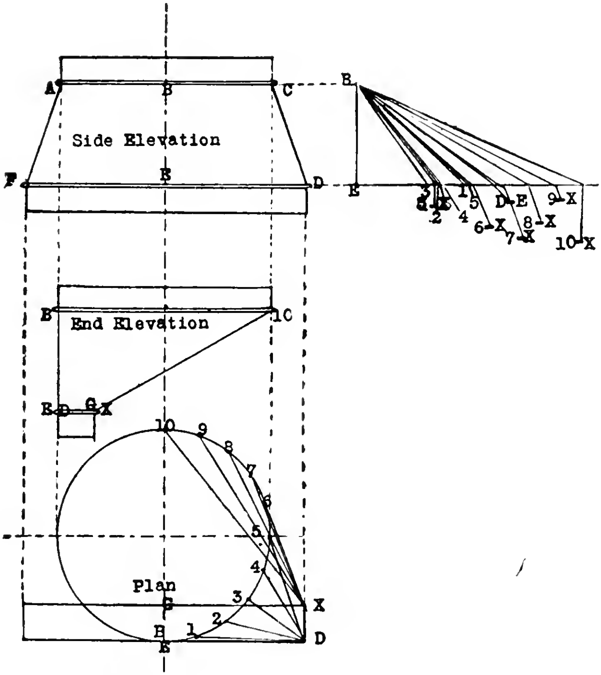


Fig. 2.

the perpendicular E B equal to the vertical height of the body of the article, and the base exactly at right angles to it, and of indefinite length. With the dividers measure each of the distances from the corner D to E, 1, 2, 3, 4 and 5 and set each one as found, off to the right from E on the base line of the diagram of triangles, marking each one for future references. Then take the distances from X to 5, 6, 7, 8, 9 and 10, being careful to number each one.

Now to develop the pattern, draw the right angle B E D, making B E equal to the vertical height (B E of the diagram of triangles) and E D equal to E D of the plan (one-half the length of one side of the parallelogram) and with one pair of dividers take the distance from B to 1 on the D of T and place one foot at D on pattern, and with another pair of dividers set to one of the spaces on circle place one foot of these at B on pattern describe a short arc to intersect an arc made by the other spanned from D, thus locating the point 1 of the irregular curve of pattern. Keep the one pair of dividers set the length of one of the spaces and continue in rotation, setting the other pair from B to 2 on the D of T and span from D to meet the space dividers at 2, and continue the measurements thus until 5 is located on the curve line of pattern. Then take the distance from 5-X from B on the D of T and span downward from 5 on the pattern and meet it with a measurement from D equal to D X on the plan (the width of the parallelogram). Then proceed with the remaining distances the same as with the first quarter of the circle, except we span from X instead of D to locate 6, 7, 8, 9 and 10.

It was necessary for us to take the measurement from 5 to X as well as from 5 to D on plan and transfer it to the D of T in order to locate the point X of the pattern.

Now to locate the point G of pattern take the distance 10 to G shown in "end elevation" and span it downward from 10 on pattern and meet it with the

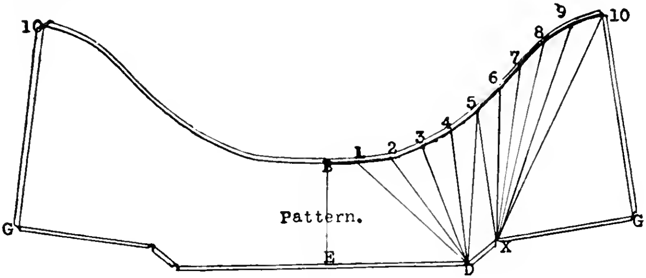


Fig. 3.

distance X G of plan (half the length of parallelogram) spanned out from X. Connect the points thus found by straight lines from D to X, from X to G and from G to 10, and by drawing a free hand curve through B, 1, 2, 3, 4, 5, 6 7, 8, 9 and 10, which completes one-half the pattern. The other half may be drawn in the same manner, or by cutting out this half and scribing around it.

The end elevation was referred to once in the above description, and a measurement from that elevation was used in locating G on the pattern, but we could have located it without the end elevation, by measuring across from 10 to G on the plan and transferring the distance to the base line of the D of T, then from that point to B is equal to 10 G of the elevation, and of the pattern as well.

Of course, an allowance must be made all around this pattern, to lock the ends of pattern together, and to lock the collars on.

Tee on a Tapered Pipe.

For convenience in describing we will use definite dimensions—viz.: A tapered pipe (frustrum of a cone) 8 inches in diameter at base, 3 inches at top and 8 inches perpendicular height, about 8½ inches slant height, intersected by a straight pipe 2 inches in diameter, at an angle of 30 degrees to the axis of the tapered pipe.

To develop the patterns for the above described article:

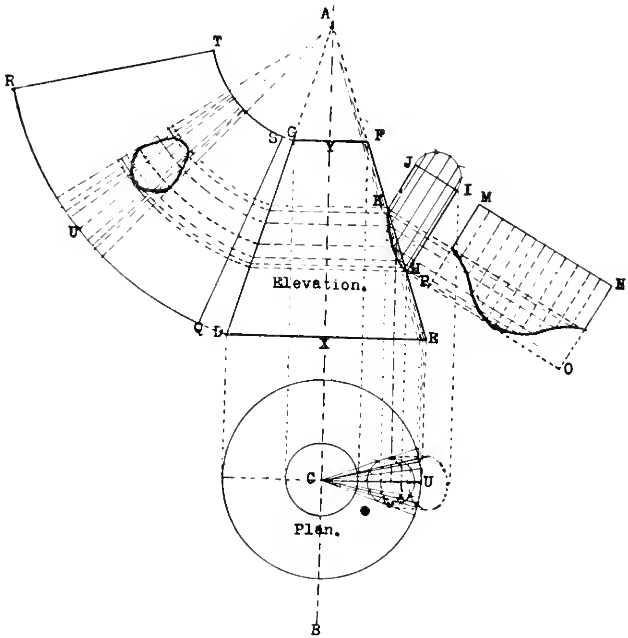
Draw a center line A B and with C on this line as center construct the plan of the tapered pipe, consisting of a circle of 3 inches diameter surrounded by a concentric circle 8 inches in diameter. Then draw an 8-inch diameter through C at right angles to A B, and from the ends of this diameter extend dotted lines upward any convenient distance to the points D and E. Connect D and E by a straight line parallel to the diameter drawn in plan, and at right angles to A B, thus forming the base of an elevation of the article.

On the center line 8 inches above the point X, where it intersects the base line D E, mark Y, and through L draw G F 3 inches long, being careful to make it just 1½ inches each side of Y and parallel to D E. Connect E F and D G and continue the lines until they meet on the center line at A.

Next draw the 2-inch pipe projecting from the side

F F of elevation and at an angle of 30 degrees to the center line A B, represented by the straight lines H I J K. This completes the elevation.

Now drop dotted lines from H and K down to the



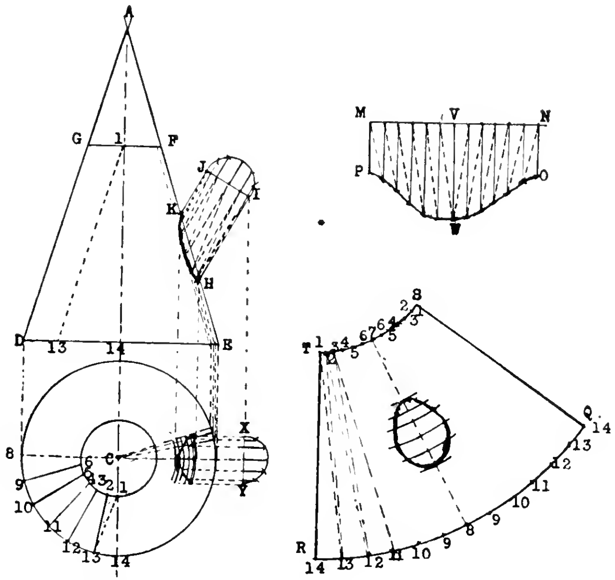
transverse diameter of plan, and using for center a point midway between these lines on this diameter, describe a 2-inch circle and space it into any number of equal spaces, here 12. From center C draw radial lines through these space points just to the outer circle (base of tapered pipe), and from those intersections above and including the diameter line, draw parallel dotted lines upward to D E, and radial lines from A to meet these on D E.

Find the center of the line I J representing the upper end of the 2-inch pipe, and draw a semi-circle upon it as shown, and space it into six equal spaces, and from these points draw parallel lines to intersect each in turn of the radial lines, and draw a free hand curve through the points of intersection, which gives us the true elevation view of the shape of the base of the small pipe, shown by the heavy curve line H to K.

To develop the pattern for this pipe draw the stretchout M N O P equal to 12 of the spaces on the semi-circle I J and space it into 12 equal spaces as shown and placed exactly parallel with the pipe. Then draw lines at right angles to the pipe and stretchout, from the points of intersection on curve H K to intersect with the space lines on stretchout, and through these points of intersection draw the curve the same as in making an elbow pattern.

To develop the pattern for the tapered pipe, set the dividers at A and with radius A D draw the arc Q R and with radius A G the arc S T. Step off one-quarter of the large circle in plan into any desired number of equal spaces and, if only half the pattern is desired in a piece as here shown, step twice the number found in the quarter circle on the arc Q R, and connect R T and Q S by drawing radial lines towards A. This will then be the pattern for half the tapered pipe. If, however, it is desired to make the pattern in one piece, step off four times the number of spaces found in the quarter circle of plan, onto the continued arc Q R.

To cut the opening in this pattern for the small pipe to fit, draw the radial line A U wherever desired—here shown in the middle of the half pattern—and from it space off each way the spaces obtained in plan



by drawing the radial lines through the space points in small circle to the circumference of the base. The line A U of pattern is the same line as C U in plan, hence we space on Q R each way from U the same distances as shown in plan each side of U. Then draw radial lines from A to all these points on Q R. Next draw parallel lines across the elevation from the intersecting points on curve H K at right angles to A B and intersecting the side D G and with the dividers draw curves from the points where the horizontal lines meet D G, using A as center to intersect the radial lines drawn from A to Q R, and through the points of intersection draw the irregular egg shaped oval which will be the shape of the opening.

All locks and laps must be allowed outside of the pattern lines.

To develop patterns for the same article by triangulation.

Draw plan and elevation the same in outline as for projection, and the semi-circle I J on end of small pipe and space it the same as in the previous example. Drop dotted lines from the points H and K to the transverse diameter of plan and space the portion between them into 6 equal spaces, and with C as center draw short concentric arcs through these space marks. Draw a dotted outline of the small pipe projecting as far as the point I in elevation and on its diameter X Y draw a semi-circle spacing it the same as the one in elevation.

Draw lines from the semi-circle X Y to intersect the arcs and through the points of intersection draw the irregular curve as shown, which represents the top view of the small pipe intersecting the tapering pipe.

Now through the intersections above the diameter draw 3 radial lines to the large circumference of plan and project lines from these points up to base line D E of elevation, and draw radial lines from A to meet them. Draw parallel lines from the semi-circle

I J to intersect the radial lines and mark the curve H K.

Space one quarter of the large circle of plan into 6 equal spaces, and make lines towards the center C and just to the small circumference, thus spacing the small circle into the same number of equal spaces as the large one. Number the points on the inner circle 1 to 7, and those on the outer circle 8 to 14. Draw a diagonal line from 1 to 13 and set off its length on base line of elevation as shown from 14 to 13, then the distance from the center of the line F G and 1, to the point marked 13 on the base line, will be the true length of the diagonal line 1 to 13. And the side G D or F E is the true length of 1 to 14, 2 to 13, etc.

Now draw one side of pattern T R, the length of D G and mark one end 1 and the other 14. With a pair of dividers spanned to the length of the line 1 to 13 in elevation set one point at 1 at the top end of the line T R, and with a second pair of dividers spanned one of the spaces of the large circle of plan, measure out from 14 at the lower end of the line T R and mark a short arc across one made by the dividers reaching from 1, thus locating 13. Next take the distance D G of elevation and with one foot of dividers at the newly found point 13 measure upward and locate 2 just the distance of one of the spaces of small circle out from 1. It is a great convenience to have a third pair of dividers and keep them set to this distance. And as 1 to 13, and D to G happen, in this instance, to be the same length, they can be used without change for both measurements. Now mark from 2 to 12 measuring out from 13 with the dividers which are set to the large circle spaces. Then from 12 to 3 measuring out with those set to the short spaces, and so on until one-half, or if so desired, the whole pattern is completed.

To get the opening for small pipe mark down on center line of pattern the distance from F to K (elevation) and up from 8 the distance from E to H, and locate the center * where the side lines of pattern would cross, and using center * draw short arcs through the points marked. (By the way, if the work has been correctly done, the distance from Q or R to * will be the same as from D or E to A of elevation.) Next measure from point F to each in turn of the intersection points in curve between K and H and transfer them to the center line of pattern, measuring down from 7 each time, and draw an arc through each using * as center. Now take the distance from the center line, or rather the transverse diameter of plan, to the intersection point on each of the arcs and transfer each measurement to the corresponding arc on pattern, and through these points draw the curve for the opening.

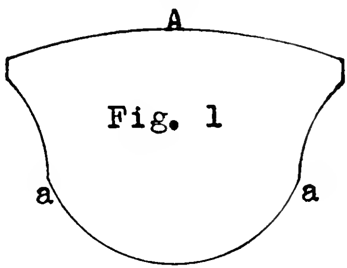
For pattern for small pipe, draw M N the length required for circumference of pipe, in this case about 6 5/16 inches, and M P and N O each equal to J K of elevation. Space M N into 12 equal spaces and draw the center line V W equal to H I, then draw lines from the space points parallel to V W of indefinite length but not longer than V W, and measure the distance from each of the points on the straight line I J to each corresponding point on the curved line H K and transfer each in turn to each side of the pattern.

These measurements may be verified by a diagonal measurement from each point as found, back to the last preceding point as shown by the diagonal dotted lines on both pattern and elevation.

Fruit Jar Filler.

A very convenient and ready selling fruit jar filler and dipper combined is here shown.

The article is made in two pieces, which are shown



in Figs. 1 and 2. Fig. 1 is the dipper portion, and should be raised slightly with the hammer. The edge A, of Fig. 1, is to be double-seamed to the edge B, of

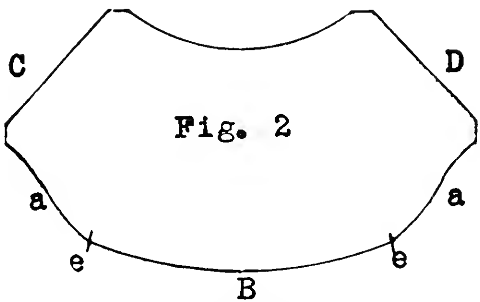


Fig. 2, between the points marked e and e. The edges C and D are locked together forming the top side of the funnel portion. And those edges marked a a a a are simply hemmed and flattened down in the burring machine. A wire makes the edge too thick to dip into the fruit.

Fig. 3 shows the finished article, with the exception of the handle, which may be a dipper handle, soldered and well bossed, or a large saucepan handle riveted and soldered at the point marked E.

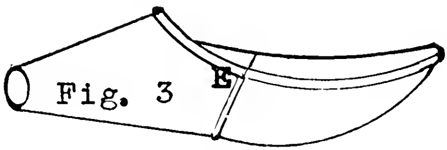


Fig. 3

This dipper and filler, when once tried, becomes a favorite with the ladies of the house, and will sell readily when its many uses become known in a neighborhood.

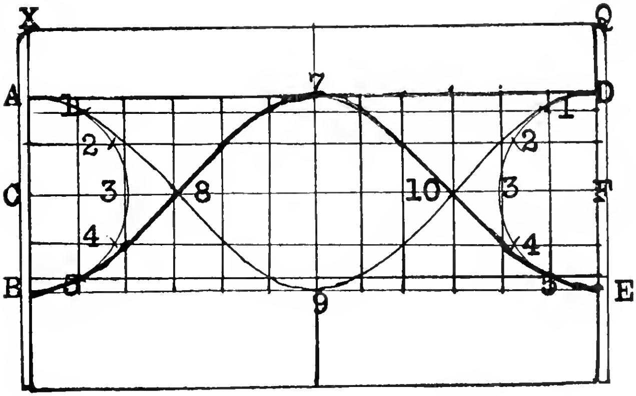
Elbows, angles, tees, roof saddles, chimney thimbles, etc., all cut in the same manner.

We will first consider a square two-piece elbow, and a very convenient method of cutting it. By a square elbow I mean one of 90 degrees

Lay out the blank of sufficient length to make a pipe of the desired size, 18⅞ inches for 6-inch pipe, or 22 inches for 7-inch. Then allow as much on each side as will be required for locks, or lap if to rivet.

We will now suppose we are to cut a 7-inch 90-degree elbow in two pieces. We will take a piece of sheet iron about 23 x 14 inches and mark the lines XY and QZ 22 inches apart and parallel. This will leave a half-inch for lock on each edge if we have previously cut it 23 inches long.

On the line XY, about 3 inches down from X mark A; 3½ inches from A mark C, and 7 inches from A mark B. In the same manner, and at the same distances mark on line QZ the points D, F and E. A and B, and D and E are each 7 inches apart on their re-



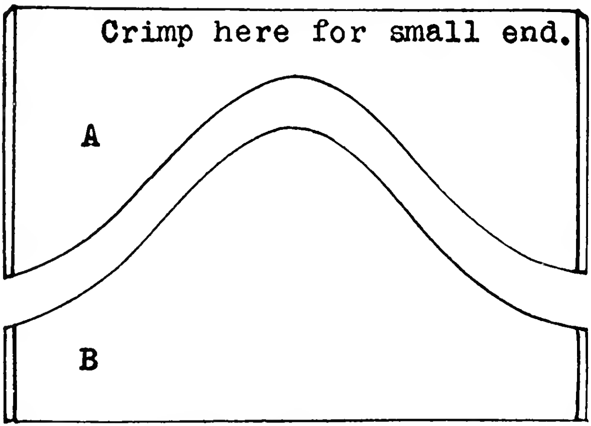
Elbows Fig. 1.

spective lines XY and QZ. This is the correct distance, because the rise or backset of a 7-inch elbow is 7 inches, or just equal to the diameter of the pipe This is the same in any other size, that is, the rise for any size of 90-degree two-piece elbow is just the diameter of the pipe.

Now span the dividers 3½ inches, the radius of the pipe, and with one foot at C, describe the semi-circle A to B. And with one foot at F describe one from

D to E. Next draw the center line from C to F, and with the dividers unchanged place one foot at 3 where the center line crosses the semi-circle, and mark short arcs at 1 and 5. From A, same span, mark 2, and from B mark 4. Proceed the same at the other end of pattern, thus dividing each semi-circle into 6 equal spaces.

Draw parallel lines from XY to QZ tnrough these

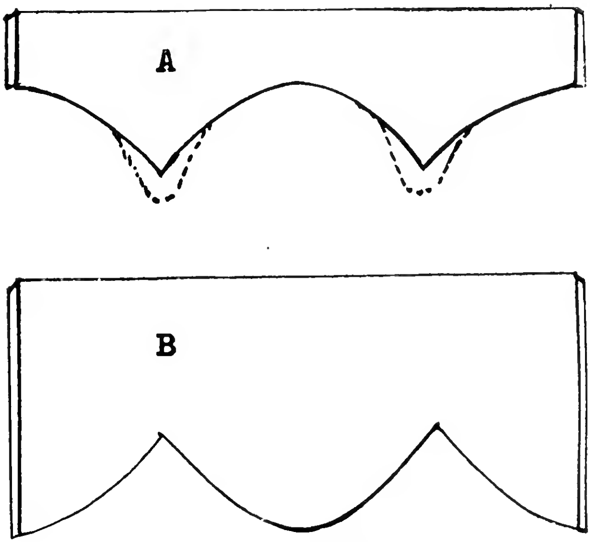


Elbows Fig. 2.

points, dividing the pattern into 6 unequal spaces, as shown in Fig. 1 of Elbows.

Space any one of the parallel lines, or the bottom edge of sheet into 12 equal spaces, and draw lines from the points perpendicularly, crossing the horizontal lines as shown, and draw a freehand line through the alternate points of intersection, from B to 5, to 8, to 7, to 10, to 5 and ending at E. This line is clearly shown by the heavy curved line in Fig. 1.

Cut on this line, and we have the two pieces A and B shown in Fig. 2, which, when formed up and locked will make a two-piece 90-degree elbow with one seam in the throat, and one on top.



Elbows Fig. 3.

To make a roof saddle for the side of a half-pitch roof, cut on same line.

But if for comb of roof, cut from B to 8, then down to 9, up to 10 and down to E, and use the lower piece shown by B of Fig. 3. The other piece resulting from this cut is a tee pattern, but without allowance for lap, which may be added as desired, as shown by dotted lines in A of Fig. 3. It is, however, the true intersection line of the Tee.

A Fig. 3 is also the pattern for a stove-pipe thimble to fit in a corner. And the other piece, B, is a thimble to fit the projecting corner of a chimney.

Thus far we have only been working with angles of 90 degrees. To make patterns for other angles it is only required to get the rise of the miter line, and span the dividers to equal one-half of it, after which the process is the same. The semi-circles must be of a diameter equal to the required rise.

To Find the Rise of Miter Line for 90 Degree Elbow of Any Number of Pieces.

An easy manner of finding the rise of miter line for 90 degree elbows of any number of pieces, is as follows:

Draw a square having each side equal to the diameter of the pipe, as shown by A, B, C and D of Figs. 1, 3 and 5 of Miters. Draw the diagonal line from A to C, and with the dividers set the length of one side of the square, and one foot at C, draw a quadrant from B to D, and divide one half of it into 1 less equal spaces than the number of pieces desired in the elbow. Miters, Fig. 1, shows method of getting the miter line for a three piece elbow, Fig. 3 a four piece, and Fig. 5 a five piece. And Figs. 2, 4 and 6 show the pattern developed.

In all cases the spacing on the quadrant must be done accurately, and the miter line extended through the point to the side of the square, and the true rise of the miter line is the distance from B to the point where the miter line cuts the side of square, marked E in Fig. 1.

To prove that this method gets the true rise, it is only necessary to refer to Fig. 7, which shows the out-

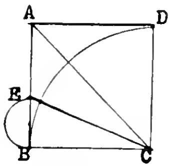


Fig. 1.

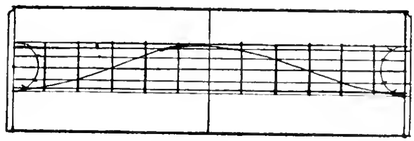


Fig. 2.

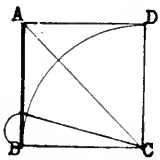


Fig. 3.

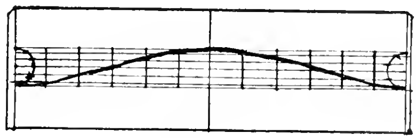


Fig. 4.

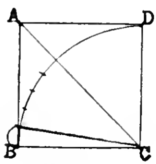


Fig. 5.

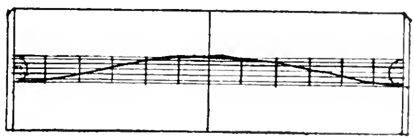


Fig. 6.

line of the long, or outer, side of a three piece elbow drawn within the square, and drawn to a larger scale.

This drawing also clearly shows the reason for spacing half the quadrant into one less than the number of pieces desired. A three piece elbow only has two miter lines. A four piece, three, etc.

The foregoing methods may also be applied to the cutting of patterns for angles of any shape as well as 90 degrees. It is only necessary to find the rise of the

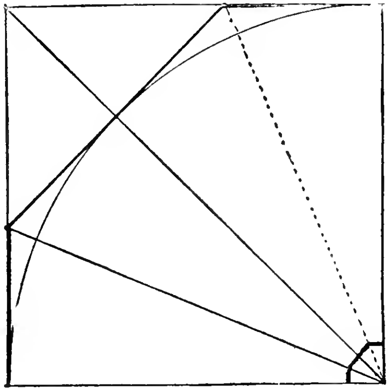


Fig. 7.

miter line, and draw the pattern as described by using semi-circles whose diameter is the rise required.

Elbows of Less Than 90 Degrees, Called Angles.

As before stated, these patterns may be obtained in the same manner as those we have been studying, after we obtain the rise of the miter line.

We will now suppose we have found the required pitch of an angle to fit a certain place, by setting a bevel, or with two pieces of iron riveted together, or with two pieces of lath or shingle, as H and I of Fig. 1.

Draw AB and BC along the two blades of HI, and bisect the angle thus formed. This may be done by spanning the dividers an equal distance each way from

B and marking points as A and C, then with these points as centers and radius greater than A to B, strike

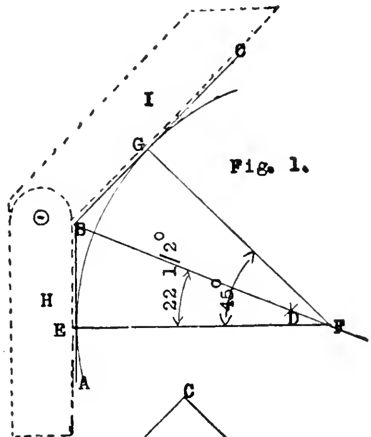


Fig. 1.

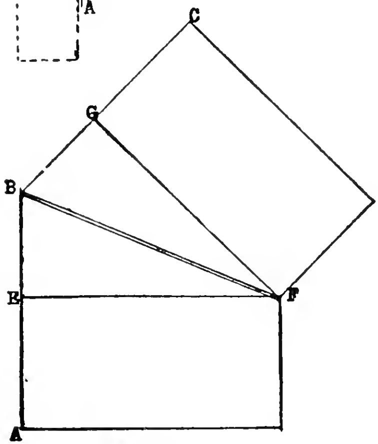


Fig. 2

the intersecting arcs at D. Draw BF indefinitely through the intersection, and on this line locate a point F just the diameter of the pipe distant from the nearest point on AB, which may be done by spanning the dividers to the diameter of pipe and striking the arc AC. Then draw EF at right angles to AB by means of one of the elementary rules for drawing a line from a given point to a given line, perpendicular to the given line.

When E is accurately located, BF will be the miter

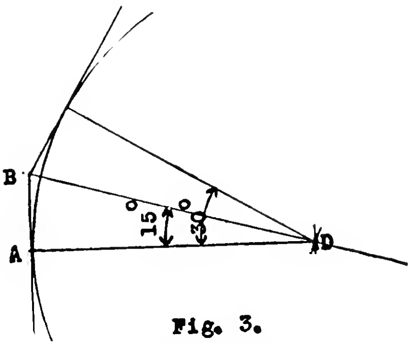


Fig. 3.

line, and the distance E to B is the required rise, and hence is the diameter of the semi-circles from which we develop the pattern. In other words, span the dividers one-half the distance E to B for the radius, and proceed as in the development of elbows as before given.

The angle shown in Fig. 1, the complete elevation of which is shown in Fig. 2, is 45°. But it is not necessary that we should know the number of degrees.

If, however, the required degrees are known, and we have a protractor, the process is even more simple.

Draw AD, Fig. 3, equal in length to the diameter of pipe, and by the protractor, draw DB at one-half the required angle.

For instance, for a 30° angle, we draw DB at an angle of 15° to AD. Then one-half the distance A to B is the radius for our semi-circles.

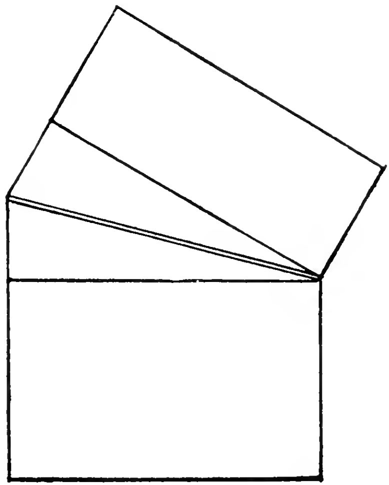


Fig. 4.

The elevation of the finished 30° angle is shown in Fig. 4.

To Draw Pattern for Any Regular Tapering or Flaring Article

The method here described will apply in drafting patterns for any of the round flaring and tapered articles made in a tin shop, whether basins, pans, coffee pots or "Sibley stoves." Provided the bottom and top are parallel, and the sides a regular taper.

Draw an elevation of the article, full size, as A, B, C, D, of Fig. 1, and extend the side lines until they meet, as at E. Then with E as center, and E D as radius, describe an arc cutting D and C, and if the pattern is to be in one piece, continue indefinitely to F. And with the same center, and radius E to A,

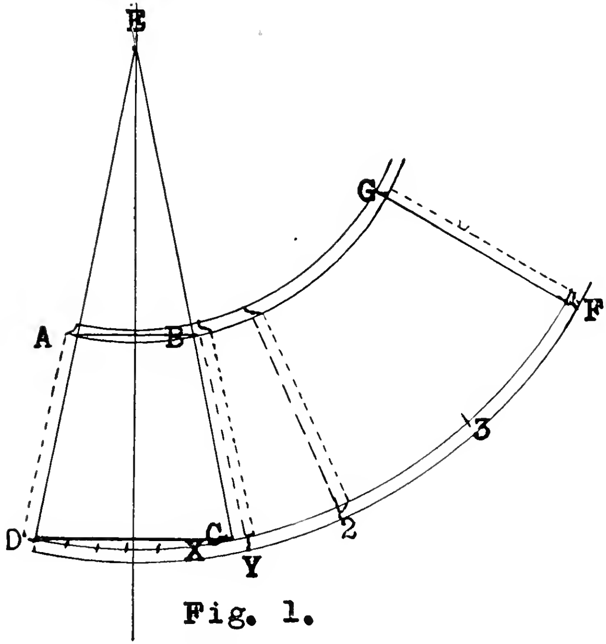


Fig. 1.

strike an arc through A and B and extending indefinitely to G.

Next draw a circle the size the large end of the finished article is to be, as Fig. 2, and divide it into quarters, as shown. (Or if more convenient, draw only a quarter circle.) Space the quarter circle into

4, 5, or 6 spaces, or any convenient number, (here 5) as D to X, Fig. 2, and step these onto the line D F, as shown from D to X in Fig. 1. Then span dividers from D to X and step off three more times, 2, 3, F, thus locating the point F, and making the arc D F almost equal in length to the circumference in Fig. 2.

Draw an arc outside of, and parallel to D C F, as an allowance for burr or wire, according to whether the large end is to be the top or bottom of the finished

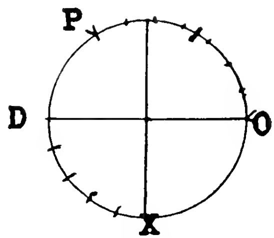


Fig. 2.

job. And another arc inside of, and parallel to A B G. Also, allow edges for lock or lap, parallel to A D, and G F, as shown by dotted lines in Fig. 1.

If it is desired to make the pattern in two pieces, use only twice the distance D X as shown at 2 in Fig. 1. And if it is to be in three pieces get one-third the circle, Fig. 2, by stepping twice the radius, as O to P, and divide this into a number of equal spaces (here 7), which step on arc D F of Fig. 1, from D to Y.

It is a mistake sometimes made by tinners, to step 6 times the radius of the required circle, on D F, to locate F, as this will make the pattern too short. While

6 times the radius just measures around inside its own circumference, yet it will not measure the same length of line when applied to the arc of a circle of a different size. This is illustrated in Fig. 3, where the circle shown is the same size as that in Fig. 2, and the radius

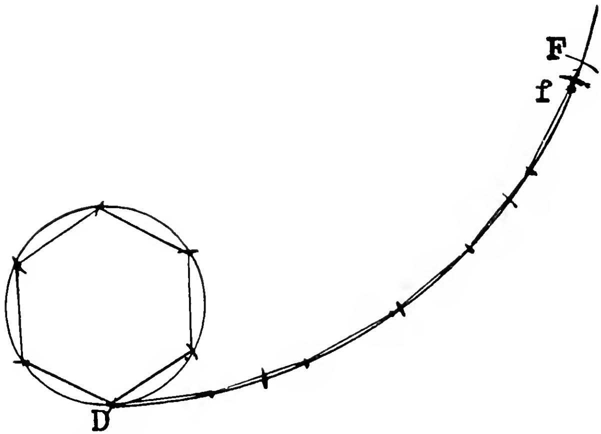


Fig. 3.

is shown stepped around it in six steps. Also, D F is made the same as D F in Fig. 1, and the six steps shown only reaching to f, showing how much too short the pattern would be if measured in this manner.

Even the method I have described is a little short of the true length but will be found near enough for most cases. If greater accuracy is desired I would recommend cutting a narrow strip of light sheet metal just the required length, and bending it to the proper curve, measure from D to locate F.

Some Convenient Dimensions of Tinware.

In the following dimensions the locks, burrs, wire locks, etc., have all been allowed. That is for small neat seams. Don't put a pint cup together with a "stove pipe lock."

There are two regular sizes of No. 8 wash boilers. The No. 8-18, and the small No. 8.

For the No. 8-18 cut 3 pieces 14 x 19, or 1 piece 56 x 14.

For the No. 8 small cut 3 pieces 13½ x 18, or 1 piece 53 x 13½.

For No. 9 boiler cut 3 pieces 14 x 20, or 1 piece 59 x 14.

Covered Buckets.

2 quart	2 pieces	10	x 5½
3 quart	2 pieces	10¾	x 6
4 quart	2 pieces	12	x 7
6 quart	2 pieces	12¾	x 8½
8 quart	2 pieces	13⅜	x 9½

Flaring Pails. (Net Sizes.)

2 quart,	6¼	in. diam. top,	4½	diam. bot.,	4 deep
4 quart,	7½	in. diam. top,	5	diam. bot.,	5¼ deep
6 quart,	9¼	in. diam. top,	5½	diam. bot.,	6½ deep
8 quart,	10½	in. diam. top,	6	diam. bot.,	7½ deep
10 quart,	11½	in. diam. top,	7	diam. bot.,	8 deep
14 quart,	13	in. diam. top,	9	diam. bot.,	9 deep

Pans. (Net Sizes.)

2 quart,	9	in. top,	6 in. bot.,	3¾	in. deep
6 quart,	12¾	in. top,	9 in. bot.,	4	in. deep

10	quart,	14	in. top,	11	in. bot.,	$4\frac{1}{4}$	in. deep
14	quart,	$15\frac{1}{4}$	in. top,	10	in. bot.,	6	in. deep
16	quart,	18	in. top,	11	in. bot.,	$6\frac{1}{2}$	in. deep
20	quart,	$19\frac{1}{2}$	in. top,	13	in. bot.,	8	in. deep

Cans. (Cut to Best Advantage.)

To Hold.	Size to Cut Sheet.
1 gallon	7 x 21 inches
2 gallons	10 x 25 inches
3 gallons	$10\frac{1}{2}$ x 30 inches
4 gallons	12 x 32 inches
5 gallons	12 x 36 inches
6 gallons	13 x 40 inches
8 gallons	14 x 42 inches
10 gallons	16 x 46 inches
15 gallons	20 x 48 inches
20 gallons	20 x 57 inches
25 gallons	22 x 60 inches
40 gallons	26 x 70 inches
50 gallons	26 x 76 inches
75 gallons	30 x 86 inches
100 gallons	36 x 96 inches

To find the contents of cylindrical vessels.

Multiply the square of the diameter in inches by the height in inches, and this product by the decimal .0034. The result will be the gallons, and decimal fraction of a gallon.

This is a shorter method than finding the cubic inches and dividing by 231, and the result is exactly the same.

Practical Suggestions.

To Clean Water Backs When Filled Up With Lime or Alkali.

Pour slowly into the casting, muriatic (hydrochloric) acid.

This must be done carefully, as it will boil over and waste the acid unless care is taken.

When the lime has all been removed, wash thoroughly, and replace.

To Cut Heavy Iron With the Stock Shears.

When very heavy iron is to be cut by hand, it will often be found a great help to turn the shears wrong side up and slip a piece of 1-inch gas pipe, or larger if necessary, onto the tang, thus making a long leverage, and the pipe stands so nearly perpendicular that the workman can stand almost erect, and yet has a good leverage on the work.

To Lock the Edges of a Pitched Cover, or Can Top.

Often when making a cover or can top with only a slight pitch, it is desirable to lock the seam, but difficult to do so in the folder. Try slipping each edge in the slot of the rod of gutter beader, and turning the rod just enough to break the edge up a little more than square, when the seam may be grooved down very nicely.

Temporary Handles for Soldering Coppers.

These may be quickly made by wrapping around the shank several thicknesses of asbestos paper. Draw it snug with a wire, and it will be found to answer the purpose very well.

To Tin Black Iron Rivets, or Other Small Articles.

Put them in a bowl of raw acid (hydrochloric) until the black scale is well eaten off. Rinse with water and place in "killed" acid; i. e., acid which has had all the zinc it will eat, and then without rinsing, drop into a pot of melted solder. Remove with a strainer.

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