PRACTICAL

SHEET METAL WORK

AND

DEMONSTRATED PATTERNS

A COMPREHENSIVE TREATISE IN SEVERAL VOLUMES ON

SHOP AND OUTSIDE PRACTICE AND PATTERN DRAFTING

VOLUME VI

CIRCULAR CORNICE WORK

COMPILED FROM THE

METAL WORKER

PLUMBER AND STEAM FITTER

EDITED BY

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PREFACE

THIS book, which is designated as Volume Six of the series of PRACTICAL SHEET METAL WORK AND DEMONSTRATED PATTERNS, is intended as the connecting link between the preceding volume, in which is presented a collection of valuable pattern problems in cornice work, and the succeeding volume which contains practical suggestions and the like on cornice work. This book has been compiled to cover the subject, so far as material is available, of curved or circular sheet metal work as applied to the architectural line, commonly known as cornice work. Accordingly both patterns and practical articles are embodied in it, which it is sincerely hoped, will be of immeasurable help to those engaged in this class of work.

The presentation of this series is made possible by the fact that, since its inception, METAL WORKER has in its employ and at its service, experts in the fields it covers; notably so in sheet metal work. The knowledge of these men is brought to light in answering inquiries from readers. Contributions are also received from readers dealing with practical methods, shop kinks and ideas. This accumulated information has been duly sorted and compiled into these series. As the majority of writers of this information are unknown, the publisher can do no more than express, in this preface, sincere thanks. Those who are known are George W. Kittredge, William Neubecker, H. Collier Smith and Max Wolfsteiner, to whom especial thanks are accorded.

J. HENRY TESCHMACHER, JR.

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Practical Sheet Metal Work and Demonstrated Patterns

CONSTRUCTING REGULAR POLYGONS

In the accompanying illustration Fig. 1 is shown a short method for obtaining any regular polygon having 3 to 12 sides, inclusive, the length of the side being known.

First draw the length of one side as A B. With A as center and A B as radius, describe an arc, which intersect by an arc struck from B as center and B A as radius. Through the point of intersection 6 erect the vertical line C L, intersecting A B at C.

Divide the arc A 6 into six equal parts, as shown. From the third space F draw a line to B, intersecting the vertical line at 3. Using 3 as a center describe a circle which will pass through A and B and upon which the distance A B can be placed three times. Through the points thus obtained a three sided figure can be drawn.

From F draw the line F 4 parallel to A B, intersecting the vertical line at 4. Using 4 as center describe a circle which will pass through the points A and B, and upon which the distance A B can be placed four times. Through these points a four-sided right angled figure can be drawn.

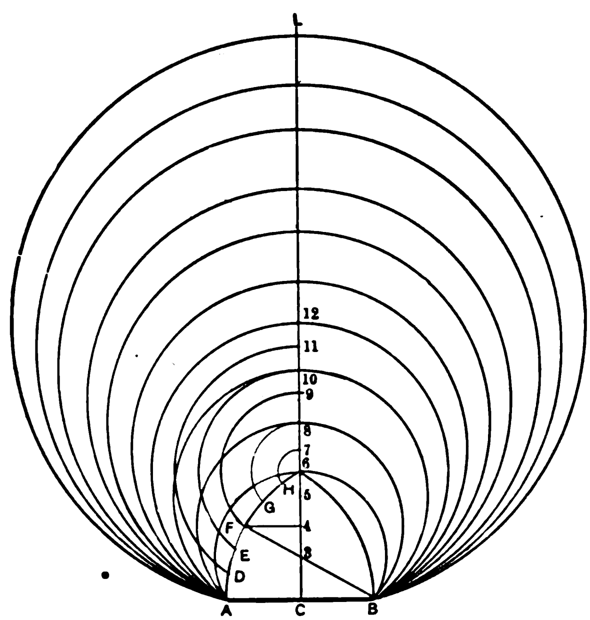


Fig. 1. Method of Constructing Regular Polygons.

Using 6 as center and 6 H as radius, draw the semicircle 5 7, cutting the vertical line as shown. Then 5 is the center with which to draw a circle which will pass through A and B, and around which a five-sided figure can be measured with a side equal to A B.

With 6 as a center describe a circle which will pass through the points A and B, and around which a six-sided figure can be spaced with sides equal to A B. Using the point 7 (previously obtained) as a center, describe a circle which will pass through A and B, upon which a seven-sided figure can be measured the sides of which equal A B.

Using 6 as center draw the arcs D 11, E 10, F 9 and G 8. Then will 8, 9, 10 and 11 be the centers with which to describe circles which will cut through A and B and around which eight, nine, ten and eleven-sided figures can be drawn, respectively, having sides equal to A B.

Where the circle struck from 6 as center intersects the vertical line L C at 12, then 12 is the center with which to draw a circle cutting A and B and around which a twelve-sided figure can be drawn with sides equal to A B. To avoid a confusion of lines the polygons are not drawn, but can be verified by measurements.

ROUND SHAFT MITERING AGAINST A BALL

For a solution of the problem shown in Fig. 2, it is advanced that if reference is made to Problem 73, page 176, of the "New Metal Worker Pattern Book" it will be seen how the moldings of adjacent gables of a pinnacle can be mitered against a ball. The principles involved in this case are exactly the same as those explained in the problem referred to, but as the conditions are different the diagram shown in Fig. 3 has been prepared.

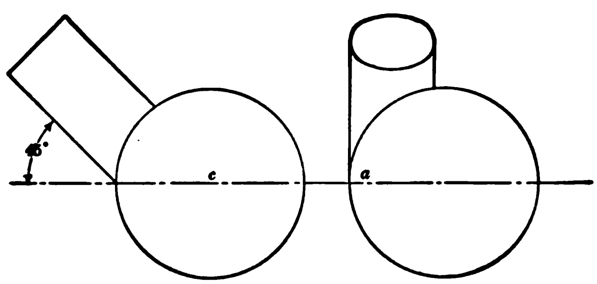


Fig. 2. The Problem

From an inspection of the diagram Fig. 2, it seems that the outer side of the pipe must be tangent to the sphere, and that the pipe is to be inclined when viewed from the side. Attention is called to the fact that while the view at the left shows the desired angle of inclination, it does not correspond with the view at the right, which may be accepted as correct in itself. The point of tangency, *a*, between the outline of the pipe and that of the ball, can be at only one point in the other view, that is the point *c*, as *c* is the one point on the surface of the ball which is farthest from a plane passing through the center of the ball parallel to the surface of the paper. As the line which represents the side of the pipe in the view at the right would be represented in the other view by a line drawn centrally between its two outlines, it will be seen that the center line of the pipe in the view at the left, as there drawn, would pass to one side of the point *c*, and would therefore not touch the surface of the ball.

A correct side view of the pipe and ball in the relative position represented in the view at the right may be obtained as shown in Fig. 3, in which the two views are, for convenience, designated as side and end. Since C of the side view corresponds with point C^1 of the end view, as explained, therefore from C draw a line at the required angle, which extend as a center line, and upon it draw the profile of the pipe, as shown at A. Also upon the center line of the pipe in the end view draw the corresponding profile B, and divide both profiles into the same number of equal spaces, as shown.

In this operation care must be taken to locate the point 1 correspondingly in

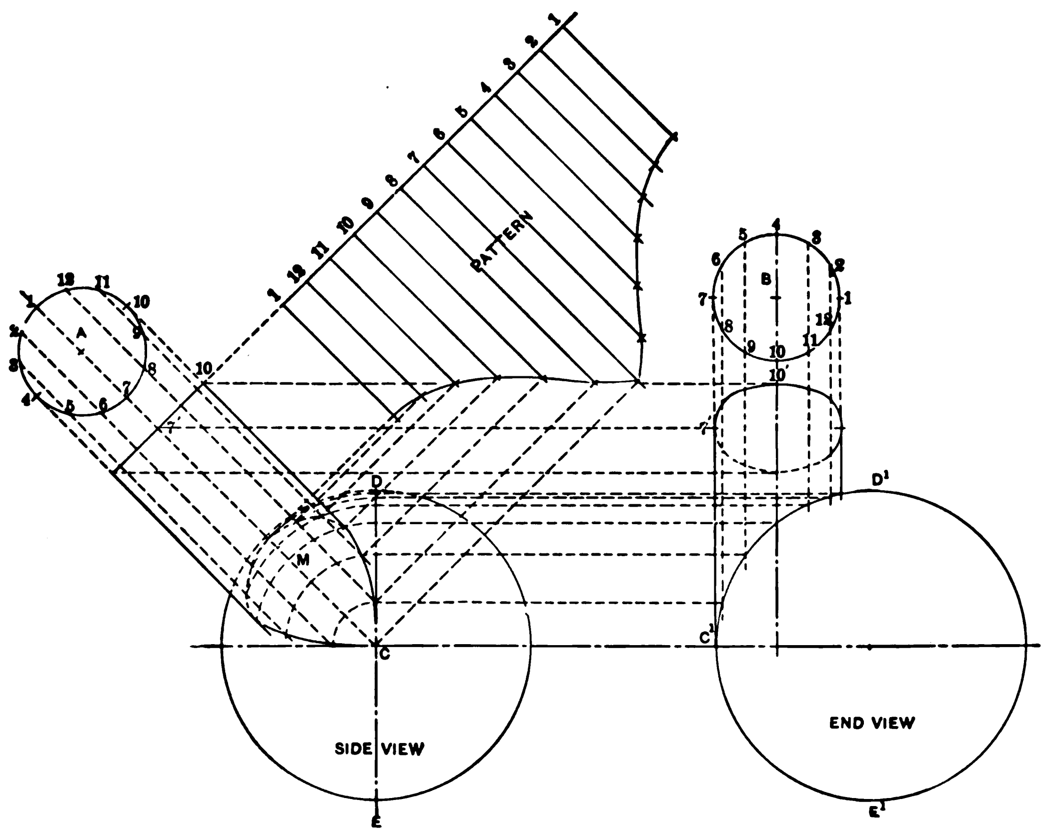


Fig. 3. Method of Mitering a Cylinder Against a Ball or Sphere

both profiles. It will be noted, for instance, that the point marked 7^1 of the end view, which appears on the outer side or edge of the pipe, will, when the pipe is viewed from the left side, appear in the middle of the pipe, as shown by 7^1 of the side view; and that for the same reason the point 10^1, which is in the middle in the end view, will appear at the side in the side view, all as shown by the dotted lines of projection. The correct arrangement of the points in the two profiles is therefore shown by the small figures.

Proceed now to drop lines from each of the points on profile B to intersect the outline of the ball between C^1 and D^1, as shown, which outline may, for the time being, be considered as the section of a cylinder taken on the line D E of the side view. Therefore from each of the points of intersection on the arc of C^1 D^1 project lines horizontally to cut C D of the side view, as shown. Now from the points on profile A project lines parallel to the center line A C, continuing them indefinitely into the elevation, as shown. Then with C as center, describe arcs from the several points previously obtained on D C to cut lines of corresponding number just drawn from profile A. A line traced through the points of intersection, as shown at M, will give the desired miter line from the several points in which the pattern may be obtained in the usual way, all as shown.

The angle at which the pipe is placed in the side view in no way influences the result in the pattern. Since all sides of a sphere are alike, the pipe, having been made up according to the pattern, may be turned around upon the ball to any desired angle.

PATTERN FOR DOUBLE FLARING COLLAR

For a method of cutting a pattern for a double flaring collar in one piece without a seam at the top, accompanying diagrams will show how this can be done. It should be understood that this rule can only be used when the inner and outer flares, *a b* and *b c* in Fig. 4, have similar angles. First, draw the plan, as shown, bearing in mind that, in practice, only one-quarter plan would be necessary, as shown by C 7 B. Through the center of the plan C draw the center line D E, and through and above A B draw the section *a b c*, which represents the profile through A B in plan. Both of these flares, *a b* and *b c*, are similar. Now extend *c b* and *b a* until they intersect the center line at *d* and *e*, respectively. Using *b* as center and *b e* as radius, describe the arc *e d*, which will meet *c b* extended at *d*, because both flares are similar.

For the pattern in one piece, proceed as follows: With radii equal to *d b* and *d c*, and with *d* in Fig. 5 as center, describe the arcs *c c'* and *b b'*. Then, with radius *e a* in Fig. 6 and with *d* in Fig. 4 as center, describe the arc *a a'*. Draw a line from *c* to *d*, and on the outer curve *c c'* lay off four times the stretchout of the quarter outer circle shown from 1 to 7 in plan in Fig. 4. Draw a line from *c'* to *d*. Then will *c' c a a'* be the full pattern, laps to be allowed, as shown.

Even though the pattern has been obtained, if the mechanic does not understand how to roll the double flare, it will be of no value. When turning the collar, it should not be soldered together until a crease has first been made along the center curve of the pattern *b b′*, as shown, at *i*. This crease, or bead, is obtained by running the pattern through the beading machine. Should the width of *c b* in the pattern be greater than the depth of the throat in the beading machine, then a small crease can be obtained by laying the pattern on a round

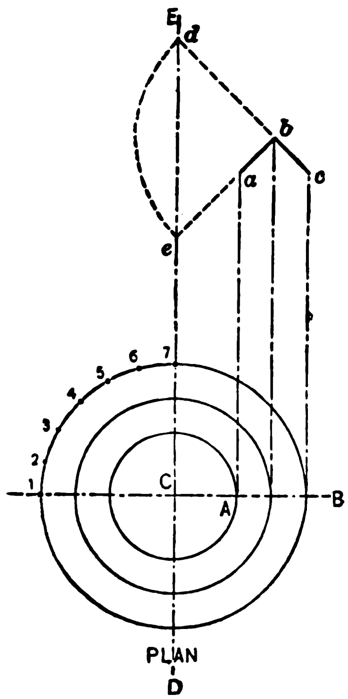


Fig. 4. Plan and Section

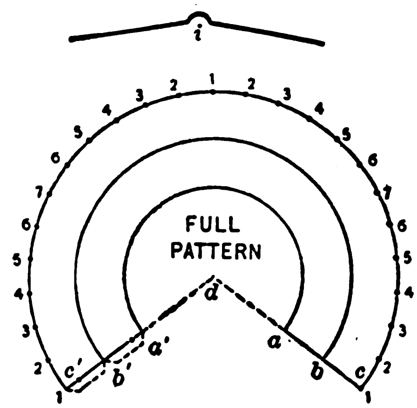


Fig. 5. The Pattern

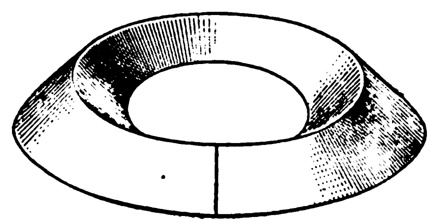


Fig. 6. Perspective View of Collar

bottom stake and with a mallet making a slight crease along *b b′* of the pattern. This bead, or crease, is obtained so as to obtain the bending edge of the collar. Then bend over the bottom stake until the true angle shown by *a b c* in Fig. 4 is obtained. This will bring the true curve of the collar, or the double curvature of the two flares, after which the cross seam on A B in plan can be soldered or riveted. Fig. 6 shows a perspective view of the collar.

DRAWING ARCS OF LONG RADII

The following is an explanation of short methods of drawing arcs of long radii, also for striking arcs, using sheet metal trammels. In Fig. 7 is shown the plan and elevation of a flaring article, in which A B C D is the elevation, E F G H the plan of the bottom and J K L M the plan of the top. Now if the lines D A and C B were extended until they met the center line O P the radius would become so long that it would be inconvenient to use it. What is desirous is some short rules whereby the radius need not be employed. In the illustrations herewith are shown three methods. The first, in Fig. 8, is based upon the principle, shown in Fig. 9, that a line (A) drawn tangent to the required arc (B) will be perpendicular to a line (D) drawn from the center of the circle (C) to the point of tangency (E).

Applying these principles to Fig. 8 proceed as follows: Let A C D B be the elevation or section of a tapering article. At right angles to A B and C D draw

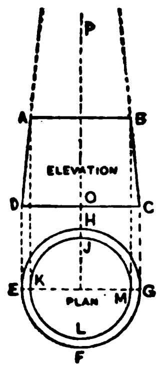


Fig. 7. Plan and Elevation of Flaring Article

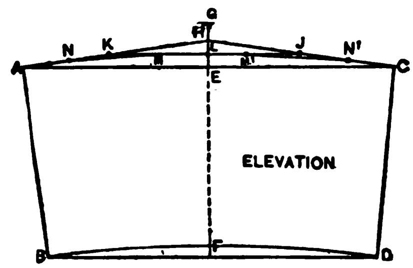


Fig. 8. Diagram Showing Method of Obtaining Flaring Pattern by Means of Square and Dividers

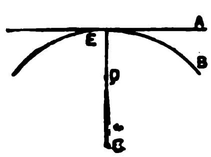


Fig. 9. Diagram Showing Principle Involved in Fig. 8

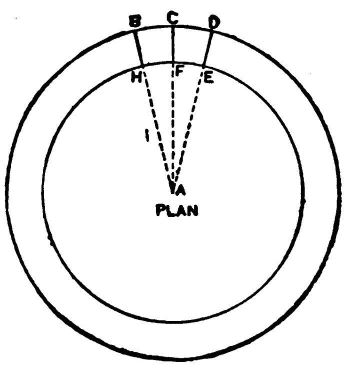


Fig. 10. Method of Obtaining Flaring Pattern by Means of Divisions in Plan

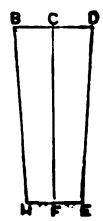


Fig. 11. One Section of Pattern

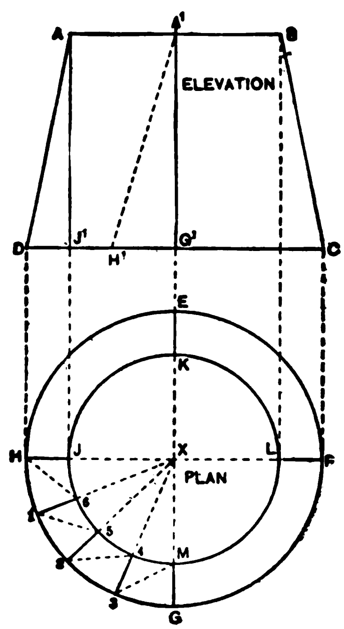


Fig. 12. Obtaining Flaring Pattern by Means of Triangulation

the lines A H and C H, intersecting each other at H. Then will lines drawn at right angles to A B and C D, which are portions of the radii of the required arc, be tangent to the arc at points A and C. Bisect the lines A H and H C at points K and J and draw the line K J. In the same manner bisect A K, K L, L J and J C by points N, M, M^1 and N^1 respectively, as shown. A line traced through these points, as shown by A N M L M^1 N^1 C will be an approximate sweep of the pattern. For the lower sweep draw a line parallel to the upper sweep, as shown by B F D. Various segments would have to be joined on the line A B or C D until the correct length on the pattern was obtained.

Another rule that may be used for developing patterns where the radius is unknown is shown in Fig. 10, in which the two circles represent the plan of the top and bottom respectively, the half difference between the two being equal to C F. Draw any line from the center A, as A F C; step off any convenient spaces, as B and D, from which draw lines to the center A as shown, cutting the inner circle at H and E. Now knowing the slant hight of the article draw any vertical line, C F in Fig. 11, equal to the slant hight of the article. Through C and F draw lines at right angles to C F, making C B and C D equal to C B and C D of Fig. 10 and F H and F E of Fig. 11 equal to F H and F E of Fig. 10. Draw lines from B to H and D to E in Fig. 11, which completes the pattern for that portion of the frustum shown in plan, Fig. 10, by B D E H.

A sufficient number of pieces such as that shown in Fig. 11 can be placed side by side to constitute a pattern of any desired length, and though not strictly accurate will answer any practical purpose.

In Fig. 12 is shown a simple rule giving accurate patterns, in which A B C D is the elevation of the article, E F G H the plan of the bottom and J K L M the plan of the top. Assuming that the frustum is to be made in four sections, divide one quarter of the plan H G into equal spaces, as shown by the small figures; from these small figures draw lines to the center point X, which will intersect the inner circle J M, thus dividing it into the same number of equal spaces as H G. Draw a dotted line from H to 6 in plan. Take the distance H 6 and place it as shown from H^1 to G^1 in elevation, and draw a line from H^1 to A^1. Then will A^1 H^1 represent the actual distance on the finished article on the line H 6 in plan, and A D of the triangle A D J^1 the distance on the line H J in plan.

For the pattern proceed as follows: Draw any vertical line, as J H in Fig. 13, equal to A D in elevation, Fig. 12. Now with J 6 in plan as radius and J of Fig. 13 as center describe the arc 6. Next with A^1 H^1 in elevation, Fig. 12, as radius and H of Fig. 13 as center, describe an arc intersecting the arc 6. Then using H 1 in plan, Fig. 12, as radius and H of Fig. 13 as center describe the arc 1, which intersect by the arc struck from 6 as center and A D of the elevation as radius. Draw J 6, 6 1 and 1 H, which will give the pattern for one segment of the entire pattern. As four segments are required to complete the quarter pattern add as many to the pattern obtained as shown in Fig. 13, which will constitute the quarter pattern required.

In Fig. 14 is shown the method employed when it is desired to obtain the length of the radius by calculation, it not being convenient to extend the sides A D and C B. Let it be assumed that the base of the article is 60 inches and the top

54 inches and the slant hight 12 inches, then multiply the large diameter by the slant hight and divide by the difference between the large and small diameters. The large diameter is 60 inches, the slant hight is 12 inches, and 12 multiplied by 60 gives 720. Divide this by the difference between the large and small diameters, which in this case is 6, giving 120 inches, or 10 feet, radius. Having obtained the radius in the above manner a sheet metal trammel can be made as shown in Fig. 15, in which A is the trammel bent in the brake as shown, with a hole, B, as the center point, the holes C and E representing the width of the flare. A nail or scratch awl can be placed in the hole B and a pencil or awl can be placed in the holes C and

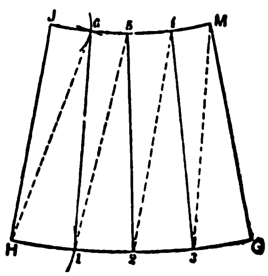


Fig. 13. One-Fourth of Full Pattern

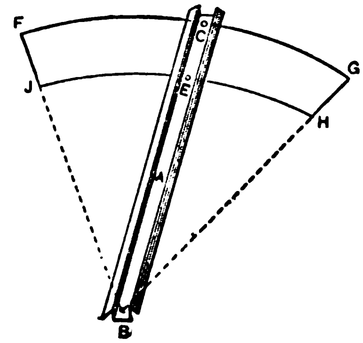


Fig. 15. Method of Using Sheet Metal Trammel

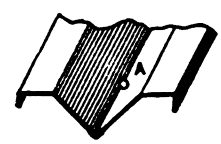


Fig. 16. Section of One Form of Trammel

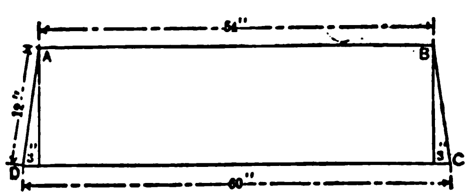


Fig. 14. Obtaining the Radius by Calculation

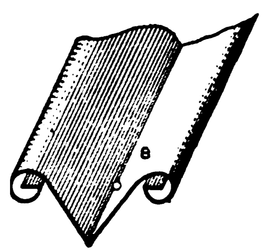


Fig. 17. Another form of Trammel

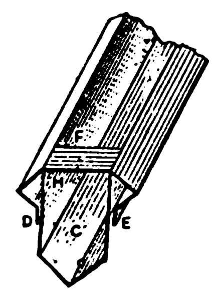


Fig. 18. Still Another Form of Sheet Metal Trammel

E and the arcs F G and H J struck, drawing the radial lines from F and G toward the center B. These trammels can be saved for future use by soldering the holes C and E and punching new holes for the flare and radius required.

In Figs. 16, 17 and 18 are shown various forms of trammels, in which A, B and C respectively represent the centers. The form in Fig. 16 can be bent in the brake, while if a bead former is at hand the beads in Fig. 17 can be made on the former or beaded by hand. Where a radius is required from 10 to 15 feet in length the shape shown in Fig. 18 would give accurate results, there being no bending of the trammel. Flanges D and E and braces F soldered at intervals of 4 or 5 feet will insure sufficient rigidity and consequent accuracy.

DESCRIBING AN ARC OF LONG RADIUS

For a solution of the old time problem which, stated in general terms, is that of describing the envelope for the frustum of a cone having such slight taper that its apex is too far away to be of practicable use, even though it can be found. Of the solutions given in other books, etc., some have been only approximate, but considered practicable. In others mathematical accuracy has been obtained by the use of algebraic operations, or by the extraction of square root. The author offers herewith what he believes to be the only geometrical solution of this problem

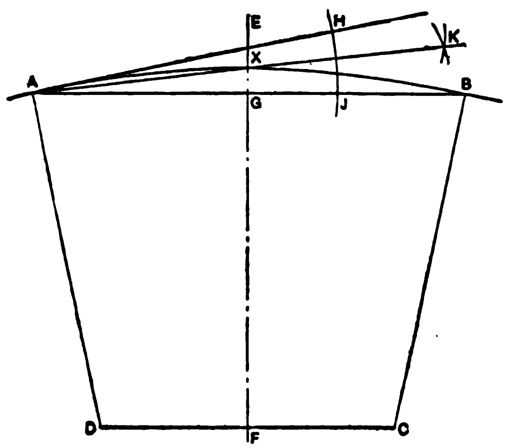


Fig. 19. Method of Finding the Rise of an Arc for the Pattern of a Conical Frustum of Very Slight Taper

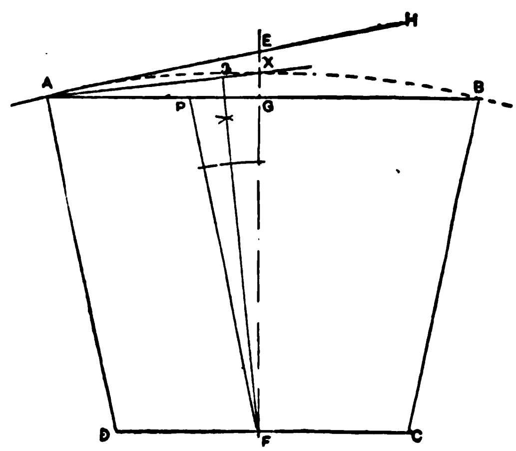


Fig. 21. Diagram Demonstrating the Method Shown in Fig. 19

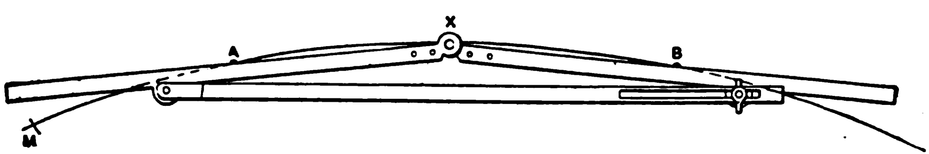


Fig. 20. Adjustable Instrument for Drawing Arcs of Circles of Very Long Radius

which has thus far been given, a solution which is exact and so simple that the wonder is that it has never appeared before. While the problem calls only for the arc of the circle necessary in the pattern, its solution has been looked for naturally through first finding the length of the radius and from that the rise or versed sine of the arc. In the solution here given the center is not a factor in obtaining the result.

In Fig. 19 of the accompanying diagrams A B C D represents an elevation of a section of tapering article of which E F is the center line. In order that the angles may be clearly shown the cone is here made very tapering, it being understood that the rule is equally applicable to cones of any taper. A prolongation of the two sides A D and B C will obviously produce an intersection on the center line E F extended. The radius with which to describe the pattern of the cone is the distance from the intersection mentioned to A or B, and the arc if drawn from that center through both those points will cut the center line somewhere above G. The exact point may be found in the following manner: From A first draw A H at right angles to A D, then bisect the angle H A B, as shown by the line A K, cutting the center line at X. The bisection may be accomplished in the usual manner by first drawing an arc from A, as center, with any convenient radius, cutting A H and A B in points H and J. Now from H and J, as centers, with a conveniently shorter radius, describe two arcs, cutting each other at K, and draw A K. Then will A K bisect the angle, and its intersection with the center line at X will be the point through which the arc from A to B must pass. With the three points A, X and B given the arc may be described by means of a triangle sliding against pins placed at A and B, substantially as given in the illustration, Fig. 20.

An adjustable triangle for general use in similar cases may be constructed of strips of wood such as are used for window stops, preferably those of hard wood, which, of course, must be perfectly straight on their working edges. They should be hinged together in such a way that the pin or rivet of the hinge shall be a pencil or other scribing point, or instead may be a short tube to receive such a point. It must be noted also that the center of the hinge (the scribing point) must be in line with the working edges of the strips, all as shown in Fig. 20. A brace pivoted at one end to one arm of the instrument and slotted at the other end to pass under a thumb nut fixed in the other arm will render it adjustable to a sufficient degree for general use. In using the tool, first place pins at A and B of Fig. 19, then bring the edges of the arms against the pins and the scribing point to X and tighten the clamp screw. Then, keeping its edges against the pins, the tool may be slid along in either direction, describing the required arc A B. To extend the arc beyond the points A and B, which will be necessary to complete the pattern, first describe short arcs from A and B as centers, with a radius equal to A X, as shown at M and N in Fig. 20. Now, removing the pins, place one of them at X and, bringing one arm of the tool against the same and the scribing point to A or B, place the other pin against the other arm, and on the arc M or N, as the case may be, then continue the arc as before. This operation may be repeated to prolong the arc as desired. This method of drawing an arc is strictly geometrical and is quite as accurate as any other means provided the adjustments are accurately made, and is applicable in all cases where the rise or spring of an arc is known or where any three points of an arc are given. The arc for the other edge of the pattern, passing through D and C, may be drawn by the same method or by any other method of drawing parallel curves.

For the benefit of those who may wish a demonstration of the accuracy of the above method of obtaining the middle point X of the desired arc, the following will suffice: Since the chord A B of Fig. 19 or 21 is at right angles at its middle point to the center line, which is also a radial line, it will be seen that the chord of any arc is at right angles at its middle point to a radius. Therefore the chord of one-half of A B—that is, A X, must be at right angles to a radius drawn to its middle point. Such a radius must necessarily be midway between E F and A D, and must bisect the angle made by A D and E F when those lines are produced to the center or apex of the cone. The angle of this radius may easily be found by first drawing through F, of Fig. 21, the line F P parallel to A D, and then bisecting the angle P F G, as shown by F S. Now, because the lines A H and A B are respectively at right angles to F P and F G, the angle H A B must be equal to the angle P F G. If therefore a line, as A X, be drawn from A and at right angles to F S, it must bisect the angle H A B, and being at right angles to F S must at its intersection with the center line at X terminate the chord of half of A B, or, in other words, locate the middle point of the arc A B.

It should be carefully noted that although the line A X bisects the angle at A it does not bisect the line E G for the reason that A E is longer than A G, since it is the hypotenuse or longest side of the right angle triangle A G E, of which A G is the base. E X is therefore greater than X G. Of course the more nearly the sides A D and B C of the cone are to being parallel the less will be the distance E G and the less will be the difference between E X and X G.

PATTERNS FOR SQUARE DENTILS IN SEGMENTAL PEDIMENT

This problem deals with the method of how to obtain the patterns for the square dentil blocks fitting against the molds of a segmental pediment, as shown in the accompanying illustration, Fig. 22, in which A B represents the horizontal molding on which the pediment is to rest. Through B, the center point, draw the line E F at right angles to A B. Then from B as center, using the desired radius, as B H, describe the arc H D. Now place the hight of the mold upon the center line E F, as shown from H to C, and using B as center and B C as radius describe the outer arc C A. Now parallel to E F draw the line I J, upon which, in its relative position to the points C and H on the line E F, draw the true section of the mold on C H, as shown by X K L. Then draw the side of the dentil M N L, which will represent a true section of the dentil also on the line C H. Now space and draw the dentils in their proper positions in the elevation, as shown by *a*, *b*, *c*, *d* and *e*.

Divide the section of the mold into an equal number of spaces, as shown by the small figures 1″, 1, 2, 3 and 4, through which points, at right angles to E F,

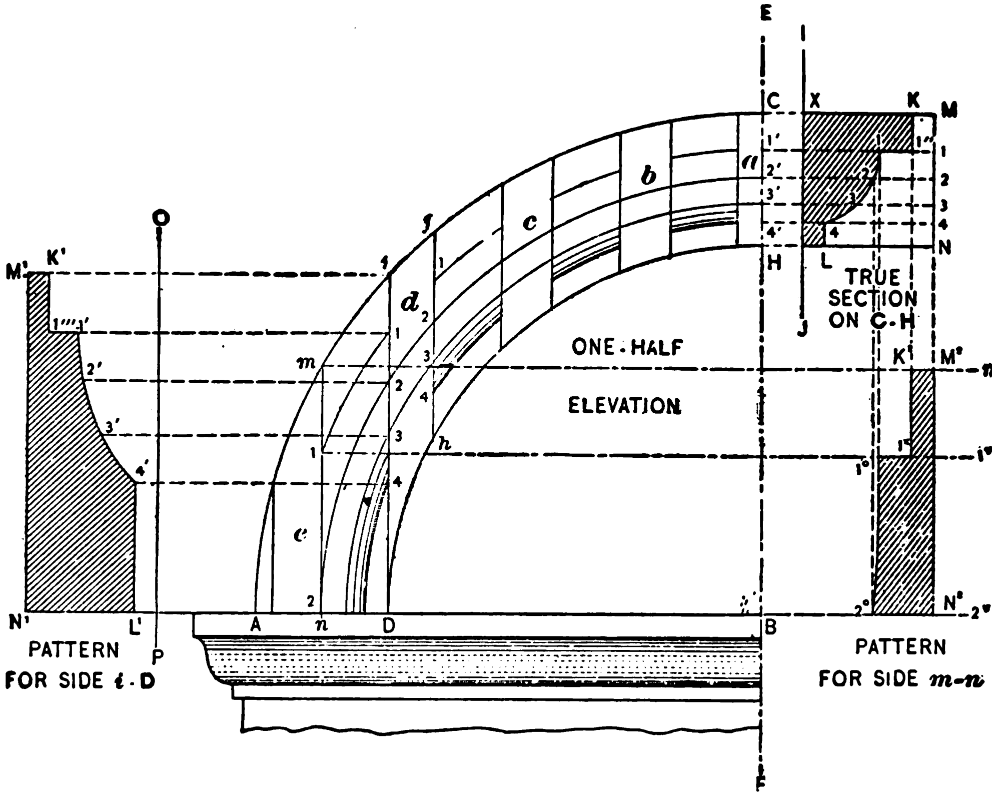


Fig. 22. Patterns for Square Dentils in Segmental Pediment

draw lines intersecting the face of the dentil M N in section at 1, 2, 3 and 4, and the center line E F at 1′, 2′, 3′ and 4′. Using B as center and with radii equal to B 1′, B 2′, B 3′ and B 4′ draw short arc between each dentil intersecting the sides of the dentils, as shown, for example, in the dentil *d* by 1, 2, 3, 4 on both sides.

It will be noticed that the sides of the dentils intersect the moldings each at a different angle and a separate pattern is required for each side. To explain the principles it is shown how the pattern for the side *i* D of the dentil *d* is developed, which can then be applied to the other sides. Parallel to *i* D draw any line as O P. At right angles to *i* D and from the various points *i*, 1, 2, 3, 4 and D draw lines through the line O P indefinitely. Now measuring in each instance from the line I J in the true section take the various distances to the various points in the mold, as K, 1″, 1, 2, 3, 4 and L, and place them on the lines drawn from *i*, 1, 2, 3, 4 and D in the elevation, measuring in each instance from the line O P, as shown by the points K^1, 1‴, 2′, 3′, 4′ and L^1. Then take the distances from K to M and L to N in the true section and place them from K^1 to M^1 and L^1 to N^1 in pattern for side. Trace a line through points thus obtained, then will K^1 M^1 N^1 L^1 K^1 be the pattern for the side of the dentil *i* D in elevation to fit against the circular molding on the vertical plan *i* D. In precisely the same manner obtain the sides for all the dentils *a*, *b*, *c*, *d* and *e*.

In the dentil *e* the side *m n* intersects but part of the molding, and to show this method clearly where only part of the mold is intersected proceed as follows: Parallel to *m n* draw any line, as M^2 N^2, in line with M N of the true section. At right angles to the side of the dentil *m n* and from the intersections *m*, 1 and 2 draw the lines *m m′*, 1 1^v and 2 2^v, which intersect by lines drawn from points having similar letters and figures in the true section parallel to M N, thus obtaining the intersections M^2, N^2, 2°, 1°, 1^x, K^2 and M^2 in the pattern. A line traced through these will give the pattern for the side *m n* in elevation.

The patterns for the face of the dentils should be pricked directly from the elevation; thus *i f h* D is the face pattern for dentil *d*. The pattern for the top of the dentil *d* is a square piece of metal as long as *f i* and as deep as K M in section; while the pattern for the bottom is as long as *h* D in elevation and as deep as N L in true section. In the same manner obtain the patterns for the faces, tops and bottoms of the other dentils.

THE MITERS BETWEEN STRAIGHT AND CURVED MOLDINGS

Where two horizontal moldings of similar profiles intersect with a curved molding having the same profile, one at an acute angle and the other at an obtuse angle, to find the patterns for the two horizontal moldings; the same principles that are used in developing panel miters may be applied to this, but care must be observed in placing the profiles in proper position. It may be added that the miter lines in plan will be slightly irregular, so as to miter with the curved molding.

In the accompanying diagram Fig. 23, the section line A B C D E represents the wall line of the building. Place the profile in its proper position, as shown by

F. Space same into spaces, as shown by the small figures 1 to 13. At right angles to D E draw G H, perpendicular to which and from the points of intersections in F draw lines intersecting H G, as shown.

From the center O draw O J, upon which place a tracing of the various points on H G, as shown by similar figures, placing 11″ 12″ upon B C D. In similar

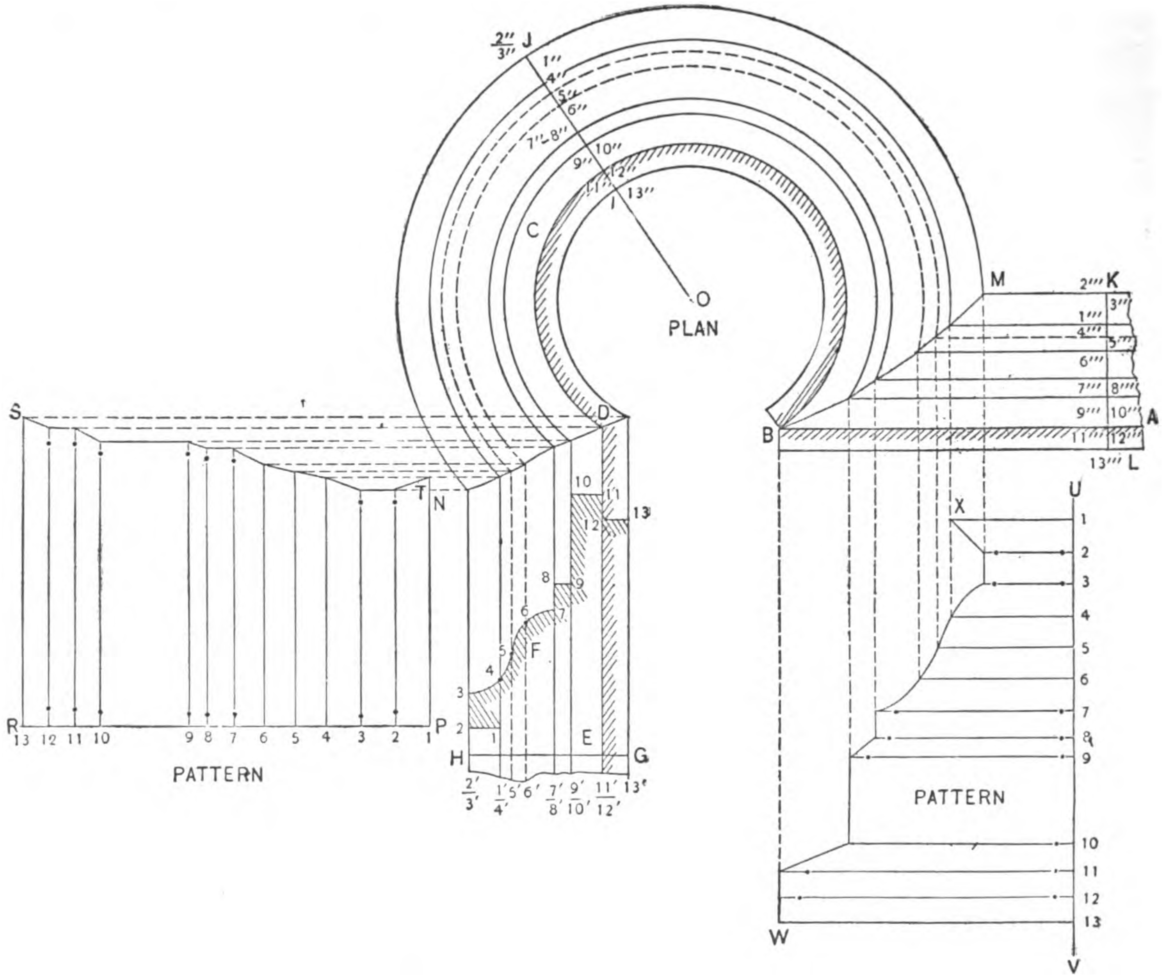


Fig. 23. Miter Between Moldings

manner draw the line K L, upon which place a tracing of H G with the various intersections, as shown.

With O as center and with radii equal to the various intersections on J I, draw arcs, as shown, which intersect with lines drawn parallel to E D and B A from similarly numbered intersections on H G and K L. Through the various points of intersection thus obtained draw the miter lines N D and M B.

For the pattern for the cornice, D N H G, proceed as follows: At right angles to N H draw P R, upon which place the stretchout of the profile F, as shown. At right angles to P R and through the small figures, draw lines which intersect with lines drawn from intersections having similar figures on the miter line N D at right angles to N H. Trace a line through the points thus obtained. Then will S T P R be the pattern for N H E D. In similar manner obtain U V W X, the pattern for B A K M.

Whether the circular cornice is made by hand or machine the miters are not cut on the blanks until the cornice is formed up; then, pressing the circular cornice tightly against the miters M B and D N, the miter line is marked on the circular cornice with a pencil. It is then taken off and trimmed, laps being allowed on the circular work, while the horizontal pieces of cornice have no laps at their miters.

RULES FOR CUTTING CURVED OGEE MOLDINGS

The method of averaging the profiles is shown in Fig. 24, where A B represents the molding and C D the averaged line, which is drawn through the profile in the manner indicated. This method is used when the mold is to be hammered by machine. If a machine is not available, the mold can be hammered up by hand, making the ogee in two sections with a joint at *a*, as shown in Fig. 25. Then, the upper half of the ogee would have to be stretched and a line drawn

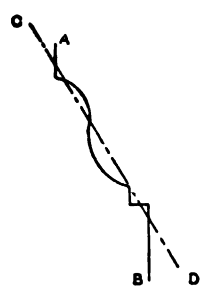


Fig. 24. Averaging the Mold When Made by Machine

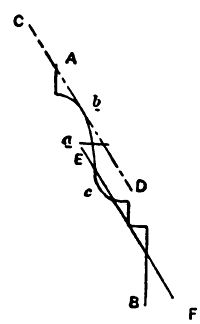


Fig. 25. Averaging the Mold When Made by Hand

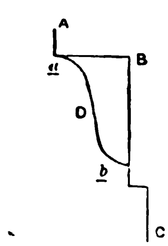


Fig. 26. Method of Stripping to Receive the hand Mold

through *b*, as shown by C D, while the lower half would have to be raised and a line drawn through *c*, as shown by E F. In speaking of the upper half to be stretched and the lower half to be raised, it is assumed that the mold is to run around the corner of a building. After the mold has been hammered up, it is set in position, as shown in Fig. 26, by D, soldering along the edges *a* and *b*. It will be noticed that A B C is "stripped" throughout, and the curved mold D is soldered in position. This gives a true curve to the work, and answers as a stay into which the curved molding is fitted.

TRUE PATTERNS FOR CIRCULAR MOLDINGS

The following are directions for measuring the blanks or patterns when the molding is to be in one continuous piece, as in the case of an urn, vase or other article. When hammering it is often the case that the ends of the blanks or patterns are fastened together by means of rivets or solder, and it is necessary to know the true amount of iron required so that when the blanks are hammered to their true profile the diameters at top and bottom are of the size first determined. In Fig. 27 is shown the plan and elevation of a molding, and if for a vase or urn can be considered as one-fourth the plan. Let A B represent the center line, C D E F the elevation of a molding formed by a flare and G H J K one-fourth the plan. As the flare L M is uniform, extend the line until it meets the center line at N. From the point M erect the perpendicular M G, cutting the line A H in plan at G. Now with A as center and A G as radius describe the arc G K, which divide into equal spaces, as shown from 1 to K. With N in elevation as center and radii equal to N M and N L draw the arcs M K^1 and 1 J^1. From N draw any line, as N H^1, cutting the inner arc at G^1. Then starting from G^1 step off six spaces as shown from G^1 to K^2, similar to six spaces shown from G to K in plan. From N draw a line to K^1, extending it until it cuts the outer arc at J^1. Then will G^1, H^1, J^1, K^1 be one-quarter of the pattern or blanks, of which four would be joined together to complete the full blank.

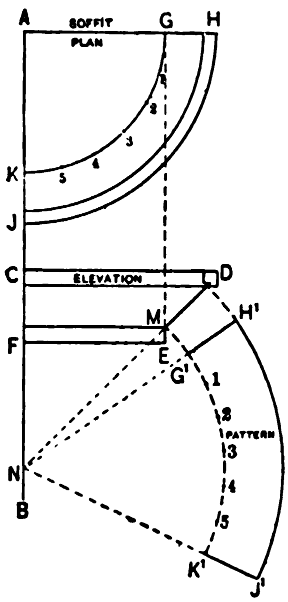


Fig. 27. Molding Formed by Flare

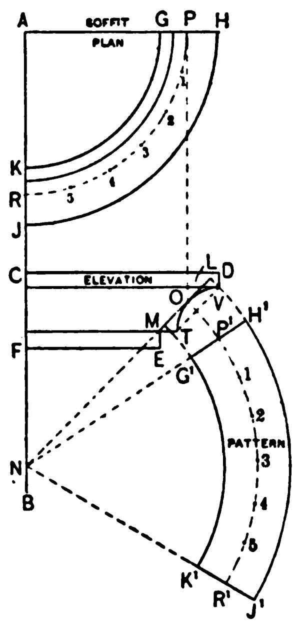


Fig. 28. Molding Formed by Stretching

In Fig. 28 is shown the plan and elevation of a molding formed by stretching, in which A B is the center line, C D E F the elevation and G H J K the plan. Care should be taken when averaging the cove T V to draw the line L M at such an angle that the mold can be stretched with the least amount of labor and time. To do this proceed as follows: Connect the extreme ends of the cove by the dotted line T V. Bisect the cove and obtain the point O. Now through the point O draw the line L M parallel to T V and extend the line L M until it intersects the center line A B at N. From the point O lay off on the line M L the stretchout of the cove O T and O V, as shown by O M and O L. Then when stretching the point O remains stationary while L and M will be stretched until they meet at V and T, the amount of hammering being equal on both sides, as shown by L V and M T. From the point O in elevation draw the line O P parallel to A B until it intersects the line A H in plan at P. With A as center and A P as radius describe the arc P R which divide into equal spaces, shown from 1 to R. Now with N as center and radii equal to N M and N L describe arcs L J^1 and M K^1. From N draw any line, as N H^1, cutting the arc at G^1. With N as center and N O as radius describe the dotted arc O R^1, cutting the radial line N H^1 at P^1. Measuring from P^1 set off six spaces equal to the six spaces shown on the corresponding line in plan from P^1 to R^1 in pattern. From R^1 draw a line to the center N, cutting the arc at K^1, and extend the line until it cuts the outer arc at J^1. Then will G^1 H^1 J^1 K be one-quarter of the pattern.

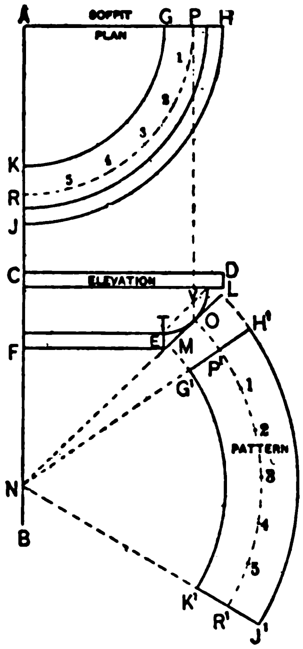


Fig. 29. Molding Formed by Raising

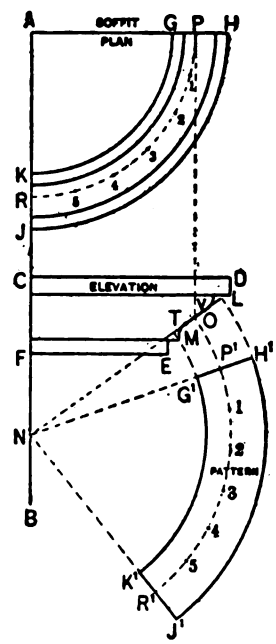


Fig. 30. Molding Formed by Raising and Stretching

In Fig. 29 is shown the plan and elevation of a molding formed by raising; that is, the outer edges L and M are drawn in by means of the raising hammer and block. In this case it is assumed that the point O remains stationary, it not being drawn inward, as are points L and M. The method employed for obtaining the pattern for this mold is precisely the same as described in connection with Fig. 28, similar letters referring to similar parts. In Fig. 30 is shown the plan, elevation and pattern for a molding formed by raising and stretching, the mold being known as a reversed ogee. In this case the portion T V remains stationary, the same as if it were a flaring mold, as shown in Fig. 27, while the portion from V to L in Fig. 30 is raised similar to Fig. 29, and that part shown from T to M in Fig. 30 is stretched similar to the mold in Fig. 28. The measurement for the blank in Fig. 30 could be taken either on points T or V, but the center of the mold O has been used as the measuring point, so that the description given in connection with Fig. 28 can also be applied to Fig. 30, similar letters referring to similar parts. In

Fig. 31 is shown the method of averaging an ogee. Let A be the profile; average the line B C so that T V will remain stationary, as shown; then will the portion above V be stretched and below T be raised. In Fig. 32 A shows the profile of a mold which would have to be made in two sections with a seam at B. For the lower section the average line would be drawn as shown by D E, only touching the mold at F. Both sections would be raised as in Fig. 29. In Fig. 33 is shown the method of averaging a bead or three-quarter circle. Let A be the profile and D E F the bead, which is divided into three sections, as shown by the seams B and C. As the three sections will be raised, average the sections similar to the rule given

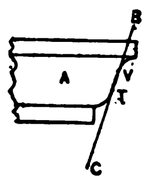


Fig. 31. Method of Averaging an Ogee

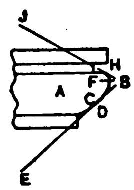


Fig. 32. Profile of Mold Made in Two Sections

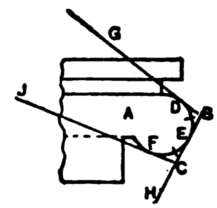


Fig. 33. Method of Averaging a Bead or ¾ Circle

in Fig. 29, as shown by the average lines G D, E H and F J. The method of obtaining the patterns for Figs. 31, 32 and 33 is the same as described in connection with Fig. 28. Should any other shape arise the rules given above are applicable in any case, care being taken to divide the profile into such sections as to raise or hammer them with the least amount of time, and be careful to study which portion will be raised or stretched. It is always better to place in an extra section and obtain one more seam in a large mold than to take chances of making the pattern for a large mold, which would take more time and labor in hammering and thin out the metal.

DESIGNING HAMMERED ROSETTES

The following is an explanation of how to get the pattern for a rosette having eight scallops, to be 4 inches in diameter and raised 1½ inches deep, as shown by Fig. 34 and size of raising hammer used and how many can be raised at one time, also how to make a drawing showing the correct appearance of the rosette as viewed from the side, and how to develop the pattern from this.

It is generally understood among workers in this line that accurate patterns for work requiring much hammering cannot be cut, since the stretching of the metal in the process of raising may be more or less, according to circumstances, and the necessary amount of allowance can only be determined by experiment.

But while this is true, it is not a difficult matter to construct, from given data, correct front and side elevations of any design which will show how it will look when finished. Such drawings will aid materially in determining whether the design as previously conceived will be satisfactory or whether some alteration must be made before going ahead with the work. Furthermore, with accurate drawings of the completed design at hand, from which definite measurements can be made, the workman can make such allowances for the stretching or drawing in of the metal as will enable him to lay out a fairly accurate blank. And with such an approximation to start with one or two experiments in raising should enable one to produce a very accurate blank.

Fig. 34 of the annexed drawings is an approximate reproduction of required article in which it is inferred that the scallops are drawn about as one expects to

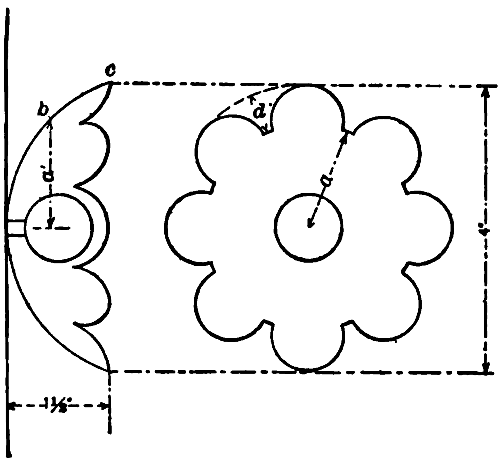


Fig. 34. Reproduction of Sketch of Required Article

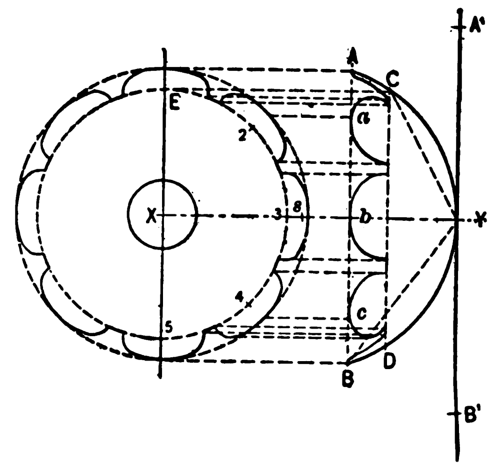


Fig. 35. Method of Constructing Correct Front and Side Elevations of Hammered Rosette

see them "in the flat," or before the metal is raised or dished to the curve shown in the sectional view at the left. Inasmuch as corresponding points in the two views must be at the same hight or distance from the center of the design, it will be seen that, if the scallops as drawn were accepted as the correct front elevation, the distance of its deepest part from the center, shown by *a*, would if set off in the profile, show that point to be at *b*, and the depth of the scallop to be *b c*. This distance is much greater than its width, on account of the obliquity of the metal at the edge, and would produce a scallop of oval shape, which is apparently not intended.

In Fig. 35 is shown a front and side elevation of the rosette with a scallop of the approximate size of that shown in Fig. 34, which may be drawn in the following manner: First draw a circle showing the extreme size (4 inches) of the rosette; and, with its centers on the same horizontal line, draw the profile of the side view to correspond with that of Fig. 34, terminating it at A and B by horizontal lines projected from the top and bottom of the elevation. From A set off the depth of the scallop, as measured at *d* of Fig. 34, and shown by C of Fig. 35, and draw the vertical line C D. Next project a line from C to the center line of the front view, as shown by C E, and with the radius X E draw the dotted circle shown. Divide this circle into as many spaces as the number of scallops required (eight), locating the points 2, 3, 4, etc. From each of these points set off half the width of a scallop each way and draw its outline tangent at the middle to the outer circle, as shown. To complete the side view first project lines from the middle point of each scallop or point of tangency just mentioned to intersect with the line A B, as shown at *a*, *b* and *c*, and from the two inner points of each scallop on the circle E 5 project lines cutting the line C D of the side view, as shown by dotted lines. From the points thus obtained the outlines of the scallops may be drawn through the points just obtained on A B, as shown.

Since the surface at the edges of the rosette is oblique to the plane of the view, the outlines of the scallops, though intended to be circular, must appear elliptical, because the oblique projection of a circle is an ellipse. The ellipses are more flattened in the front view than they are in the side, because the angle of the metal is more oblique to the plane of that view than to that of the side view. The correctly drawn elevation now shows that the circle forming the bases of the scallops is much greater in diameter than the corresponding circle of Fig. 34, with the radius *a*, and that therefore the scallops must either be larger or be further apart than shown in Fig. 34.

With reference to a pattern for a blank, it will now be seen that a full stretchout of the profile A Y B would, if set off on the vertical line, reach from A^1 to B^1, giving a diameter of nearly 5½ inches. This distance must of course be reduced by the amount which, in the judgment of the workman, the metal will stretch with the hammering necessary to produce the curve of the profile. A radius equal to the chord of A Y or B Y would be a safe estimate for a blank upon which a circle with a radius somewhat less than the chord C Y may be drawn as the base of the scallops. These dimensions will, of course, have to be verified by experiment, as explained above. Unless it is desirable to cut the scallops before raising, they can most easily be outlined upon the dished blank by a carefully trimmed template or pattern.

Two or three blanks may be raised at one time during the first part of the operation, provided sufficient metal be left on the blank outside the outline at three or four points to permit notching and the turning under of some points or lugs to bind the several pieces together while being hammered. Each piece must, however, be finished separately to insure uniformity of size. A raising hammer weighing from 2 to 2½ pounds will be best adapted to the work.

CONSTRUCTING BALLS OF SHEET METAL

When large balls must be raised by hand of galvanized iron or sheet copper it is well to know the best method of developing the patterns and raising the ball. These large balls are usually employed in ornamental cornice work. The ball can be raised in zones or horizontal sections or can be made from gores or vertical sections. It is best to make them from zones, as the pieces are not so apt to warp as in the gores. Using the zones there is more waste of material than in using gore pieces, but the labor is less in raising the zones than in raising the gores; hence the preference to the zones. So the reader can take his choice, as the two methods of developments are given.

The pattern for the ball constructed by means of zones is shown in Fig. 36, in which the same principle is used as that in drawing the pattern for a flaring vessel. First draw the elevation of the ball of the required size, as shown. Divide into as many zones as desired—in this case six. When the ball is large more zones must be used. Divide the semicircle in equal parts, as shown by 1, 2, 3, 4, 3, 2, 1. Through the center of the ball draw the vertical line A B. Through the extreme points of the zone 3 4 and 3 2 draw lines which extend until they meet the center line at A and D, respectively. Where the zone line 3 $3'$ intersects the center line A B at C use C as a center and draw the quarter section C $3'$ $3''$, shown shaded. With A as center and radii, equal to A 3 and A 4, draw the arcs 3 3° and 4 4°, making the length of 3 3° equal to twice the girth of the quarter section $3'$ $3''$. From A through 3° draw a line intersecting the arc 4 4° at 4°. Then 3 3° 4° 4 is the half pattern for zone C, to which laps are allowed, as shown by the dotted lines.

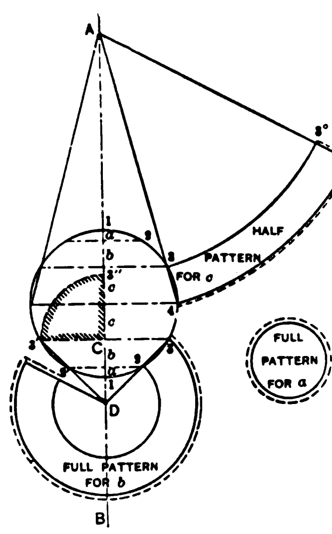


Fig. 36. Patterns for Zones

Now with D as center and radii equal to D 2 and D 3, draw the arcs 2 $2'$ and 3 $3'$. On the arc 3 $3'$ lay off the girth of four times the quarter section $3'$ $3''$, and draw a line from 3′ to D, cutting the inner arc at 2′. Then 3 3′ 2′ 2 is the full pattern for zone *b*, to which edges have been allowed. With radius equal to 1 2 draw the full pattern for zone *a*, as shown. The laps shown denote the extra stock added for soldering.

The method of obtaining the pattern for the gore piece is shown in Fig. 37. This is an approximate shop rule, and while not strictly accurate it is one usually used by sheet metal workers and is as correct as is ever required in commercial work. The rule is as follows:

Draw any line, as A B, upon which describe the elevation of the ball, as shown by C D E F. Divide the ball into as many parts as gores required (in this case 12), D *b* showing the width of one gore. At right angles to A B draw any line, as C^1 E^1, making D^1 C^1 and D^1 E^1 equal to D C and D E in girth. Take one-half of the gore

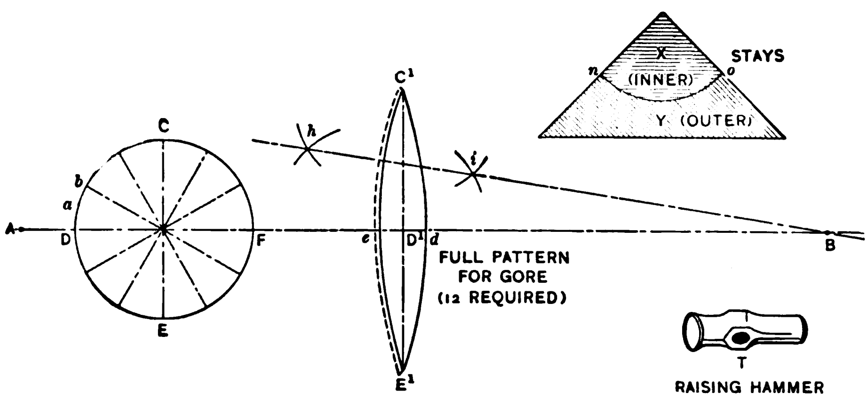


Fig. 37. Pattern for Gore

D *b* as *a b*, and place it on each side of the line C^1 E^1, as shown by D^1 *d* and D^1 *e*. Now with C^1 and *e* as centers, with radius greater than half of C^1 *e*, describe arcs, which intersect each other at *h* and *i*. Through these points draw a line intersecting A B at B. With B as center and B *e* as radius, draw the arc C^1 *e* E^1. Take the distance D^1 B and place it as shown by D^1 A, and with A as center draw the arc C^1 *d* E^1, which completes one of the 12 gores required. A lap is allowed for soldering purposes, as shown by the dotted line.

Having cut the required zones or gores an outer and inner stay is required to use as a gauge to raise the ball. This stay is shown by X and Y. A cut made along the profile of the ball, indicated by *n o*, will give an inner and an outer stay, as shown. T shows the form of raising hammer required, which can be obtained in different sizes. When raising the ball a wood or lead block is employed. The trunk of a tree is convenient or a heavy lead block, which can be formed into any shape, then recast and used again.

Fig. 38 gives a few hints on raising the ball. A° shows a lead block into which the proper curvature has been made with the raising hammer. Care should be taken in making the mold that the curve A B is similar to the circle contained in the flaring strip, and that the curve B C is similar to the curve of the ball. When raising, the flaring strip should be placed as shown in diagram F. The flare *b′* is placed in the position shown and the raising hammer used along the center at *a*; the edges *c* and *b* will buckle slightly, but these are dressed out by using the raising hammer along *c* and *b*. To obtain a smooth surface a round headed stake, H, is placed in the bench, as at J. The raised flare L is placed on the stake and then by means of the mallet M a smooth surface is obtained. In this way the flares shown by *b c* in diagram D E are raised. The flat disks *a* and *a* are raised in a shallow surface, as shown at X.

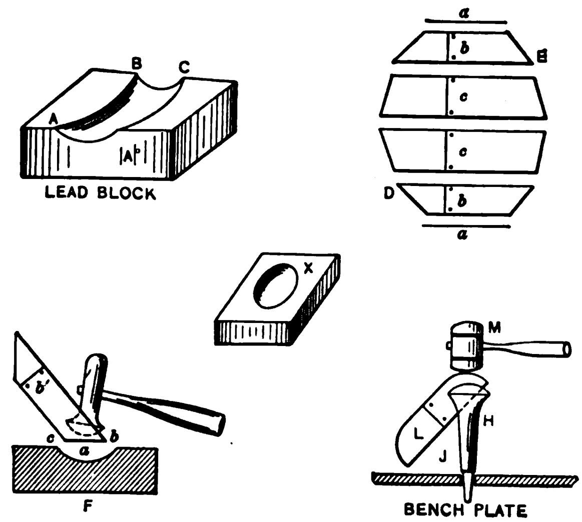


Fig. 38. Raising the Ball

FORMING BEADS FOR CIRCULAR WORK

It may be proper to remark that it would not pay to raise beads from patterns obtained from flaring sections the same as in circular molding work, but they can be made easily and cheaply as shown in Figs. 39 to 41, which illustrate the contrivance and method of making beads of any size and radius.

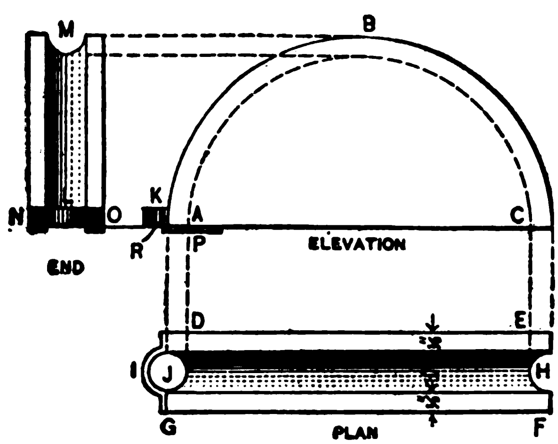


Fig. 39. Plan and Elevation of Bead Former

Let it be assumed that a bead is to be made for a panel, and assuming that the bead is 1 inch in diameter, obtain a piece of board 2 inches thick, cut to the required diameter, so that the semicircle A B C in elevation in Fig. 39 will represent the diameter of the bead at its central point, as H in Fig. 41. A half circle 1 inch in diameter is now cut around the semicircular wooden templet, as is clearly shown in plan by D E F G at H and J. A piece of band iron 3-1×61 inch in size is now formed to a shape, as shown at I in the plan, Fig. 39, so that the circle J is a trifle over 1 inch in diameter, to admit the inch bead. This is placed at the bottom of the wooden templet on one side only, as at K in the elevation, and as shown at L in the end view M. The method of fastening the band or clasp will be better understood by first referring to Fig. 40, in which A is the clasp with flanges on both sides, while C is the pin with holes punched, as at D. The pin C, of which two are required, is now fastened with screws on either side to the bottom of the templet A B C, as at P in Fig. 39, allowing it to project as far as shown by R, to allow the clasp to fall into it, as at N and O in the end view M L. This allows the clasp to be taken off and put on at pleasure.

The method of using the templet is shown in Fig. 41. Make the required quantity of 1-inch bead in straight lengths of sheet zinc, giving it but ¼-inch lap, and being careful that it has a true circle. One end of the tube is closed by soldering a bottom into same, after which white sand is heated and put into the bead; this makes the zinc soft and pliable. If the circle is of a small diameter, say 12 inches, rosin is melted in a ladle and

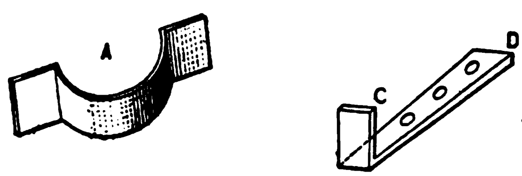


Fig. 40. Clasp and Pin

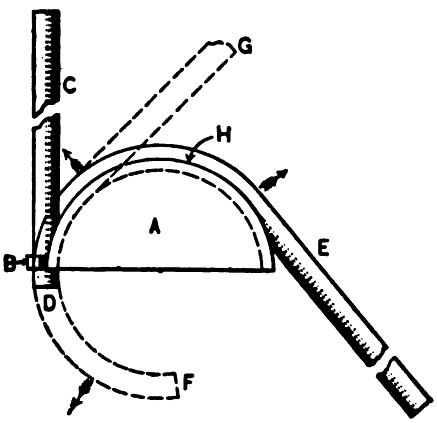


Fig. 41. Method of Bending the Bead

poured into the bead, which keeps the bead from buckling on the concave side when forming to the required shape. As is well known, on the conventional rolling machine there are grooves of various depths in the rolls to allow the forming into circular shape articles that have a wire therein. By setting the rolls so as to form to required radius and exercising due care and judgment in the operation, these beads can be most expeditiously formed by this machine; keeping the seam to the inside of the radius. And assuming that the tubing is ready, the closed end is inserted into the clasp B of the templet A in Fig. 41, as shown at C, allowing it to project below the clasp B, as at D. Now grasp C, and having the templet A securely fastened in a vise, draw over slowly but firmly and the bead will look as at E, Fig. 41.

Care should be taken when inserting the tubing that the soldered side is on the convex side, as shown by the arrows, for if the lapped joint is placed toward the bottom, buckles are apt to occur. The bead being bent as far as E, it is now turned until it has the position shown by the dotted lines F G, when it is pressed over the templet as before described until the circle is obtained. The clasp B is now taken out, when the bead can be removed.

If desired, the bead can be made in two parts. When a bead is required and the radius is very large, as in a cornice, Gothic windows or other similar work, the templet is made with only a segment of the required circle, which answers the purpose just as well. On one job of sheet metal casings over Gothic windows on a church 2½-inch bends were required. As this size could not very well be made of zinc, lead pipes were used of the thinnest gauge obtainable, and these were formed over a templet as described. It made a neat job, the joints and miters being cut with a hack saw. This method of forming beads will be found to turn out good work with but one seam, while raising by hand on large beads requires sometimes two or four seams, to say nothing of the time and labor involved.

PATTERN FOR SINK STRIP HAVING A COMPOUND CURVE

This problem is the development of the pattern of the sink strip shown in the elevation of Fig. 42 by *a*, in the section C of that figure by *b* and in the plan by *c*.

As the sink strip is in the form of a compound curve the pattern must be developed by triangulation as outlined in Fig. 43. First draw the center line A B and the half elevation E J H C F. In its proper position above the elevation draw the half plan of the cap, the arcs being struck from the center A. The section line D 14 represents the wall line, and C 1 the face line of the cap.

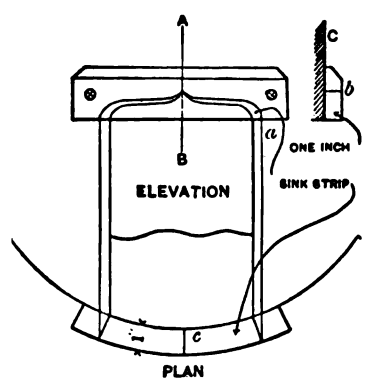


Fig. 42. The Problem

Locate the point 14 in elevation at pleasure, and from the corners 7 and 8 in plan, representing the corners of the sink strip, drop vertical lines intersecting C F in elevation at 7 and 8. Now at pleasure draw the desired curves 1 to 7 and 8 14, which represents the elevation of the sink strip, whose plan is shown respectively by 1 7 and 8 14.

Divide the curves 1 7 and 8 14 in elevation into equal parts, as shown, and from the intersections 1 to 7 erect perpendicular lines intersecting the outer curve in plan, as shown from 1 to 7. In a similar manner from intersections 8 to 14 in elevation erect vertical lines cutting the inner curve in plan from 8 to 14.

Draw solid and dotted lines in both plan and elevation as shown. These lines in plan then represent the bases of triangles which will be constructed, the altitudes of which are equal to the vertical distances of the corresponding numbers shown by the dotted lines and heavy dots in elevation.

For example: To obtain the true length of 5 10 in plan place this distance, as shown, at M, and erect 5 5′ equal to the vertical distance between the points 10

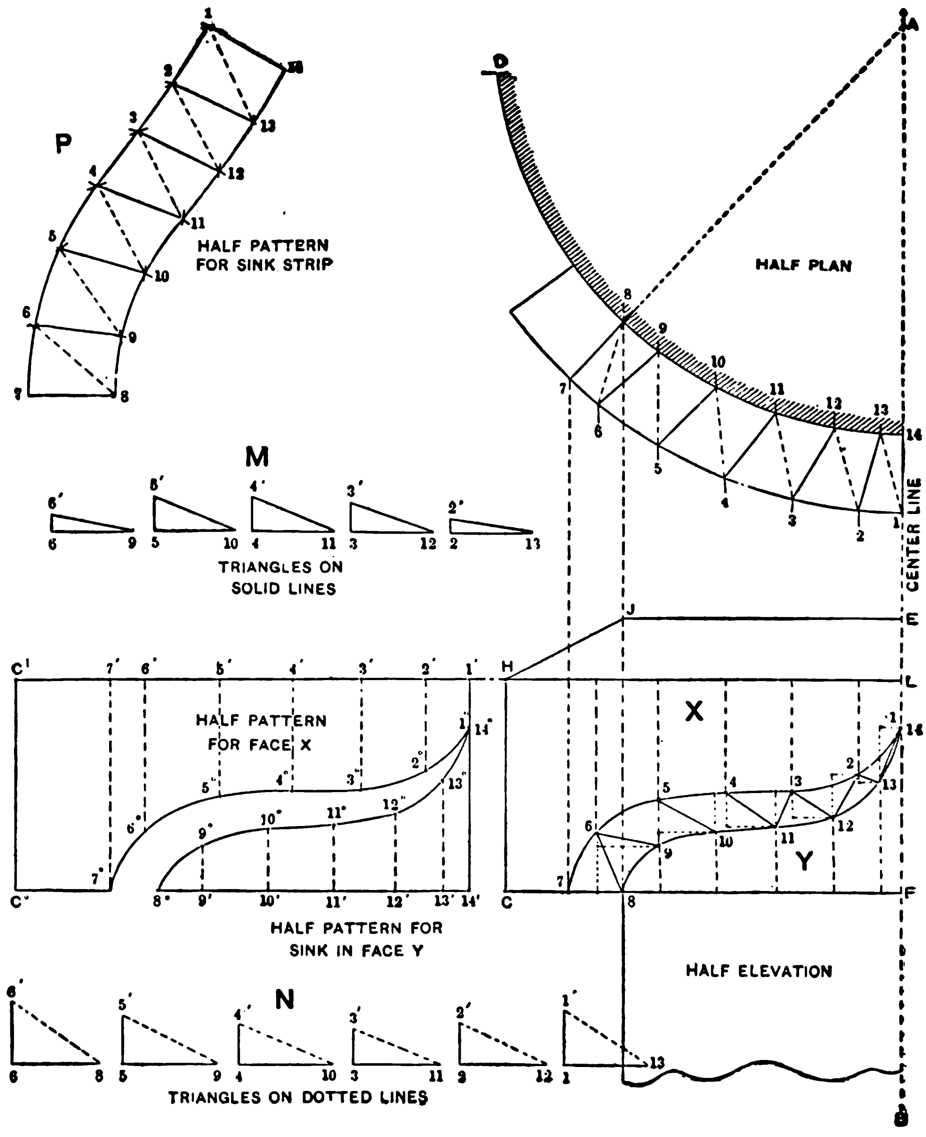


Fig. 43. Plan, Elevation, Diagram of Triangles and Patterns

and 5 in elevation. Then 5′ 10 in M is the true length of the similar numbered line in plan or elevation. Obtain the rest of the solid lines in similar manner, and also the true lengths of the dotted lines shown at N.

To obtain the half pattern for the face X, take the stretchout from 1 to 7 to C in plan and place it on L H extended as 1^1 C^1. Draw the usual measuring lines and intersect by horizontal lines (not shown) drawn from similar numbered intersections in elevation, resulting in the curved line 1° to 7°. Then C^1 1′ 1° 7° C° is the half pattern for face X. For the half pattern for the sink in face Y, take the stretchout from 8 to 14 in plan and place it on F C extended as 8° 14′. Erect vertical lines and which intersect by horizontal lines from corresponding numbers in Y. Then 14° 8° 14′ is the desired pattern.

Having found all the true lengths the pattern for the sink strip P is developed as follows: 7 8 and 1 14 in P are obtained from similar numbers in plan. The dotted and solid lines in P are obtained respectively from the slanted dotted and slanted solid lines in N and M. The distances from 1 to 7 in P are obtained from 1° to 7° in the half pattern for the face, while the distances from 8 to 14 in P are obtained from 8° to 14° in the pattern for the sink in face. The pattern for the face is now formed to correspond to the curve C 1 in plan; the pattern for the sink in face to correspond to the curve 8 14 in plan, and the pattern for sink strip formed so that 1 7 in P fits on 1° 7° and 8 14 in P on 8° 14°.

PATTERNS FOR THE CHAMFER AND GORE PIECE OF A TABLET

Where a tablet the outer curve of which is struck from one center and its inner curve is struck from three centers is to be joined by a chamfer, to find the pattern for the chamfer connecting these curves, also the pattern for the gore at the end of the chamfer, proceed as follows:

In Fig. 44 A B C shows the detail of the tablet, in which the patterns for the chamfer and gore piece A D E, the sunk panel J I Y Z G H X and the chamfer K are to be developed.

The face of the tablet Z F Y I is pricked directly from the elevation onto the metal. The return strips around the curve, side and bottom of the tablet are straight strips of metal equal in width to O *f* in plan, with the curve 1 2 3 4 C in elevation added to the corners, as shown. The chamfer K in elevation is similar to the chamfer K^1, so that when developed the pattern K^1 can be used for K. The bottom H X of the sunk panel is also pricked from the elevation directly onto the sheet metal. For the miter cut I of the panel and the curved molding Z G H

X Y, the reader is referred to "The New Metal Worker Pattern Book," on page 107, for the panel miter, and pages 254 to 258 for the principles relating to curved moldings.

For the chamfer and gore A D F E proceed as follows: From the point N, from which the outer curve is struck, at right angles to A B draw the line N 6, as shown. The centers *c* and *e* and *a* and *b* represent respectively the centers for the inner curve of the chamfer and curves of the panel molding. From the point *m*, being the center with which the curve 1 4 of the gore is struck, draw a line at right angles to A B, as shown by 1 *m*. Now obtain a true section on L M, as shown by the half plan O P R, which gives a horizontal section of the panel mold and chamfer. The true radial miter line F 11 in elevation is obtained by laying a straight edge from the center N to F and drawing the line F 11. Now divide the outer curve 6 to 11 and inner curve 5 to F both into the same number of equal parts, and the outer curve 11 to A and inner curve F to D also both into the same number of spaces, as shown. Now connect opposite points by lines, as shown from 5 to 6 to 7 to 8 to 9 to 10 to F and to 11, and from F to 12 to 13 to 14 to 15 to A and to D. Then will these lines represent the bases of triangles which will be constructed as shown in Fig. 45, in which draw any horizontal line, as A B, upon which place the various lengths of the base lines in elevation in Fig. 44, as from 5 to 6 to 7 to 8 to 9 to 10 to F and to 11, as shown by similar points adjoining each other on A B in Fig. 45 as 5 to 6 to 7 to 8 to 9 to 10 to F and to 11. As the highest point of the chamfer is on points 5, 7, 9 and F in elevation in Fig. 44, take the vertical hight of the chamfer shown by V W in plan and place it on perpendiculars in Fig. 45 erected from similar points 5, 7, 9 and F, thus obtaining the points $5'$, $7'$, $9'$ and F^1. Now draw the slant lines $5'$ to 6 to $7'$ to 8 to $9'$ to 10 to F^1 to 11, which will represent the true lengths on similar numbered base lines in elevation in Fig.

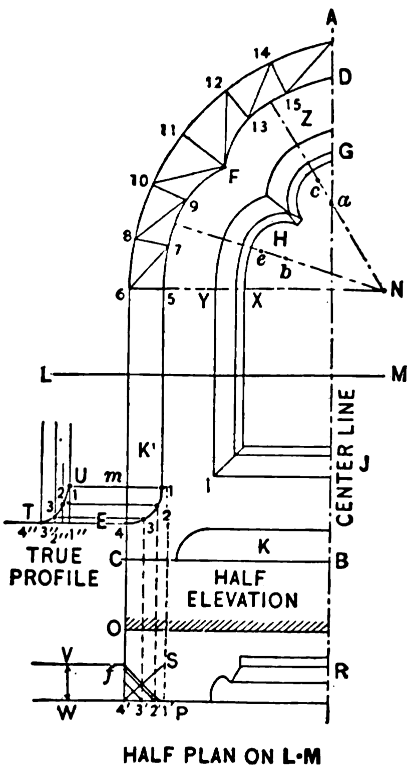


Fig. 44. Half Plan and Elevation

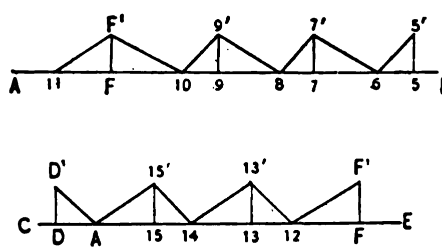


Fig. 45. Diagrams of Triangles

44. Thus, for example, the slant line F^1 10 in Fig. 45 represents the true lengths on the finished chamfer on the line F 10 in elevation in Fig. 44.

In precisely the same manner obtain the triangles on the base lines F to 12 to 13 to 14 to 15 to A to D, as shown by similar figures on C E in Fig. 45.

Having obtained these triangles the pattern is developed as follows: Draw any line, as 5 6, in Fig. 46, equal to f 1′ in plan in Fig. 44 or 5′ 6 in Fig. 45. Now with 5 7 in elevation in Fig. 44 as radius and 5 in Fig. 46 as center describe the arc 7, which intersect by an arc struck from 6 as center and 7′ 6 in Fig. 45 as radius. Now with 6 8 in elevation in Fig. 44 as radius and 6 in Fig. 46 as center describe the arc 8, which intersect by an arc struck from 7 as center and 7′ 8 in Fig. 45 as radius. Proceed in this manner, using alternately as radii first the divisions on the inner curve of the chamfer in elevation in Fig. 44 then similar numbered slant lines in Fig. 45, the divisions on the outer curve of the chamfer in Fig. 44, then the proper slant line in Fig. 45, until the line F 11 in Fig. 46 is obtained. Now using 11 as center proceed in similar manner, using alternately as radii first the outer divisions in Fig. 44, then the proper slant line in Fig. 45, the divisions on the inner curve in Fig. 44, then similar numbered slant lines in Fig. 45, until the line A, D in Fig. 46 has been obtained. Trace a a line through points thus obtained, as shown from A to 6 and 5 to F to D, which will be the pattern for the curved chamfer, a slight bend being necessary along the line 11 F.

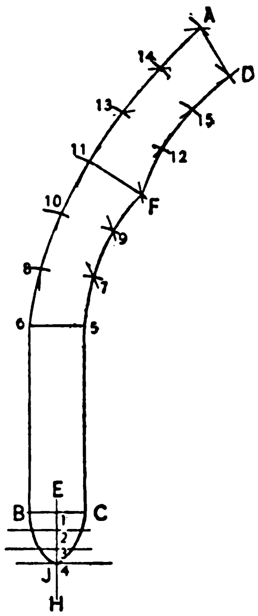


Fig. 46. Pattern for Chamfer and Gore, A D F E in Fig. 44

For the straight portion of the chamfer, shown by 5 1 m 6 in elevation in Fig. 44, take the distance from 5 to 1 and place it on the lines drawn at right angles to 5 6 in Fig. 46, as shown from 5 to C and 6 to B, and draw a line from B to C. For the pattern for the gore piece, shown by m 1 4 in elevation in Fig. 44, proceed as follows: Divide the curve 1 4 into equal spaces, as shown by the small figures 1 to 4, from which at right angles to C B drop lines intersecting the face line in plan at 1′, 2′, 3′ and 4′. From these points parallel to P f draw lines intersecting the side O 4′, as shown. Now from the corner 4′ at right angles to P f draw the line 4′ S, on which line a true profile must be obtained. Parallel to C B in elevation from the point 4 in the gore piece draw the line 4 4″ indefinitely, upon which place the distances contained on the line 4′ S in plan, as shown by points 1″, 2″, 3″, 4″, on 4 4″. At right angles to 4

4″ and from the small figures draw lines, as shown, which intersect by lines drawn from points of similar numbers on 1 4 parallel to C B. Through the intersections thus obtained draw the line as shown by U T, which will be the true profile on 4′ S in plan.

Bisect B C in Fig. 46 and obtain the point E, from which at right angles to B C draw the line E H. Take the stretchout of the true profile in Fig. 44 and carry each space separately onto the line E H in Fig. 46, starting with 1 from the point E, as shown from 1 to 4. Through these small figures parallel to B C draw lines, as shown. Now, measuring in each instance from the line 4′ S in plan in Fig. 44, take the various distances to 1′, 2′ and 3′ and place these distances on similar numbered lines in Fig. 46, measuring on either side of the line E H. Trace a line through points thus obtained, then will B C J be the pattern for the gore added to the end of the chamfer.

PATTERN FOR TWISTED SQUARE SHAFT OF CURVED PROFILE

Where a square shaft of curved profile is twisted to such an extent that the top plane will make a quarter turn, to draw the plan and elevation of the shaft, also the pattern for its sides, proceed as follows:

In Fig. 47 is shown a view of the model. It may be well to remark that it is impossible to obtain a strictly true pattern for the shaft. While the pattern shown in Fig. 49 is geometrically correct, it will, however, require some stretching on its edges to bring it to the required curve and twist.

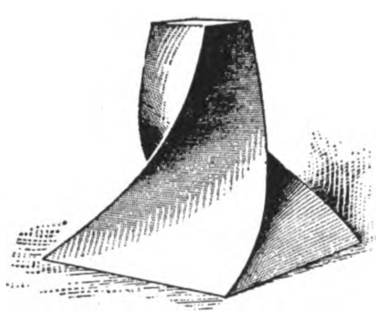


Fig. 47. View of Model

In Fig. 48 let A B C D represent the elevation of the shaft without the twist, the section on D C being shown in plan by H I J K, and the section on A B in elevation by 1″ in plan. Draw the center line through the plan and elevation, as shown by E F G. The curves A D and B C are drawn at pleasure. Now divide E F into an equal number of spaces and draw the horizontal planes 1, 2, 3, 4, 5 and 6, intersecting the curve B C at 1′ to 6′. From these intersections parallel to the center line drop lines into the plan and obtain the horizontal sections in plan view, as shown by 1″, 2″, 3″, 4″, 5″ and 6″.

Using these horizontal sections in plan and elevation the twisted plan and elevation will be constructed as follows: From the various hights 1 to 6 in elevation extend the horizontal lines indefinitely, as shown. Now take a tracing of the various sections 1″ to 6″ in plan and place them in the twisted plan in such positions, gradually turning each plane until the side X of the plane 1″ in plan has been turned one-quarter, or 90°, as shown by X in the twisted plan. As five planes are twisted divide 90° by 5, making 18°, the difference in twist given to each plane. In other words, the side of the plane 5 5′ should be placed at an angle of 18

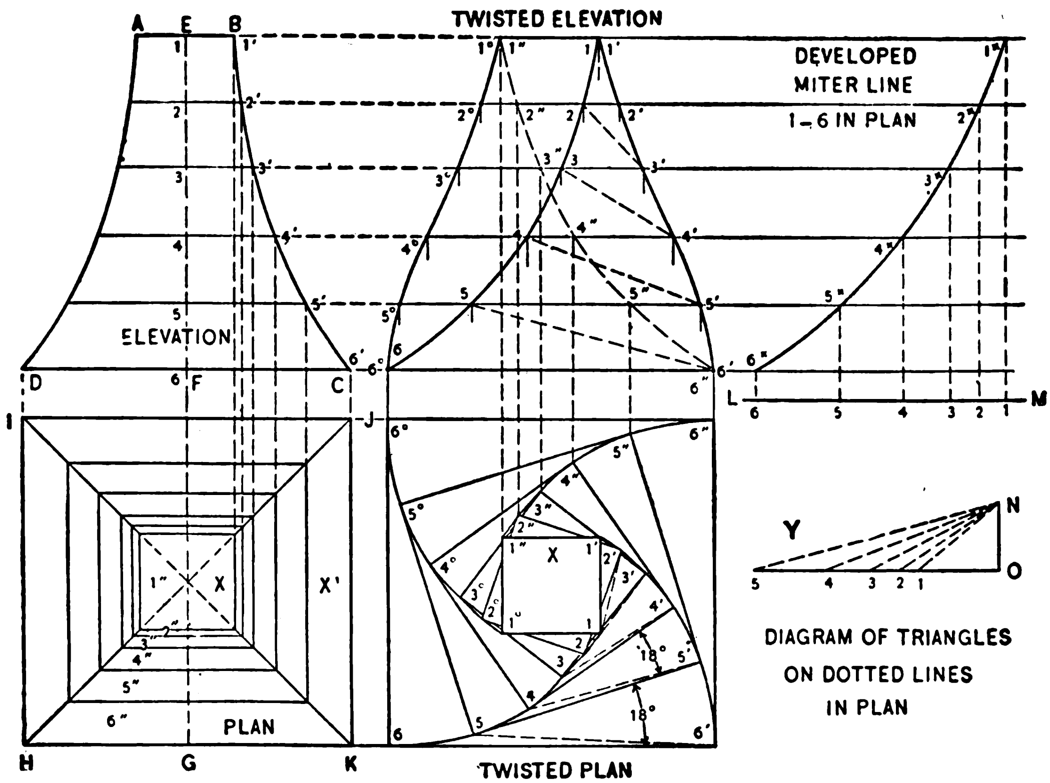


Fig. 48. Plans, Elevations and Developed Miter Lines and Triangles

degrees to the side of the plane 6 6′. In similar manner the side of the plane 4 4′ should be placed at an angle of 18 degrees to 5 5′, etc., until all of the planes are in their proper positions, as shown by 5″, 4″, 3″, 2″ and 1″ in the twisted plan. Then through the corners draw the miter lines 1″ 6″, 1′ 6′, 1 6, and 1° 6°, which completes the plan view of the twisted shaft.

For the twisted elevation project lines from the various corners of the sections on the miter lines 1″ 6″, 1′ 6′, 1 6, and 1° 6° in plan, intersecting similarly numbered lines in elevation, as shown respectively by 1″ to 6″, 1′ to 6′, 1 to 6 and 1° to 6°. A line traced through these points will be the twisted elevation.

The next step is to develop the true length of one of the miter lines, the four being similar. To do this draw any horizontal line, as L M, upon which place the stretchout of the horizontal projection of the miter line 6 5 4 3 2 1 in the twisted plan, as shown by similar numbers on L M. From these points at right angles to L M erect lines intersecting similar lines drawn from the points in the elevation, thus obtaining the intersections 1^x to 6^x, through which trace a line, which will be the developed miter line.

As the pattern will be developed by triangulation a set of triangles must be obtained on dotted lines drawn from 6′ to 5, 5′ to 4, 4′ to 3, 3′ to 2 and 2′ to 1 in plan, the altitudes of which equal the vertical hights of the planes in elevation. Draw any horizontal line, as 5 0 in Y, equal to 5 6′ in the twisted plan. At

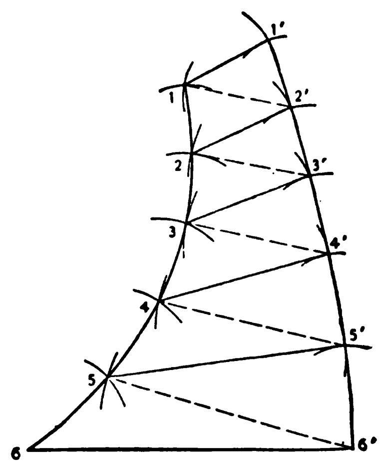


Fig. 49. The Pattern Shape

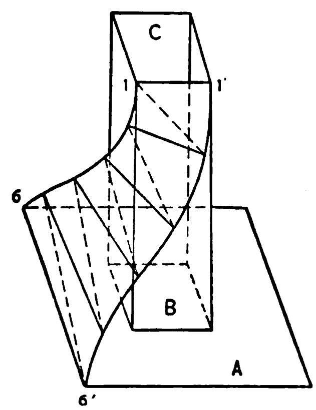


Fig. 50. Model for Stretching

right angles to 5 0 draw O N, equal in hight to one of the spaces between the vertical planes in elevation. Draw a line from N to 5 in Y, which is the true length on 6′ 5 in plan. In similar manner, as shown in Y, obtain the true lengths of 5′ 4′, 3, 3′ 2 and 2′ 1. It should be understood that the solid lines in plan represent the true lengths of the horizontal planes in elevation.

For the pattern proceed as follows: Draw any horizontal line in Fig. 49 as 6 6′, equal to 6 6′ in plan in Fig. 48. Now with 6^x 5^x in the developed miter line as radius and 6 in Fig. 49 as center describe the arc 5, which intersect by an arc struck from 6′ as center and N 5 in Y in Fig. 48 as radius. Now again using 6^x 5^x in the developed miter line as radius and 6′ in Fig. 49 as center describe the arc 5′, which intersect by an arc struck from 5 as center and 5′ 5 in plan in Fig. 48 as radius. Proceed in this manner, using alternately as radii, first the divisions in the developed miter line, then the length of the slant lines in the diagram of triangles, then again the length of the divisions in the developed miter line, then the length of the solid lines in plan, until the line 1 1′ in Fig. 49 is obtained. Trace a line through the points thus obtained. Then will 1 1′ 6′ 6 be the pattern shape.

If the pattern shown were slightly bent upon the solid and dotted lines, right and left, the pattern would assume the shape shown in Fig. 50. In other words, it would turn from 6 6′ at the bottom a quarter circle and meet 1 1′ at the top. This, however, would show corners on the surface, which is not desired, and for that reason, as before explained, the edges will have to be stretched. Before the stretching is done a model should be constructed, as shown in Fig. 50. A represents the size of the bottom of the shaft, in the center of which place a square shaft equal to the hight of the twisted shaft and in size equal to its top. Then using the pattern just developed the edges are stretched until the desired curve and twist are obtained. It is then fastened temporarily and the next side stretched to fit the corners 1 6 and 1′ 6′. It is suggested that whatever the size may be the shaft be worked from soft copper, which stretches easily to the desired shape.

OBTAINING THE BLANKS FOR THE BOTTOM OF A CIRCULAR BAY WINDOW

To obtain the blanks for a bay window as shown in Fig. 51 in which A B D E is the front elevation of the sill molding, shown in side view by K, and B D C is the front elevation of the bottom of the bay, I K J being a plan view showing the curve struck from the center H. As the front of the bottom of bay must have the shape indicated by B C D taken on the line I J in plan, it will be necessary to establish a true section on the line S K in plan from which to obtain the radii for blanks or patterns. To obtain this true section proceed as follows: Divide the curve D E into any number of spaces, as shown by the small figures 1 to 6. From these points and at right angles to B D drop lines as shown, intersecting the wall line I J at points 1^1 to 6^1. Then with H as center and radii equal to H 6^1, H 5^1, etc., draw arc intersecting the center line S K, as shown from 1^2 to 6^2. At any convenient point opposite the front elevation draw any vertical line, as T U. Now extend the lines from the points in the profile E D C until they intersect the vertical line T U, as shown. Now, measuring in every instance from the point S in plan, take the various distances to the numbered points and place them upon lines of similar numbers, measuring in every instance from the line T U in section. Thus take the distance S K in plan and place it as shown from the line T U to K; then again take the distance from S to 1^2 in plan and

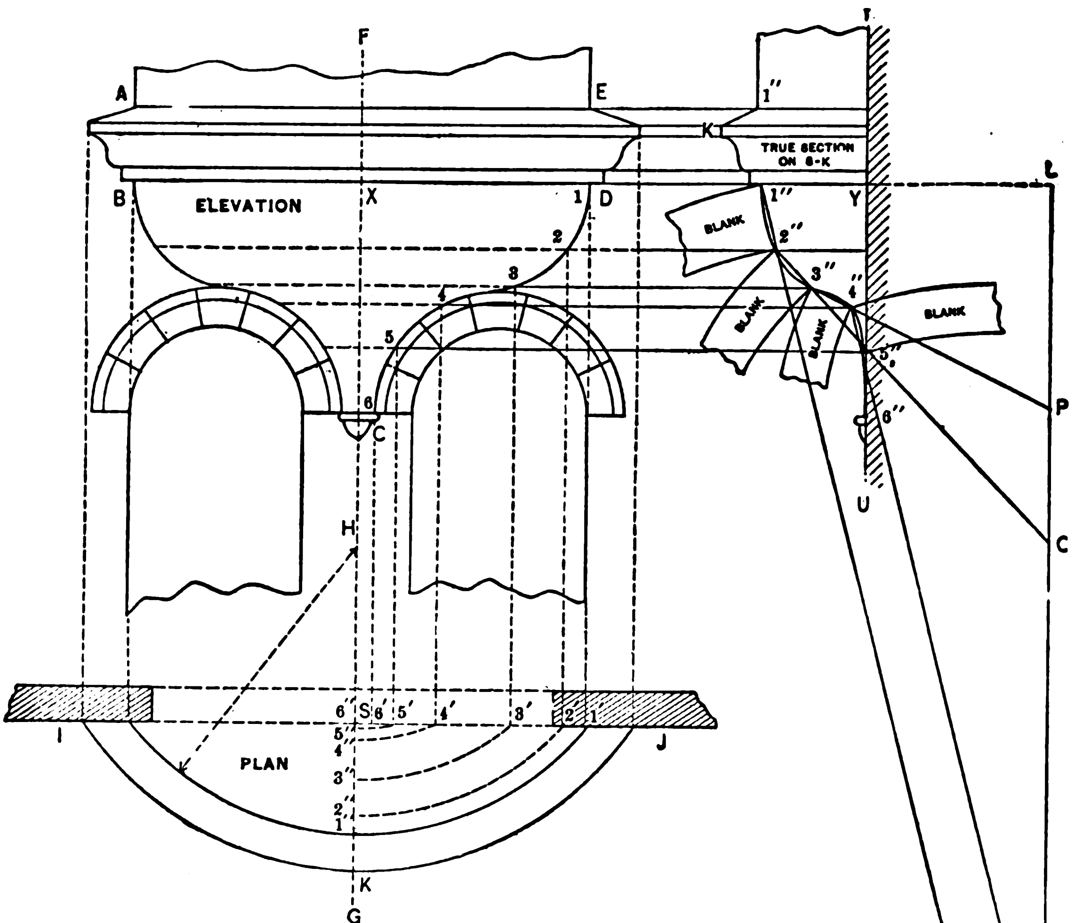


Fig. 51. Plan, Elevation, True Section and Method of Obtaining Radii for Blanks

place it as shown from the line T U to 1^2 on the line 1 in section. Proceed in this manner until all the points in the true section have been obtained. Trace a line as shown, when 1^2 6^2 Y will be the true section on the line S K in plan.

For the patterns or blanks proceed as follows: It should be understood that the usual method for making the bottom of bays round in plan is to divide the profile of the molding into such parts as can be best raised or stretched. Assuming that that this has been done, take the distance from 1^2 to H in plan, and place it as shown by 1^2 to L in section. From the point L draw a vertical line, L N, as shown. For the pattern for the mold 1^2 2^2 in section average a line through the extreme points, as shown, and extend the same until it meets L N at N. Then with N as center and N 2^2 and N 1^2 as radius describe the blank, as shown. The other blanks are obtained in precisely the same manner. The lower portion shown from 5^2 to 6^2 is a straight strip stretched as required. The upper or convex molds will be raised either by hand or machine. If by hand use the raising hammer and block. The lower or concave mold will be stretched by machine or hand, using the stretching hammer and stake. A model should be made to which to raise and stretch the work. This model may be made as follows: If the bay is large, draw the elevation of the bottom of bay on the floor and put in the various horizontal lines 2, 3, 4, 5 and 6, also the center line X C, upon which place the true section 1^2 Y 6^2. Now upon the various horizontal lines 2, 3, 4 and 5 place sections of similar numbers shown in plan. Then upon this model the molds will be raised or stretched to conform to the various sections. Tack the joints or seams, take it off the model, rivet and soak with solder. Allowance for lap should be made on all patterns.

PATTERNS FOR FLUTED BOTTOM OF CIRCULAR BAY

In the accompanying illustrations, Fig. 52, A B C D E shows the front elevation of the bottom of the bay, and F G H the soffit plan struck from the center J on the line E C in elevation. Before the flutes can be placed in position a background must be made to receive them. The line of this background is shown in plan by the dotted line K L M, and shown approximately in elevation by the dotted line N O. These lines being established, divide the plan into the number of flutes desired, as shown, letting the circular heads or semicircles meet the dotted line K L M, as shown. From the plan project up the flutes in elevation, as shown. This is not necessary in practice, but is shown here to give a clear understanding.

The next step is to construct the side view, from which the radii and patterns are obtained. Take a tracing of the plan F G H, with the center point J, and place it in the side view, placing the line G F in a vertical position, as shown by F^1, G^1, H^1 and J^1, letting the line K^1 L^1 M^1 represent the background, similar to K L M in soffit plan. Extend the line F^1 G^1, as shown by P R, which represents the wall line. From the front elevation project the hights of the moldings, as shown by the dotted lines S and T, and from L^1 in plan in side view, at right angles to $H^1 J^1$, erect a line intersecting the bottom of the cove at 5. Now, with the desired center as U, describe the arc 5 3, touching the desired points at top and bottom. This arc represents the background, to which the flutes should be soldered. This background will be made of flaring strips of metal, which can be raised if desired, but is unnecessary, because the flutes will cover the entire

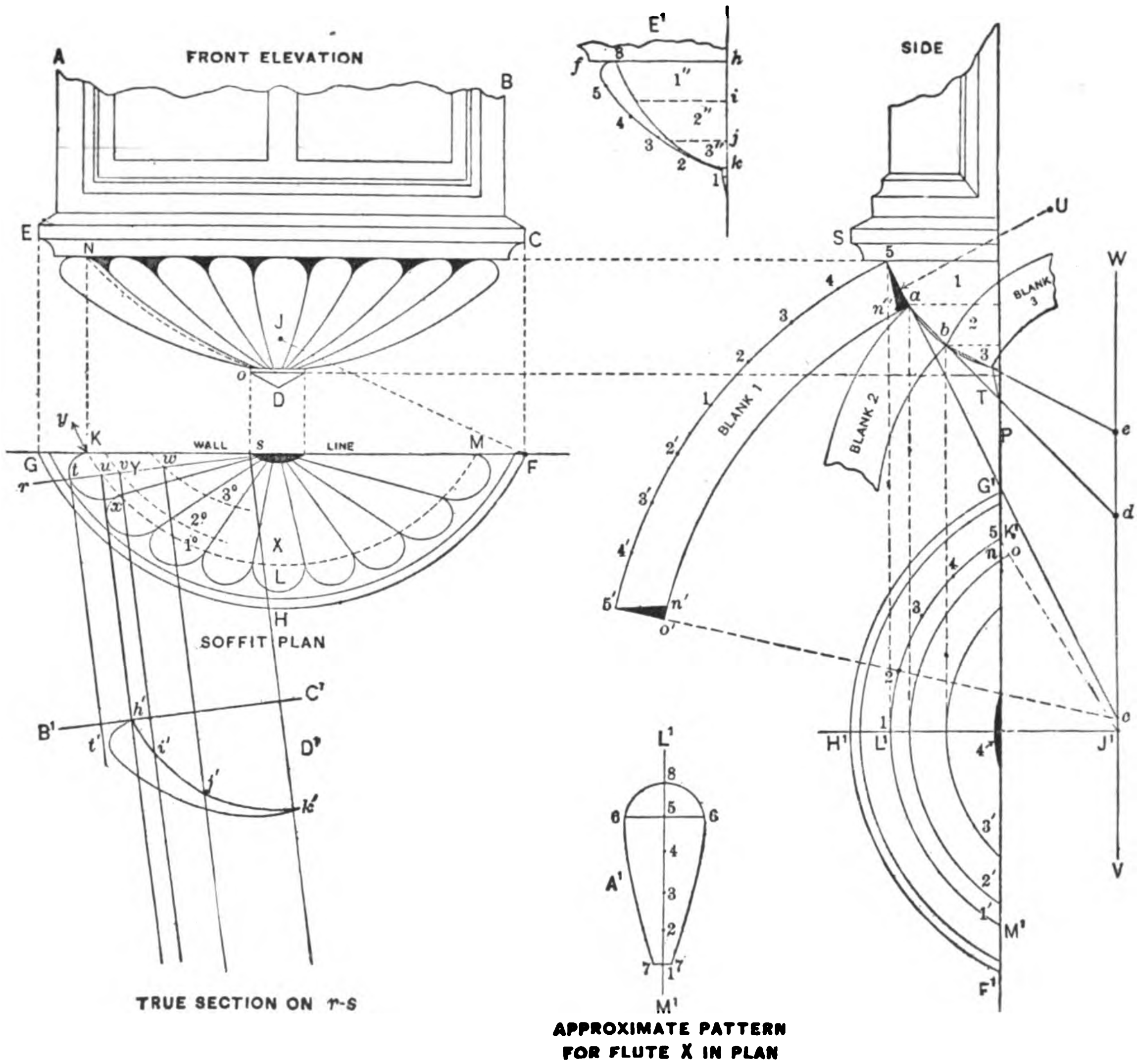


Fig. 52. Patterns for Fluted Bottom of Circular Bay

surface. For this reason divide the curve 5 3 into a number of equal spaces, to avoid sharp corners, as shown by the points *a* and *b*, thus making three flares, numbered 1, 2 and 3. To obtain the radii for these three flares, draw lines through the points 5 *a*, *a b* and *b* 3, intersecting the line V W, drawn parallel to the line $F^1 G^1$ through J^1 at points *c*, *d* and *e*, respectively. From the points a and b draw horizontal lines in the side view, as shown, and drop vertical lines, intersecting the center line H^1 J^1 in plan, as shown. With J^1 as center and through these intersections draw the arcs $1'$, $2'$ and $3'$, which correspond to the flares 1, 2 and 3 in the side. For the pattern for flare 1 proceed as follows: With c as center and radii equal to c a and c 5 describe the arcs 5 $5'$ and a o'. As the point 5 in side view is shown in plan by the arc $1'$, divide one-half of the arc $1'$ into equal spaces, as shown by points 1 to 5, and set off double these spaces on the arc 5 $5'$ on blank 1, as shown from 5 to 1 and 1 to $5'$. From $5'$ draw the radial line $5'$ c, cutting the arc a o' at o'. As the wall line G^1 F^1 in plan crosses the arc at other than radial lines, so will the end lines of the blanks be other than radial lines. Therefore, from 5 in plan draw a radial line to the center J^1, and extend the arc $2'$ to o. As the arc $2'$ represents the plan line of the point a of the flaring strip 1, measure the distance o n in plan, and place it, as shown, from o' to n' and a to n'' in blank 1. Then the portion shown shaded will be that part which will be cut off the pattern. In precisely the same manner will the blanks 2 and 3 be developed, using the centers d and e, respectively, on the line V W, measuring on the arcs $2'$ and $3'$ in plan for the lengths of the patterns. After the blanks are developed they can be soldered together, using the arcs shown in plan as stays. Thus the arc K^1 L^1 M^1 in plan is soldered to the top of blank 1, the arc $2'$ in plan to the top of blank 2, the arc $3'$ in plan to the top of blank 3, and the shaded portion of 4 in plan to the bottom of blank 3. This forms the model to which the flutes are fitted, after which they are raised. The model is now divided into equal spaces, as desired, and lines drawn, with crayon or marking acid, to the bottom, so that a line is obtained as a guide for raising and fitting.

In getting out the patterns for the flutes, they will only be approximate, as some metals will stretch more than others, according to the gauge in use, and will therefore require some trimming. With the model as above made, an experienced hand would require no further stays, but would raise to the lines shown on the model. But one less experienced would require stays through the center of each one of the flutes in soffit plan, which would be tacked with solder in its proper position on the model and the flutes raised accordingly.

As these stays are also used for obtaining the amount of material for the flutes, the method of obtaining the stay for the center flute X in soffit plan will be shown, and to avoid a confusion of lines, diagram E^1 shows a reproduction of the flares 1, 2 and 3 in side view, as shown by $1''$, $2''$ and $3''$ in diagram E^1. It should be understood that this center flute X is the only flute on the bay which is symmetrical, all the others being cut by the arc K L M at other than at right angles to their axis. For example, note the axis line r s in the flute Y. Now draw the section of the flute X in diagram E^1, as shown by 1 to 8, which also represents the stay. Divide the section into equal spaces, as shown by the small figures 1 to 8. Now draw any vertical line, as L^1 M^1, in diagram A^1, upon which place the stretchout of the section of the flute in E^1, shown from 1 to 5, as shown from 1 to 5 on L^1 M^1 in diagram A^1. At right angles to L^1 M^1 and through points 1 and 5 draw the lines 6 6 and 7 7, respectively, making 6 6 equal to the stretchout of the semicircle L of the flute X in soffit plan, and the distance 7 7 equal to the stretchout of the flute X at its apex, shown in elevation at the bottom of J or measured direct from the model. From 6 to 7 on both sides in diagram A^1 draw slightly curved lines, as shown. Then 6 7 and 7 6 will be the pattern for the flute X in plan. This should be raised with the raising hammer and blocked until it fits the stay and model, as before explained, and will require a little trimming. In some shops the circular top of the flute is soldered separately to the flute by using a quarter ball. If care is taken this separate head can be soldered so that the seam will not be noticed; but to make a first-class job the circular head is hammered directly on the flute, by adding to the pattern in A^1 the semicircle 6 8 6, using 5 as the center. As each one of the flutes in plan becomes longer as they reach the wall line, it becomes necessary to obtain a true section through the center of each flute to obtain the amount of stuff required; also to use as a stay in raising.

In this case four different stays would be required, and, for example, the method is shown for obtaining the true section on r s in plan. The same principles being applied to the other three, this should be sufficient instruction for all. Therefore, through the flute Y draw the centeı line r s. Now, with radii equal to J^1 $1'$, $2'$ and $3'$ in plan in side view, and with J in front elevation as center, describe partial arcs in soffit plan, as shown by 1°, 2° and 3°, intersecting the line r s at u, v and w. At right angles to r s and from the intersections u, v, w and s draw lines indefinitely, as shown. Parallel to r s draw any line, as B^1 C^1. Now, measuring in each and every instance from the line f h in diagram E^1, take the distances to lines i, j and k, and place them on similar vertical lines drawn at right angles to r s, as shown by similar letters h', i', j' and k'. Trace a line, as shown. Then h' k' C^1 will be the true section on r s in plan. Around this section draw the section of the flute, as shown. Then in the same manner, as shown in diagram A^1, obtain the approximate pattern, being careful to note that the length of the one side of the flute Y, shown from s to y, is greater than from s to x, as is also the case in the other flutes.

A PEDIMENT MITERING ON A WASH CIRCULAR IN PLAN

This is the exemplification of the method of obtaining the blanks or patterns of a pediment shown in Fig. 53. It will be seen that a cornice passes around a curved wall, upon the sloping roof or wash of which is placed the pediment in question. The line A C B of the plan, indicating the face of the pediment, shows it to have an equal projection at all points from the curved wall. Thus, while the pediment moldings are designated as straight, and it is presumed they are intended to appear straight in the front elevation, they must necessarily be curved in one or the other of two ways, according to the interpretation to be put upon the diagram. Apparently, here is presented material for the expounding of an interesting question of cornice work; and an exposition was prepared, substantially in full as follows.

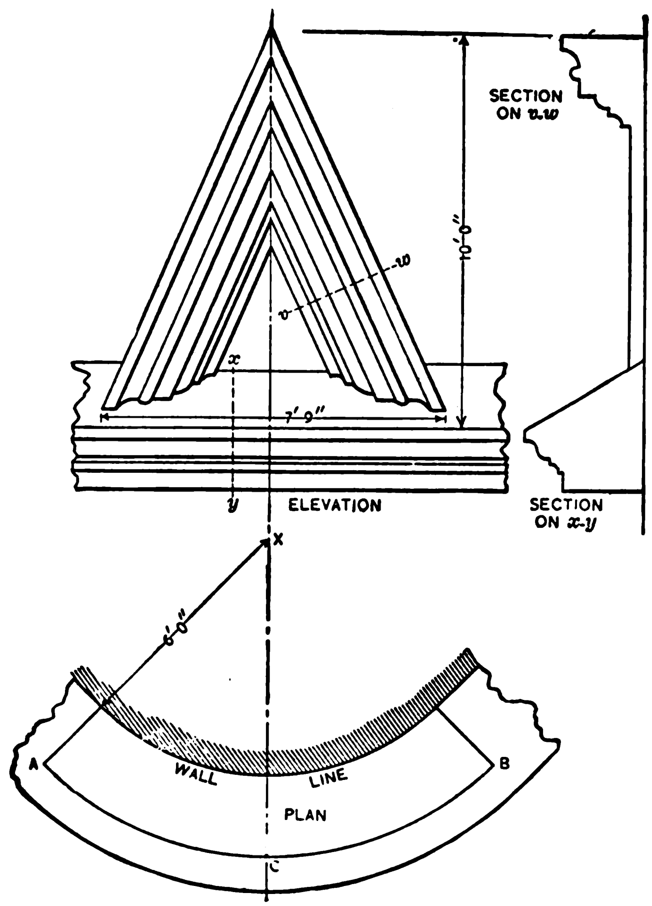


Fig. 53. The Problem in Question.

The plan leaves room for doubt as to the nature of the roof and the soffits or lower sides of the several members of the pediment molds. If the lines at A and B of the plan running toward the center X, and apparently showing the sides of the roof of the pediment at its base, are to be accepted as drawn—that is, not parallel to the line of the apex at C—they would indicate that the roof is a spiral or warped surface, and the soffits of the moldings, which should properly be parallel to the roof, also partake of the same twisted character. If such is intended, the problem would be solved like that of a spiral conveyor. The roof and all parallel surfaces, if drawn according to the above supposition, become similar to the form of the flange in a spiral conveyor. As stated in the problem referred to, the blanks from which such surfaces are to be constructed require more or less stretching at both edges to bring them to the desired form. While the roof surfaces are not referred to, their form determines the character of the moldings of the pediment.

In Fig. 53, as in the case of many other drawings accompanying inquiries sent to the *Metal Worker*, certain disparagements exist. The distance A B of the

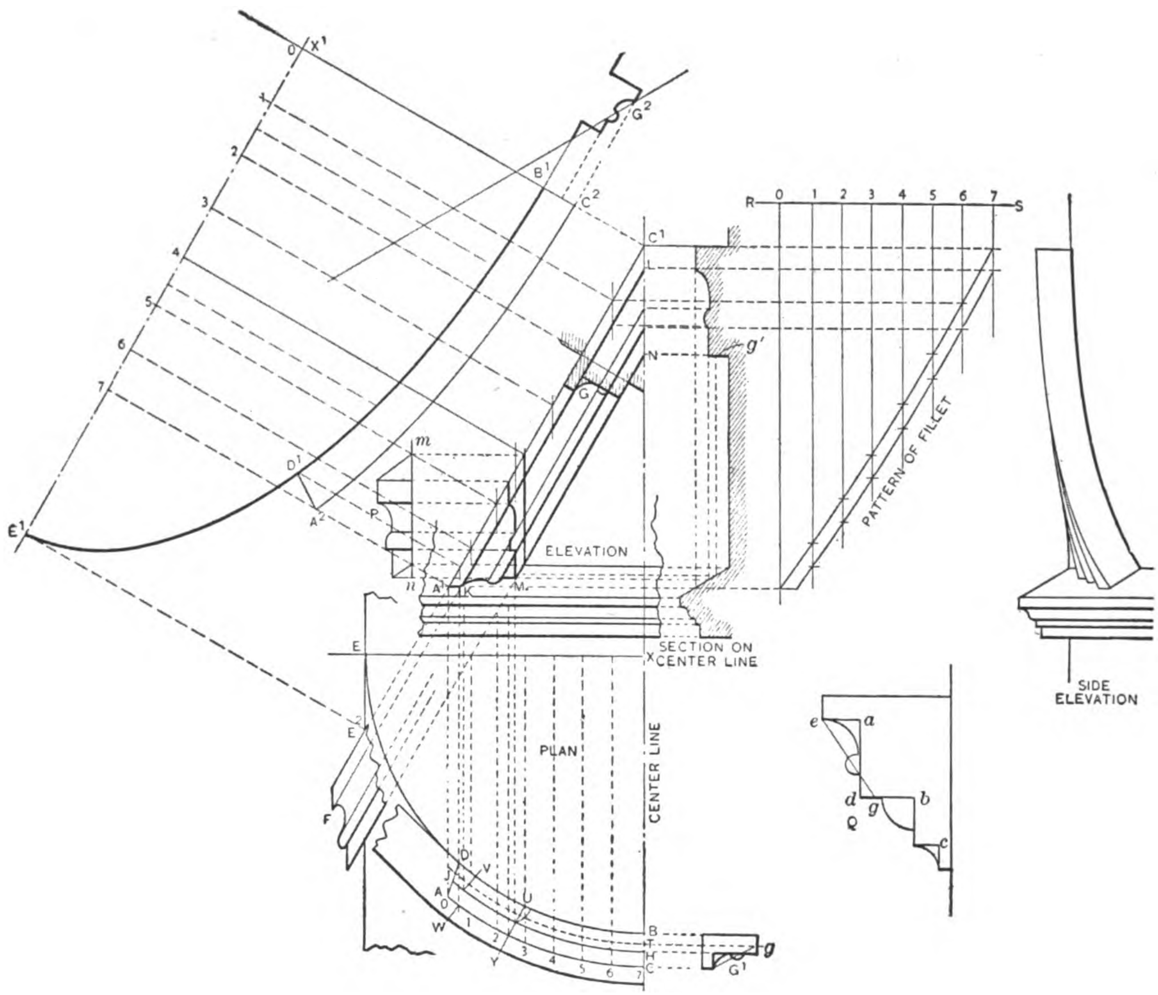


Fig. 54. Plan, Elevations and Sections, Showing Method of Obtaining Curves of Pediment Molds

plan, for instance, does not agree with the width of the pediment at its base in the elevation at the point marked 7′ 9″. As the drawing sent is said to be to a specified scale, it is possible that the curve A C B is intended only to show the extreme face or projection of the pediment in plan, and that the lines A and B drawn toward X are intended to show the limits of the curve rather than the base of the pediment. An interpretation which, therefore, seems more probable than that above assumed, is that the roof and all the soffits recede on straight lines, thus being simple inclined planes devoid of wind or twist. A side view of the pediment as thus constructed will appear as shown at the right in Fig. 54. Since the intersection of any inclined plane with a cylindrical surface produces an ellipse, the course of the moldings of the pediment as they follow both the curve of the wall and at the same time the plane of the roof must thus be elliptical.

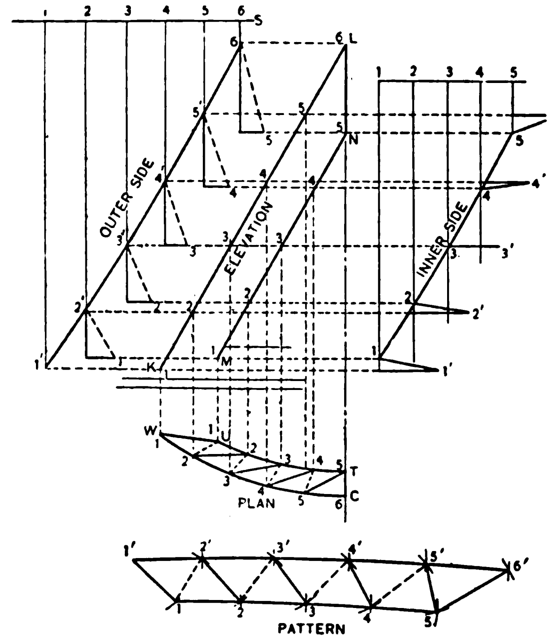


Fig. 55. Plan and Elevation of Blank or Mold in Fig. 54, With Pattern Obtained by Triangulation

The problem, according to the latter supposition, involves forms quite uncommon in architectural work, but the principles governing the same are those employed wherever a change or raking of stay is required. The forms produced by the above conditions are such, however, that while triangulation is the proper method to be employed in developing the blanks for the moldings, it is possible that other methods may be substituted. To simplify the work, Fig. 54 shows the elevation, section and plan of a design similar to that of Fig. 53, but better adapted to the purposes of demonstration. Having less pitch than that of Fig. 53, its moldings have therefore a greater proportion of curve in a given length, while a portion only of the profile shown in Fig. 53 is used, since the treatment of the part used may easily be extended to the whole.

In order to more thoroughly understand the nature of the forms under consideration, it is generally conceded that it is well to first enter into a short analysis of the same.

A more perfect idea of the form of the moldings can be obtained by extending them to include not less than a quarter of a circle in plan, thus obtaining as it were, a whole, of which the mold required is a part. Therefore first extend the wall line B D of the plan in Fig. 54 to E, completing the quarter circle, and from E erect a perpendicular into the elevation indicating one side of the cylinder in that view. Now extend the lines of the pediment moldings in elevation till they cross the outline just drawn, finishing the same as shown at F. . To save space the elevation of the extended molding is allowed to cross a portion of the plan, which it is hoped will cause no confusion. If the elevation as thus completed be considered for the moment to be that of a wall, rectangular in plan, the profile F will then represent that of a level return, and it will be seen that, as is always the case when an inclined mold meets a level on one at the angle of wall, the profile of one of the molds (in this case the level mold at the foot) must be raked in the regular manner, as shown at F, in order to form a miter. Since, however, the wall is cylindrical instead of rectangular, the only conclusion to be drawn is that the pediment mold must, from its crossing with the center line, undergo a gradual change of profile as the sides of the cylinder are approached, where its profile must be as just obtained at F.

In view of this change of profile, the surface of a blank for such a mold becomes variable in flare. The only scientific method, therefore, of arriving at a true pattern of the same is by triangulation. The conditions here, as in many other problems, are, however, such that it is a question how to discriminate between that which is geometrically accurate, involving thereby much labor, and that which, if less accurate, is more expedient, especially in the case of the patterns for blanks for raised molds, where the result depends as much upon the manipulation of the work under the hammer as upon the shape of the blank.

The method of determining the patterns will be governed some what by the construction adopted. As the pediment thus partakes of the nature of an arch in a circular wall, what the pattern cutter really requires more than the pattern for the blanks is a correct templet or form to assist him in raising the mold, as with such assistance any approximately correct blank can by proper manipulation be brought to the required form. Since, as above stated, the profile of the mold is different at each point, it will be advisable to adopt such a construction as will bring all the flat surfaces into correct position, and at the same time form an angle or groundwork into or against which the mold can be placed and fastened after raising, and which will at the same time provide a guide or templet in perfecting the curve of the mold during the operation of raising. An enlarged sectional view of the mold, showing a construction based upon this idea, is shown at Q of Fig. 54. The section includes the entire profile as given in Fig. 53, the upper portion only being used in the demonstration. As will be seen by inspection, the flat surfaces—that is, the vertical faces of some of the fillets and the horizontal surfaces or soffits—are extended inward behind the molded forms, meeting and joining at points *a*, *b* and *c*, for which joints perfect miters can be developed. Referring now to the profiles shown at G and G^1 of Fig. 54 it will be seen that the upper fillet of the mold is part of a cylindrical surface, a plan or profile of which is shown by the line A C and its radius is X C, while the lower fillet and all that surface shown from *a* to *d* in section Q is part of a cylindrical surface the plan of which is the line V H.

To obtain the pattern, therefore, of the upper fillet of the mold, that member must be considered for the time being not as a part of the mold of which G is the profile, but as part of a great cylinder with a profile A C, mitering against two plane oblique surfaces, one of which is the roof of the pediment, shown by the line A^1 C^1 of the elevation, the other surface being the plane of the soffit K L, corresponding to *e a* of profile Q. Therefore divide the arc A C of the plan into any convenient number of equal spaces and place a stretchout of the same on any line, as R S, drawn at right angles to the sides of the cylinder in elevation. From the several points on A C erect lines cutting the miter lines A^1 C^1 and K L of the elevation, and from the points of intersection with the same carry lines parallel to R S, cutting corresponding lines of the stretchout, thus obtaining the pattern as there shown. The pattern for the surface forming the back of the mold and the fillet below, corresponding to *a d* of profile Q, is obtained in an exactly similar manner, V H being its plan or profile and K L and M N its miter lines.

The patterns for the roof and soffits, these surfaces being as before explained oblique planes intersecting the sides of a cylinder, are composed of elliptical curves, the method of obtaining which is no different from that employed in the problem familiar to all—viz., that of cutting a hole in a sloping roof to fit against a round pipe. The roof A^1 C^1 in this case fills the space between two pipes or cylinders, one of which is shown in profile by the line D B of the plan, and the other by the line A C. Its pattern can be most easily obtained by the usual operation of raking. For this purpose the points on A C used in the former operation may be used again. Intersections from them having been already obtained on A^1 C^1, the roof line in elevation, lines may now be carried from each of these points of intersection at right angles to A^1 C^1, cutting any parallel line as E^1 X^1, forming part of the major axis of the ellipse. Set off from E^1 X^1 on each of the parallel lines just drawn the distance of corresponding points on A C as measured from E X of the plan. A line traced through the points so obtained, as shown from A^2 to C^2, will give the front line of the pattern. The line of the back corresponding to a section of the wall B D may be obtained in exactly the same manner from a series of points assumed on B D of the plan. Project lines, as before from them, first to A^1 C^1, then to E^1 X^1, and set off on the same from E^1 X^1, the distances of points in B D from E X, thus obtaining the line B^1 D^1 and completing the pattern of the roof. In order to more clearly show the nature of the curves of the roof and the line which the molding must follow, the complete quarter ellipse or section on C^1 E^2 of the elevation corresponding to B E of the plan is shown by B^1 D^1 E^2. For the soffit corresponding to *e a* of profile Q, the lines A C and J H of the plan with K L of the elevation are used in the same manner as described in obtaining the pattern of the roof, while J H and B D of the plan with M N of the elevation are used in obtaining the pattern for the soffit corresponding to *d b*.

The pattern for the fillets and soffits having been cut by the methods above given, the joining of their edges insures of itself the correct profile of those members at the different parts of their course. A templet is thus formed in which all the principal lines of the mold are established, and the filling in, as it were, of the molded portions becomes as much a matter of manipulation as of science.

Since as above stated, triangulation is the only strictly correct method of arriving at a pattern for the blank, the essential points of such an operation will be briefly outlined. The angle of flare for the portion to be raised must first be determined by a line drawn upon the profile at G^1, and the stretchout of such portion be set off on this line. On account of the smallness of profile, G^1, where this can be more clearly shown on profile Q, where *e g* shows the angle or assumed profile of the blank, the stretchout of the mold (the cove and bead), extending from *e* to *g*. From the point corresponding to *g* on profile G^1 project a line to the center line at T, and from X as center with X T as radius, draw an arc indefinitely representing the plan of the inner or lower edge of the blank. The projection of point *g* from the wall line may now be set off from the wall line of the sections on the center line, as shown at g', and a line from g' first dropped upon the wash of the level cornice, and carried thence horizontally to intersect with M N of the elevation. A line from this intersection dropped into the arc from H of the plan at U, and a similar line dropped from K of the elevation into the arc A C of the plan at W, will complete the plan of the blank.

To avoid a confusion of lines the elevation and plan of the blank with the method of triangulation are shown in Fig. 55, in which corresponding parts bear the same reference letters as in Fig. 54. Divide the both lines of the plan into any convenient number of equal spaces, as shown by the small figures. Since the inner line is the shorter, one less space may be used in it than in the outer. Connect points in C W with those of similar number in T U by solid lines, and with those of next lower number by dotted lines. These several lines crossing the plan will form the bases of a series of right angled triangles; the hypothenuses when obtained giving correct distances across the pattern. On account of the arch being curved in plan the elevation does not give the true length of the upper and lower edges of the blank. These distances must, therefore, be obtained by development—viz.: For the outer line of pattern erect lines from the several points assumed in C W of the plan, Fig. 55 cutting K L of the elevation, and upon any horizontal line as R S set off a stretchout of C W and draw the several measuring lines as shown. Horizontal lines from the several points on K L intersecting measuring lines of corresponding number will give the required development. This operation is exactly the same as that employed in obtaining the inner line of the pattern of fillet in Fig. 54, the reason for which is obvious, since both lines must be of the same length. Should this operation be conducted upon the drawing shown in Fig. 54, the points originally assumed upon the plan in that view could be used, in which case the spaces upon the line K L as obtained from the plan and given in the pattern of the fillet could be used in the development of the pattern. The line giving the true length of the inner edge of the pattern is obtained in exactly the same manner as shown at the right in Fig. 55.

In constructing the several right angled triangles, hypothenuses of which are to give the required measurements across the pattern, their altitudes have been obtained upon the measuring lines of the previous operation by projection from the elevation, as shown. Thus the bases of the triangles at the left are on lines projected from the points on the inner or shorter side of the elevation while their altitudes are determined by the projection of lines from points bearing the next higher number on the outer side of the elevation. The lengths of the bases are equal, respectively, to the lengths of the dotted lines crossing the plan, and the hypothenuses 1 2′, 2 3′, etc., shown dotted, are therefore the true distances across the pattern on lines corresponding to the dotted lines of the plan. The bases of the triangles at the right of the elevation, which are equal in length, respectively, to the solid lines crossing the plan are upon lines projected from points on the outer side of the elevation, while their altitudes are determined by lines from points of the same number on the inner side of the elevation, the hypothenuses 1 1′, 2 2′, etc., being the correct distances across the pattern on lines corresponding to the solid lines of the plan. The method of constructing the successive triangles forming the pattern from the hypothenuses of the several triangles in conjunction with the spaces in the developments of the two sides is clearly shown in the pattern; the figures bearing primes belonging to the outer side of the pattern, while those of the inner side are without. Being the same as that employed in the final operation of all problems in triangulation, the method requires no further explanation.

On account of the irregularity of the mold, due to its change of profile as explained above, the cutting of a blank by any method is at best but an approximation. If it is desired to employ the method of cutting blanks usually applied to circular molds, to the present or any similar case, the curve, which is elliptical, must first be approximated by an arc of a circle, or perhaps by a combination of arcs, according to its extent. The curve to which the mold in question must be raised is, of course, that obtained at the outer edge of the roof and shown by A^2 C^2 of Fig. 54. The center of an arc which will approximate this curve will be found by experiment to be somewhere on the line C^2 X^1 extended, which may be designated as Z, but is too far from X^1 to be shown in the diagram. To find the length of radius for a blank first place a profile of the mold in correct relation to the oblique projection, as shown at G^2, through which draw the line of flare as previously explained (as shown on profile Q), and extend the line of flare till it meets a line from Z drawn parallel to X^1 E^1. The distance from the point of intersection to the outer point of G^2 will be the length of the desired radius. The distance of point Z from B^1 in the diagram, Fig. 54, is 6⅜ inches, while the length of radius found, as explained, is 13 inches as measured on the diagram, or about 48 feet by the scale of the diagram.

In consideration of the constant change of profile in the mold at each successive point, it may be advisable to construct one or more stays to assist in bringing the blank to its proper form, especially if the mold were in a similar case extended further along toward F than that shown in Fig. 54. As a vertical section of the mold is more easily obtained than one at right angles to the lines of the elevation, and answers the purpose just as well, such a section may be developed as shown at P. Draw a line Y U across the plan at any desired point toward the center X. Divide the curved portions of profiles G and G^1 into corresponding spaces and carry lines from the several points in profile G^1, first horizontally to the center line, then from the center X around the curve, cutting the line Y U of the desired section. From the several points of intersection thus obtained erect lines to the elevation, which intersect with lines from points of corresponding number from profile G drawn parallel to A^1 C^1. Lines connecting the several points of intersection will give the elevation of the desired section or stay. From the several points of intersection so obtained carry lines horizontally, cutting any vertical line as *m n*. Upon each of the horizontal lines set off from *m n* the projection of corresponding points in profile O, as measured from the wall line. Lines traced through the points of intersection will give the desired vertical section of the mold. This operation is not shown in full on account of the smallness of the drawing, but will no doubt be understood.

In the solution of any similar problem it should be noted that the more nearly horizontal the moldings of the pediment are drawn the more nearly will their curve approximate the arc of a circle; and the change of profile being for the same reason less, the more regular in flare will their blanks become, and the more applicable will be the rules governing circular molds. On the contrary, the more nearly vertical the moldings of the pediment are placed the more nearly straight will they become and the less need will there be of applying any rule or method referring to curved molds, as a perfectly straight mold formed to the required profile (as G) in the regular way could easily be brought to the curve by proper hammering.

BLANK FOR A CURVED MOLDING IN AN ARCH IN A CIRCULAR WALL

The last problem in the "New Metal Worker Pattern Book," is introduced in that work as a final mention of the great variety of conditions which may exist in the construction of arches in curved walls. The demonstration is written in general terms showing how principles explained in previous problems may be applied. The diagram there given shows the moldings of a semicircular arch in a curved or cylindrical wall with a radius in plan probably three times that of the arch. The moldings, having a profile similar to that shown at A, Fig. 56, of the annexed diagrams, are carried around the opening of the arch in such a manner that the soffits, or those portions which are horizontal in that section, remain parallel to the center line of the plan throughout their course, as shown by a plan at the springing line. In the latter part of the second paragraph of the demonstration it is stated that the soffits above referred to might, with equal propriety, have been drawn radially toward the center of the curve of the wall in plan, and that in such case the profile would remain nearly normal at all parts of the arch.

Therefore to develop the patterns under the latter conditions or with lines drawn radially, proceed as follows to develop the pattern for the blank after its flare at the various parts of the arch has been determined. The flare of the blank, as the sides of the arch are approached, under these conditions will, of course, be much increased over that of a blank for a mold the soffit remaining parallel to the center line of the plan, as in the problem. A comparison of the profiles of the arch at the springing line drawn according to the two methods under consideration is shown at V of Fig. 56, the different flares of the blanks being shown by the oblique lines. Although, as above stated, the profile of the arch, according to requirements, would remain nearly normal throughout its course, yet certain changes must take place, and a sufficient number of profiles or stays will have to be raked, not only as a means of determining the flare and thereby the plan and elevation of the blank so that it may be triangulated, but also as a means of con-

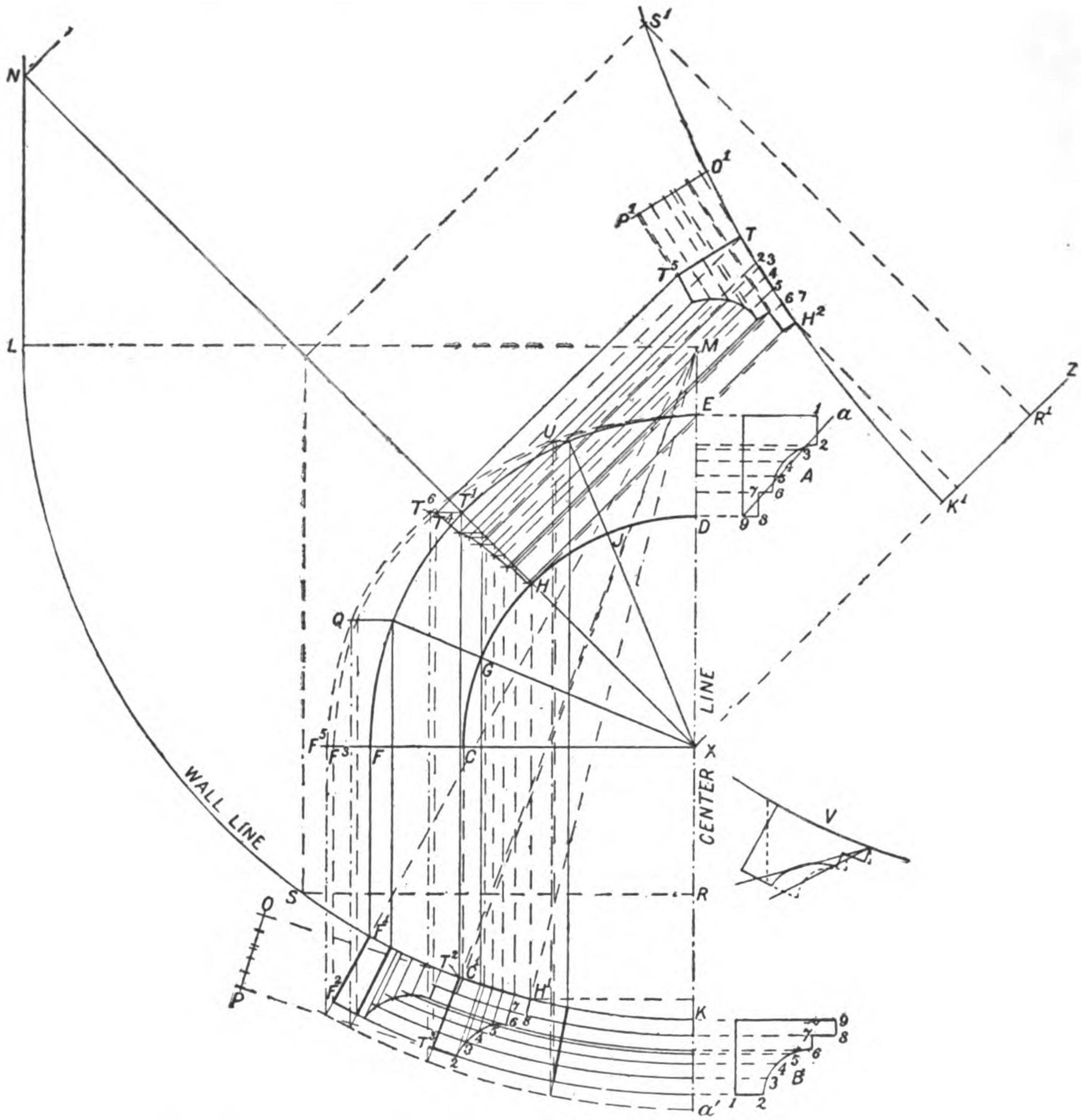


Fig. 56. Method of Developing Profiles for an Arch in a Curved Wall.

structing a templet for use in raising the mold, such as that shown in Fig. 744 of the "New Metal Worker Pattern Book."

It is evident, therefore, that the problem consists primarily in ascertaining the true profiles of the arch on a certain number of radial planes. In the illustration herewith given, it is assumed that the inner line or soffit of the arch, one-half of which, shown by C D, is a semicircle in the elevation, and that a section upon its center line is that shown at A. The plan of the wall against which the moldings of the arch are placed is shown below, the center from which the curves are struck being at M. First drop a perpendicular from the point C, cutting the inner line of the arch in plan at C^1. Divide the curved portion of the profile A into any convenient number of equal spaces and project lines from its several points and angles to the center line of the arch, as shown from D to E. Now set off the several spaces in D E upon the plan, beginning at C^1, as shown from C^1 to F^1, and erect the perpendicular from F^1, cutting the springing line of the arch at F. It will be noted that on account of the obliquity of the lines of the plan at this point the distance F C is less than E D. For the same reason the width of the arch mold, as measured on the surface of the wall in the elevation, upon lines radiating from the center X, must apparently decrease from the center toward the base as the obliquity of the wall increases. These widths can only be determined as the sections upon the several lines assumed are developed.

To develop the profile of the arch on the springing line, first place a duplicate of its profile A in such a position in the plan that the lines of projection shall be parallel to the center line, and that its wall line shall coincide with the wall line of the plan, all as shown by B. Divide the curved portion into the same number of equal spaces as at A, and from the several points and angles project lines upon the center line, as shown, and thence carry them around the center M indefinitely. Now from the center M draw radial lines through the several points between C^1 and F^1, cutting the arcs of corresponding number just drawn. A line traced through the points of intersection, as shown from F^2 to C^1, will give the desired profile.

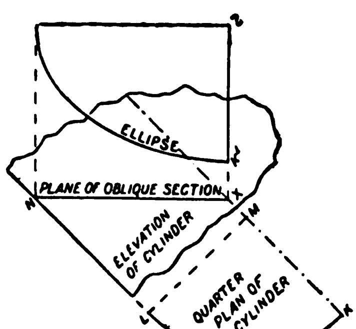


Fig. 57. Reduced Diagram, Showing Relation of Parts in Fig. 56

Divide the curve C D of the arch into any convenient number of spaces, as shown by the points G, H and J, through which draw lines from the center X indefinitely, these lines representing the planes upon which it is desired to construct sections of the curved wall, and against them profiles of the arch molding. The method of constructing the sections upon these lines is necessarily more complicated than that employed at the springing line, for the reason that the sections, being oblique to the axis of the cylindrical wall, are necessarily elliptical in outline. It is advisable to make these sections as few in number as will define the course of the mold, as after an elevation and plan of the blank have been obtained from them its outlines may be redivided for the purposes of triangulation.

Before obtaining the profile or stay of the arch corresponding to one of the oblique lines previously drawn, as X H, it will first be necessary to construct at least a partial section upon the plane which that line represents through the circular wall surface F F^1 of the plan, of which M is the center. As any oblique section of a cylinder is an ellipse, any convenient method of drawing a perfect ellipse may be employed after the major and minor axes of the same have been ascertained. In the present case K M is one-half the minor axis of all the oblique sections. To find one-half the major axis of either of the sections first complete the quarter plan of the cylinder by extending the arc of the wall line till it intersects a horizontal line from M, as shown at L. From L erect a perpendicular, forming the outline of the cylinder in elevation, then extend X H, the line of the desired section, till it cuts the outline of the cylinder, as shown at N. Then X N will be one-half the major axis which is to be used with K M in constructing the elliptical section against which a stay or profile of the arch at H must be developed. The relations existing between the plan, elevation and elliptical section of the cylinder are more clearly shown in Fig. 57, in which the reference letters correspond with those used in Fig. 56. As this operation possesses no features not generally understood this diagram will require no further explanation.

As the only portion of the ellipse required is that against which the back of the stay is to be placed, each portion may also, and perhaps more easily, be obtained in the following manner: First drop a perpendicular from the intersection H of the plane of the section with the soffit or intrados of the arch (the position of the extrados not having been yet determined) to the wall line in plan at H^1. A sufficient portion of this line from H^1 toward L, as to S, may now be divided into spaces, and lines drawn from each of the points so obtained at right angles to the center line K M, cutting the same between K and R. The several spaces thus obtained on the center line may be transferred to any convenient position on a line, X Z, drawn from X at right angles to X N, as shown from K^1 to R^1. From the several points assumed between H^1 and S on the circular wall line erect perpendiculars cutting H N, and finally from the points thus obtained on H N project lines parallel to X Z cutting corresponding lines drawn from K^1 R^1 parallel to X N. A line traced through the points of intersection between H^2 and S^1 will give the portion of the ellipse required. This operation is only partially shown in the drawing, and when the elliptical section has been obtained the lines employed in obtaining the same should be erased to avoid confusion with the points and lines of the subsequent operation of obtaining the stay.

Upon the line H^2 S^1 set off from H^2 the several spaces upon the line D E representing the width of the arch mold, beginning with D, as shown from H^2 to T. From the points in H^2 T carry lines, shown dotted in the diagram, at right angles to X N, cutting the same from H to T^1, and from the points on H T^1 drop perpendiculars cutting the wall line in plan, as shown from H^1 to T^2. Lines may now be drawn from the center M through the several points in H^1 T^2 to intersect with the arcs of corresponding number previously drawn in the plan, all as shown between H^1 and T^3, and as described in connection with the profile at F^2 C^1. Lines traced through the several points of intersection will give the true plan of the section or stay to be placed against the line X N of the elevation. It will now be necessary to obtain a correct presentation of the section in the elevation. Since by the original requirements all horizontal lines of the sections are to be drawn radially from M of the plan, it follows that each point of the profile will appear in elevation, not at the point on H T^1 which represents its position on the wall surface, but upon a line drawn horizontally from such point away from the center line. Therefore, from the points in H T^1 draw horizontal lines to the left (from the direction of the center line) and intersect them by vertical lines of corresponding number erected from the intersections previously obtained at H^1 T^3 in the plan. The vertical lines are omitted in the diagram, but the intersections are shown between H and T^1 of the elevation. Having now obtained with accuracy the position of the several points in the profile in plan and elevation, perhaps the most practicable method of obtaining the stay is as follows: Through the points H^1 and T^2 draw a straight line and extend the same to any convenient distance outside the plan, across which draw at right angles any line, as O P. From the several points of the section in plan carry lines parallel to H^1 O cutting P O. Now through points H^2 and T of the elliptical section draw a line, which continue to any convenient distance above or below, across which draw at right angles the line P^1 O^1. Upon P^1 O^1 set off from O^1 the several spaces previously obtained on P O, as shown, and from the points thus obtained draw lines indefinitely parallel to O^1 H^2, intersecting the same with lines of corresponding number drawn from H T^4 parallel to H H^2, shown solid in the figure. A line traced through the points of intersection, as shown by H^2 T^5, will give the required profile or stay.

It may be remarked that the profile just developed is not, strictly speaking, a section on the plane X N, because its horizontal lines are drawn, not in the plane of the elliptical section, but radially from the axis of the cylinder—that is, from a perpendicular erected upon M of the plan acting as a directrix of those lines, the other directrix being the elliptical curve H^2 T, shown in plan by H^1 T^2, and in elevation by H T^1. The surface of the stay is therefore really a twisted surface, being, as it were, radial to both curves. The twist is, however, too slight to be considered where practical results only are looked for. Of course, it is possible to construct a perfect section through the arch mold upon any one of the lines radiating from X, or in fact upon any plane that can be shown upon the drawings after an elevation has been completed. Such an operation, though complicated, would be both interesting and instructive. After the sections on the several lines radiating from X have been developed the lines of the elevation may be drawn from the points on E D corresponding to points 1, 2, 6, 7, 8 and 9 of profile A, through corresponding points of the several sections, one of which only (that representing point 1) is shown dotted in the diagram, passing through T^4 and terminating at F^3. A complete front elevation of the arch, showing all the lines of the moldings as they would appear when finished, is not, so far as obtaining the pattern is concerned, necessary, but a correct elevation and plan of the splayed surface representing the blank for the raised mold must, of course, be completed, and this may be accomplished as soon as the line representing the flare has been drawn and its extreme points located upon the several sections.

A suitable flare for the blank is shown by line drawn from *a* to point 9 of the normal profile A. Its length must, of course, be equal to the stretchout of as much of the mold as it is desired to raise in one piece, but so far as the demonstration is concerned may be assumed to be of the length drawn. The point *a* being on the line of the top of the profile extended, its projection may be set off on the center line of the plan, as shown at *a′*, from which point an arc is drawn parallel to the other lines of the plan, as shown dotted in the drawing, forming the outer line of the plan of the blank. To obtain the elevation of the line from *a* of the profile first extend the lines F^1 F^2, T^3 T^3, etc., corresponding to the top lines of the several stays, shown by heavy lines crossing the plan till they cut the dotted line drawn from *a′*, as shown. From these several intersections erect perpendiculars, shown by a dot and dash line, cutting the extended top line of corresponding stays in elevation, as shown at F^5, Q, T^6 and U. The elevation of the outer line of the blank may then be drawn through the points thus obtained, as also shown dotted and outside of the line corresponding to point 1 of profile A. Should the inner point in the profile of the blank fall at any point other than that shown, the position of its line in elevation may be found in a similar manner by first locating it upon the plans of the several sections in plan in accordance with its position on profile A.

The outlines of the blank having thus been obtained in the plan and elevation, a tracing or other accurate duplicate of the same should be made upon another sheet of paper, so that the subsequent operations of triangulation may be conducted as a separate operation and without confusion of lines. The several operations necessary to complete the work from this point are given in Problem 215, to which the reader is referred.

In the working out of any similar problem in actual practice the pattern cutter must use his own judgment in discriminating between that which is scientifically accurate and that which is practical and less laborious. Where the width and projection of the mold are considerable in proportion to the span of the arch correct stays should be developed, but in a comparatively narrow mold the result produced by the raking of the intermediate stays would vary so little from the normal profile that the latter could be easily adapted to the requirements.

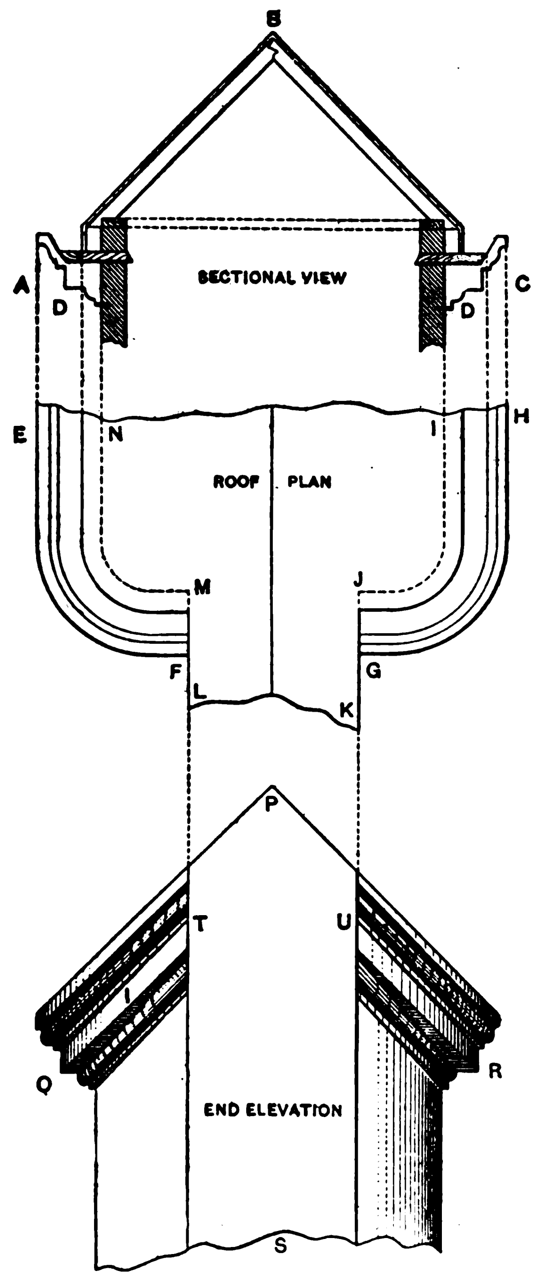


Fig. 58. Sectional View, Roof Plan and Elevation

A PROBLEM OF CIRCULAR MOLDING

The following is the method of obtaining a round molding running to a gable, as shown in the plan view and elevation in Fig. 58, in which A B C shows the sectional view of the hipped roof, D and D representing the profiles of the horizontal molding. Underneath the sectional view, in its proper position is shown the roof plan, in which E F G H shows the outline of the molding and I J K L M N the face line of the wall. The horizontal moldings E and H in plan view turn around the corner and then follow the lines of the pitched roof, butting against the brick walls J K and L M at G and F, as indicated in the end elevation at V T, while O P R gives the pitch of the molding. The problem is the same in principle as that of a horizontal hand rail turning up at an incline around the well hole. The most practical method of obtaining such a round corner is to construct a model, as shown in Fig. 59, in which the body indicates the wall line of the building, the pitch of the roof being also indicated. Profiles of the molding are now cut and soldered to the body, as shown, care being taken to place them in such a manner that the stays would all radiate from a common center. Where the pitched roof is shown on the model it will be noticed that the stays or profiles are soldered at right angles to the lines of the roof, each profile being placed in such a manner that the end profile on the horizontal line of the roof of model will stand vertically. When the model is completed the patterns for the various strips are obtained by using heavy paper. Hold it over the various members and trace a line on the paper from profile to profile until the full pattern is obtained. For the ogee and cove moldings the metal must be raised or stretched as required. If the corner was to be made of pressed zinc or copper the model as made would be filled between the profiles with modelers' clay, and the curved molding worked out in clay, after which a plaster of paris cast should be taken and the iron, lead or zinc dies made from same. That portion of the raking molding which butts against T and U in elevation in Fig. 58 is developed the same as the butt miter shown on page 97 in "The New Metal Worker Pattern Book."

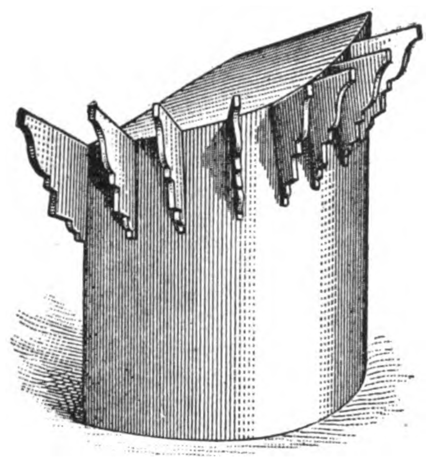


Fig. 59. General View of Model

PATTERNS FOR CIRCULAR PEDIMENT

Before proceeding with the following demonstration, attention is called to the fact that it is an eminently practical method of producing cornice work of this nature and was adopted by a cutter, who subsequently, made several by this mode of procedure. Although the problem could be solved by the principles of Problem 218 of "The New Metal Worker Pattern Book," it is to be remembered that the laying out of all curve moldings, and the like, is perforce, approximate. Hence, the method here given is entirely feasible and to be recommended. Of course the pattern is not strictly accurate and must be trimmed to the required stretchout of the curve, whether it be a cove or ogee. For example, take the cove J shown in

Fig. 61, obtain the blank as shown in Fig. 69, find the central line on the paper blank, and as the stretchouts of the coves at top and bottom vary then add one-half of the stretchout of the top profile on either side of the center line of the top of the paper blank, and do the same for the bottom. Then trace a curved line at top and bottom of the paper blank, as nearly parallel to the center line as possible. Then raise or stretch as required. On a large curve the blanks are cut about 24 inches long; this allows them to be easily hammered and handled.

For the patterns and blanks, therefore, proceed as follows: For a pediment shown in Fig. 60, in which A B C is an elevation and E D F the plan. The molding for the center panel is shown in section by M N, which is a section on A K in elevation. The fluted rosette in the center panel is shown by O L, and the center by H J.

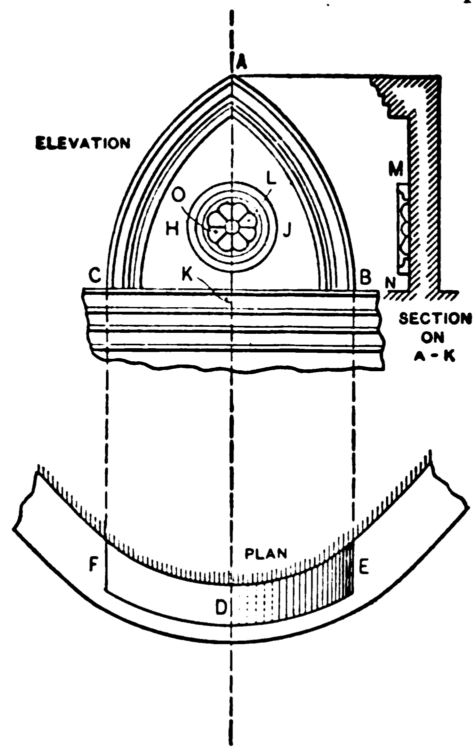


Fig. 60. A Sketch of the Pediment

The method which will be employed for obtaining the pattern for the circular pediment will be by parallel lines, and is the rule most common in cornice shops. This rule, however, is based on the assumption that the finished pediment will have parallel lines when viewed from the front and top only, as shown in the half elevation and plan in Fig. 61, while in plan the widths will vary from those at the top in elevation. For example, the distance 1′ 1″ in plan is wider than 5′ 5″; as is the distance 1′ 10′ in plan wider than *n o* in elevation, etc. If the lines of the molding were to be parallel throughout in face and sink strips the pattern would have to be developed by triangulation and sometimes where only one pediment is wanted the time and labor in obtaining the patterns would be more than the profits would allow; and as the difference between the two methods is hardly noticeable on a large radius, the patterns by the parallel line methods are presented. The same rule also applies to the circular panel in Fig. 60, in the center of the pediment, as this cannot be done on the hammering machine, unless the panels were of such size that they could be pressed in one piece. The pattern or blank for the molds will be obtained in a practical manner by strips of paper, as hereafter shown, while the pattern for the flute will be explained in connection with Fig. 70.

Referring to Fig. 61, let 1 5 6 10 11 15 H be the half elevation of the pediment, and A B C D E F G K the full section on the line P H. Underneath the half elevation in its proper position draw the outer curve 1′ 5′, which represents the plan view on 1 5 6 10 in elevation. Take the distance C D in section and place it in plan on the center line P H extended, as shown from 6′ to 6″; then, using the same center point from which the outer curve was struck, draw the arc 6″ 10″ until it intersects the vertical line dropped from the point 10 in elevation at right angles to L H. In similar manner, take the distance E F in section and place it on the center line in plan from 15′ to 15″; using the same center point,

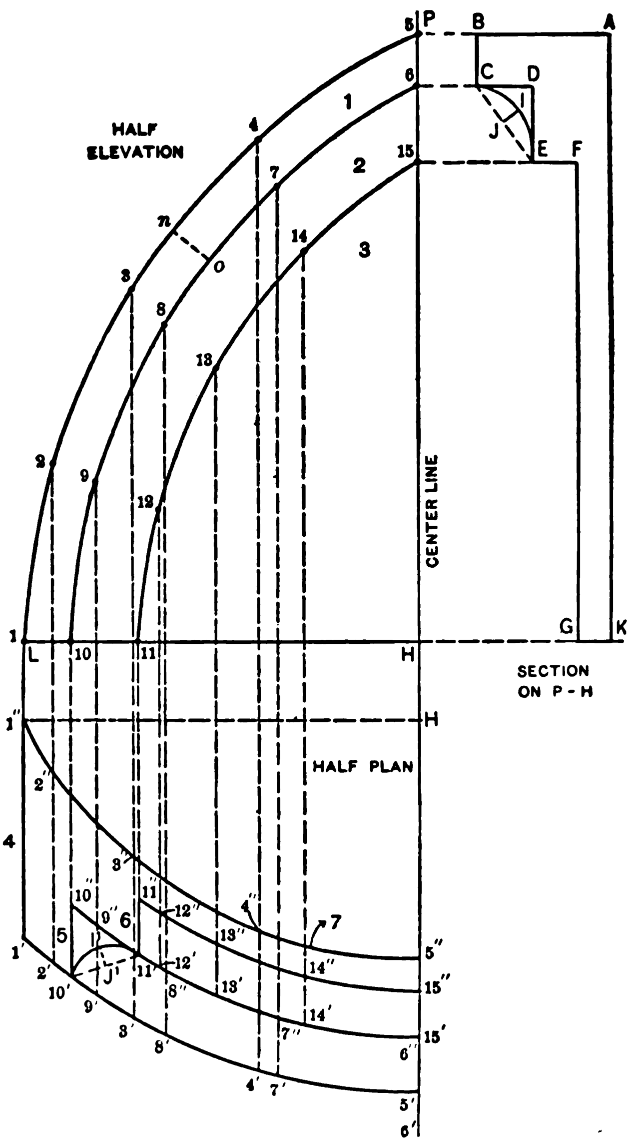


Fig. 61. Plan and Elevation, Showing Measuring Lines

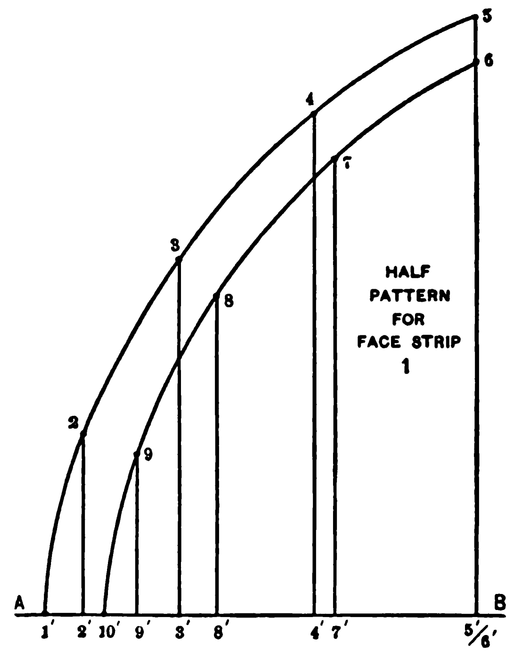


Fig. 62. Pattern for Face Strip No. 1

strike an arc 15″ 11″, intersecting the vertical line dropped from the point 11 in elevation at right angles to L H. Then, finally, take the distance B A in section and place it from 5′ to 5″ in plan, and using the same center point strike the arc 5″ 1″, intersecting the line drawn at right angles to L H in elevation from the point 1. Through the points thus obtained trace a heavy line; then will 1′ 10′ 10″ 11′ 11″ 15″ 5″ 1″ 1′ be the true section on the line L H in elevation.

As the cove C E in section is taken on the line P H, a proportionate section

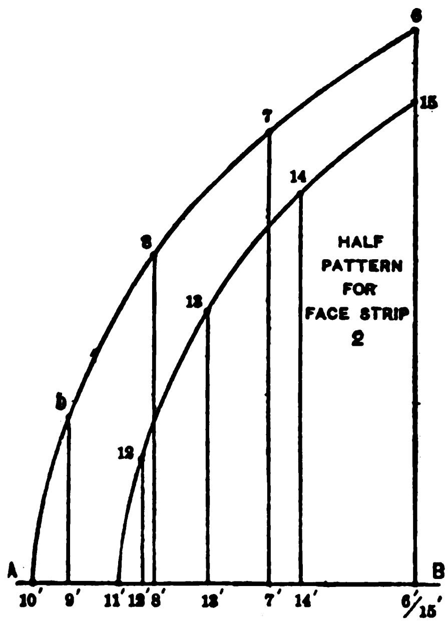


Fig. 63. Pattern for Face Strip No 2

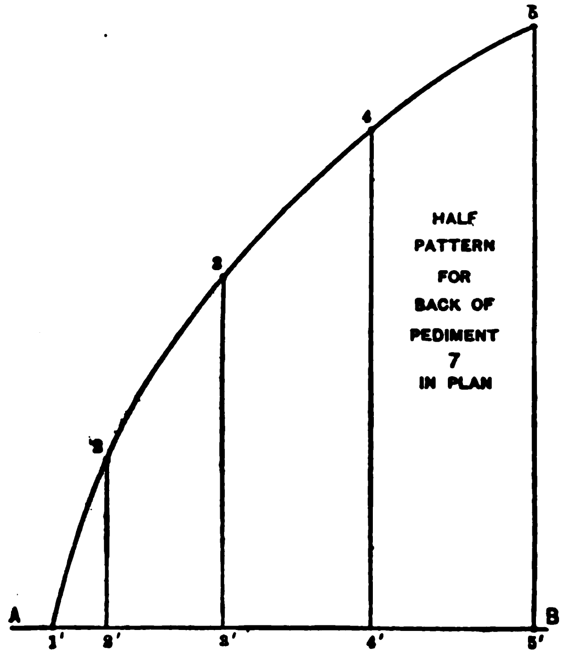


Fig. 65. Pattern for Back of Pediment

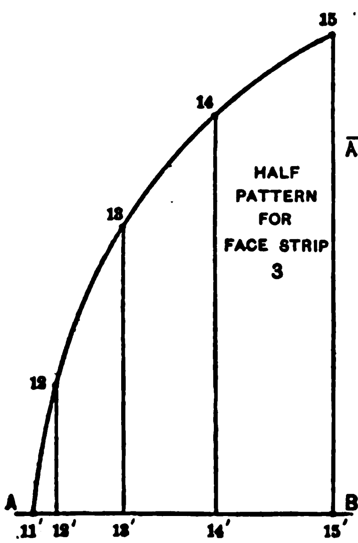


Fig. 64. Pattern for Face Strip No. 3

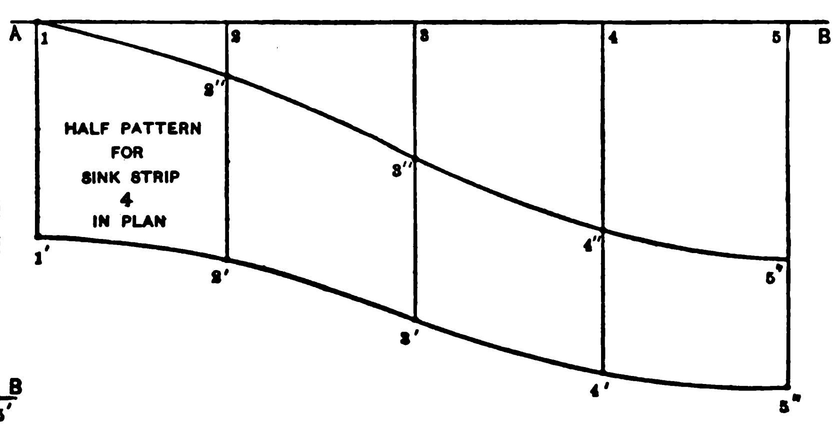


Fig. 66. Pattern for Sink Strip No. 4

must be obtained on the line 1 11 in elevation, as follows: Draw a line from C to E in section, which bisect and obtain the point J. At right angles to C E draw the line J I, intersecting the cove, as shown. In similar manner draw a line from 10′ to 11′ in plan, which bisect and obtain the point J^1. From J^1 at right angles to 10′ 11′ draw a line equal to J I in section, as shown by J^1 I^1 in plan. Now draw the curve 10′ I^1 11′ which will be a proportionate section on 10 11 in elevation. In this manner, no matter what shape the pediment has in elevation or what shape the mold is in section, the same principles are employed. To obtain the measuring lines, divide the various curves in elevation, 1 5, 6 10

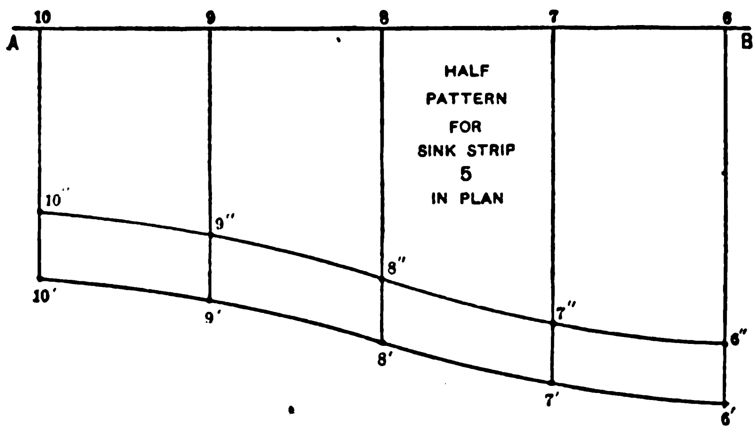


Fig. 67. Pattern for Sink Strip No. 5

and 11 15 into equal spaces, as shown by the small figures 1 to 15. At right angles to L H in elevation, and from points 1 to 5, drop vertical lines, as shown, cutting corresponding lines in plan, 1′ 5′ and 1″ 5″, as shown, by intersections 1′ 2′ 3′ 4′ 5′ and 1″ 2″ 3″ 4″ 5″, respectively. In similar manner, from points

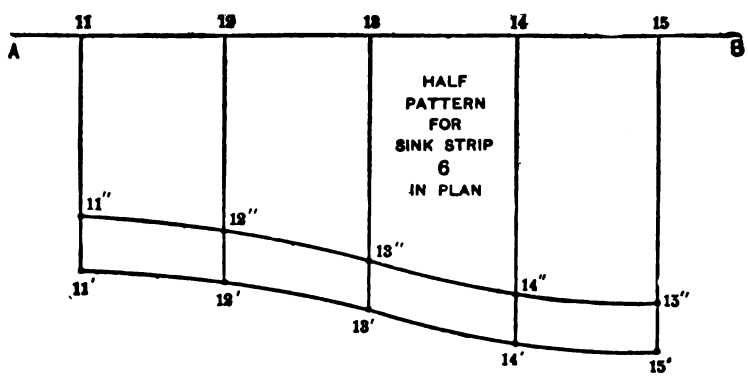


Fig. 68. Pattern for Sink Strip No. 6

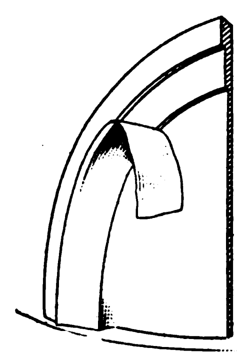


Fig. 69. View of Model, Showing Face Strip

6 to 10 in elevation, and at right angles to L H, drop vertical lines, as shown, intersecting corresponding lines in plan, 10′ 6′ and 6″ 10″, as shown by intersections 6′ 7′ 8′ 9′ 10′ and 6″ 7″ 8″ 9″ 10″, respectively. Then again, from intersections 11 to 15 and at right angles to L H in elevation, drop lines intersecting similar lines in plan, 11′ 15′ and 11″ 15″, as shown by intersections

11′ to 15′ and 11″ to 15″, respectively. This will give the necessary measuring lines both in plan and elevation. For the pattern for face strip 1 in elevation, draw any horizontal line, as A B, in Fig. 62, upon which place the stretchout of all the points contained in the curved line 1′ 5′ in plan in Fig. 61, as shown by similar numbered intersections on A B in Fig. 62. At right angles to A B and from intersections on same line draw vertical lines, as shown. Now, measuring in each and every instance from the line L H in elevation in Fig. 62, take the various hights to points 2 3 4 5 6 7 8 9 and 10 and place these hights on lines of similar numbers in Fig. 62, measuring in each and every instance from the line A B, as shown by intersections 2 3 4 5 6 7 8 and 9. Trace a line through points thus obtained, then will 1′ 5 6 10′ be the pattern for face strip 1.

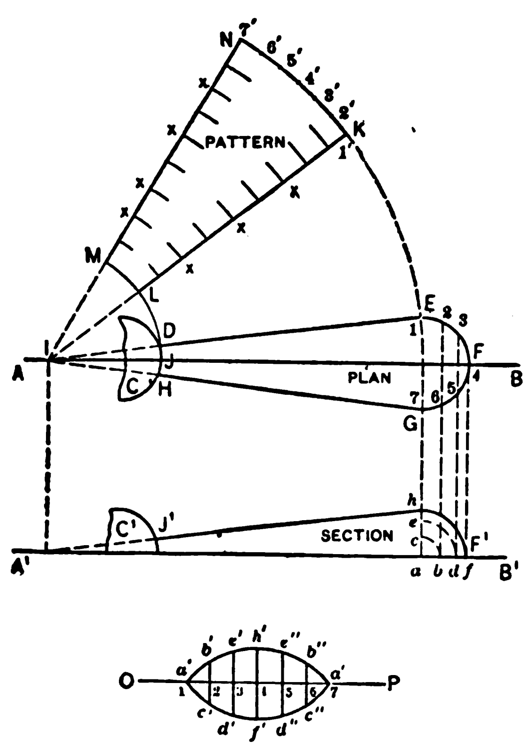


Fig. 70. Patterns for Flute of Rosette

For the pattern for face strip 2, draw any horizontal line, as A B, in Fig. 63, upon which place the stretchout of all the points contained in the curved line 10″ 6″ in plan in Fig. 61, as shown by similar numbered points on A B in Fig. 63. At right angles to A B and from intersections on same draw lines as shown. Now, measuring in every instance from the line L H in elevation in Fig. 61, take the various hights to points 6 7 8 9 10 11 12 13 14 and 15, and place these hights on lines of similar numbers in Fig. 63, measuring in each instance from the line A B, as shown by intersections of similar numbers. Trace a line, then will 6 10′ 11′ 15 be the pattern for face strip 2.

For the pattern for face strip 3 in elevation in Fig. 61, take the stretchout of all points on the curve 11″ 15″ in plan and place it, as shown by similar points 11′ 15′, on the line A B in Fig. 64; erect vertical lines, as shown, and obtain hight from similar points in elevation in Fig. 61. Trace a line in Fig. 64, then will 11′ 15 15′ be the pattern for face 3.

For the back of the pediment, or part 7 in plan in Fig. 61, take the stretchout of the curve 1″ 5″ in plan and place it as shown by points 1′ 5′ on the line A B in Fig. 65. Erect vertical lines, as shown, and obtain hights from points of similar numbers in elevation in Fig. 61. Trace a line through intersections obtained in Fig. 65, then will 1′ 5 5′ be the pattern for part 7 in plan in Fig. 61.

This completes all of the face strips required. For the sink strips shown by 4 5 and 6 in plan proceed as follows: For the roof of the pediment take the stretchout of 1 2 3 4 and 5 in elevation, Fig. 61, and place it as shown by 1 2 3 4 and 5 on the horizontal line A B in Fig. 66, at right angles to which and from the small figures drop lines, as shown. Now, measuring in each and every instance from the line 1″ H^1 in plan in Fig. 61, take the distances to the various points 1″ 2″ 3″ 4″ and 5″ on the curve 1″ 5″, and to points 1′ 2′ 3′ 4′ and 5′ on the curve 1′ 5′ and place them on lines having similar numbers in Fig. 66, measuring in each instance from the line A B, as shown by points 1 2″ 3″ 4″ 5″ and 1′ 2′ 3′ 4′ 5′, respectively. Trace a line through points thus obtained, then will 1 1′ 5′ 5″ be the half pattern for sink strip 4 in plan.

In the same manner draw the horizontal line A B in Fig. 67, upon which place the stretchout of 6 7 8 9 10 in elevation in Fig. 61, as shown by similar numbers. At right angles to A B and through the small figures draw lines, as shown, upon which place the distances (measuring from the line A B) of the various points 6′ 7′ 8′ 9′ 10′ and 6″ 7″ 8″ 9″ 10″ in the half plan in Fig. 61, measuring in each instance from the line 1″ H^1, as shown by similar numbered points in Fig. 67. Trace a line, as shown by 10′ 10″ 6″ 6′, which will be the half pattern for sink strip 5 in plan. Now take the stretchout of 11 12 13 14 and 15 in the elevation in Fig. 61, and place it as shown by points having similar numbers on the line A B in Fig. 68. At right angles to A B and through the small figures draw lines, as shown, upon which place the various distances (measuring from the line A B) obtained in plan in Fig. 61, measuring from the line 1″ H^1 to points 11′ 12′ 13′ 14′ 15′ and 11″ 12″ 13″ 14″ 15″, as shown by similar numbers in Fig. 68. Trace a line through points, as shown by 11′ 11″ 15″ 15′, which will be the pattern for sink strip 6 in plan in Fig. 61. This completes all of the face and sink strips required for the circular pediment.

When forming or rolling the face strips previous to soldering they must be rolled parallel to the vertical lines in patterns, to correspond to the respective curves in plan. In similar manner, when rolling the sink strips they must be rolled parallel to the vertical lines in patterns, to their respective curves in elevation. For the blank for the curved molding proceed as is shown in Fig. 69, in which A is the perspective view of a small model, and B B shows how the pattern for the blank is obtained, by taking a strip of heavy paper and placing it over the angle C, which is to receive the mold. Rub the fingers along the corners, which will leave an impression on the paper, which is then cut out, allowing on either side for the stretchout of the cove C E in section in Fig. 61 after which it is raised to conform to the molds C E and 10′ 11′ in plan. This same rule is applicable for any other shaped mold. Where the pediment is very large the blanks are usually cut up to 30 inches long, being the width of the iron in stock.

For the flutes O or L in the center of the panel in Fig. 60, if a large rosette can be used from stamped zinc, it can easily be bent to the required curve. Where the panel is very large the flutes can be made separately, as shown in Fig. 70, in which A B is the center line and C the center ball. Draw the plan view of the flute, as shown by D E F G H.

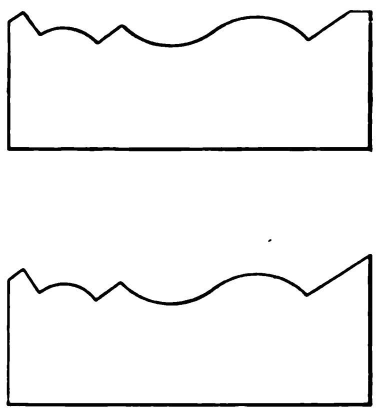
Directly below the plan draw the section. A^1 B^1 is the base line, C^1 the center ball, and J^1 F^1 the section of the flute. Extend the lines E D and G H in plan until they intersect at I. Now with I as center, and radii equal to I D and I E, draw the arcs D M and E N. From any point, as K, on the arc N E, draw the line K I, intersecting the arc D M at L. Divide the half circle in plan, as shown by the small figures 1 to 7, and then take these spaces and, commencing at the point K in pattern, step off six spaces, as shown from 1′ to 7′. From 7′ draw a line to I, intersecting the arc D M at M. Then will K L M N be the pattern for the flute. Where the flutes must be curved in section notches are placed in the pattern, as shown by *x x x*, etc., and then slightly raised with the raising hammer.

For the pattern for the quarter ball at the end of the flute, take the stretchout 1 to 7 in plan and place it on the line O P, as shown from 1 to 7. At right angles to O P and through the small figures draw lines, as shown. Now from points 1 to 4 in plan drop lines, intersecting the line A^1 B^1 in section at *a b d f*. With *a* as center, and radii equal to *a b*, *d*, *f*, draw the quarter circles *b c*, *d e* and *f h*. Take the stretchout of *b c*, and place one-half on either side of the line O P at both ends, as shown by *b′ c′* and b″ c″. In the same manner, take the stretchout of *d e* and *f h* in sections and place it on either side of the line O P, as shown by *d′ e′* and *d″ e″* and *f′ h′*. Trace a line, as shown, which will be the pattern for the one-quarter ball, which must be raised. In this manner the large flutes are obtained.

MAKING CURVED MOLDINGS

It is interesting to note the gradual change which has taken place in the way of manufacturing circular cornices. While some few of the larger firms have been making curved moldings by machine for many years, it has only been in recent years that the machine known as the Kicker or Hammering machine has come into common use. It has been said by pretty reliable authority that the first machine used by pioneers at this business was constructed of a sausage machine, which was altered to suit this work. Since that time manufacturers of sheet metal machinery have put machines in the market which have many improvements and can be used to make anything in the line of curved moldings, curved bracket faces, curved hip rolls, curved gutter, curved skylights, etc.

It must be admitted that a machine of this type run by electricity and controlled by a keyboard is the most practicable, but it is possible to turn out fine



Figs. 71 and 72. The Contour of Dies

Fig. 73. Forge for Melting Casting Zinc

work where power is not available and the operator has to use foot power. The same principles are involved in both operations.

Circular moldings are often stamped on a drop press, as well as made on circular machine rollers, but the hammering machine is generally given the preference on account of the cost of dies for the above mentioned machines. It is not the intention of the writer to give the impression that circular work can be turned out cheaper on a hammering machine at all times. For this is not the case where many circular bay windows, circular dormers, etc., are to be made alike, as the work could probably be turned out at less cost on a drop press.

These hammering machines include several sets of cast iron dies, which may be all a person would need for ordinary work, but those who have to execute designs for prominent architects who will not allow you to alter their detail drawings to suit your dies, will soon find the necessity of casting special dies, which is generally done of zinc unless there is a great deal of duplicating to be done; in that case cast iron dies are preferable. Cast iron molds for the purpose of casting zinc can be had which cast the top and bottom die at one time. One style leaves three openings in each die, so as to use less zinc; but it requires very little more zinc to cast a solid die, and thereby one does not run the same risk of breaking them in removing them from the mold or later in the machine. Some operators use wood dies stripped with galvanized iron altogether for the two principal dies, as well as the side dies. However, this practice is not to be recommended, at least for dies with two or more members, because the finishing blows which bring the mold up to the proper sweep and give the true outline to the profile must naturally be very hard, especially when working up a cornice with a small radius.

In taking a profile of an ogee or other member for which dies are to be cast, use a strip of heavy black iron to form the division between the two dies, as shown in Fig. 74. The idea of using black iron is so that the zinc will not adhere to the division strip, which it invariably does if the division strip is made of tin or galvanized iron. One must be careful, too, not to use even clean black iron. It is essential to have, if possible, the side which comes nearest the gauge of the hammering machine to end with a short, flat surface as illustrated in Fig. 71. This will enable the operator to hold the blank firmly against the gauge during the raising operation, thus insuring accurate work, while a blank used on a die similar to Fig. 72 will be turned up almost immediately after starting and become irregular.

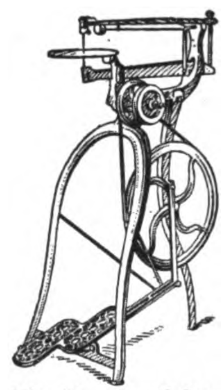


Fig. 75. Scroll Saw

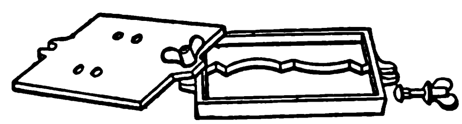


Fig. 74. Molds for the Dies

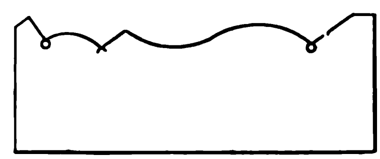


Fig. 76. Profile of Wooden Die

When heating the zinc, to which a little lead has been added for casting, a forge like the one in Fig. 73 will be found satisfactory, using an iron pot about a foot wide and 6 in. deep mounted on two bricks to keep it from resting directly on the bottom over the blower. This will allow some coal to burn beneath it and heat the pot on the under side. Charcoal will be found very economical for this purpose if we extinguish the fire immediately after casting. The ladle used for pouring the hot metal should be large enough to fill the mold without redipping it into the pot. The zinc can be cleaned by using rosin. This should be done if scrap zinc is melted. If a mold like the one in Fig. 74 is used it should be set level with a drip pan beneath it, and have two holes over the space for each die, one into which to pour the hot metal, and the other for the air to escape; otherwise the zinc will blow out and the die become imperfect. It is well to heat the mold to prevent chilling the metal before it has had time to adapt itself throughout. This also applies to the two cast iron funnels, one of which is set directly over each die. If the side dies are to be of zinc the top die is left in the mold until two more bottom dies have been cast. In connection with the casting of dies, it might be well to mention that it is often possible to have as many as three or four of the different small profiles cast in one die, as one can be be used without injury to the rest.

In some instances the side dies can be of hardwood stripped with galvanized iron. Where there is a great deal of this work to be done, a scroll saw like the one in Fig. 75 will be found very handy. The board to be used should be the same thickness as that of the dies, generally about $\frac{5}{8}$ in. The bottom die is placed on the board so the grain of the wood runs with the length of the die, and marked off. It will be found that the dies will not split so easily as when the grain of the wood runs with the short side. The inner bends of a wooden die are apt to be rounded and will need to be made sharp with a rasp after sawing, owing to the difficulty of bringing the saw around at that point. Some operators make a complete turn in the corner, as shown in Fig. 76, on this sort of work, and then plug the openings left by the operation. The advantage of the regular scroll saw over the hand saw lies in the ability of the operator to make a straight cut through the board without any effort on his part, as the saw blade is adjusted at right angles to the level plane on which the board rests. The metal strip which is put on for protection is formed over the profile of wooden die and extended down back and front, where it is nailed.

Where the profile of a stock die is very much like the one shown on full size detail of a cornice it can generally be used without detection, and also where stock dies are used which are not identically the same as shown on the detail on a circular cornice which is mitered with a straight cornice of the same profile. It is necessary to alter detail immediately before straight work is got out, because the difference in hight of the various profiles will be very noticeable at the intersection of the curved and straight moldings.

Having cast the necessary dies or selected such stock dies available as the case may be, the next step would be to obtain the radius by which it is intended to strike the blank for the machine. The method for striking these blanks is too generally known to be considered here, but where the radius is too long to be obtained by the usual method on the drafting table, as is frequently the case, the following method will be found sufficiently accurate for most work. It will be supposed that a cornice shown in the illustration, Fig. 77, is a full size detail of a circular cornice, such as would be used on a bay window with a radius of 6 feet, and it is desired to obtain the radius of blanks for the large ogee and other members which is proposed to be made on the machine. The center line is drawn 1 ft. 6 in. back of the wall line, or, in other words, the center line is drawn back of the wall line 6 ft. to a scale of 3 in. to 1 foot. The line which is drawn through the ogee

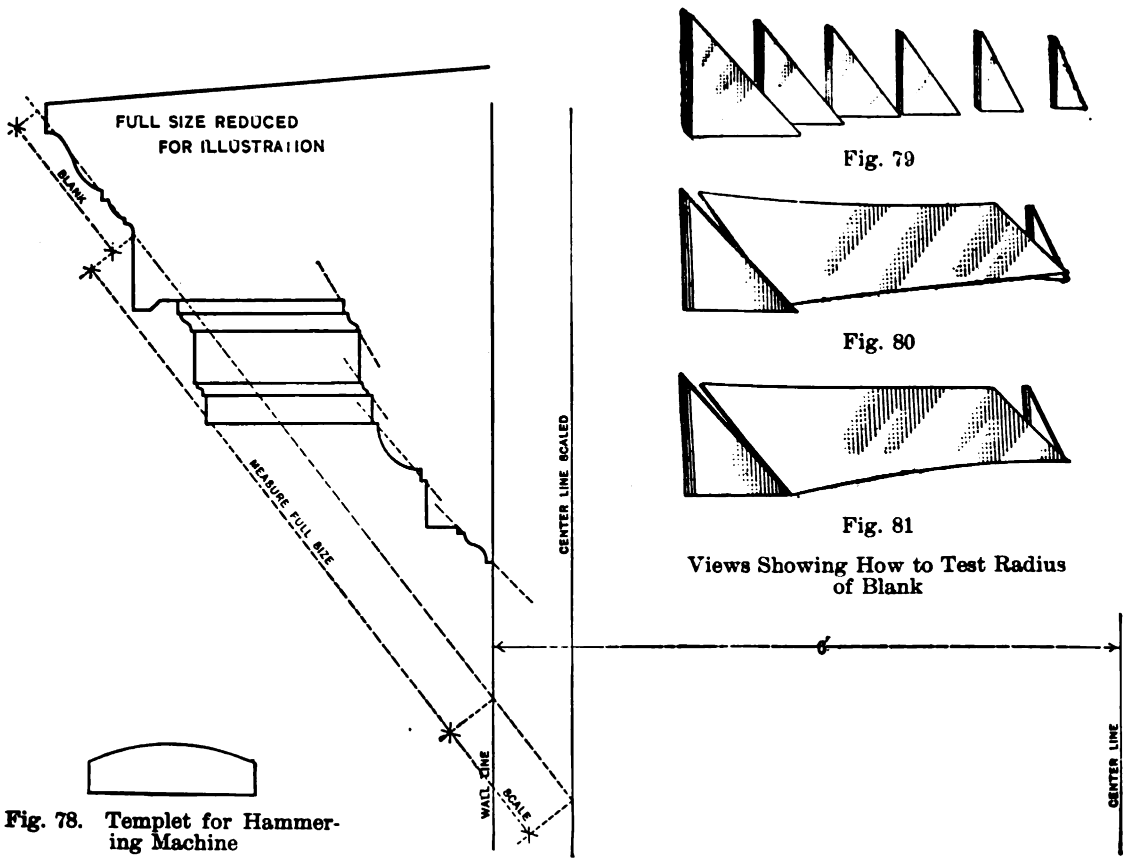


Fig. 79

Fig. 80

Fig. 81

Views Showing How to Test Radius of Blank

Fig. 78. Templet for Hammering Machine

Fig. 77. Detail of Circular Cornice on 6-Ft. Radius

and other members to intersect the center line will now be measured with the 3-in. scale between the wall and the center line, and by adding the distance between ogee and wall line full size to the first measure the radius is obtained with which blank for ogee is to be struck.

Many of the shops where hammering machines are in use have a set of radii templates, as illustrated in Fig. 78, ranging from 4 ft. to 20 ft. or more, including probably every 3 in., such as 4 ft., 4 ft. 3 in., 4 ft. 6 in., etc., and when they reach

10 ft. only every 6 in., as 10 ft., 10 ft. 6 in., 11 ft. These templates are great time savers and take up very little room. If the radius of the ogee is 8 ft. 5 in., for example, use the 8 ft. 6 in. template on both sides of the blank to avoid cutting two lines in duplicating, as it is not absolutely necessary to have the inner curve correct, because it has to be trimmed before it is ready for soldering. The blank is passed through the machine to test the radius before any duplicating is done, the machine having been adjusted to receive the blank by setting the three bottom dies on a level and approximately radial to the center of a 6-ft. radius template, when held at right angles to members which set perpendicular on cornice, the bay window cornice having a radius of 6 ft.

The gauges are now set so that the blank projects over the die as much on one side as on the other, with one gauge slightly projecting over the other to take up the shrinkage. And as the work progresses the gauges are shifted forward until the profile is made. Then the center bottom die is gradually lowered until desired sweep is obtained. The operator can tell immediately from experience whether the radius he has used in cutting his blank is too great or too small by holding it against the stays after it has been brought up to the profile and proper sweep. If found high in the center the radius used is too small, and if found high at the ends and low in the center the radius used is too great.

In order to make this clearer take, for example, a 45-degree flare, such as a frustum of a cone, the radius for which is 3 ft. When held in place against stays this blank would fit right in place, coming on a level with top and bottom of them, as in Fig. 80. To see the effect of a blank struck from a 4-ft. radius it is found when holding it in place it stands up at the ends, Fig. 81. A circular molding being merely a molded flare would naturally act likewise. If the operator uses good judgment the test piece will generally fit the stays, and should he find it too great or too small the radius should be increased or decreased, as the case may be, to make it perfectly true.

In working up a set of blanks through the machine it might be well to pass all of them through at one time before altering the gauges. It is arbitrary whether inside stays with the cornice inverted on the bench or outside stays with the molding as it is shown are used in building the cornice. Some operators are of the opinion that the seams can be sighted better where the inside stays are used. However, if the cornice is copper or galvanized iron that must be exceptionally neat, it is the opinion of the writer that outside stays are preferable, for in that case all the soldering is done on the inside of the cornice, leaving the front free from acid stains and surplus solder.

When a cornice is about 3 ft. or more in hight it is often made in two parts, unless the entire profile stays are nailed right to the floor, where the mechanic can reach every part to solder. All straight members should be prepared in the brake with the greatest of accuracy, and soldering edges should be arranged so as to come horizontal when it is most convenient to solder. And such members as A in Fig. 84 can be made in the brake and stretched around with the stretching hammer, while one like B, Fig. 84, which often occurs at the drip of a cornice, could be turned on the burring machine. These points should always be carefully looked into, as the cost of soldering running seams on circular work is a big item.

It will be necessary to trim away the surplus metal from the blanks which have been passed through the hammering machine. Frequently the operator has to cut off a member right in a sharp corner, as shown. It is difficult to accomplish this

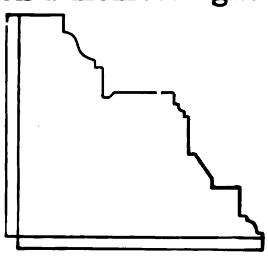


Fig. 82. Outside Stay

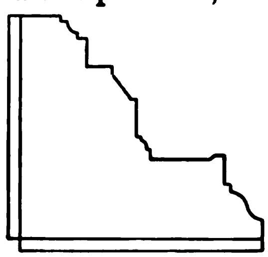


Fig. 83. Inside Stay

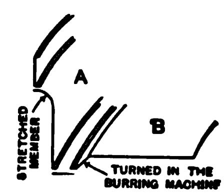


Fig. 84. Dividing Work According to Operations

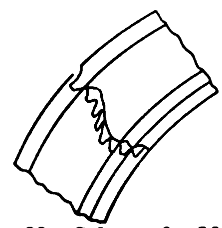


Fig. 86. Scheme for Making Good Appearing Laps

with the ordinary hand shears, and an excellent machine for this purpose is shown in Fig. 85.

In order that the seams of the curved members may appear perfectly smooth, the operator should notch the laps and bend them as shown in Fig. 86. This countersunk effect can be produced by hammering at the lap line while a dolly is held against it on the other side. But it will be found much easier to prepare laps as shown, because the two pieces can be held perfectly flush when soldering and the seam will be almost invisible from the distance. Before soldering the mechanic should see that all flat strips which have been cut fit in their respective places.

Sometimes small strips need to be brought back to place, due to the stretching of the iron while cutting. Having fitted all members to the stays, the mechanic proceeds to tack them together. This should be done with the greatest care. The part on which the start is made can be tacked to the stays to hold it in place while the apprentice or helper is holding a flat piece of heavy iron against the edge, thereby bringing the part to be soldered together all along. If this is not done the strips will sag between the stays and the work becomes very irregular.

The operator of a hammering machine has a great variety of work to get out, and he should experiment a great deal to gain experience as to the best method to employ. Trouble is often experienced with the ends of blanks passed through becoming too quick. This is due to the fact that as the end approaches the die makes deeper indentations on the blank than at the middle, because there is less resistance at that point. This defect can be easily remedied by bringing the lower dies on a level again and bearing down on molded blanks as they are being passed through. This operation will also take out dents and make the work perfectly smooth. To avoid the trouble at the ends in making such moldings as occur on bull's-eye windows, etc., the operator can solder the blanks together and pass them through the machine in one piece, and then, should the diameter be a little too large or too small, the work can be adjusted by opening one of the seams. The writer has passed work of this description, in the form of a clock face of 7 ft. diameter, through the machine with success, and no doubt it is possible to make work of a larger diameter. This method dispenses with the use of stays; all that is necessary is the circle which the work is to fit. The blank piece takes a very irregular form at first on account of the double thickness at the seams; therefore the operator should progress very slowly and have two assistants to hold the work at the same angle as it is being passed through the machine.

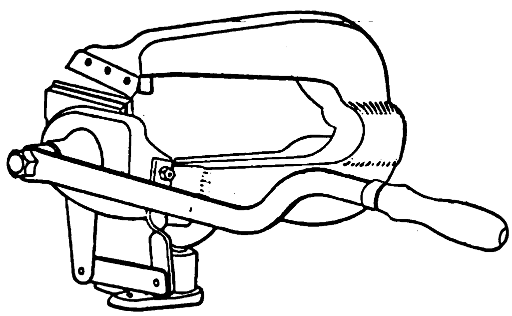


Fig. 85. Type of Scroll Shear

Among the different types of cornices which require a little more skill to turn out than the regular circular bay window cornice might be mentioned the swelled bay, such as shown in Fig. 87. Before getting out a cornice of this description, it is very essential to test the radius of the brickwork and see if it is in keeping with the plan. Because the mason in laying off his template will sometimes consider the possibility of using certain stock brick which approach the radius shown, but are not altogether the same. And in that case if the cornice were made according to the drawing, it would not fit in place.

There are many ways to test the brickwork, but the surest way is to cut a small template about 3 or 4 ft. long of sheet iron, and should there be any difference it would be an easy matter to fit it at the building. If it is possible to cut the straight part and the small curve in one piece, it would probably be better in order to avoid making a seam at that point. One seam is generally left open in the shop for convenience in handling, although the cornice is sometimes made in one piece where there is no scaffold to work from when setting it. Another thing to be considered is that the curve on the bay is struck from different centers, and these centers must be first located before the radius of the various blanks to be passed through the machine can be determined. To set the stays on which this cornice is put together, it is necessary to have the entire plan of the bay window unlike the regular bays which are struck from one center.

Having placed the stays and cut the pattern for the first section, starting with a straight piece and the curve in one, proceed to pass it through the machine with

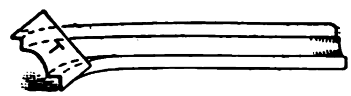


Fig. 88

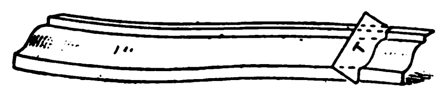


Fig. 89

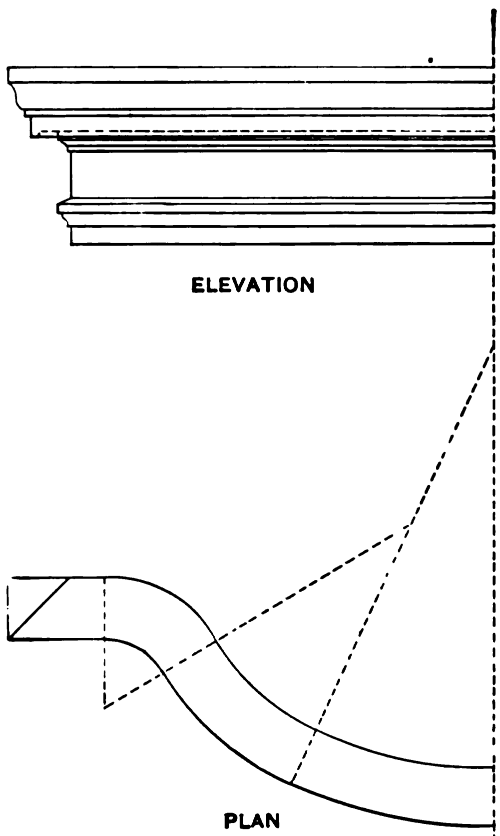


Fig. 87

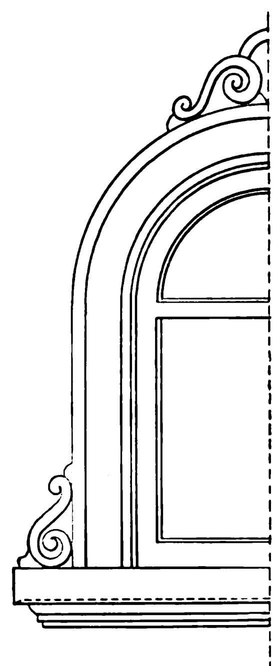


Fig. 90

Various Details of a Swell Bay and Dormer

all the bottom dies on a level until the profile is correct, and then the center die is lowered, and that part of the molded blank which shows round in plan is brought up to the proper sweep. When the radius of the blank is very small, it sometimes becomes necessary to fasten a piece of sheet metal on that part of the lower die which requires the most stretching. This can be accomplished by using a strip wider than the die and letting it extend down to where the die is clamped in place.

This strip must be removed again when the finishing blows are struck to smooth the work.

In Fig. 88 is shown a molding passed through the machine which is curved in plan beginning with a straight piece like the starting piece of a swelled bay. This molding has been placed on the bench in an inverted position in order to facilitate illustration. It will be seen that in making the different curved moldings the top die will often have to be used on the bottom, and the side nearest the gauge on the side away from the gauge. In order to show which position the dies were in when the molds in the illustration were made, the top and bottom die have been sketched in place.

In Fig. 89 is shown a compound curved molding in plan. This piece could also be used as a starting piece of a swelled bay if a seam were made at the straight piece. It will be found more difficult to turn out a piece like Fig. 89 than the one

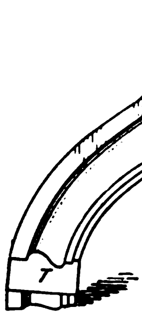


Fig. 91

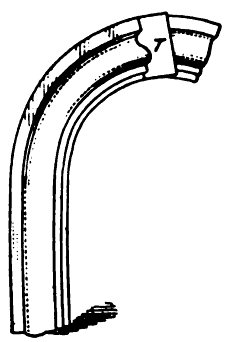


Fig. 92

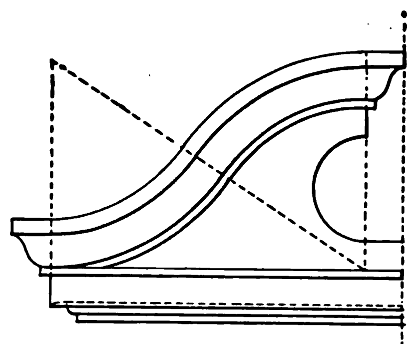


Fig. 93

Curves in Elevation and Broken Pediment

shown in Fig. 88, because the dies which have been set for one curve will have to be changed for the other. Yet if either position was used for dies shown on Fig. 89 to pass the entire mold through to get the profile and bring up that part for which the dies are correct and change to the other for the rest, it can be accomplished with a little practice. The operator must be careful not to pass the point where the other curve starts. The curve shown in Fig. 88 also occurs in elevation in many instances as the circular top dormer in Fig. 90.

In Fig. 91 is shown a molding passed through the machine which is curved in elevation, beginning with a straight piece like one-half of the molding on the circular dormer or starting piece of broken pediment. The dies were set, as shown, to turn out this piece, and the operation is practically the same as in making the mold shown in Fig. 88. It is also possible to make the compound curve in elevation in one piece as in Fig. 92, though this will be found a little more difficult than the mold shown in Fig. 91, the operation being similar to Fig. 92, but dies are set different, as shown. Moldings which are curved in plan as well as in elevation, such as the patterns are developed for in Problem 218 in "The New Metal Worker Pattern Book" are worked up very much like Fig. 88. In fact, after the operator has put the profile in a blank for Fig. 88 and is ready to bring it up to the proper sweep, he will find the blank curved both in plan and elevation. Therefore, the principal thing in bringing up a piece curved in elevation and plan with any degree of accuracy is to develop the pattern correctly.

Besides the big variety of curved moldings which can be turned out on the hammering machine, it is possible to make many different kinds of bracket or console faces. These curved pieces are made from straight blanks, the width of which are the same as the stretchout of the section of the bracket face. The die is cast half the width of the face. Operators sometimes use straight pieces as blanks for moldings, which ordinarily would be struck from a center. This can only be done when the molding has very little projection, and then two of the molds must be cast on one side, as shown, and after they have been brought up to the proper sweep they must be cut with the band saw or slitting shears. The advantage in making molds by this method lies in the operator being able to make the molding any sweep, and that they can be made the full length of the sheet.

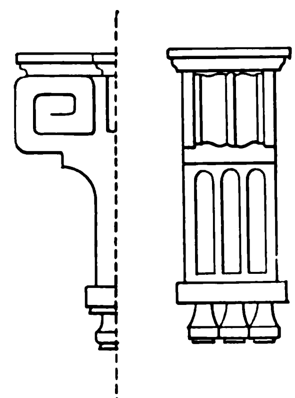


Fig. 94. Console or Bracket

In Fig. 95 is shown a bracket such as is used at the base of a bay window. This bracket with the exception of the bit of stamping on the sides was turned out on the hammering machine. It was made of soft copper, which became hard from the many blows of the machine. The first step, as in the previous methods of making brackets, is to cast a top and bottom die taking in the entire profile of the face of the bracket with two extra dies for side dies. And while the zinc is hot a top and bottom die should be cast corresponding to the profile of the molded member which follows the curve of the face from the large volute to the small one. This molded member has a slight swell in the middle of the bracket tapering to each end; therefore, the profile must be taken at the widest point.

No side dies are necessary in this case, as the piece is held level during the operation of raising. Having cut a piece of soft copper a little wider than the stretchout of the profile of the face, and as long as the distance between the two volutes with dies set to raise side toward large volute, proceed to pass it through the machine. This curve is brought up to the proper sweep, leaving the part toward the small volute straight. The top die is now put on the bottom and the bottom one on the top, and with side dies to correspond with bottom die, the straight part is brought to the proper curve. The part of the face which turns around the small volute was made in two pieces, because the radius is so small that the piece will turn up and strike the plunger. That part of the bracket is often spun, but if the work when turned out on a hammering machine is finished with rapid blows struck while it is being slowly passed through the machine it will come out perfectly smooth. The center die is lowered far below the other during this operation.

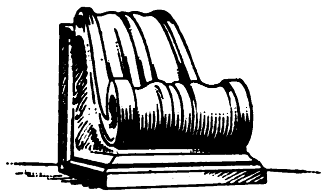


Fig. 95. Bracket Turned Out on Hammering Machine

Blanks are now cut for the molded member on the side of the bracket extending from the large volute to the small one. The curved blank is taken right from the drawing and the width increased to the stretchout of the profile at the widest point. The blanks are then passed through the machine until the profile is properly brought out, when the deepest member, which is shown tapering on the drawing, is slit from each end with the shears and squeezed together. It is then soldered with a countersunk seam. In trimming away the surplus metal from each side of this molded member they are also tapered, as shown on the drawing. The volutes are cut and soldered in the usual way, it being impractical to stamp them without some modifications.

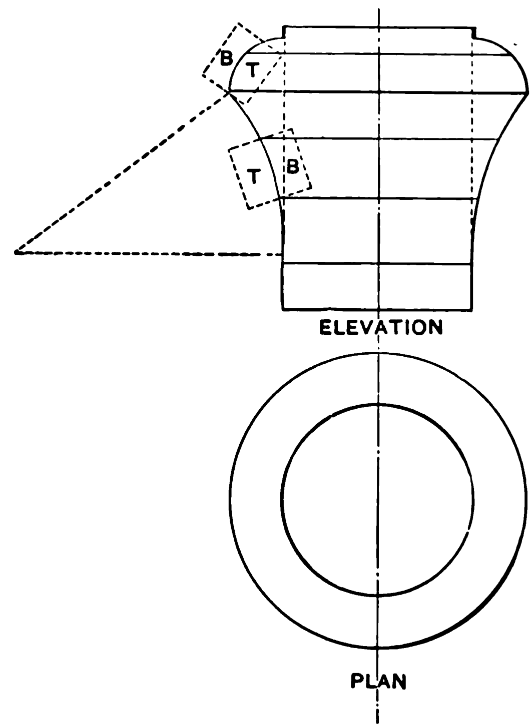


Fig. 96. Application of Work to Smokestack Cap

Where the saving of time and tedious hand raising and stretching is most noticeable is on such work as a top cap of a large smokestack, where it is shown perfectly round in plan and the work has to be made in zones. Those which are made in gore patterns riveted together forming a polygon in plan are seldom raised or stretched, as the silhouette is the same as that of a chimney top made in raised and stretched zones.

It is necessary to cast two dies to make a smokestack cap like the one shown in Fig. 96. One for the raised zones and one for the stretched zones. If heavy iron be used the operator should cast the die at least ¾ in. thick, as the heavy blows which are required on such work are likely to break the ordinary dies. On some machines the part which receives the dies is made to accommodate dies of different widths, and where this is not the case an interchangeable part is generally furnished with the machine which will receive the wide dies. The dies are sketched in the position they were in during the operation. The cap is made in two halves, as well as the iron band at top and bottom to which the work is riveted. These bands are then bolted to the top section of the stack, which is set with the aid of a derrick.

Occasionally, the sheet metal worker has to furnish balls of sheet metal, which are too large to be spun on a lathe. In that case he could make them on the hammering machine, either in zones or gore patterns, by casting one top and bottom die, using the same stays for putting them together as when raising them by hand.

PATTERNS FOR CIRCULAR MOLDINGS—PREPARING THE ROLLS AND DIES

The following is to explain a short rule for obtaining the radius for striking the pattern for any circular molding, no matter what size diameter the circle for the circular molding may have. The formula will also be given and applied for obtaining the pattern without using the radius, or having any recourse to a center, when developing the flaring strip. This rule will be found useful when developing patterns for flaring articles, when the radius is of such length as to make it impractical to use.

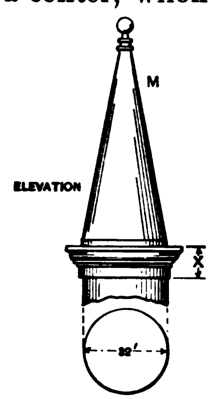


Fig. 97
A Circular Tower

To show how the rule is used in practice, let M in Fig. 97 represent a circular tower, around the eave of which a circular molding indicated by X is to be placed, the diameter of the tower being 32 ft. in this case. Let A, Fig. 98, represent the full size drawing of the mold X, and B C the wall line. Using the usual method, the line D E would be drawn parallel to and at a distance of 16 ft. from B C (being one-half of the 32 ft. shown in the plan) and the radius with which to strike the pattern would be obtained by averaging a line *d b* through the mold A and extending it until it met the center line D E, when the full size radius would be obtained.

This same radius can be obtained with less labor and less space by means of a scale drawing as follows: As the diameter of the tower is 32 ft., take one-half, or 16, and scale this to any desired scale, in this case ⅛ in. to the foot. Having the full size drawing A in its proper position against the wall line C B, draw the line D E parallel to and at a distance of 2 in. from B C, which will represent 16 ft. by the ⅛-in. scale. Average a line through the mold A as shown by *a b*, and extend it until it intersects the center line D E at F. Then as all that part to the right of the line B C is drawn to ⅛-in. scale, and that part to the left of B C is full size, then scale the length from F to H ⅛ in. to the foot, while all that part outside of H shows its true length. Then F H will scale 24 ft. 9 in., and was obtained in an actual distance of 2 in. [The scale used originally was ¼ in. to the foot, making the distance between B C and D E 4 in., and more convenient and accurate than the ⅛-in. scale necessitated by the space limitations of the printed page.]

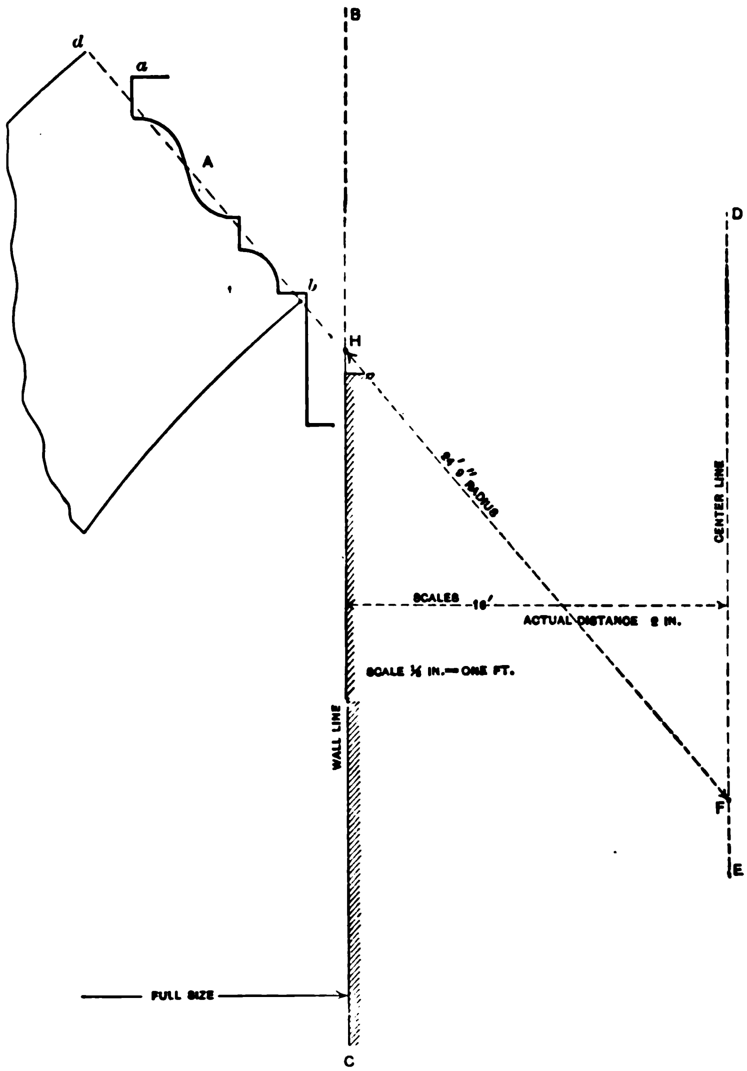


Fig. 98. Obtaining Radius by Means of a Scale Drawing

Now starting from *b* in the mold A, obtain the girth from *b* to *a* and place it as shown from *b* to *d*. It will be assumed that the distance from H to *b* measures 3 in. and the girth from *b* to *d* 1 ft. 3 in. Then the radius from F to *d* would be 24 ft. 9 in. + 3 in. + 1 ft. 3 in. = 26 ft. 3 in., which would be impractical to use, and therefore a rule must be employed for obtaining the pattern without having recourse to the center of so long a radius.

This is accomplished by using the formula shown in Fig. 99 in which R represents the radius and W the width of the metal sheet from which the pattern is to be cut. Now if the hight of H can be found it will be a simple matter to construct a fixed triangle and draw the segment *a b c*. The following simple formula will give the hight of H, no matter what the radius or width of iron is used. $H = W^2 \div 8\ R$. This formula saves the labor of extracting the square root and is accurate enough for all practical purposes.

In Fig. 100 is shown the practical application of the formula. The radius in this case is 26 ft. 3 in., and the length of the sheet from which the pattern is to be

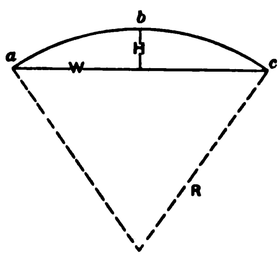


Fig. 99. Explaining the Formula

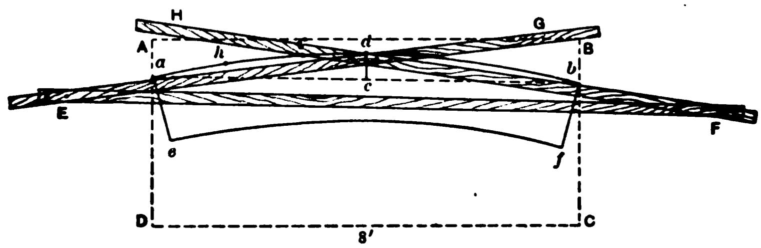


Fig. 100. Practical Application of Formula

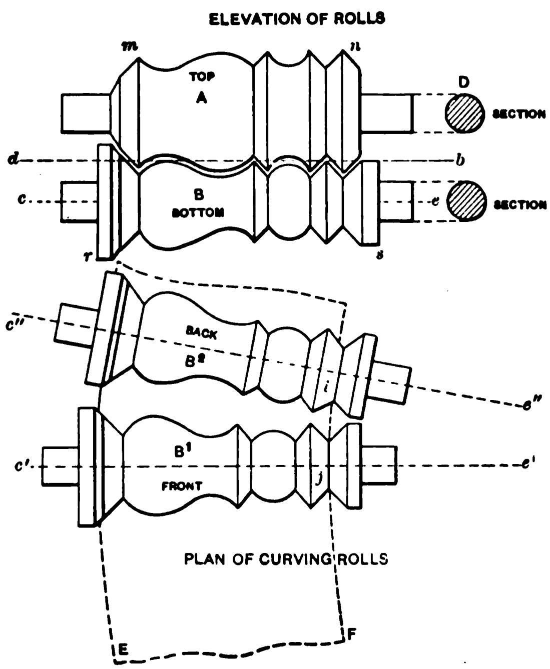


Fig. 101. Preparing Rolls for Molding Machine

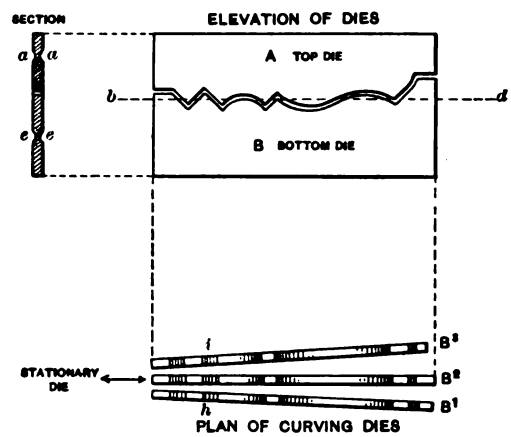


Fig. 102. Preparing Dies for Hammer Machine

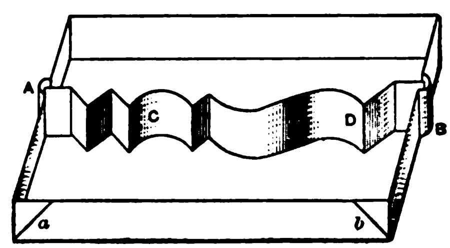


Fig. 103. A Shop-Made Mold

cut is 8 ft. Using the above rule and reducing all terms to inches gives $H = 96^2 \div (8 \times 315) = 9216 \div 2520 = 3\frac{2}{3}$ in., the hight of *c d* in Fig. 100. Now using a 96-in. sheet as shown by A B C D, drive a nail at *a* and *b*. Draw a line from *a* to *b*, bisect it and obtain *c*. Erect the vertical line *c d*, equal in hight to $3\frac{2}{3}$ in. Then make a triangle shown by E F G H from metal or wood strips and stiffen it by the cross brace E F, constructing it so that the vertex comes at *d*, and the strips E G and F H touch the nails at *a* and *b*. Moving the triangle, and always keeping the sides touching the nails at *a* and *b*, the arc may be traced by a pencil held at *d* and as shown by *a d b*.

The width of the flare *d b* in Fig. 98 being 1 ft. 3 in., draw a line parallel to the arc *a d b* in Fig. 100 and 15 in. distant, as shown by *e f*. From *a* and *b* radial lines can be drawn approximately by dividing the arc *a d* into three or more parts, and drawing *a e* at right angles to the first two points as *a h* on either side. Then *a b f e* represents the flaring strip cut from an 8-ft. sheet, a number being required to complete the circle, making allowance for laps and trimming of the ends. The approximate amount is determined by multiplying the diameter 32×3.1416 and dividing the length of the arc *e f* into the product.

There are two styles of circular molding machines in use. The one in which the circular molding is formed by means of rolls and the other by means of dies using vertical blows. The method of preparing the rolls is shown in Fig. 101. Take a tracing of the profile A in Fig. 98 with the line *d b* drawn through it, and place it so that the line *d b* will be in a horizontal position, as shown by *d b* in A, in Fig. 101. At right angles to *d b* and from the corners of the various members draw lines as shown and reverse the tracing as shown by *m n* for the top and *r s* for the bottom, the width of the rolls being regulated by the diameter of the shaft section D.

For forming a circular molding for the tower in question there would be required one top roll and two bottom rolls. When a large amount of molding is required, the rolls are made from cast iron or zinc, but when only a small quantity of molding is required, they can be turned by the wood turner from hard wood having a tough close grain such as maple.

In passing the blank or pattern through the rolls a guide is used passing through the rolls A and B in elevation, setting the back roll in plan in such a position that when a center line, c' e', through the front roll B^1 will be intersected by the center line c'' e'', through the back roll B^2 at a distance equal to the radius of the pattern or 25 ft. measuring from *i* and *j*, which correspond to *b* in Fig. 98. When the rolls are closed the blank will have the required profile but not the required pitch; the proper pitch is obtained by raising the back roll B^2 in Fig. 101 at c'' until the proper curve is obtained. The back roll B^2 is worked upon the same principle as the back roll in a stove pipe former, which is raised at one end if any flaring articles are to be rolled on it.

The second method of preparing the dies for the hammer or kicking machine is shown in Fig. 102. This machine is up to date and the cost of preparing the dies amounts to but a few cents. A tracing of the mold A in Fig. 98 with the averaged line *d b* drawn through it is placed in the position shown by *d b* in Fig. 102. Lines are drawn at right angles to *b d* and the top and bottom dies A and B are drawn to the desired hight, as shown. The width of the dies should be about ½ in. wide, as shown in section. A groove is shown at *a a* and *e e* into which the clamp catches in, holding the dies, although this is not necessary in the different make of machines.

In making a circular mold of the job in question, three bottom dies and one top die would be required. The bottom dies would be set as shown in the plan, in which the center die B^2 is stationary and the outside dies B^1 and B^3 set so that a line drawn through the center of the outside dies would meet at a distance of 25 ft., the radius of the pattern, when measured from *h* and *i*, which points correspond to the point *b* in Fig. 98. When passing the blank through these dies, in Fig. 102, the pitch or rise of the mold is obtained by raising very slightly the ends of the dies B^1 and B^3. The higher these ends are raised the smaller the circle.

When only a small quantity of molding is required the dies are cut from hard wood, using a scroll saw and cutting along the profile between A and B in elevation, using ½-in. stuff. If, however, a larger quantity of molding is to be formed, the dies can be cast from zinc or a cheap grade of babbit metal using a shop made mold, as shown in Fig. 103. This consists of a pan ½ in. deep with folded corners, *a* and *b*, having a small groove worked into the sides at A and B. Construct the pan from No. 14 black iron to keep it from warping, and cut a ½-in. strip of No. 18 black sheet metal to keep the dies from adhering to each other. Form on the brake the profile desired, as shown by C D and slip the ends of this into the slots A and B. Then melt either zinc or babbit metal and cast, securing the male and female dies. A blow with the mallet will loosen them.

UTILIZING A POWER PUNCHING MACHINE AS A KICKER

This is a description of how the lower jaw of a power punching and shearing machine was specially constructed by having that portion of the lower jaw directly under the plunger made detachable, so it could be temporarily removed, and replaced by special tools and devices. Among other things it was used as a substitute for a kicking machine or drop press in stamping circular moldings.

Fig. 104 shows the specially designed adjustable table attached to the front of the machine. On this the lower dies were supported, the upper dies being carried by holders attached to the plunger *a*. Fig. 105 is a front view of the table; Fig. 106 a side view; Fig. 107 a plan looking upward; and Fig. 108 a vertical section on line *a a* of Figs. 104, 106, and 107. Fig. 109 is a view of strap *b*, which was made of 1½-in. square steel. This strap was secured to the machine by bolts *c* and removable pins c^1 and c^2, Fig. 104.

The table was made of cast iron, planed on the top surface and in the guide-ways working against *b*. It was raised and lowered by means of the 3 in. diameter stud screw *d*. The style of punching machine used had a plunger *a*

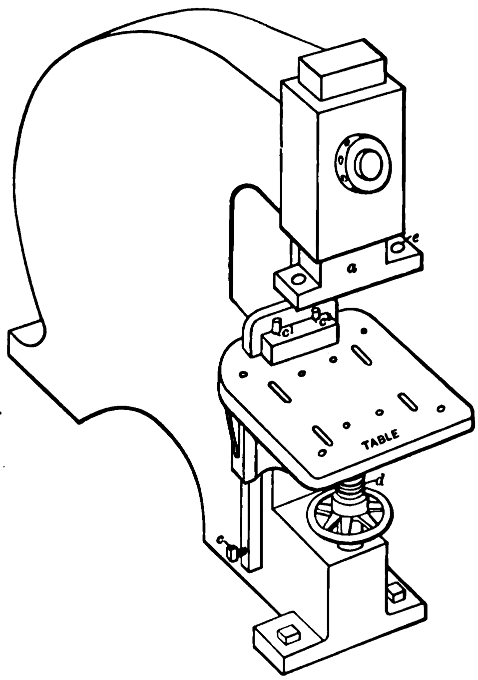


Fig. 104

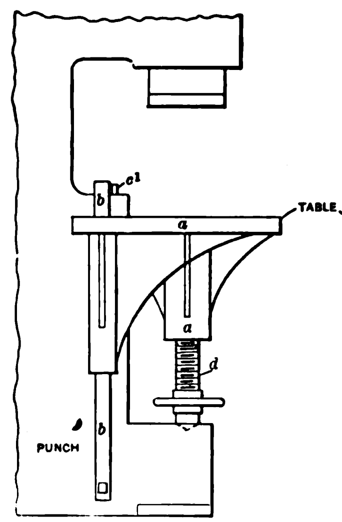


Fig. 106

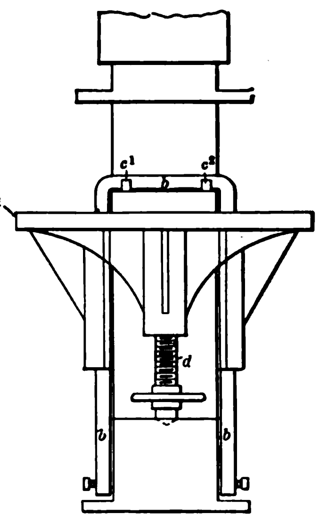


Fig. 105

The Machine and Details

made with a broad bearing surface to which the die holders were attached and secured by bolts through holes *e*, Fig. 104.

Two different types of dies were used, namely, segmental dies, which are cast to the radius of the moldings to be stamped, and kicker dies consisting of four slabs of zinc about ⅝ in. thick, with one edge cast to the profile of the moldings.

The fittings for holding the bottom segmental die on the table are shown in Figs. 110 and 111, and the top die holder against the plunger looks like Fig. 112. When both are placed in the machine with the dies in position they look like Fig. 113. The bolts *a* and a^1, Fig. 112, are cast into the top die. The top die holder is nothing more than a flat plate of cast iron about 1 in. thick, drilled for bolts *a* so that these bolts secure both die and holder to the plunger. In segmental dies no adjustment is necessary to strike moldings of different radii except that afforded by the stud *d*, the dies being made to the radius of the molding.

But when kicker dies are used, provision must be made for the vertical as well as radial adjustment of the guide dies in order to stamp moldings of different radii.

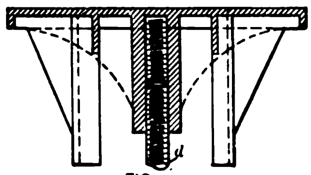


FIG. 108

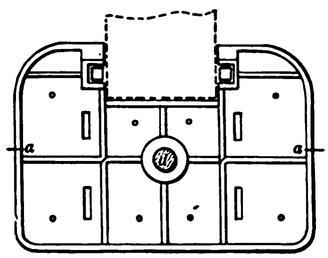


Fig. 107

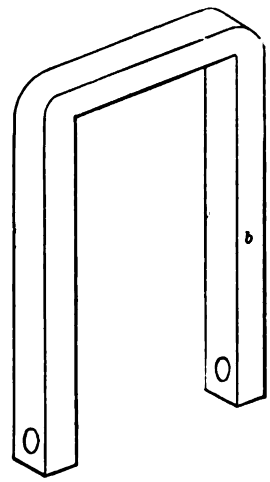


Fig. 109

Other Details of Machine

The holding arrangement for the bottom kicker dies *g* and *h* is shown in Fig. 114, and that for the top kicker die *f* in Fig. 115. Fig. 116 is a front view showing all the kicker dies in place in the machine. It will be seen that dies *g* and *h* are secured by ordinary angles bolted to the table. Die *h* is of course stationary, but dies *g* can be tilted and adjusted to different positions to suit varying radii of

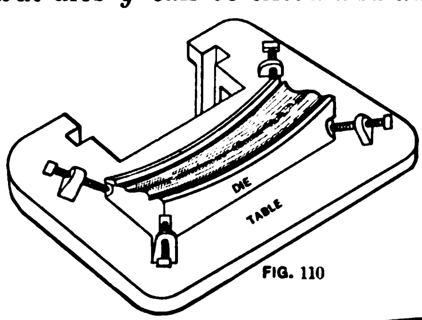


FIG. 110

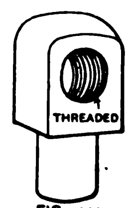


FIG. 111

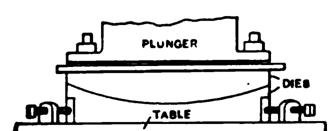


FIG. 113

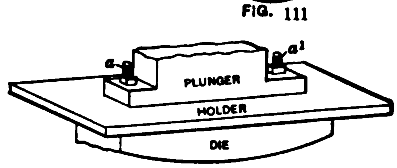


FIG. 112

Segmental Dies and Details

moldings. The tilting was accomplished by bolts *i*, which are threaded through the angle and rest on top of the table; the angles which hold dies *g* being secured to the table by bolts J. The slots in the angle through which these bolts pass allow of lateral adjustment of dies *g*, slots in the table allow of longitudinal adjustment, and the vertical adjustment is accomplished by means of vertical slots in the angles to which they were bolted. As the pressure on dies *g* was comparatively light, bolts K could be tightened sufficient to firmly hold the dies.

Fig. 117 is a section on *a a* of Fig. 115, and shows more clearly the position and method of securing top die *f*. Plate *i* is ¼ in. thick, by 1½ in. wide with length equal to that of the die. When marking die *f* for drilling the holes through which it is bolted to the flange of the holder, die *h*, was bolted in position

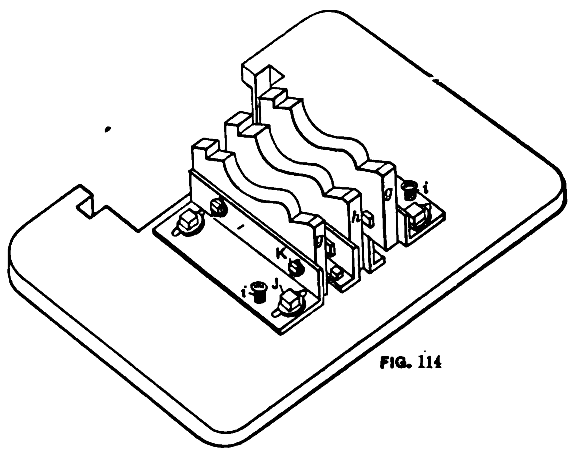


FIG. 114

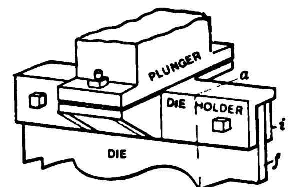


FIG. 115

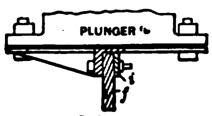


FIG. 117

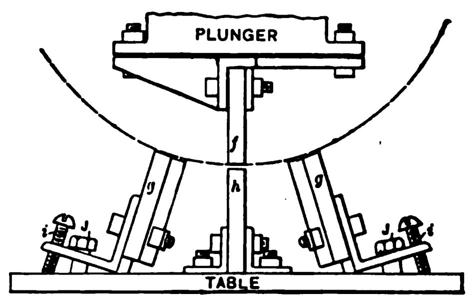


FIG. 116

Kicker Dies and Details

and die *f* placed on top of it and the plunger let down to place, when the holes were marked. Thus dies *f* and *h* were firmly secured so as to match perfectly.

The casting of the table was made quite thin, say about ⅜ in. in thickness, as indicated in Fig. 108, it being amply stiffened by the ribs. While there are drawbacks to the use of a machine of this character, namely, the comparatively slow and limited stroke of the plunger, it is superior to hammering up such circular work by hand and entailing the large amount of additional work in putting together incident thereto, and for concerns who have such a punch and who do not care to invest in a circular molding machine, the scheme is a very good make-shift.

The average stroke of a medium size machine of the character referred to is about $1\frac{1}{2}$ in., so that in stamping up circular work with either type of dies mentioned, it was necessary to let the adjustable table down low enough to allow of passing the work through and getting it only partially stamped to shape, and then the table was raised by means of the screw stud *d* and the work passed through again, bringing it down pretty near the shape, and lastly the table was raised high enough to bring the dies together, when the work was passed through and finished.

Even in a kicking machine or drop press it is necessary to pass the work through several times when the moldings to be stamped are of any considerable depth or the radius is acute, but when the moldings are shallow and the radius is great, moldings can be stamped in a drop press using dies of the first mentioned type by a single operation, it being necessary only to run over the work lightly the second time. This is of course impossible when the dies are used in the punching machine on account of the limited stroke, as when the top die is at the highest point permitted by the stroke it is not far enough above the bottom die to admit of inserting the blank material which is to be stamped, hence the necessity for lowering the table and passing the material through for partial shaping before it was possible to bring it down to the finished shape.

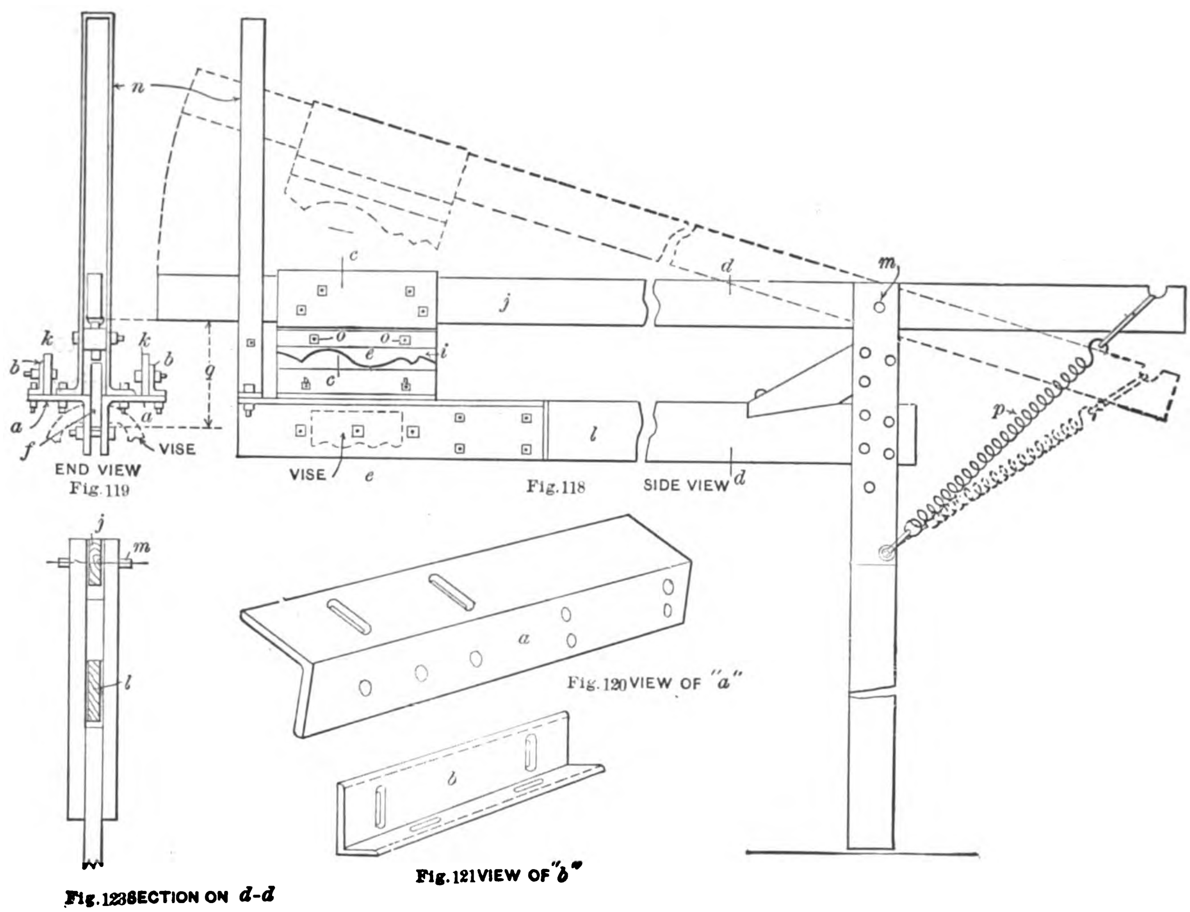
Although the stroke was slow and limited the difference in time in turning out the small moldings as compared with the drop press work was very little when dies of the type shown in Fig. 113 were used. Dies of the character shown in Figs. 110, 112 and 113 were first made in plaster of paris and afterward cast of zinc or iron in sand. Hence considerable skill and expense were required to turn out perfect dies.

A HOME MADE CIRCULAR MOLDING MACHINE

In small shops that do not have enough circular molded work to justify the installation of any of the standard circular molding machines, a simple and inexpensive device can be constructed for the purpose and used in an ordinary vise, as indicated in the cuts herewith.

Fig. 118 is a side view and Fig. 119 an end view of the complete device, held in position in an ordinary bench vise. Fig. 120 is a view of members *a*, Fig. 121 is a view of members *b*, Fig. 122 is a section on *c c* of Fig. 118, Fig. 123 a section on *d d*, Fig. 124 a section on *e e* and Fig. 125 is a plan view showing the relative position of members *a* and *b* and the swivel or radial adjustment of angles *b* on angles *a*.

Members *a* are made of ¼×4-inch angle iron and are about 24 inches long. Members *b* are made of 1×2-inch angles 10 inches long. The center anvil die *f*, Figs. 120 and 124, is clamped between the 4-inch angles, which are in turn clamped in the vise as shown. Die *f* rests on the two bolts *g*, which serve as a foundation for same and at the same time hold the angles together.



Elevations and Details of a Home Made Circular Molding Machine

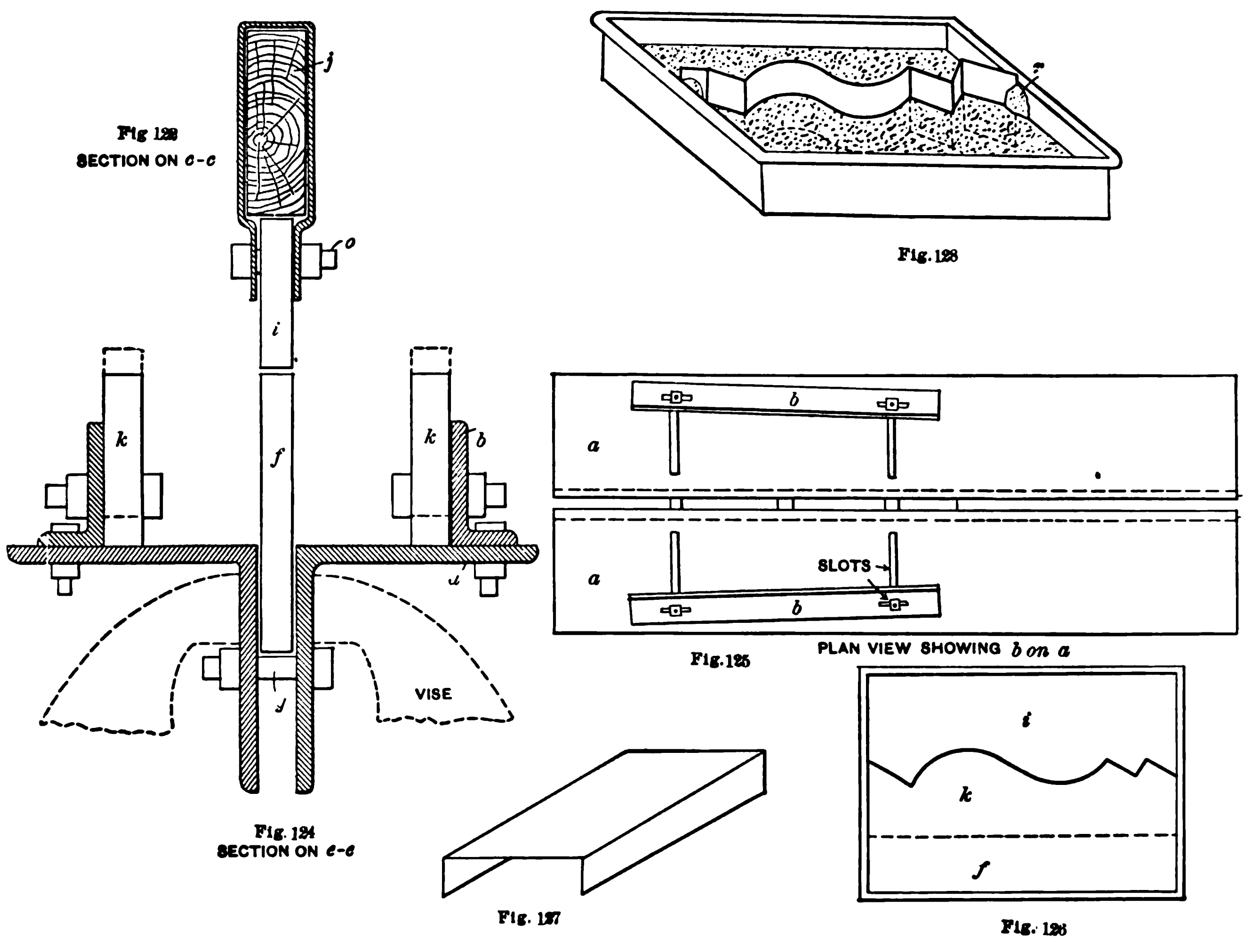
The hammer die *i*, Figs. 119 and 122, is secured by a No. 14 sheet iron cuff which slips over and is bolted to the wood lever *j* and extends down on each side of the die *i* and is bolted through same with two ⅜-inch bolts, Fig. 118. The guide dies *k* are bolted to angles *b*, as shown, through vertical slots in the angles, which allow of vertical adjustment of the dies *k* in order to provide for hammering up of moldings of different radii.

The lower wood member *l* is bolted in between angles *a*, as shown; *j* and *l* are hinged together at *m*, as shown, a very stout hinge connection being used for the purpose and bolted, not screwed, to the wood member; *l* braced and provided with a detachable extension support to floor; *d*, counter-balance spring, assists in raising lever *j*. The metal part *n* is a guide made of $\frac{1}{4} \times 1\frac{1}{2}$ inch band iron, and guides the action of handle *j* so that the die *i* will strike accurately on die *f*.

It will be seen that to change die *f* it is only necessary to slightly loosen bolts *g* and the vise, when it can be lifted out and another die substituted. Die *i* must of course be drilled for bolts *o* and can be changed by removing the bolts. The vertical and longitudinal slots shown in angles *b* and the radial slots in angles *a* indicate without further explanation how the dies *k* can be adjusted to suit moldings of varying curves. The handles *j* and *l* should be made of hardwood, *j* being 1×4 inches in cross section and *l* 1×3 inches. From the dies to hinge *m* should be about 4 feet.

A man and helper are required to operate the machine on ordinary work, although for some moldings one man can operate it very well. The hammer arm *j* must of course be worked up and down by hand in the same way that the pepper box and swedging machine of our fathers were operated. The hammer bar *j* should be reinforced where it works in guide *n* with a sheet iron covering, and guide *n* should be so formed as to allow of very little lost motion of *j* when dies *i* and *f* are brought together; but as soon as they are separated—that is, as soon as *j* is slightly raised—the two sides of *n* should diverge a trifle so that *j* will work loosely between them. The material in this device costs but little and it can be made at odd times, so that the total cost would not be much, and if properly made and used fairly good results will be obtained.

The dies *i* and *f* are made as follows: First make a sheet iron pan (cast iron is better) $\frac{5}{8}$ inch deep, with width equal to *q*, Fig. 119, which is about 7 inches, and 10 inches long, as indicated in Fig. 126. The edges should be stiffened so that the sides will stand rigid. Now cut a strip of black iron of gauge equal to the material to be stamped up, about 2 inches wide, and form it to the profile of the molding to be stamped, and set it in the pan, Fig. 126, as indicated, making the part *f* 1 inch wider than *i*. Secure this strip by laying a bar of iron on top of it or weights on the bar or by clamping it, taking care to see that the pan is resting on a perfectly level surface. Now melt a sufficient quantity of zinc and pour this into the pan on each side of the strip of iron, taking care to see that the pan is filled just level full, scraping off all dross, and when the zinc is cool remove the dies without disturbing the strip if possible—and, by the way, the pan should be made just a trifle flaring so as to facilitate removing the dies. The easiest way to remove the dies is to solder the end of a bar of solder to the center of each die, as the bar then constitutes a handle with which the die can be lifted. It is easy to melt the bar loose afterward. The two dies thus made are dies *i* and *f*. Die *i*



Details of Construction of Home Made Circular Molding Machine

should not be taken out until after dies *k*, which are those fixed to angles *b*, are made as described below:

To make dies *k* provide a piece of black sheet iron formed up as indicated in Fig. 127, with a length just equal to that of the pan and a width equal to the difference in width between dies *k* and *f*, Fig. 124. It should be set into the pan on the *f* side of the molded strip as indicated by the dotted line, with the edge of same against the side of the pan and the zinc poured into the space *k*, the result being a die with profile exactly the same as that of *f* but with less depth, which it will be seen is necessary because *k* rests on top of angles *a*, Fig. 124, whereas *f* extends down between them. Die *i* is then slipped in place in the cuff of handle *j* and marked to be drilled for bolts *o*. Dies *k* are also placed against angles *b* and marked for drilling the holes through which the bolts pass which secure them to angles *b*. Care should be taken to drill the holes in dies *k* as low down as possible so as to admit of the maximum adjustment in the vertical slots of angles *b*.

If the molded strip fits into the pan imperfectly the melted zinc in opposite dies will run together slightly, but this will not be serious, as the rough edges of the dies can be quickly dressed up with a file after breaking them apart. The same applies to possible leakage of the melted zinc past the inner edge of piece Fig. 127, resulting in a superfluous casting inside of the hollow piece and slightly attached to die *k*. Fire clay can be used to stop such leakage, but its use usually involves more trouble than filing up the dies.

The following better method of making such dies can be used where good molders' sand is to be conveniently had: Make a pan of No. 20 gauge black iron the same size as indicated in Fig. 126, but increase the depth to 3 inches, as indicated in Fig. 128. Fill with good molders' sand properly mixed for casting to within ⅝ of an inch of the top of the pan; then the molded strip can be pressed into the sand, which holds it perfectly in position. The piece Fig. 127 can easily have its edges pressed down in the sand, which prevents any leakage and holds it in position. To prevent the melted zinc from running around the ends of the molded strip a fillet of sand can be made in the corner as indicated at *r*, Fig. 128. Before placing the strip in it is of course necessary to see that the surface of the sand is tamped perfectly smooth and firm, so that the underside of the die will be true.

ANOTHER HOME MADE CIRCULAR MOLDING MACHINE

It is within the range of possibility that it is necessary to construct a "home made," either by reason of the regular manufactured machine being too costly or not adapted to the work at hand. Of interest, then, should be this description of a circular molding machine as shown by Fig. 129, which is made of 1½-in. wrought iron pipe. A nipple about a foot long is used for a hinge on special pieces of timber fastened to one of the roof supports of the shop. At each end of this nipple there is a heavy elbow and from these elbows extend two pipe arms, fastened together by means of band iron braces, as indicated. A coiled spring suspended from the ceiling attaches to this arm near the point where the dies are inserted, and facilitates the operation of the hammer by hand.

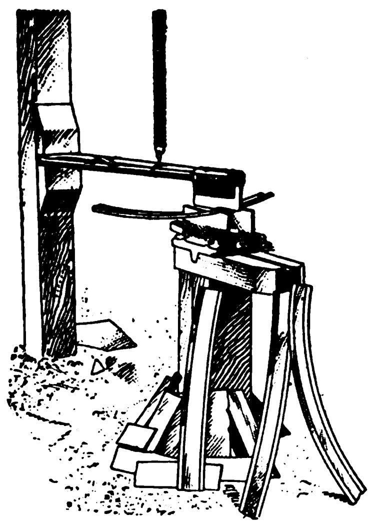


Fig. 129. Home Made Circular Molding Machine

Special castings were made for the hammer heads and connected with the wrought iron pipe by means of set screws. The anvil of the hammer is supported on a timber upright braced at the floor. The bed is provided with adjustable seats for three dies. The dies are also adjustable to suit the arc of the circle for which the molding is to be made. The dies are made of soft metal in the shop, and the tool is not only popular with the workmen, but its service has been entirely satisfactory to the owners. Under this hammer some very large work of special character has been satisfactorily completed.

CIRCULAR MOLDING MACHINE FOR SHOP USE

The following cuts and description of machine to be used for raising curved moldings may fulfil the requirements of those desirous of a home made machine constructed on lines similar to the foregoing hints. In Fig. 130 is shown the side elevation of machine. A is a heavy block of wood that serves to hold the block

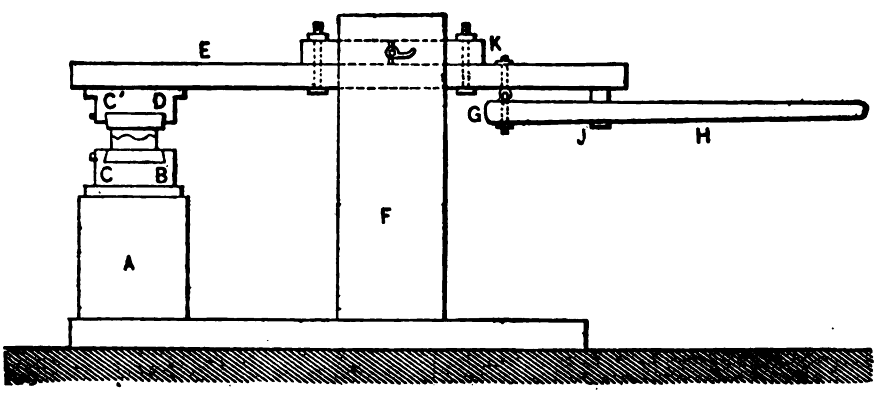


Fig. 130. Side Elevation of Machine

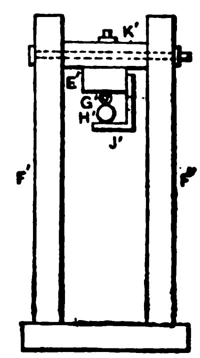


Fig. 131. End Elevation, Showing Swivel

of cast iron B, which is provided with set screws to hold in the block of wood C, to which the dies or forms are bolted. D is a similar block of iron, only it should not be as heavy as B. B and D are fastened to the wood work by bolts that go through the flanges. To have the machine work properly, the wooden block A should go into the ground or be made very solid, so there will be no rebound. When very large work is to be done, the iron D and the mold may not be heavy enough; then a lead cake or piece of iron can be fastened on to the beam above D, so as to get as heavy a blow as may be required. The beam E is secured to the holder K by means of two bolts. The plank sides F should be quite wide and made as firm as can be so the beam will not "wobble," or the dies will not come together true. The swivel joint G is to allow the handle H to be withdrawn from the holder J. When working the machine it would be inconvenient to let go of the handle H, so as to allow the beam to fall, but by having the handle swiveled to the beam, and on the rest or holder J, the beam can be raised up as far as required, and when the handle is moved from the rest the beam drops with a sharp blow. The higher the beam is raised the heavier the blow will be. To have the machine arranged properly, so the dies could be adjusted, it would be well to have slots in the beam E so it could be moved forward and back along K, being secured in the desired position by means of the two bolts. Slots should be cut in the two side planks so the beam could be raised or lowered at will, being secured by the bolt passing through K. In Fig. 131 is shown the partial end elevation of machine. F' F'' represent the side planks through which the bolt passes to secure the beam holder K'. The handle H' is fastened to the beam E' by the swivel G'. When the beam is raised by means of the handle the handle is thrown to the left, thus passing beyond the holder J'. The beam is then at liberty to fall and strike the required blow.

PRESSED ZINC WORK

Sheet metal workers are probably all aware that pressed sheet metal ornaments, parts which go to make a large percentage of the architectural sheet metal work these days, can be purchased from concerns making stamping their specialty. There are occasions, however, when a knowledge would be valuable of how to make the models, the clay to use the casting of the zinc dies, etc., despite the fact that the pressed work could be bought at a lower figure than they can be made by a shop not fully equipped for this work. In view of this, the following description of two of the methods was prepared by a practical sheet metal man:

Let it be assumed that a number of rosettes are required in the panels of a cornice. In Fig. 132 is shown a front and sectional view of a pressed zinc rosette, the panel being made of galvanized iron, and the ball B and the flutes A being pressed of sheet zinc and tacked with solder inside of the panel as shown. Fig. 133 represents an enlarged front and sectional view of the ball shown in Fig. 132; to obtain the pattern for this ball proceed as follows: Divide the section of the ball shown in Fig. 133 into any number of equal parts, as shown. Now draw any horizontal line, as shown by A B, Fig. 134, upon which place the stretchout of

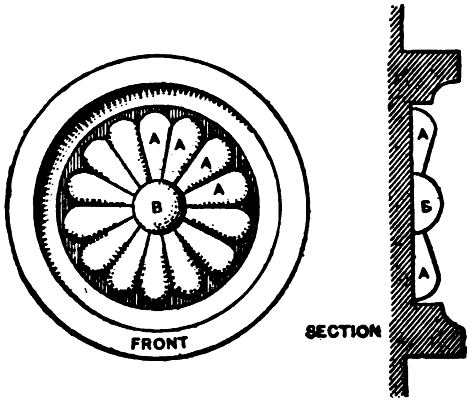


Fig. 132. Front and Sectional View of Pressed Zinc Rosette

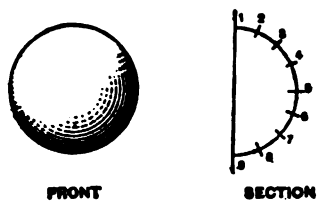


Fig. 133. Enlarged and Sectional View of Ball

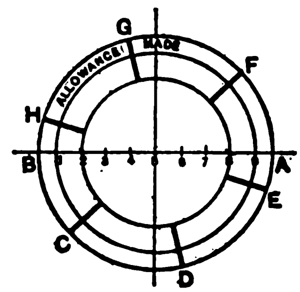


Fig. 134. Pattern for a Stamped or Pressed Ball Shown in Fig. 133

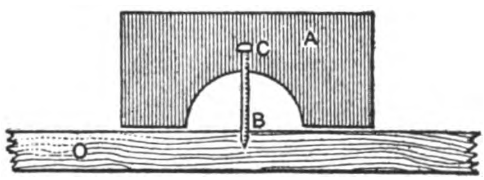


Fig. 135. Reversed Profile of Half Ball With Pin Attached

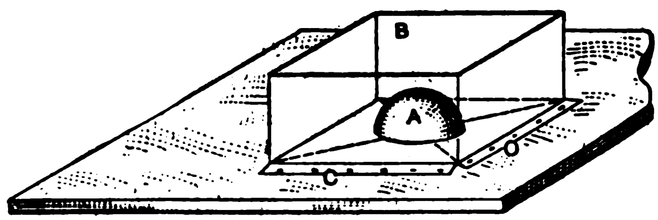


Fig. 136. Clay Ball With Metal Flange Around It

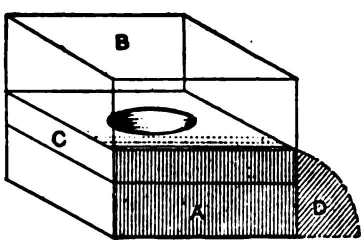


Fig. 137. Plaster of Paris Model Ready for the Molten Zinc

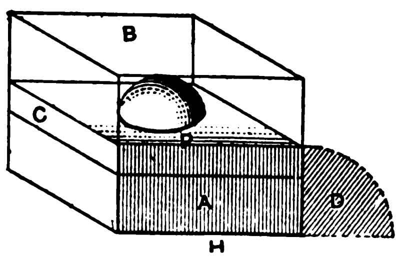


Fig. 138. Male Zinc Die With Metal Flange Ready to Cast Female Die

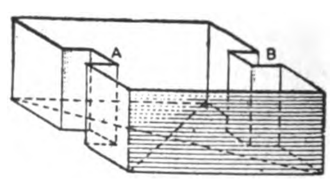


Fig. 139. Sheet Metal Flange Bent for Sliding Dies

the section shown in Fig. 133; through the center of the stetchout draw a line at right angles to A B, as shown; then taking one-half of the stretchout in the dividers as radius, strike a circle as shown by 1 9. Now set the dividers to 1 inch more radius and strike circle as shown by A B. Then will A 9 and 1 B represent the allowance for a flange around the bottom of the ball. Six notches are made on circle as shown by C, D, E, F, G and H, in Fig. 134; these notches overlap each other in stamping and give a smooth surface. Having now drawn the shape and pattern of the ball, all is ready for the clay model. The clay used is known as modelers' clay, and can be obtained from dealers in such supplies. In Fig. 135 is shown a reverse profile of ball with pin attached, for developing a ball in clay. O represents a portion of a wooden board or bench, A a heavy piece of sheet metal, B a wire nail of the required length, the head of the nail being flattened at C, so as to solder to the reverse profile A exactly in the center as shown. In practice the wire nail is driven into the board or bench, as shown at B, Fig. 135, so that the profile A still has play room to turn. The clay is placed around the center pin B until a little more than the required hight is obtained. Now slowly turn the profile A until the ball is developed. The profile and pin are now carefully removed, and the small opening made by the pin in the clay ball is filled up. It is proper to remark here that the clay should always be kept moist in working, and in case an article was being modeled which could not be finished the same day a moist rag should be laid over it, which will prevent the clay drying and cracking, and keep it moist and in good working order.

Let A in Fig. 136 represent the half clay ball which was developed by the use of the reverse profile shown in Fig. 135. A metal flange, shown at B, is nailed on the board, as shown at O O to receive the plaster of Paris. The hight of the flange above the top of the ball should be from 2 to 3 inches. When casting plaster models the plaster has a tendency to attach itself to any surface when drying. To prevent this take a little linseed oil, and with a small brush oil the entire inside of flange and board, it not being necessary to oil the clay. Now obtain an old can in which to mix the plaster of Paris. Fill the can with as much water as would be required to fill the mold shown in Fig. 136, and gradually sprinkle the plaster of Paris into it, always stirring the water so that the plaster will not form a lump at the bottom of the can. When the plaster has the consistency of mucilage it is ready to cast. This must be done as quickly as possible, for the plaster hardens rapidly. It is better to have too much plaster mixed than too little, for if the die was cast and it was found that more plaster was required, by the time the second mixture was ready the first would have hardened and a firm joint could not be obtained. After the plaster is cast into the die, shown in Fig. 136, and has become hard, the metal flange B is carefully loosened on the outside soldered joint and the nails drawn out of the board, when it will be found that the flange, on account of being oiled, can be taken off the plaster without doing any injury. It is the practice of some to cast the molten zinc directly upon the plaster of Paris mold; before doing this, however, the plaster cast must be thoroughly dried out in an oven, or over a heated stove, for if the plaster is not thoroughly dried and molten zinc put into it, steam is formed, causing the zinc to blister and

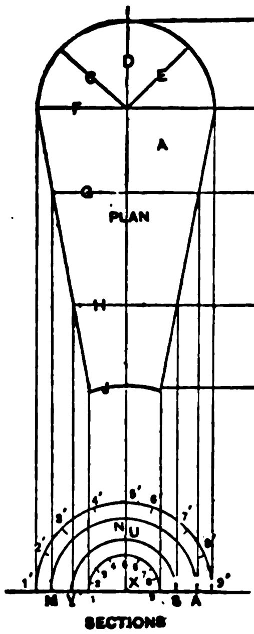


Fig. 141. Sections Required to Construct Models Shown in Fig. 142

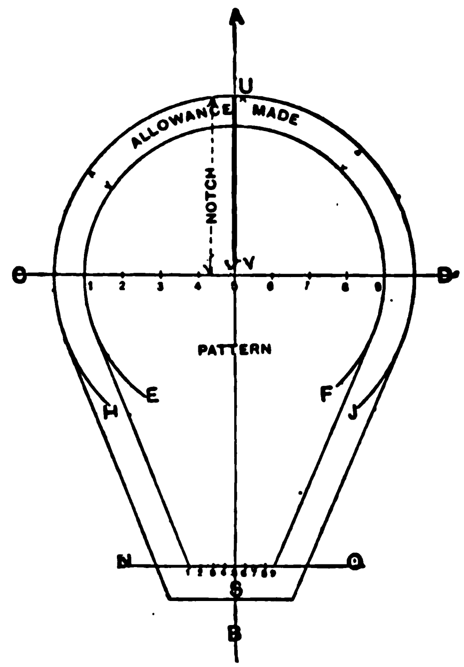


Fig. 143. Obtaining Pattern for Portion of Rosettes Shown at A, Fig. 132

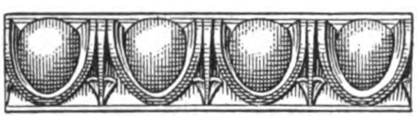


Fig. 144

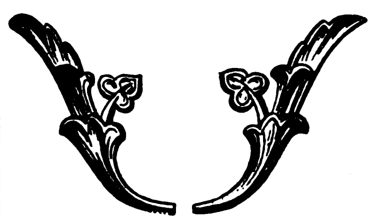


Fig. 145

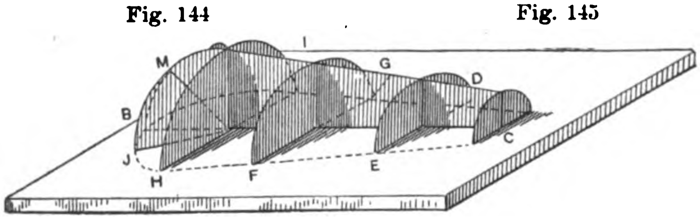


Fig. 142
Representative Ornaments and Model

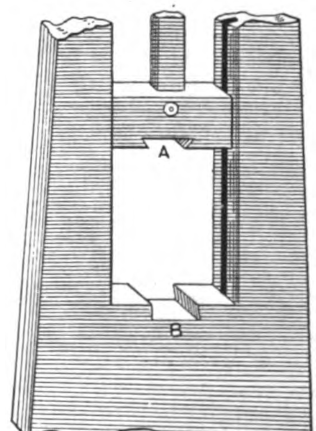


Fig. 140
A Drop Hammer

the plaster cast to crack. Let A, in Fig. 137, represent a plaster of Paris die, thoroughly dried, around which is placed a metal flange B, of black sheet iron. If any other than black iron were used, such as tin or galvanized iron, the molten zinc would attach itself to it and could not be loosened. Care should be taken in lapping the flange shown at C, Fig. 137, so as to obtain a tight fit. After the flange is placed on the plaster model cover the joint between flange and plaster with clay, as at D, to prevent any leakage of molten zinc.

Next cover the surface of the plaster mold with ordinary graphite or stove polish, which gives a smooth surface. The scrap or other zinc is then melted and the cast made, which will look as shown at A, Fig. 138. The hight from P to H should be from 3 to 4 inches. Fig. 138 shows the male zinc die obtained as explained, and also shows the metal flange around it ready to cast the female die. If the flange used in Fig. 137 is taken off carefully it can be used again in Fig. 138, as the size of the die is the same. In putting on the flange B, Fig. 138, be careful that the hight from the top of the flange is not less than 3 inches. Close the joint between the flange and zinc mold with clay, as shown at D, Fig. 138. In casting the molten zinc on the male die care should be taken that the male die is cooled and covered with a coat of graphite or stove polish. Now cast the molten zinc in the mold shown in Fig. 138, and the male and female die is ready to stamp the half balls.

If it is desired to use upright posts for the male or female dies to slide on, the flange would be bent as shown in Fig. 139, the grooves A and B being made of the same size as the uprights. This flange would have to be used in the work shown in Figs. 136, 137 and 138, the same as before explained. In doing stamped work, in the case in mind where perhaps from 30 to 50 leaves or balls were required, all that was used was a large block of wood about 3 feet high by 12 inches square, on which to place the dies, a small sized sledge hammer, a few pieces of hard wood, a pair of pliers, a can of water and a good fire, in a furnace, made either of coke or charcoal, it not being necessary to adjust uprights for these few ornaments. In case hundreds of ornaments of different designs were required, then instead of constructing uprights of wood, it would be well to obtain a drop hammer, as shown in part in Fig. 140. These drop hammers can be obtained from manufacturers of presses, dies and the like; the drop hammer being built to suit the force of the blow required. If a drop hammer is used, the zinc castings would have to be provided with a dovetail to fit in the dovetails shown at A and B, Fig. 140. Although other joints could be made on the hammer and block of the press, the dovetail is about the best method that can be employed.

Now to explain the method of stamping balls without the use of the wooden uprights or the drop hammer. The number of balls required having been cut after the pattern shown in Fig. 134, a charcoal or coke fire is started in a furnace to heat the zinc. Put the wooden block in the right position, heat the male and female dies, then place a piece of zinc on the fire, care being taken not to burn it. To tell whether the zinc has the right heat, dip a stick of wood into a can of water and let a few drops of water fall on the zinc. If the metal has the right heat the drops of water will jump off at once. Take the zinc off the furnace with the pliers and place it on the heated female die, being careful to set the zinc exactly in the center (leather gloves are useful for this to prevent burning the hands). Place the female die on the sheet. Take a slat of hard wood in the left hand and lay it on the die, and using the small sledge with the right hand, gradually drive the male into the female die. This operation will have to be performed two or three times, always heating the sheet, until the finished ball is obtained. Fat or oil on the sheet of zinc will facilitate stamping.

In Fig. 141 are shown the sections required to construct model shown in Fig. 132. Let A, Fig. 141, represent the enlarged plan view of one of the flutes shown at A, Fig. 132. B, Fig. 141, is the side view or section of flute. Divide the plan view into sections as shown by the lines C, D, E, F, G, H and J. The sections shown underneath the plan indicate the sections taken through the lines F, G, H, J; 2, 3 and 4 on side view represents the section through the lines C, D and E in plan. Having the sections now prepared, the model for the clay is made as follows: Let Fig. 142 represent the model prepared of sheet metal, ready for the clay. Fig. 142 represents a board, on which a duplicate of the plan, shown in Fig. 141, is placed.

Upon the center line B C, Fig. 142, place the side view shown in Fig. 141; on the line C, Fig. 142, place the section shown by 1, 5, 9, Fig. 141; on the line E D, Fig. 142, the section V U S, Fig. 141; on the line F G, Fig. 142, the section M M R, Fig. 141; on the line H I, Fig. 142, the section 1′ 5′ 9′, Fig. 141; on the line J X, B X and M X, Fig. 142, the section shown by 2 3 4, side view, Fig. 141. Now fill the metal model with clay, and smooth off even with the top of the sections. Place a flange around it and cast the plaster of Paris, the same as explained for the balls. In Fig. 143 is shown the pattern for stamping the flute shown in Fig. 132. To obtain the pattern proceed as follows: Divide the outer and inner circles of sections shown in Fig. 141 into any number of equal parts, as shown. Now draw perpendicular line, as shown by A B, Fig. 143, and at right angles to A B draw the line C D, upon which lay off on each side of the center line A B the half of the stretchout of the outer circle of sections shown in Fig. 141, as shown by the small figures 1, 2, 3, 4, etc., in Fig. 143. Set one leg of the dividers on the point 5, and with 5 9 or 5 1 as radius strike an arc, as shown by E F; make an allowance of 1 inch and strike another arc, as shown by H J. Measure the distance from 1 to 2, side view, Fig. 141, and lay it off on the line A B from 5 to 5, Fig. 143. At right angles to A B draw a line through the point 5, as shown by N O, Fig. 143, upon which place on each side of the center lines A B the stretchout of the inner circle of sections shown in Fig. 141, as indicated by the small figures 1, 2, 3, 4, etc., in Fig. 143. From the points 1 and 9 on the line N O draw two lines tangent to the arc E F, as shown from 9 to 9 and 1 to 1, which will be the required pattern; make the same allowance on the lower part of the pattern as shown by A J and S. A notch is made from U to V to allow the zinc to overlap. In Figs. 144 and 145 are shown sketches of a right and left scroll and an egg and dart molding; the cast zinc models of which would be made in the same manner as before described.

Another way of making pressed zinc work is as follows: After the plaster model has been obtained and partly dried, a coat or two of shellac is given to it, so as to make a smooth surface. It is then taken to the iron founder and an iron model cast. A flange of black sheet iron (not tin or galvanized) is placed around it, using the clay so as to stop any leakage of molten lead. After the flange is in position the lead is cast into it. Several lead casts are made, for the lead being softer than the iron, when the male die is not laid properly on the female die the result is that the lead die becomes flattened and a new one is required. Cast zinc can be used in connection with the iron die with good results.

The foregoing hints should be sufficient for those who desire to do simple stamping and will be of assistance to the sheet metal cornice assembler for it is customary to purchase the stamping from the manufacturer in parts, the assembling of the various parts being done by the cornice maker. On very large work it is customary to send the large plaster cast thereby permitting the cornice man to tack with solder the parts on the plaster model insuring accurate assembling. For those who desire to make a home made drop hammer the following is appended:

The machines ordinarily used for this work are called hammers, and when made of iron are quite expensive. The originator of the devise shown in Fig. 146 makes no other claim for his machine than that it was efficient in the work for which it was constructed. The dies were made of white oak and the bed of the machine was made of a piece of yellow pine 3 feet long and about 12 inches square. Notches were sawed in the end of this piece, from which pieces of 2 × 4 hickory run up 5 feet high and connect with a cross bar. A block of yellow pine similar to the bed with notches carefully made so that it would slide smoothly on the hickory uprights, made the hammer to which the die was attached. To the center of the top cross piece a large wheel was attached, so that a piece of strong rope operating over it would run down through a hole placed midway between the uprights. One end of the rope was attached to the hammer, and the other end run over the wheel and over a second wheel placed at the end of the upright; and at the extreme end of the rope a piece of wood 12 inches long was attached for a handle for operating the machine. It is said that when the uprights of the machine were lubricated the hammer could be raised and would fall with considerable force by gravity, and that very little difficulty was experienced in operating it, the power being supplied by one workman, who placed both hands on the cross piece in the rope and raised the hammer to the point directed by the workman who manipulated the sheet iron.

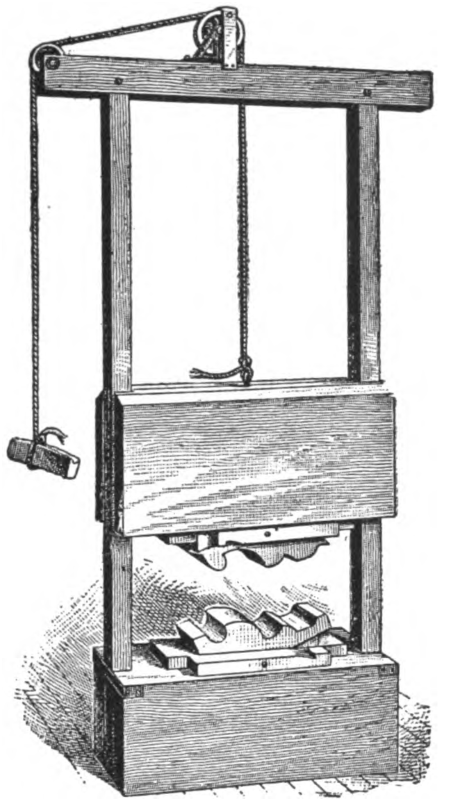


Fig. 146. An Improvised Drop Hammer

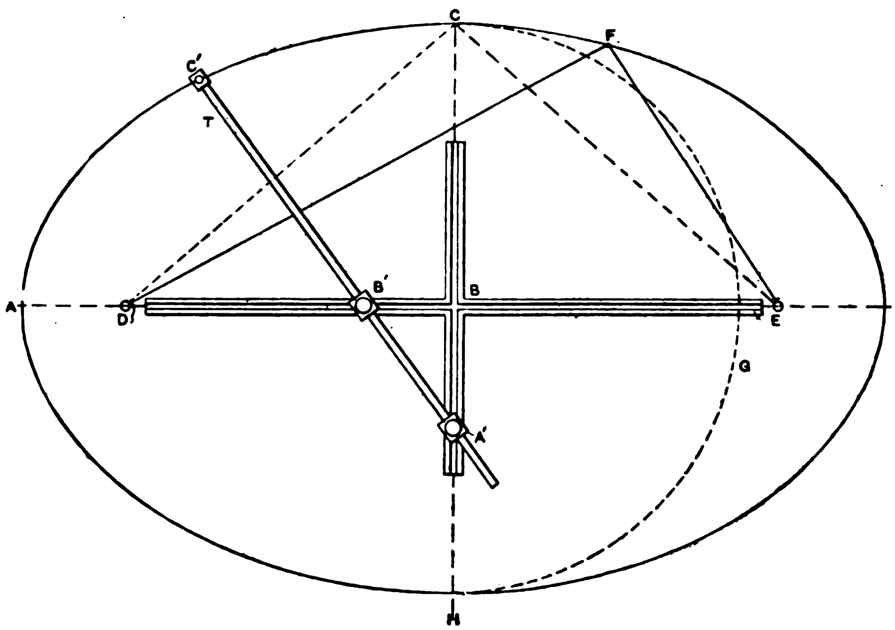
If power is available, the machine could be set up near a revolving overhead shaft. The raising and allowing the hammer to drop would then be in this fashion: The rope is wound around the shaft, say three times; if then the rope is held taut by the suspended handle, it will raise the hammer, and by letting go of the handle it will drop.

The following receipt for cleaning stamped copper work has been used in practice and will overcome the difficulty of soldering, owing to dark color of the copper, which is caused by heating the copper to anneal, and the grease used as lubricant. First dip the ornaments in solution of potash and boiling water until the grease has been removed; then dip them in a solution composed of 1 part water, 1 part sulphuric acid and ¼ part nitric acid. As the solution is very powerful, owing to the amount of oil of vitriol or sulphuric acid in it, the ornaments should only be dipped in same and removed, and when the dark color has disappeared rinse them in clean water and scour with sawdust or small thin shavings. In mixing the solution a glass or wooden vessel is best. The water should first be placed in the vessel, then the oil of vitriol added, which will cause the water to boil; when this has cooled add the ¼ part of nitric acid, when the solution is ready for use. In practice a hogshead is often employed in which to mix the solution, and which can be covered up when not in use.

INSTRUMENT FOR DRAWING AN ELLIPSE

It may be interesting to some of the readers to know how to draw an ellipse of any size, as well as an egg shaped figure or oval, Fig. 147, similar to the cross section of a sewer. The instrument for doing this consists of two parts, one of which is cross shaped, the pieces being at right angles to each other and having a groove in their top surfaces. The other part of the instrument consists of a beam with two sliding buttons having round pins on the under side to fit into the grooves of the cross pieces, also a pencil fixed in a button at the end.

The trammel is exactly the same as the beam of a beam compass, with this difference, that it has a circular button to fit into the groove instead of a needle.



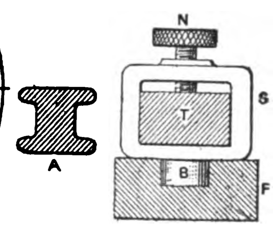


Fig. 148 Details of the the Trammel

Fig. 147. Diagram Showing Method of Drawing an Ellipse

Again, the beam or trammel of the beam compass is usually I-shaped, as shown at A in Fig. 148, but this is flat, as the sleeve S, which holds the knob or button, keeps it sufficiently rigid as indicated in the larger section. The salient feature of the apparatus is not so much the trammel as the grooved cross shaped frame in which it works. The principle could be applied to the generation of a large ellipse by simply having two lines laid off at right angles representing the major and minor axes of the ellipse, and then taking a batten and putting in nails at the length of the half major and half minor axes. Then when the nail representing the minor axis is placed anywhere on the major axis and the nail representing the major axis is swung around until it rests on the minor axis, then the end of the batten is a point of the ellipse.

In order to generate an ellipse make C′ B′ of the diagram equal to C, B, which is half the minor axis of the ellipse, and make A′ C′ equal to A B, which is half the major axis of the ellipse. Now place the buttons in the slots or grooves and slide them along so that when B′ moves along the horizontal slot A′ will simultaneously move along the vertical slot, then C′ will generate an ellipse.

To generate an ellipse by means of a cord first draw the major and minor axes and then take half the major axis A B and with C as a center draw an arc bisecting the major axis in D and E. By this means D and E are established as the focii of the ellipse. Place pins at D and E with a cord around them and then stretch it until it comes to C; now with the cord kept taut generate the ellipse. While this is an easy method of doing the work, the one first described is more exact.

For generating a still larger ellipse a wire can be used instead of a cord, as the latter stretches and the whole value of the operation consists in its exactness.

RAISING CORNICE TO BUILDINGS

The following is a description of the method of hoisting cornices and setting them on the wall as adopted by shops in Greater New York: On residence work, especially in the Boroughs of Brooklyn and Queens, the cornices would be 20 or 25 ft. in length and usually 4 ft. deep, with about 2 ft. projection. They are made complete in the shop, and on ordinary operations there are a row of houses, in which case, if the fronts of buildings are not obstructed with scaffolding, etc., the cornices are stood on the ground against the wall and directly beneath the place on which they are to be set, then raised by the derrick, wired securely to building and backed up with the brick wall. The derrick is a light affair and easily moved from roof to roof. Sometimes this cannot be done at the front; then an unobstructed place is found, maybe in the rear of one of the buildings, and all cornices hoisted by the derrick at that point. If it is not a windy day the cornices are carried over the roofs to the required place and laid on their faces until all have been so placed, the fastening wires attached and lifted on to wall by three or four men and fastened. Should the building have a circular or octagon bay front, the circular or octagon piece would be in one part and the straight "tail" another. These are hoisted into place and inside miter made after they are on the wall and tied strongly. If the cornice is of a long run, say, the side street end, known here as the gable end cornice, it is made in 24-ft. lenghts and seams made after setting all the lengths on the wall.

On very high buildings the derrick is often used, substituting a light steel cable for the rope. Naturally it is very slow work to wind 10 or 20 stories of cable, and as there is most always a hoisting machine, similar to a freight or passenger elevator, it is generally planned to make cornice so that it can be carried or taken up on the elevator. Very large cornices have been known to be hoisted this way, but 16 ft. seems to be the limit of length. Now these elevators by reason of the tremendous amount of material required in the construction of a high building are rushed to their absolute capacity, and the superintendent of the building is adverse to lending it to "mere roofers." However, by the liberal use of "oil" the attendants of the elevator work willingly and smoothly, and by a lot of coaxing and offering to pay well for its use, the superintendent allows the cornice man to have the hoisting machine, stipulating that it be after working hours. It pays, though, rather than essaying to hoist by the hand derrick. Still, a hand derrick must be used to set the cornice on the wall, for in most cases there are structural steel lookouts, making it necessary to swing the cornice quite some distance out, and it won't do to take chances of letting the cornice fall or throwing a man from the roof.

On one 32-story job the structural steel men had the huge boom derrick still in working order, an unusual occurrence, and advantage was taken of this to hoist a very large copper cornice. The cornice certainly went up in quick time then, but the customary small hand derrick was used to place the cornice on the wall.

Further information is that when the cornice is of long lengths the joints are usually lapped all to one side, and if the mason's scaffold can be used on the outside the joints are tacked and riveted and soldered on the inside. In some places where it is impossible to rivet, small round headed bolts are used, and fastened with nuts on the inside. If the scaffold has already been removed on the outside, and the joint comes away from any window from which a scaffold might be erected and no scaffold is available, then part of the plancher and frieze of the cornice is removed, so that one can reach certain parts of the molding on the face of the cornice from the inside, when the joints can be tacked and bolted. If the cornice is of copper, brass bolts should be used. Under no consideration should the joints be only tacked, for it is only a matter of time when these tacks burst open and the results are the unsightly open seams in cornice work which ones sees so often. All joints should be riveted or bolted.

When a molding or cornice is to be mitered around the corner of a building and the outside scaffold is in place and can be used, then the miter is joined together at the building. If, however, the scaffold is removed, the return arm is usually connected to the main piece as long as it can be conveniently raised to the building (about 3 ft.), for it is easier to join a seam from the inside than to join a miter. Existing conditions must be known before definite instructions can be given the outside men, but the methods described are usually employed.

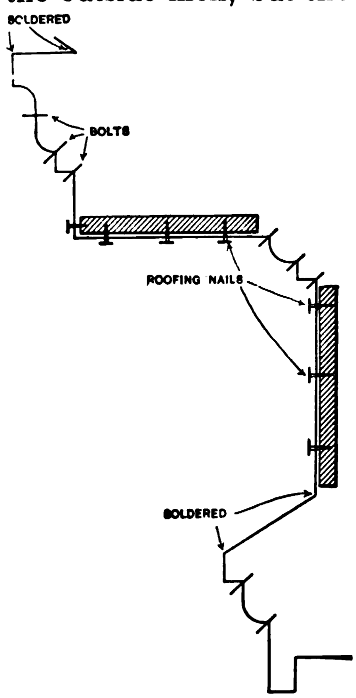


Fig. 149. Vertical Section

It is customary on galvanized ironwork to do as little soldering as possible, and rivets are rarely used in making the seams. The accompanying sketch, Fig. 149, shows where bolts are placed, first being sure that the sections of the cornice are plumb and that the members are as nearly in line as possible. Note the piece of board placed back of the frieze and also back of the plancher, with the roofing nails driven in to hold the metal in place. This makes a neat, strong and, an essential detail, a rapidly constructed seam. The foregoing does not apply to copper work. No bolts should be used, but the seams should be tacked on the inside, riveted strongly and then soldered on the back.

It is a much mooted question as to which is the better method, a miter or a short return. Experience has taught that a cornice like that shown in the sketch can best be erected with a short return, making the seam on the building. If a cornice has brackets, enrichments and the like, making the miter on the building is invariably the best practice. It seldom happens that one cannot reach the outside of a cornice. If necessary a boatswain's chair could be slung from the derrick used to hoist the cornice. One must be resourceful in the building trades.

TINNERS' FIRE POTS

One of the most expensive items in the equipment of a sheet metal working establishment is the fire pot; owing to the rough usage and exposure they receive they are indeed short lived. For this reason they should be constructed as heavily as practicable. And when business is dull, it is well for those responsible to see that an ample supply is at hand; replenishing if necessary. For it is vexating, to say the least, to stop important work to make some of these pots, when all the workmen are busy on rush orders.

A good fire pot for all ordinary purposes can be made of No. 20 black iron (it is useless to employ galvanized iron as it peels, though of course when using as scrap it does not matter) of the dimensions shown in Fig. 150. Fig. 151 is a sectional view, showing the method of seaming the round bottom on to the body of the fire pot, and riveting the bottom to the base. The following will make clear how the fire pot is constructed. After the base A, shown in Fig. 150, is formed, place and rivet the angle B, which is made of light brace iron, at each end of base, using the band iron with which the sheet iron is packed. After the braces are riveted on, run the bottom, shown at A in Fig. 151, through the turning machine until an upright edge or flange is obtained. Now rivet the bottom on to the base, as shown in Fig. 151. Next lay out the pattern of the body C, Fig. 150, cutting out the opening into which the soldering irons are placed before forming up on the rollers. After the body C is rolled up and riveted, a band iron ring of the same material as before mentioned is placed and riveted on the upper top edge of the body. Now form a handle of ¼-inch gutter rod, and punch a hole of the required size on either side of the body, as shown, through which to secure the handle. Then form up the lip D, Fig. 150, allowing flanges for riveting on to the body. Place the body in its proper position on top of the flanged bottom and seam, as shown at A in Fig. 151. It will be seen that the lip D, Fig. 150, is raised higher in the front than at the body; this is done so as to keep the soldering iron or hot coal from dropping out when moving the fire pot from place to place. An angle is riveted to the lip and to the base A, as shown in Fig. 150. This angle helps to sustain the lip and keeps it from breaking off when the soldering irons are placed on it. The small angles on either side of the pot and at the rear are riveted in place, and give strength and stiffness to the entire fire pot. Instead of punching holes in the top rim of the pot for the handle, ears can be made of band iron, formed as shown in Fig. 152. And it makes it easier to carry about, if the ears are placed at the front and back of the fire pot, as then the projecting part of the base will not strike the legs of the person carrying the fire

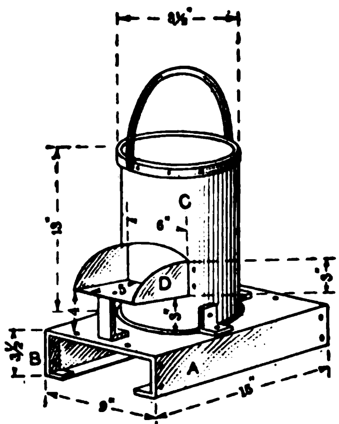


Fig. 150. Finished View, With Dimensions

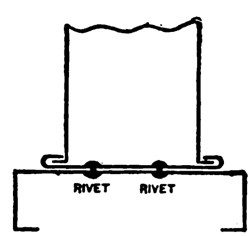


Fig. 151. Sectional View Through Bottom

pot. Of course, a cover could be made by edging a disc of metal and seaming a rim to it, just as the bottom is seamed to the body of the fire pot. Covers are seldom used, however, a handy piece of sheet iron being cut square of a size to fit on the pot and having the four corners bent down; is generally employed.

In practice two sizes are used, the large size, as shown in Fig. 150, for heating heavy soldering irons, and the next size, with a base 7½×12 inches and the rest of the pot made in proportion, is used for heating smaller irons.

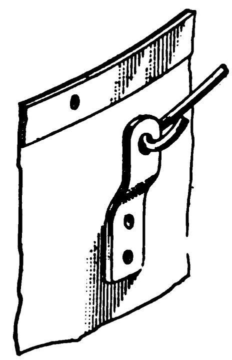


Fig. 152. Bail Ear

In laying out the patterns for a fire pot of this kind a full size drawing is made, from which measurements are taken. Assuming that Fig. 153 is such a full size drawing, the patterns are deveoped as shown in Fig. 154. Take the girth of the base *a b c d* in Fig. 154 and place it as shown from *a* to *d* in Fig. 154, and make the length *a b* as desired. Now set the dividers equal to one-half of *h h* in Fig. 153 and strike the bottom shown by H in Fig. 154, allowing an edge for seaming. Obtain the circumference of the body *f f* in Fig. 153 and piace it on *f f* in Fig. 154, and make the hight *f i* as desired. An edge is allowed at *f f* for seaming to the bottom and a lap, *f i*, for riveting. The opening *a b* is cut out of such size that a pair of 10-lb. roofing coppers can be put into the pot with

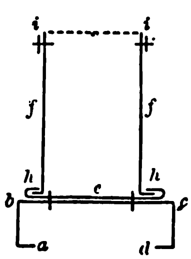


Fig. 153. Constructive View

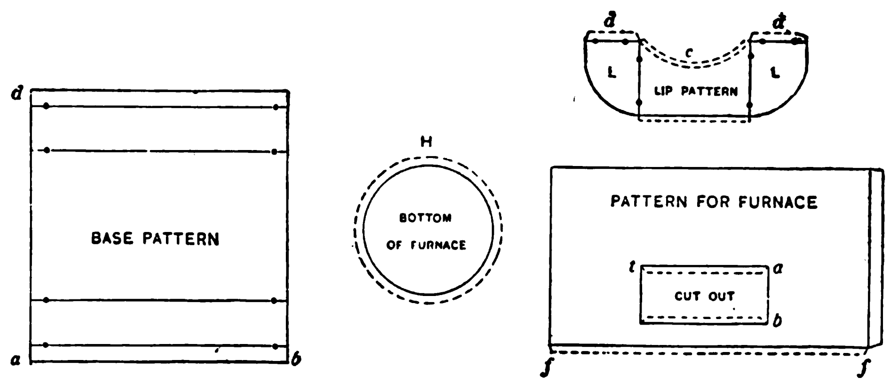


Fig. 154. Approximate Pattern Shapes of Fire Pot

ease. A hem edge is allowed at *a* and *b* in the pattern for furnace in Fig. 154, and is turned first before it is rolled. The pattern for the lip is shown at L; *c* is the bottom. The curve at *c* in Fig. 154 is made to conform to the curve of the fire pot and the girth of the curve *c* equals the length of the cutout *t a* in the pattern for furnace. The sides L L in the lip pattern are the sides shown by D in Fig. 150. The lap shown at *a* in the perspective view is shown in the lip pattern in Fig. 154 at *d* and *d*. At *c* is shown a lap for riveting against the pot, and *a* is a hem edge for stiffening the edge.

It is poor policy to construct these fire pots from light gauge metal, as the labor on the heavy gauge is no more than on the lighter gauges, and the pot will last four times as long. The brace iron is generally the stuff used to bundle the sheet by the mills, and is usually $\frac{1}{8} \times 1$ in. tinned band iron. In case the fire pot is left at the building over night it should always be placed upside down, so that in case of rain no water will settle at the bottom of the pot, which would in time rust it out. Besides, it is customary to put out the fires, before leaving, at the end of the work-day, and the water, if still in the pot, would freeze in cold weather, over night.

A CONVENIENT TINNERS' FURNACE

The detailed drawings of a convenient tinners' furnace are shown in the accompanying illustrations. The peculiarity of this fire pot is that it will stand in the desired position on a roof of any pitch and also that the furnace can be revolved on the base so as to have the front door in the desired position in regard to the

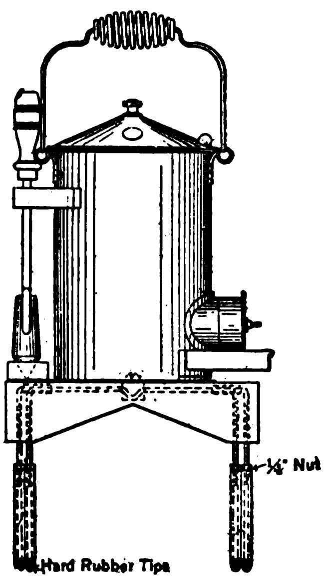


Fig. 155. Side Elevation

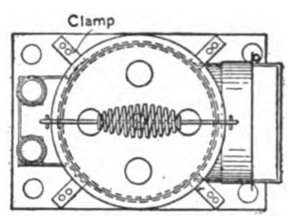


Fig. 156. Plan

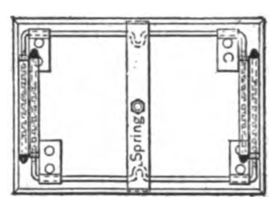


Fig. 158. Plan of Base.

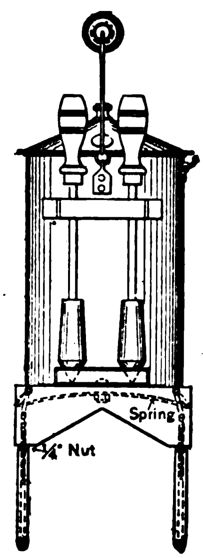


Fig. 157. Rear Elevation

wind. Fig. 155 shows the side elevation of this apparatus. From this illustration it will be seen that the soldering irons, when not in use, are set in a rack provided for them. A pan under the door of the furnace catches any coals that may fall out. The door of the fire pot closes so tightly that the fire will smolder out in ten minutes, thus saving coal from being consumed. The bolt shown at the bottom of the pot fastens the furnace to the base and permits the furnace to revolve on the base, so that the front door may always be brought to face the wind.

In Fig. 156 is given a plan view of the furnace looking from the top. The rear elevation is illustrated in Fig. 157. It will be noticed that the base is notched both front and back to permit it to rest on the ridge of a roof. When it is desired to place it on the side of a roof of any pitch one or both of the sets of legs are pulled down from a position parallel to the top of the base and set as shown. These legs are made of ¼-inch iron, on which are screwed ⅜-inch gas pipe extensions by ¼-inch nuts, such as are shown in the illustration. These pipe extensions have rubber tips on the ends to prevent them from slipping, and the length of the leg depends on how far these extensions are screwed in or out.

The bolt, referred to in Fig. 155, which is also shown in Fig. 157, fastens in place a spring shown in Fig. 157. This spring works on a crank, shown in Fig. 157 and in the plan view of the base, Fig. 158, and holds the legs in position, whether folded open or shut. In Fig. 158 the legs are shown folded up, as when not in use, representing their position when the fire pot rests on the base. This furnace shows considerable ingenuity in its construction and has advantages over the ordinary style which will doubtless appeal to many sheet metal workers.

SOLDERING COPPERS

It will amply repay master sheet metal workers to pay more attention to soldering coppers than is generally given to these tools. It is the usual custom to lay in a supply of coppers and then hand them out to the workmen as required until the supply is about exhausted; then to order a new lot and repeat the process, without giving any further thought to the matter. Care should be taken, when ordering, to specify different sizes suitable for different kinds of work. As the butts are being constantly worn away, what was a 10-pound copper when new will have resolved itself into a 5-pound copper after some usage. Therefore when ordering this should be borne in mind and proper allowance made.

In this day, nothing which will tend to increase output without increasing cost is too small to be overlooked or ignored by the foreman. From practical experience it can be said that with coppers of proper shape, size and condition a given job can be executed in half the time that will be consumed if the coppers are not of suitable shape or size and are in poor condition. A small copper should not be used on heavy work, as it cannot contain enough heat to raise the temperature of the work sufficiently to allow the solder to flow and soak in as it should. And the capacity of the work for absorbing heat is so much greater than the capacity of the small coppers for supplying it, that when the copper is applied its heat is quickly drawn off, the result being that the operator wastes much time in the futile endeavor to either keep his coppers hot, or in soldering with relatively cold ones, which means poor work, in addition to the time wasted.

After choosing coppers of suitable weight and size for the work in hand, the next point to look out for is the shape, then the tinning, and lastly, the temperature at which the copper should be maintained while in use.

In order to consider the several general types of coppers it is, perhaps, necessary to separate the work for which they are required into corresponding general classes, so as to show the adaptability of each type of copper to its particu-

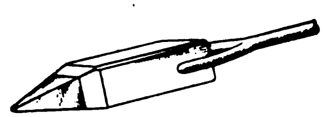


Fig. 159. Pointed Copper

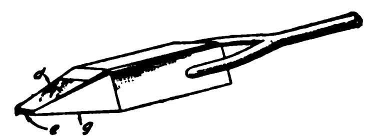


Fig. 160. Wedge Shape Copper

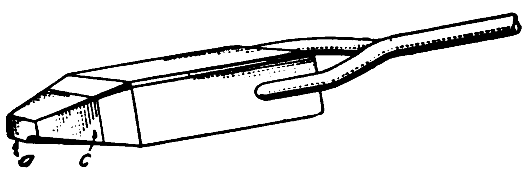


Fig. 161. Roofing Copper

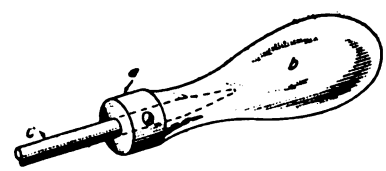


Fig. 162. Soldering Copper Handle

lar class of work. There are flat seams, such as in roofing, tank bottoms, floor linings, etc.; vertical seams, such as flashings, tank sides, wall linings, etc.; cornice seams, as in lap joints between parallel sections of moldings, gutters, conductors, etc.; miters, as in joints between two surfaces meeting at an angle, etc., and ware seams—that is, seams in tinware, vessels, etc.

For flat seam work coppers shaped as shown in Figs. 160 and 161 are best adapted, the shape of Fig. 161 being especially suitable for soldering the seams of roofing tin. In addition to the under surface *a*, surface *c* should be tinned. A notch is filed in the copper which acts as a guide. For flat seams on tank bottoms, floor linings, etc., where the pitch is slight, Fig. 160 is best. Flat seams on a surface of considerable pitch, also vertical seams, can best be soldered by the copper shown in Fig. 160 having surfaces *e f* tinned, leaving surfaces *d* and *g* "dead." With surfaces *e f* only tinned and the copper held so that *f* is on the uphill side, the solder is more easily induced to flow up into the seam than if the lower face, *g*, was tinned, as the solder is then more likely to be attracted by *g* and thereby hindered from entering the seam. When but one face is tinned, the molten solder can be easily controlled and applied directly to the desired point, whereas if the copper is tinned all around the solder is likely to be attracted to the under surface of the copper and away from the seam. When a copper like Fig. 159 is tinned on four sides it is most suitable for cornice seams and miters. This copper is forged to almost a point. This copper, tinned on four sides, is suitable for side seams and for soldering the bottom seams of ware on the outside. For soldering the bottom seams of ware on the inside the copper shown in Fig. 160, tinned all around, is especially adapted, and also for corner seams.

The shape of a copper may meet the requirements of a certain class of work, but the weight may be unsuitable. For instance, the shape of Fig. 160, tinned on one side, is what is wanted for vertical seams; but a light weight copper of this type is best suited for vertical lock seams in light zinc flashings, while a vertical lock seam in heavy sheet copper requires a soldering copper twice as heavy. The copper shown in Fig. 161 is extra heavy. To try to work with poorly tinned coppers is equivalent to trying to run a race shackled with a ball and chain. Accomplishment accompanies the use of well tinned coppers, while the attempt to use poorly tinned coppers results in fiddling the time away in comparatively ineffectual effort.

It will pay to provide every facility for quickly and easily putting coppers in good shape, and in shops using power the use of a good emery wheel for the purpose will yield more than satisfactory results. The wheel should be near a forge and vise, and a medium fine file should be kept handy for finishing the surface after the wheel has roughed it off, or the copper has been forged to the required shape.

Copper is a better metal than iron or steel for use in a soldering tool, because, firstly, there is a special affinity between the basic metals, tin and copper; secondly, it is comparatively free from scale in heating, and, thirdly, it is superior in density and heat absorbing and conducting qualities. It is difficult to retain the tinning on a butt of iron when it is heated to the temperature required for soldering purposes, and it scales so badly that the butt is quickly eaten away.

Soldering coppers as made these days, have a handle which is forced on the iron shank of the copper and to keep it from breaking an ordinary wire is wound once around the fore part of the handle. This leaves that part of the handle unprotected from the heat of the fire pot and the wood soon chars, with the result that the wire falls off and the handle splits. On outside work the men should be extremely careful not to drop tools, but with a split handle it is impossible to hold the copper and it should be obvious that a little more money spent on proper handles is cheaper than defending suits for damages from falling irons (it is history that men have been killed by falling coppers) and Fig. 162 shows how a cast iron ferrule *a* will protect the handle *b* and how a hole drilled through the ferrule, handle and shank of *c* of copper, with a pin through the hole will securely bind copper to handle.

SOME SHOP KINKS

A substitute for the cumbersome old lead cake for holding small patterns on the material in which the pattern is to be marked out with the scribe awl and pricked is shown by Fig. 163. It consists of a quick opening clamp, the lower portion of which is fastened to the bench. The material to be marked and the pattern are held in line, in respect to the stretchout of the pattern, by means of two roofing nails; and when the pattern and material are properly in place it is a simple matter to push the clamp screw down on the material and then a turn or two of the thumb screw holds the pattern rigid. When the marking has been completed the two little spring clamps on the quick opening jaws have only to be pressed together when the thumbscrew can be lifted up an inch or more and the marked out work removed.

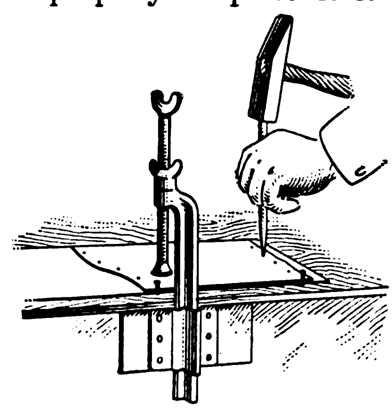


Fig. 163. A Device to Hold Small Patterns

One of the cast off tools usually found in the shop is a worn out three-cornered file. This can be worked into a scraper, which is used for scraping small articles or in places where the ordinary scraper could not be used. The finished scraper is shown in Fig. 163 which illustrates how the file is sharpened down to a point.

Every tinner has seen a carpenter hold his finger under his rule at 2 or 6 inches, as the case required, and lay it on a board with his pencil against the end and run a mark down the board to make a line to saw to when he wanted a strip. They have also seen him stop suddenly and pick a splinter out of his finger, and both have felt that there was an annoying risk attending the use of such a gauge.

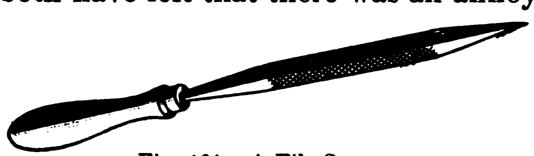


Fig. 164. A File Scraper

Here is a gauge that can be carried in the pocket, is safe, more true than the finger, and is something with which scraps of heavy tin can be worked to a profitable advantage. To make it, take a piece of tin 2 inches long and 1⅜ inches wide. Turn up an edge at a right angle on each side and ⅛ inch high. In one edge cut a triangular notch, as at A, ½ inch from the end. On the under side, just even with the upright line of the notch A, solder firmly a stop 1 inch wide, letting it run down straight ½ inch; then turn the end back for a brace and solder fast. In use, a rule is placed between the edges, with the desired measure even with the notch and held in place with the thumb, while the fingers of the left hand grasp the gauge and the rule firmly. The right hand holds a pencil at the end of the rule and a true mark can be made on rough timber or, of course, sheet metal, with safety, as can readily be seen from the cut, Fig. 165. The cost is so little that they can be sold for a dime with a good profit.

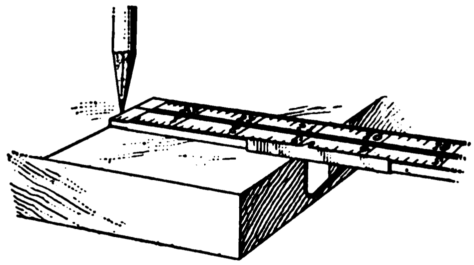


Fig. 165. Carpenters' Gauge

It has been the experience of one employer that tools are kept in better condition and there is less risk of their being misplaced and lost if a place is provided in which to keep them conveniently at hand to the workmen. In order to avoid the perplexing annoyance of having to hunt for a tool a simple device has been adopted for keeping track of the general tools which may be required by any one of a number of workmen. The same method may be adopted for keeping track of other tools on the bench of the sheet metal worker or other workman who requires a work bench. It consists of two pieces of tin hinged together, one piece being designed to be tacked against the wall and about 3 × 5 in. in size bearing in large letters the name of the tool that should be hung in the rack immediately beneath it. When the tool is in place the second piece is raised, and covers the name as the tool shows for itself that it is in place. When the tool is removed for use the cover flap drops down and leaves exposed the name of the tool which belongs there. It has been found to be a decided advantage to use this device, so that just what tools are missing can be seen at a glance, and the foreman who may have sent a man to do a given work will know if he has returned or has neglected to replace the tools. See Fig. 166.

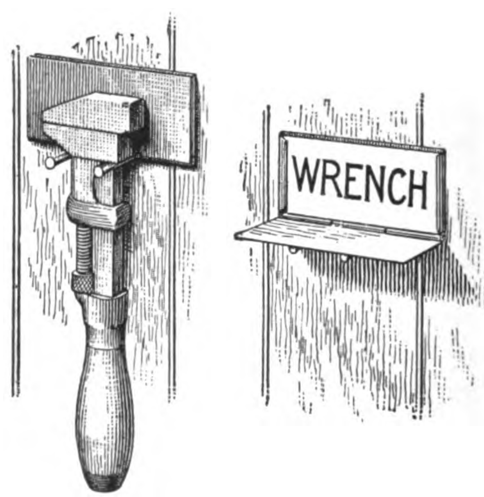


Fig. 166. A Place for Tools

When the seams are to be countersunk—that is, where a perfectly smooth joint is desired—this is accomplished as shown in Fig. 167. After the sheets have been pricked ready for the brake a slight bend is made in the narrow end of the sheet on one side only, as shown at B, the crease *a* not to be any wider than the thickness of the metal used. After all the sheets have been bent in this manner they are formed in the regular manner and set together as shown at A. Where the bends are square the corners are slightly notched. This makes a smooth seam, especially for circular work, which by reason of this class of work requiring numerous laps and joints, should have all as smooth as practical. This naturally is a decidedly important phase when work is required that will come under direct and close observation. It is to be remembered that in forming the sheets, care must be used so that the countersink will come to the inside of the formed sheet.

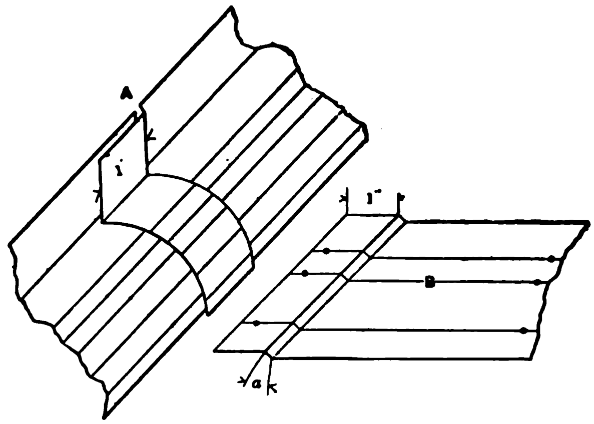


Fig. 167. Making Smooth Joints

Perhaps the following method of testing a right angle or square may prove of interest. Draw any line as A B in the accompanying illustration Fig. 168 and with any radius, using any point on A B as C as center, describe the semicircle *a c b*. If the square is a true right angle one arm should meet the diameter at *b*, the other arm at *a* and the corner come directly on the circumference at *c*.

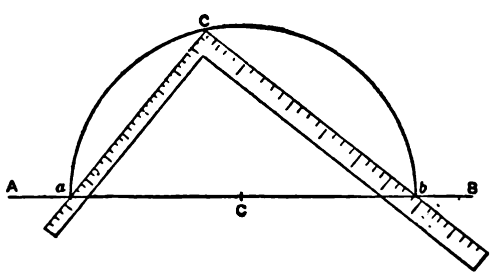


Fig. 168. Testing a Square

Every man conducting a shop whether in the plumbing or tinsmithing business has at some period in his experience had the acid bottle broken and the fumes affecting all of the goods and tools in the shop to their detriment. A very good protection for the bottle is a wood covering as shown in the accompanying illustration, Fig. 169. It is made substantially of 1-in. boards and of a size to fit a one gallon bottle snugly so that it cannot rattle around and possibly through motion sustain destruction. The box is nailed substantially together and is provided with a cover as shown. A wire bail may be readily attached so that it can be carried. This box enables it to be set under a bench or in any other place where the metal goods and tools of a plumbing and tinsmithing establishment cannot find contact with it and fracture it. The simplicity of the protection recommends it to illustration so that tradesmen generally can profit by the provision of a similar protection to an article which is entitled to some extra consideration on account of the troubles it can create. A variation of this form which would probably commend itself to some would be the addition of a weight in the bottom.

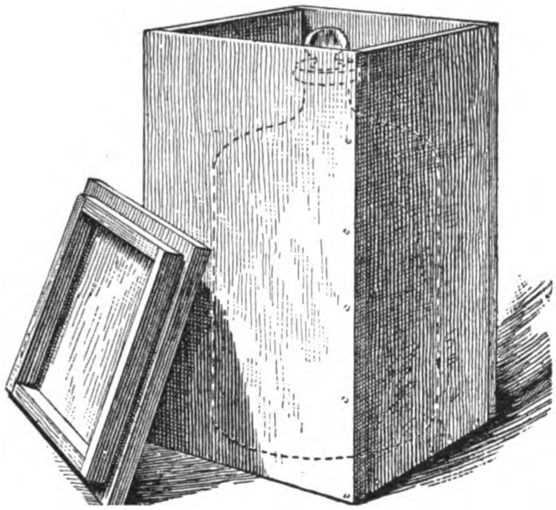


Fig. 169. Protecting the Acid Bottle

From time to time the necessity arises in a sheet metal shop for some kind of scaffolding, and usually the tradesman sends to the carpenter and borrows his. But this often takes considerable time and is, moreover, an annoyance to both mechanics. So a pair of portable brackets that can be easily stored, and at the same time readily set up on the work, would be a convenience to most shops and would undoubtedly pay for themselves in a short time.

A builder gives the following method for making such a bracket: Each bracket is made of 2×4 sticks, 36 inches long for the upright and one of the same dimensions, only 48 inches long, for the bracket. The longer piece is placed on top of the shorter, as shown in Fig. 170, and they are spiked together with two 20-penny nails,

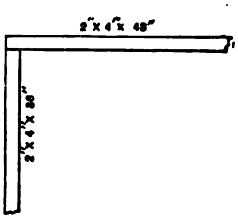


Fig. 170. The First Step

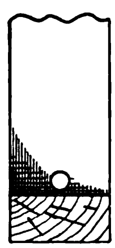


Fig. 171. The Position of the Hole

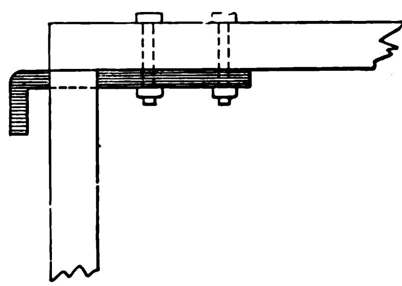


Fig. 173. The Hook Placed in the Bracket

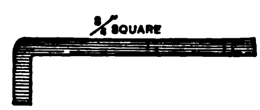


Fig. 172. The Iron Hook

driven as near the outside as possible. A ⅞-inch hole is bored in the short piece directly under the top piece, as shown in Fig. 171. Through the hole is placed an iron hook, shown in Fig. 172. This hook is made of ¾-inch bar iron, 9 inches long, and is drilled for two ⅜-inch bolts. The hook part is 2 inches long. This is bolted directly to the top bracket, as shown in Fig. 173, with the hook part extending about an inch from the back.

The bracket is completed, as shown in Fig. 174, by nailing diagonal pieces 1×6 near both ends. These are securely nailed with 10-penny nails, making a cheap, light bracket. To place this bracket on a building a hole 1 inch wide and 3 inches high is cut into the sheathing close to the stud, which allows it to be unhooked easily and at the same time gives additional stability because of its position near the stud.

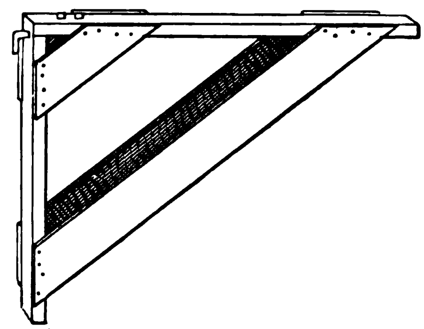


Fig. 174. The Complete Bracket

Instead of employing the hook to secure the scaffold bracket to the wall, they can be taken off and the brackets held in place by jamming a stud, of the right length, in the ground, the other end of which is placed in the angle of the bracket as indicated by Fig. 175.

When you have lent a tool to a workman the real ownership of it is often lost sight of and there is usually a dispute before one can regain his property. This is avoided when the full name of the owner is on it. The way in which the name may be engraved on any steel tool is as follows:

Take a glass bottle and partly fill it with vinegar. Place into it enough table salt to make a strong solution. Pour in enough blue vitriol to make the solution dark blue in color. Now take a piece of soap, rub it over the tool on which the name is desired, and with a scratch awl or pointed nail write the name and address. Spread the solution over the written words. When the outline of the name changes to a dark red color wash off the soap, and it will be found that the solution has eaten into the steel and shows the name and address of the owner of the tool in his own handwriting indelibly engraved in the hard steel. The cost of the solution is only a few cents, and any mechanic who is troubled by having his kit of tools depleted by those who borrow and seldom return can possibly use this suggestion to advantage.

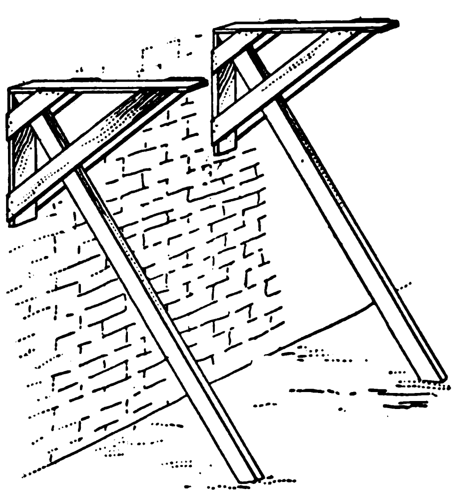


Fig. 175. Supporting Without Hooks

To clean copper work, with a rag or wad of cotton waste moistened in water clean off all acid, etc. Then go over again with a dry rag, after which the copper work is thoroughly rubbed over with a rag saturated with linseed oil. All solder that shows is bronzed by painting the soldered part with a thin solution of alcohol and shellac and before it can dry—which it does very rapidly—sprinkling powdered bronze on the shellac. It is often necessary to repeat this after the erection of the work, for on most jobs there is considerable soldering to do, and acid may inadvertently be spilled or spattered over the work. Should verdigris have formed this must first be removed with a rag soaked with water and sand; sometimes sandpaper must be used.

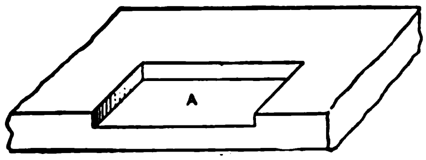


Fig. 176. Notching Out the Bench

When soldering small dentils, ornaments or other small work in cornice making, it is often the case that the outside of the work is blackened by the hot copper burning the wooden bench underneath and leaving a dark spot on the work just soldered. This can be overcome by notching out the bench as shown at A in Fig. 176 and by inserting into this a slab of marble or 3/8-inch thick skylight glass. This avoids the charring of the wooden bench and the glass or marble can be cleaned when necessary. Sometimes the glass is laid directly on the bench, thus obviating cutting.

As is well known, sal ammoniac is used to tin the soldering coppers and the structural formation of this material is such that, unless bound, it will disintegrate; that is, it will cleave along the lines of the grain or crystal and instead of having a lump there will be but a mass of stringy-like pieces.

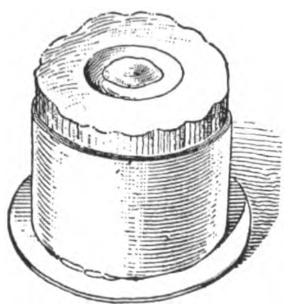


Fig. 177. Sal Ammoniac Cup Made of Sheet Lead

To avoid this, cornice-makers wrap a piece of sheet lead around the lump of sal ammoniac as tightly as possible and solder the joint, as in Fig. 177. Then a piece of lead is cut about an eighth of an inch larger all around than the wrapping and soldered to it for a bottom. The idea of using lead is that, as the sal ammoniac dissolves when the hot soldering iron is rubbed across the upper surface, the lead will also melt, thereby always leaving some of the sal ammoniac exposed.

To further add to the convenience of this essential adjunct to the soldering kit, the surface of the sal ammoniac is hollowed out in the center and a large lump of solder left therein so when tinning the copper there will be sufficient metal to obviate the need of taking a bar of solder to melt on the soldering copper during the operation of rubbing the copper to and fro across the sal ammoniac.

The lump of solder adheres to the sal ammoniac and will not be lost while being tossed about in the tool bag. At any rate, sal ammoniac should be wrapped in a rag to minimize rusting of tools.

A number of copper moldings were set over windows where, because of the moldings being in place before the windows, and the inaccurate brick and carpenter work, it was impossible to tell beforehand how wide the soffit of molding should be. The soffits were measured and put in place after setting the moldings and windows. As the molding was in long stretches, considerable soldering was required for the seams of the soffit piece, necessitating a soldering of an under surface.

This was accomplished by forging the soldering copper to a wedge shape and keeping three sides as dirty as possible, filing and tinning one surface of the copper only, and remembering to leave the burr on the side of this surface to prevent the solder from flowing off the surface of the copper.

As the metal was copper, the seams were tinned prior to setting the soffits. As is customary, a liberal quantity of killed acid was brushed on and into the seam. Then, with a copper at the right heat, as much solder was melted on the tinned surface as would stay there. The edges of the seam were held together by pushing against that part of the soffit that was below the other piece of soffit, with the end of the bar of solder; and short stretches of the seam were soldered by moving the soldering copper along slowly to allow the solder to soak into the seam. Also at intervals the lock of the molding was tacked with solder, so that the soffit edge would stay in the lock.

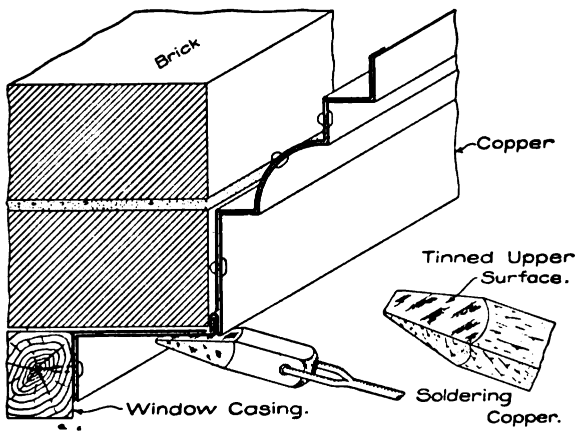


Fig. 178. Soldering Copper and Position In Overhead Soldering

In doing such work the soldering copper must not be brought in contact with the metal too abruptly, for if so the hot solder is sure to splash. Inasmuch as there is likely to be moisture on the upper surface of the soffit, it is at times impossible to prevent the hot solder from spattering. It is therefore advisable that the operator wear gloves; and as the eyes must be close to the work to watch it carefully, automobile goggles would aid in saving the eyes from injury.

Should some of the acid enter the eyes, however, there being greater danger from this than the solder, the eyes should be immediately bathed in clear running water and the man should go home, for it is highly probable that the eyes would "catch cold." It is recorded that a delicate operation was once necessary to remove a speck of solder, so small it could hardly be seen, from the pupils of one man's eyes; hence the need of the precaution.

LETTERS AND FIGURES IN SHEET METAL

One of the first steps necessary in the development of patterns for letters and figures is to know how to draw correctly the various style letters in proportion to their hight. A simple rule given in most text books is to proportion the letters or figures by squares, in which the hight of the letter or figure being known it is divided into five equal spaces the same size square being carried along horizontally indefinitely. No matter what hight the letter has it should always be divided into five equal spaces. The thickness of the letter is in every case governed by the size of the square. For example, a letter 10 inches high divided into five equal parts gives 2 inches to each part, thus making the hight of the strip 2 inches.

In Fig. 179 is shown a form of letter sunk on its face, the sinkage being cut out by means of a small chisel, then sunk as deep as required by sections A and B, by means of soldering strips on the inside and bending the outside strip direct onto the letter as is most convenient. One of the most difficult forms of letters to be worked out, on which a knowledge of pattern cutting is required, is known as flaring letters, shown in Figs. 180 and 181. The method is shown illustrating the patterns for only letters A and U. Any other letter or figure can be developed, using the same principles. Thus in Fig. 180 is shown the letter A, and B is the section or profile. For the pattern for one leg of the letter A draw the stretchout of the section B at right angles to the leg of the letter, as shown by the small figures on the line C D. At right angles to C D and through the small figures draw lines, which intersect with points of similar numbers on the letter A, as shown. For the cap of the letter A draw the line F E and place upon it the stretchout as far as required, as shown by 3 to 6, the pattern being obtained as shown by the dotted lines. In similar manner obtain the pattern H J and K L, as shown.

In Fig. 181 is shown the letter U, where part of a circle is added to the letter. The arc is struck from the center A; then through A and at right angles to the vertical arms of U draw the line B C. At right angles to B C and from A draw the vertical line A 5. Now at right angles to A 5 and in its proper position draw the profile D, as shown.

For the radii for the flaring patterns extend the slant lines in the direction of the line B C, intersecting same at E and F. Then will E 1 be the radius for the inner flaring strip and F 1 the radius for the outer flaring strip. Divide the inner and outer circle of the letter U into equal spaces, which place upon their respective patterns, as shown by similar figures. Then will J be the inner flaring pattern and H the outer flaring pattern. L will be the pattern for the semicircle. The patterns for the straight arms are obtained in similar manner, as is shown in Fig. 180.

In Fig. 182 is shown a style of letter usually obtained from dealers in stamped work, it not paying to make same by hand. When fastening letters they are

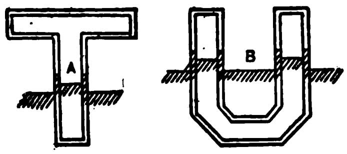


Fig. 179. Letters with Sunken Face

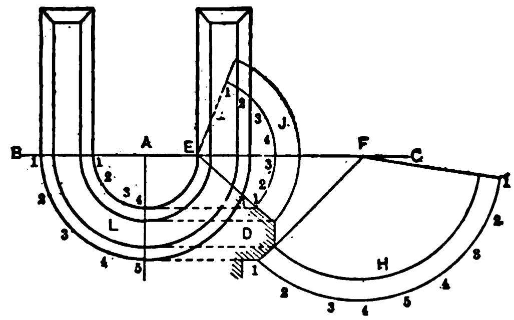


Fig. 181. Flaring Patterns for Letter U

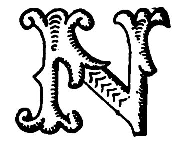


Fig. 182. A Stamped Letter

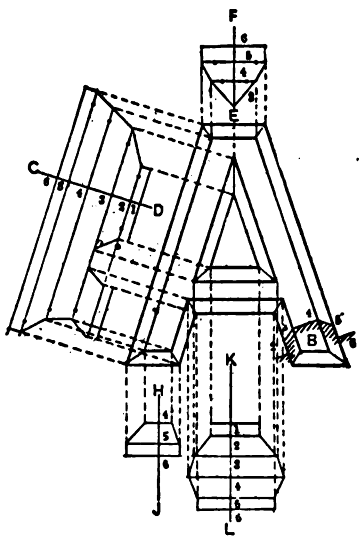


Fig. 180. A Flaring Letter

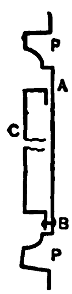


Fig. 183. Two Methods of Fastening to a Metal Panel

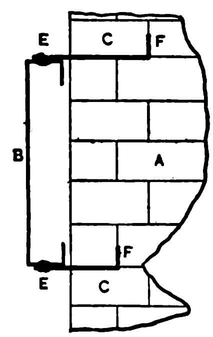


Fig. 184. Method of Fastening to a Brick Wall

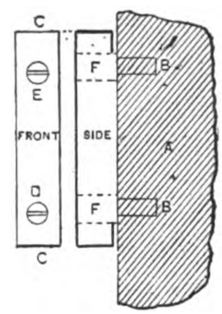


Fig. 185. Method of Fastening Letters to a Stone Wall

usually fastened to sheet metal, brick, stone or iron in the manner indicated in Figs. 183, 184 and 185.

In Fig. 183 are shown two methods of fastening to a metal panel. Let P P represent the panel and C the letter. A flange can be bent inward and soldered at A or a flange can be bent outward and riveted at B.

In Fig. 184 is shown the method of fastening the letters to brick walls as the work progresses. Let A be the brick wall and B the letter. Braces of $\frac{1}{8} \times 1$-inch band iron, shown by C C, are riveted to the letter at E and E. Then when the wall is as high as required, as at C, set on the letter or letters forming the name, having angles bent onto the braces at F and F. The wall is now carried upward, building in the angle C F, which secures the letter.

In Fig. 185 is shown the method of fastening letters to stone work. Let A be the stone, having holes drilled into same at B and B in their required position, as shown. These holes are now blocked out with lead. Let it be assumed that in fastening the letter I, holes are punched into the face of the letter—CC—to admit a ¼-inch thick screw, as shown by E and E. On the back of these letters, equal to the depth of the letter, tubes are soldered, as shown by F and F. Then, using round-headed brass wood screws and passing same through these tubes, the letter is screwed into the lead, which being soft admits the screw easily, the tubes preventing the face from bulging inward. If A were cast iron instead of stone, holes would be tapped into same, fastening in the same manner, using screws to fit the tapped holes. Where letters are fastened on a wood panel, flanges could be bent outward and fastened with small round-headed brass screws.

ILLUMINATED SIGNS OF SHEET METAL

A branch of sheet metal work to which very little attention is given, and work often encountered by cornice makers, is that of illuminated signs of stencil work in sheet metal. These signs are so made as to present a neat appearance by day as well as by night, by means of colored glass placed over the stencil cut and lights of oil or gas placed on the inside; in some cases incandescent lights are used. In Fig. 186 is shown a panel sign, the name or design being cut to suit, and colored glass fastened behind the stencil cut. This sign is well suited for show windows, being placed directly in front of the gas jets, which brings out the name prominently at night. Let A B represent the elevation of the sign, and C the section, in which D is the glass, fastened by the angles E and F. Diagram E shows an enlarged view of panel, glass and metal angles, while F shows the rear view, in which F is the panel, H the glass and J K the angle tacked with solder to the panel.

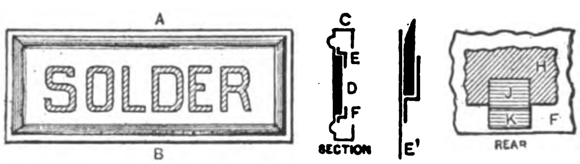


Fig. 186. Stencil Signs in Panel

In Fig. 187 is shown the elevation and section of a swinging sign, which can be drawn in against the walls of the building by day and swung out at night, and is usually employed for theatres or other public places. A shows the elevation of the sign, being finished on both sides, while B is a hood over it, acting on the same principle as a ventilator, allowing for the escape of the heated air inside, with a ridge cresting, C, all made of galvanized iron or tin and painted or japanned to suit. Any design or name can be cut into the lantern, and colored glass placed on the inside, as described with Fig. 186. The braces for swinging the sign are constructed as follows: D E is the line of wall or building into which the pin F is fastened, the plan view of pin being shown at H. J is another pin driven into the joints at the required distance. K L is a T-iron brace, the full length of the lantern, with a pivot, I, passing through the T-iron and pin F. A hole is punched in the T-iron at M, into which the rod N P is fastened, the same rod being fastened at R in the pin J. Where the rod passes through the hood B at S a cap is placed to avoid leakage. The section shown is taken on the line T U. A^1 is the brace, a section of which is shown in B^1, resting upon the body of the ventilator and upholding the hood. C^1 is the gas pipe, with the burner D^1 placed in such a position as to bring the flame E^1 between the stencil cuts F^1 F^1. Y is a section of the T-iron rod, the body of the ventilator being supported on it by

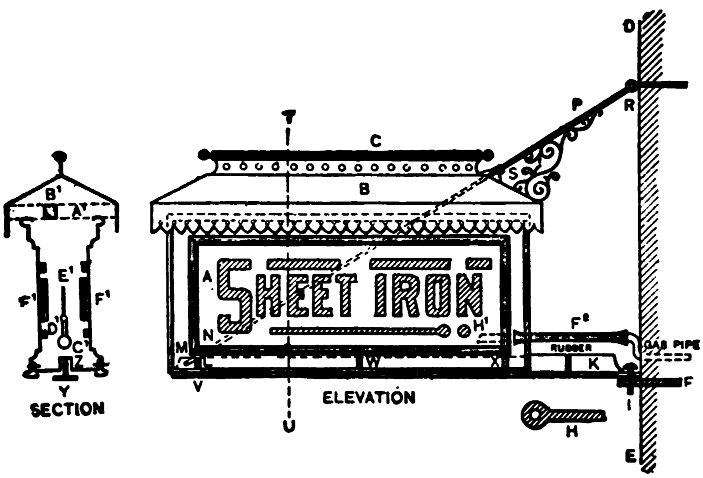


Fig. 187. Section and Elevation of Swinging Sign

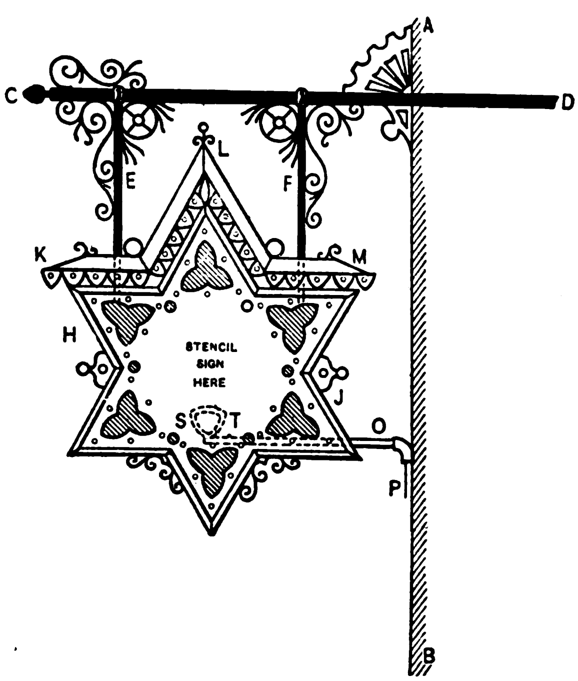


Fig. 188. Elevation of Stationary Sign

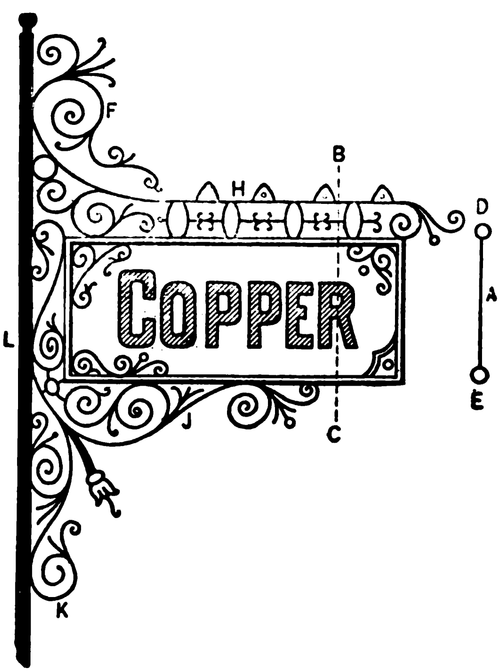


Fig. 189. Example Where Stencil Work Can Be Applied

means of the brace Z, resting over the T-iron, as shown, and riveted at the sides at intervals, shown in elevation by L W X. H^1 in elevation shows the burner pipe connected to the gas pipe from the house line by means of the rubber tube F^2, which permits the lantern to be swung around.

Fig. 188 is a stationary sign, which can be made in any desired shape. A B is the wall line, with the rod C D plugged into the wall, 1-inch gas pipe being of sufficient strength, with a zinc ball at the end C. E and F are straps of band iron fastened around the rod, as shown, and secured to the sign on the inside. The sign is in the form of a star with stencils and name cut to suit, having a depth of about 7 inches. K L M is a hood, being fastened to the body in a manner similar to that in Fig. 187. O P is the gas inlet in Fig. 188, the jet being shown by S T. The ornamental scroll work is made of 1-16 × 3/8-inch band iron riveted together as is most convenient and either galvanized or painted. Fig. 189 illustrates how stencil work can be applied without glass background. Let L represent a gas pipe or tubing, and F H J K ornamental scroll work made as described in Fig. 188. A in Fig. 189 shows a section on B C, showing the metal plate A of heavy iron in the center, and the tubing D E set around it. This style of sign is made stationary for use over a store or window, or at the corner of a building. There is no limit to styles or shapes, which are easily designed by a little exercise of the imagination.

SOME CHARACTERISTIC SIGNS

The business man who runs a tin shop in connection with his furnace, roofing and general sheet metal working business will find in Fig. 190 a sign used by a concern doing a general jobbing business. The ground consists of a piece of sheet iron, around which is an ornamental scroll frame, made of band iron 1/8 inch thick and 1 inch wide, which readily lends itself to the bends necessary to form the ornamental shapes presented. The sheet iron is attached to the scroll frame by means of bolts which are split at one end and provided with rivet holes for fastening to the sheet iron. The supporting bar may either be forged in the tin shop or by a smith of deeper dye—the blacksmith, who is better qualified for working in heavier iron. One end may either be imbedded in a brick wall or provided with offsets with holes for fastening to the framework of a building by means of wood screws, the outer end to be supported by means of wire guys.

A scroll of sheet metal, shown in Fig. 191, is suggestive of the ornamental architectural sheet metal work produced in a modern cornice shop, and is as well adapted for the tinsmith and the stove dealer as for the cornice and skylight maker.

Signs of this character, if adopted by the trade, would be somewhat novel, and if widely used might enable the general public to locate a steam fitter's, plumber's, or

Fig. 190.
A Sign that Many Can Use

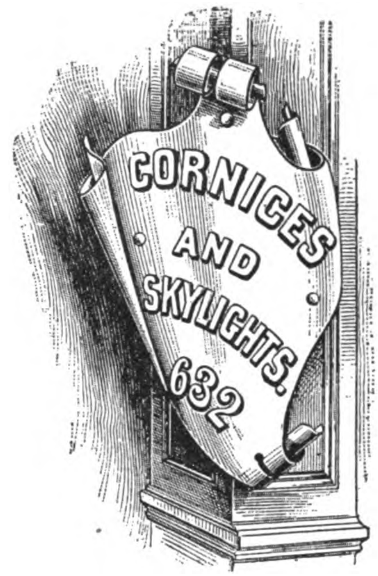


Fig. 191. For the Architectural Sheet Metal Worker

tinsmith's shop as readily as the barber shops are located by the striped poles universally used by tonsorial artists. Such signs, moreover, possess the additional merit that they can be produced in the shops of those who use them, whereas the barber will still be under the necessity of calling upon the carpenter as well as the painter.

MAKING SCROLL SIGNS

In working out sheet metal signs, as is shown in Fig. 192, a neat effect is obtained by placing scrolls at the top, bottom and corners. The scroll must be laid out in the flat correctly so that, when rolled up, it will have the proper appearance. In Fig. 193 is shown how this can be accomplished. Let A B C D represent the flat surface of one corner of the sign on which a scroll is desired, as shown in Fig. 192. In practice, the section is first laid out, from which the elevation is projected as follows: In its proper position draw the desired section of the scroll, as shown by the small figures 1 to 12 in the elevation in Fig. 193. Directly in line with the elevation draw a duplicate of A B C D, as shown by A^1 B^1 C^1 D^1. Divide the section of the scroll into any number of desired spaces, as shown from 1 to 12, the spaces from points 8 to 12 being smaller, because the curve is also smaller. At right angles to A^1 B^1 draw the line F G, upon which, starting from the line A^1 B^1, place the stretch-out of the scroll, as shown from points 1′ to 12′. At right angles to F G draw the line 12′ I and 12′ H, equal to the desired width at the end of the scroll. From I and H draw free hand

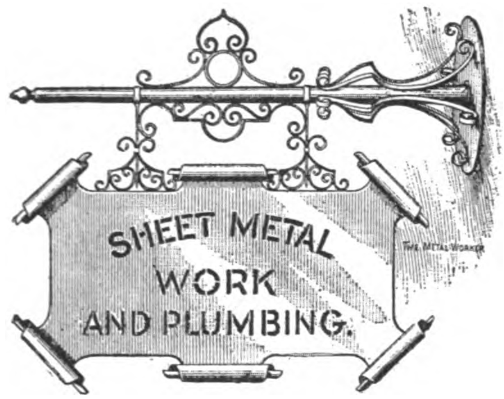


Fig. 192. A Finished Sign

curves to B^1 and A^1 respectively, as shown. Then will H I B^1 A^1 be the pattern for the corner scroll.

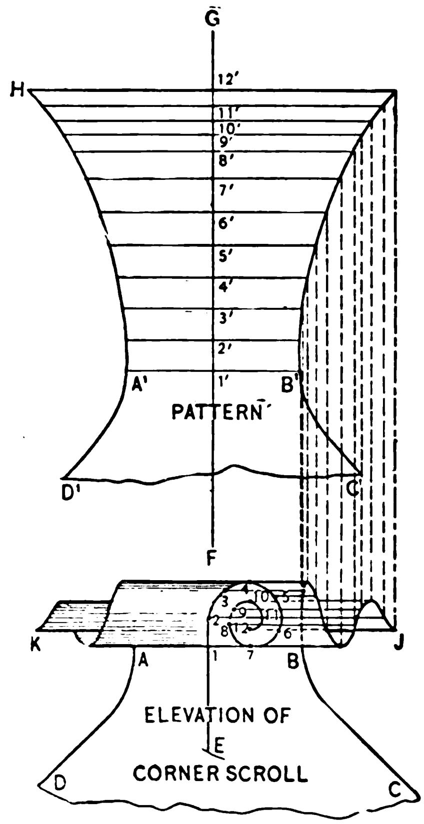


Fig. 193. Elevation and Pattern

If it is desired to know how this scroll will look when rolled up, then, at right angles to F G and through the intersections 1′ to 12′, draw lines intersecting the curves I B^1 and A^1 H. From these intersections, shown on one side only, drop lines intersecting similar numbered lines drawn from the intersections in the profile of the scroll in elevation parallel to A B. Trace a line through the points thus obtained, as shown by B J and A K, which gives the projections at the ends of the scroll when rolled up.

GASLIGHT FLASH SIGN

Those who wish to attract attention to their show windows in the evening will be interested in this article. It has all the appearance of the electric flash signs used by merchants, and the contrivance works as well as could be desired. The flow of gas is regulated by means of a diaphragm having a varying pressure upon it. When enough gas for a flash has entered the pipe the diaphragm is forced up and a plug is worked by it automatically in a supply pipe. Thus the gas is let into the lamps regularly in small quantities and makes a bright light for an instant, when out it goes, save enough of a "pilot" to keep the burner going. In the illustration, Fig. 194, the figure of a letter "A" shows how the jet is arranged. The part to the left indicates the face of the letter opened out, the same being hinged at the bottom, as shown. Each letter is a sheet iron lantern with a reflecting back wall, fitted inside with an incandescent burner. The front of the lantern is of opal glass, to show up the characters.

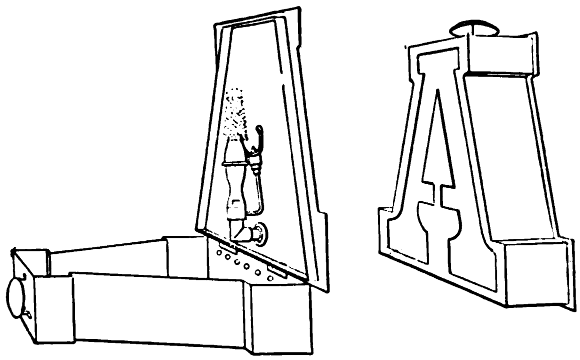


Fig. 194. Gaslight Flash Sign

The air currents are calculated so as to prevent overheating, and at the same time to prevent undue action of wind. In this case the flow is regulated by clock work, which acts upon the gas supply to each letter, there being a separate outlet for each letter, all controlled by the rotation of the same cylinder.

The consumption of coal gas per letter is about half the full consumption of the incandescent burner used, and for ten letters, ten incandescent burners are enough, with a consumption of about 4.5 cubic feet each—that is, about 2.25 cubic feet of coal gas each in actual use, while with electricity 122 lamps of five candles each would be required. To compute a corresponding use of acetylene is easy. The cost with gas is about one-eighth that of electricity for the same purpose.