PRACTICAL
SHEET METAL WORK
AND
DEMONSTRATED PATTERNS

A COMPREHENSIVE TREATISE IN SEVERAL VOLUMES ON
SHOP AND OUTSIDE PRACTICE AND PATTERN DRAFTING

VOLUME III
ROOFING

COMPILED FROM THE
METAL WORKER
PLUMBER AND STEAM FITTER

EDITED BY
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PREFACE

THROUGHOUT its existence the METAL WORKER, PLUMBER and STEAM FITTER has had the services of experts in the lines the paper represented, especially so in the sheet metal trade and pattern drafting. The experience of these experts is used to answer queries of readers who, having a problem they cannot solve, resort to the columns of the paper.

Naturally then, a large collection of every-day problems has resulted and with the assurance by numerous inquiries that in book form these solutions would be invaluable they are compiled into a series to be known as Practical Sheet Metal Work and Demonstrated Patterns.

THE NEW METAL WORKER PATTERN BOOK has long been the standard authority on the science of pattern drafting and is thoroughly complete for one desiring to study the science of pattern drafting or to use as a reference book of such.

And as most of the problems appearing in the columns of THE METAL WORKER were essentially practical it was deemed advisable, instead of just taking those problems of pattern drafting and adding them to THE NEW METAL WORKER PATTERN BOOK and making no use of the practical articles, to compile these series which will virtually be AN ENCYCLOPEDIA OF PRACTICAL SHEET METAL WORK.

The first four books will comprise articles on conductors, conductor heads, roof connections, gutters, eave troughs, roofing, ridging, finials, cupolas, etc., etc. In all a valuable reference library for the progressive sheet metal worker doing roofing work.

Inasmuch as in a compilation the work of many authors is selected, some under a pseudonym, no authorship can be given these books. The matter coming from a paper whose position of absolute authority on these subjects is undisputed should be ample recommendation. To the writers of the articles chosen sincere appreciation is expressed by the publishers. The majority of men from whom these articles emanate are not professional writers in the sense of devoting all their time to the production of printed matter, and thereby making their livelihood, but are actively employed at the trade and prepare these descriptions, expositions and demonstrations during spare time, often with no recompense than the knowledge that they are helping their fellow men; hence, too much credit cannot be given these authors' efforts, and it may be at least stated that the list includes: L. S. Bonbrake, H. A. Daniels, Henry Hall, George W. Kittredge, John W. Lane, William Neubecker, W. E. Osborne, C. T. Richards, H. Collier Smith.

J. Henry Teschmacher, Jr. (Henry Hall)

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Practical Sheet Metal Work and Demonstrated Patterns

MEASURING ROOFS

This article will give the rules for obtaining the true amount of material required when covering flat or hipped roofs and square, octagonal and conical towers; also the methods of obtaining the true lengths of the hips and valleys on pitched roofs. The diagrams shown herewith are not drawn to a scale as architects' drawings will be, but the measurements on the diagrams are assumed, which will clearly show the principles which must be applied when figuring from scale drawings or from sketches made when measuring the roof itself.

Assuming that the plans from which we are figuring are drawn to a ¼-inch scale, when measurements are taken every ¼ inch represents 1 foot, ⅛ inch equals 6 inches, and so on. If the drawings were drawn to a ½-inch scale, then ½ inch would equal 12 inches, ¼ inch equal 6 inches, ⅛ inch equal 3 inches, 1-16 inch equal 1½ inches, etc. When going estimating a small scale rule 6 inches in length is usually carried in one's pocket with pencil and note book and some loose pads. The title of the items which we propose to take off the plans is usually written as follows:

(Mention name) (What kind)
Estimate to.. for..
(Number, street and city)
roofing for building number...
(Name) (Name) (Name)
Mr. ....owner; ....and ....
(Number, street and city)
architects; number...

We now read the specifications carefully and note what material is to be used for the roof covering. If tin, note what brand is required and its thickness, IC or IX; if it is to be laid on paper or painted underneath before laying and how many coats will be applied to the top; what size sheets and how many pounds of solder will be used to the square (a square in this connection means a surface space of 10 × 10 feet); and will the tin be laid flat or standing seam. After observing these points the quantities are taken off the plans. If the roof is to be covered with slate, note what size and how thick the slates used are to be; if they are to be nailed on sheathing or porous fire proof blocks, and with galvanized or brass nails; if the slates are to be laid on paper, and if the flashing and valleys are to be of tin, galvanized iron or copper.

Knowing all this we can make our estimate accordingly. Next ascertain if the specifications call for a tile roof and whether shingle tile, Spanish or other form of tile; if they are to be laid, as mentioned, in connection with slate roofing or are to be fastened to the purlin with copper or galvanized wire. All these are important considerations in arriving at a close estimate. If a felt roof is required and the tinner is to attend to the flashing, note how many layers of felt are necessary, also if each layer of felt is to be thoroughly saturated with hot asphalt cement or just coal tar, and if gravel or slag is to be placed over the top layers. If the roof is to be covered with shingles, and assuming that the tin roofer looks after the flashing, note what kind and size of shingles are to be used, how much they will be laid to the weather and what kind of nails are to be employed, etc. We must become familiar with these points in order to figure accurately.

The following are methods of arriving at the amount of roofing required for flat roofs; so to figure the amount of material required on a flat roof, shown in Fig. 1 by A B C D, and which measures 20×20 feet. Multiply 20×20 feet giving 400 square feet. The chimney measures 1×2 feet and equals 2 square feet; deduct this from 400 square feet. Then 398 square feet will be the true amount of surface to be covered on the roof shown in Fig. 1. Allowance should be made for the flashings turning up against and into the wall at the sides. Fig. 2 is a little more difficult, and shows a plan having air shafts at the sides. A B C D represents the general plan view of the roof, which measures 22×84 feet, as shown. In a roof of this kind we will figure as if there were no air shafts at all, and then deduct the shafts and chimneys later. Thus 84×22 feet equals 1848 square feet. The shafts at each side are cut at an angle of 45 degrees, and measure from the outer corners *a* to *b* 20 feet, and from the inner corners *c* to *d* 10 feet. Now, as the angles are 45 degrees, we must average the distance between 10 and 20 feet, which will measure 15 feet, as shown from *e* to *f*. As the distance from *i* to *j* on a horizontal line is 5 feet, multiply 5×15 feet, giving 75 square feet; double this for the two shafts, making 150 square feet.

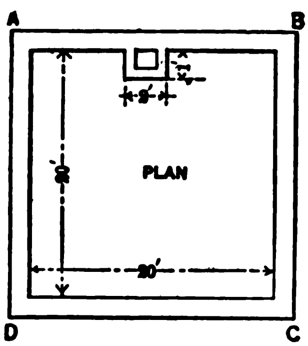


Fig. 1. Plan of Square Roof

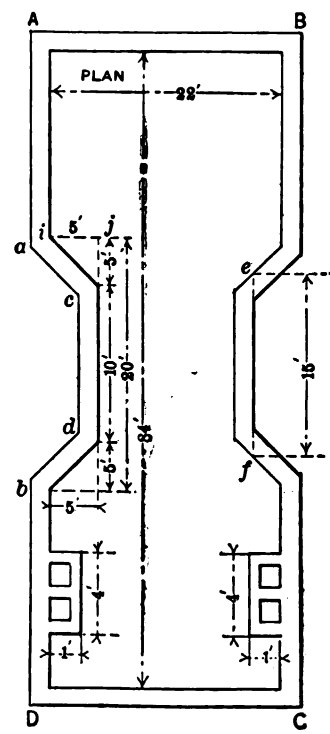


Fig. 2
Roof of Building with Air Shafts at the Sides

Two chimneys are shown, each 1×4 feet, equals 4×2 feet equals 8, plus 150 feet equals 158 square feet. Now deduct 158 square feet from 1848 square feet, leaving 1690 square feet of roof surface in a roof of the dimensions of Fig. 2, minus the flashings.

Another case of flat roof that may arise is shown by A B C D in Fig. 3. In this case the same rule is employed as that given in connection with Fig. 2. Multiply the width by the length in Fig. 3, thus: 18×60 feet equals 1080 square feet if the roof has no breaks. Now deduct the chimney of 1×3 feet, which equals 3 square feet; deduct the shaft of 8×14 feet, which equals 112 square feet. The angle at the rear of the building measures 8×20 feet, which equals 160 square feet; from this deduct one-half, which leaves 80 square feet. Now then we have 3 + 112 + 80 feet equals 195 square feet to be deducted from 1080 square feet, which leaves 885 square feet of material required to cover a surface of the size given. In diagram E is shown the principle which is applied when figuring the deduction of angles. The size of the square is 8×20 feet and equals 160 square feet, as mentioned. Now by drawing the diagonal *a b* we cut this amount in half, as shown by the shaded lines, and will make it 80 square feet, as noted.

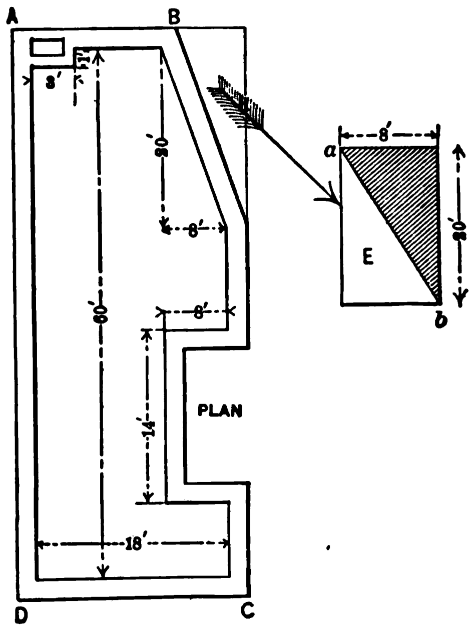


Fig. 3. Another Shape of Flat Roof

We now have pitched roofs, as shown in Fig. 4, in which A B C shows the front view of the building and D E F G the side. The length of the rafter measures 12 feet, as shown from A to B in front view, and the length from G to F on the side view measures 66 feet. Now 12×66 feet equals 792 square feet for one side. Double this and we have 1584 square feet. Now deduct the chimney, which is 6 feet wide by 2 feet, shown on the rake; 2×6 feet equals 12 square feet, which deduct from 1584 square feet, and leaves 1572 square feet for a plain pitched roof.

In Fig. 5 A B C shows the elevation of a pitched roof having four hips, and D E F G the plan of the hipped roof. The diagonal lines shown from D to F and E to G show the hip lines in plan. While it may appear difficult to some to figure the quantities in a hipped roof, it is very simple, if the rule is understood. The length of the rafter shown from A to C in elevation is 10 feet and the width of the building at the eaves of the roof is 16 feet on each side, as shown in plan. As the hipped roof runs to an apex in the center, then the distance between the eave line D E and apex a in plan will measure one-half of 16 feet, or 8 feet, as

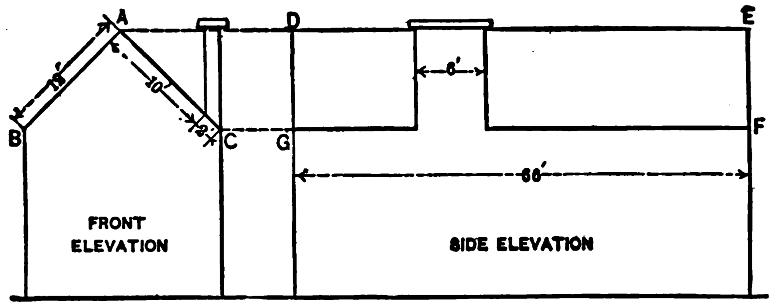


Fig. 4. Simple Form of Pitched Roof

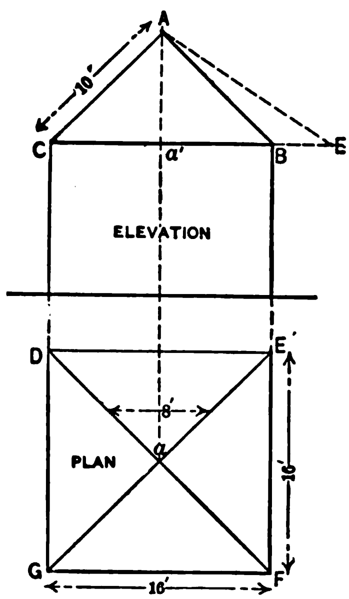


Fig. 5. Pitched Roof with Four Hips

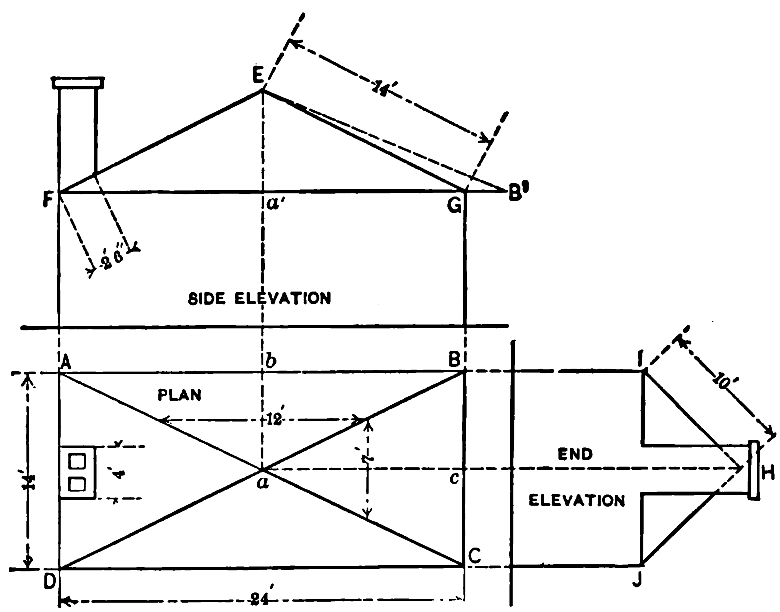


Fig. 6. Diagram Showing Method of Estimating Hip Roofs of Unequal Pitch

shown. Now multiply 8×10 feet equals 80 feet by 4 sides equals 320 square feet of roofing required on a building of the dimensions given. As the hips must be covered with a metal capping to avoid leakage on roofs, it becomes necessary to learn how to obtain the true length of the hip. This is accomplished by dropping a line from the apex A in elevation, cutting the line C B at a'. Now extend the line C B as C E^1. Now take the distance of the diagonal a E in plan, and place it as shown from a' to E^1 in elevation, and draw a line from E^1 to A, which will represent the true length of the hip. Multiplying this amount by 4 will give the amount of capping or ridge roll required on a hipped roof of the size given.

The method of estimating hipped roofs when the sides are of unequal pitch is explained in connection with Fig. 6. A B C D shows the plan of the roof, the ends measuring 14 feet and the sides 24 feet. The side view is indicated by E F G, showing the rafters of 14 feet length, and the end view by H I J, with rafters of 10 feet length. As the length of D C in plan is 24 feet, then will the averaged distance between a and b be 12 feet, while using the same rule the averaged distance between a and c is 7 feet. Now multiply the length of the rafter I H in end view, which is 10 × 12 feet in plan, which equals 120 feet; twice this is 240 feet. In similar manner multiply the length of the rafter E G in side view, which is 14 × 7 feet in plan, which equals 98 feet; twice this equals 196 feet, plus 240 feet equals 436 square feet. Deduct the chimney, which measures 2 feet 6 inches in side elevation by 4 feet in plan and equals 10 feet; deduct this from 436 square feet, which leaves 426 square feet of covering required for an unequal pitched roof, as shown in Fig. 6. For the length of the hip take the distance from A to B in plan and place it on the line F G extended in side view from a' to B^1. Then draw a line from B^1 to E, which is the true length of the hip for one corner.

A more difficult problem in roof measurements is illustrated by Fig. 7, in which a deck and mansard roof is shown, with intersecting dormers. A B C D shows the side view and A^1 B^1 C^1 D^1 the end view. The plan of the mansard and deck roof is shown by E F G H and I J K L, the dormers being indicated in the views, as shown. It is desired to see how much roofing material will be required to cover the mansard and deck roofs, also the tops and the cheeks of the dormers; also how much hip ridge for the roofs and valleys for the dormers will be needed.

The roof measures at the eaves 18 × 32 feet, and at the deck 6 × 20 feet. Now multiply 6 × 20 feet equals 120 square feet; the chimney is 3 feet by 1 foot 6 inches, and equals 4 feet 6 inches. Deducting this will leave 115½ square feet of surface on the deck roof. Now average the distances between the eave lines E F and E H and deck lines L I and I J, as follows: 32—20 feet equals 12 feet, divided by 2 equals 6 feet. Now either add 6 feet to 20 feet or deduct 6 feet from 32 feet, which will leave 26 feet, as shown. In similar manner average the end, obtaining the amount of 12 feet, as shown. As the length of the rafters in both end and side views measures 14 feet, then multiply 14×26 feet giving 364 feet, multiplied by 2 sides giving 728 square feet. Then again 14×12 feet equals 168× 2 ends equals 336 square feet, making a total of 1064 square feet. We now deduct the dormers. The length of the dormer cutting into the main roof from *h* to *j* in side view is 8 feet 6 inches; the length of the cheek from *h* to *i* is 6 feet; the width of the dormer in plan is 4 feet. Now multiply 4 × 6 feet equals 24 feet by 4 dormers equals 96 square feet. The width of the pitched roof of the dormer cutting onto the mansard roof on the rake is 2 feet 6 inches, as shown in side view,

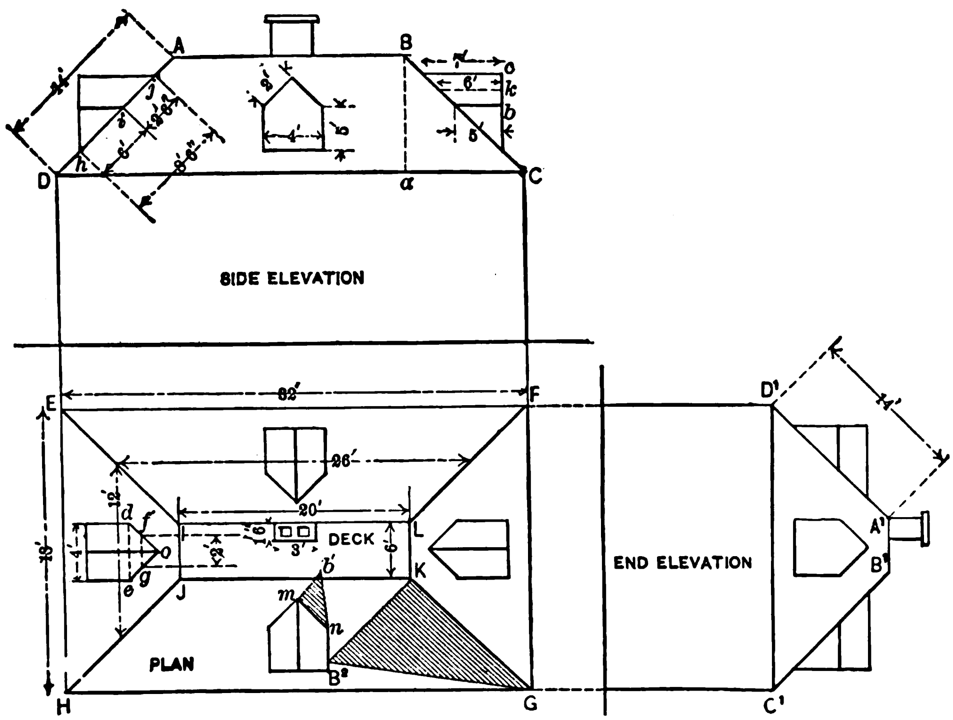


Fig. 7. Plan and Elevation of Mansard Roof with Deck and Dormers

while the averaged distance in the plan view of the dormer, between the line *d e* and the apex *o*, as shown from *f* to *g*, is 2 feet. Then 2×2 feet 6 inches equals 5 feet, multiplied by 4 dormers equals 20 feet. Now add 96 feet and 20 feet equals 116 square feet to be deducted from 1064 feet and leaves 948 square feet in the mansard roof minus the dormers. The covering for the cheeks and dormers is as follows: The hight of the cheek is 5 feet and the width of the cheek is 5 feet; 5×5 feet equals 25 feet, multiplied by 4 dormers equals 100 square feet. The pitch on the roof of the dormer equals 2 feet, as shown, while the averaged distance between the eave line *b* of the dormer and the ridge line *c* is shown by *k*, which is 6 feet. Then 6×2 feet equals 12 feet, multiplied by 8 roofs of dormers equals 96 square feet. We then have:

115½ square feet in deck roof,
948 square feet in mansard roof,
100 square feet in cheeks of dormers,
96 square feet in roofs of dormers, making a total of
1259½ square feet of material required for the mansard and deck shown. In previous problems the length of the hip was obtained from the elevation; in this one we will show how it is obtained from the plan, either method being desirable. From the point B in side view drop the vertical line B *a*, intersecting the line D C, as shown. Now take the distance *a* B and place it at right angles to K G in plan, as shown by K B^2. Draw a line from B^2 to G, which will be the true length of the hipped ridge or rafter. In similar manner the length of the valley behind the dormer is obtained. Take the hight of the roof of the dormer *b c* in side view and place it at right angles to the valley line of the dormer *m n* in plan, as shown by *m b'*. Draw a line from *b'* to *n*, which is the true length of the valley. Eight times this amount will be required, whether made of tin, zinc, galvanized iron or copper.

Fig. 8 shows a hipped roof with wing attached. Only special attention will be given to those parts which have not been explained previously. Assuming that the main building were minus the wing, it would be figured in similar manner as explained in connection with Fig. 6. We would, however, in this case have to deduct the space taken up on the roof for the chimney in Fig. 8, and deduct the space where the wing intersects the main roof. The chimney is 8×8 feet in size, as shown in plan, and intersects the pitch of the roof at a distance of 6 feet, as shown in front elevation. Now average the distance in plan between the apex *a* and the side of the chimney *b c*, as shown from *f* to *h*, which is 4 feet; then 4×6 feet equals 24 square feet. Now in the side elevation the chimney cuts into the pitch roof also at a distance of 6 feet, as shown.

The line of the chimney in plan *c i* equals 8 feet, and the ridge line, as far as chimney intersects it, from *a* to *j*, measures 4 feet. Then average the distance between *a j* and *c i*, which is 6 feet and is shown by *h k*. Then 6×6 equals 36 feet, multiplied by 2 sides equals 72 feet, plus 24 feet for the front equals 96 square feet, which would be deducted from the main roof covering. The space which will be deducted from the side of the main roof to admit the intersection of the wing is obtained as follows: The width of the wing in plan is 30 feet. Now average the distance between the points *m n* and the apex *o*, which will measure 15 feet, as shown from *r* to *t*. Now multiply 15 feet by the length of the rafter *y z* in side elevation, or 20 feet, which equals 300 square feet, also to be deducted from the main roof. For the amount of roof surface in the wing only proceed as follows: The length of the ridge from *o* to *v'* is 35 feet and the length of the eave from *n* to

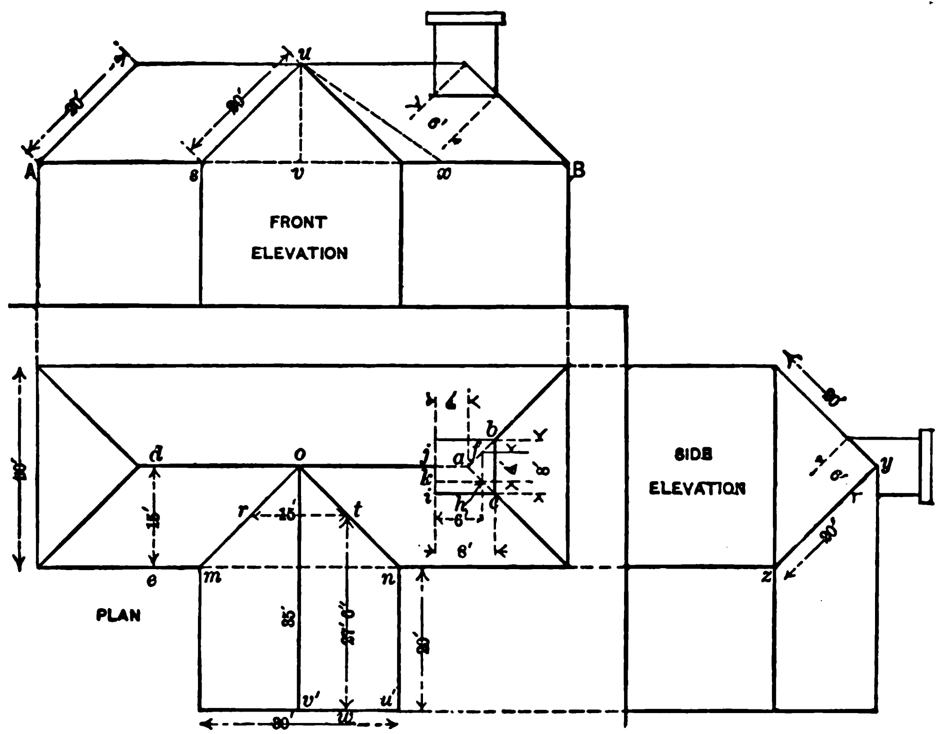


Fig. 8. Plan and Elevations of Hip Roof with Wing Attached

u' is 20 feet. Now average the distance between the eave and the ridge, which will be 27 feet 6 inches, as shown from *t* to *w*. Now multiply this by the length of the rafter *u s* in front elevation, which is 20 feet; thus 27 feet 6 inches multiplied by 20 feet equals 550 square feet, multiplied by 2 sides equals 1100 square feet of surface on the roof of wing. To obtain the length of the valley, *o n* in plan, drop a line from the apex *u* in front elevation until it intersects the line A B at *v*; now take the distance *o n* in plan and place in front elevation from *v* to *x* and draw a line from *x* to *u*, which will be the true length of the valley and at the same time the true length of the hip, because the end of the wing and the ends of the main building each measure 30 feet.

In Fig. 9 only that portion will be shown which has not been explained in previous figures, and that is, how much will be deducted from the side of the main roof to admit the intersection of the wing. Referring to the elevation, the wing intersects the main roof at a distance of 7 feet, as shown, and the width of the wing in plan is 10 feet. Now average the distance between the apex *b* and points of intersection *d* and *a* in plan, which will be 5 feet, as shown from *f* to *h*. Then multiply 5 × 7 feet equals 35 square feet to be deducted from the side of the main roof. The length of the valley is obtained by taking the distance *a b* in plan and placing

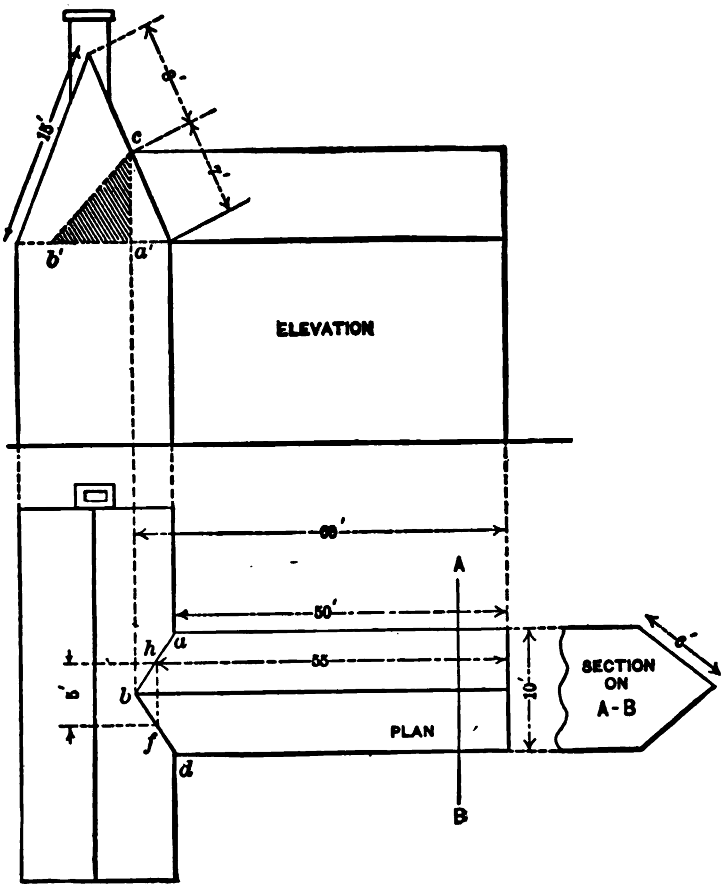


Fig. 9. Diagrams Showing Amount to be Deducted from Side Main Roof to Allow for Wing

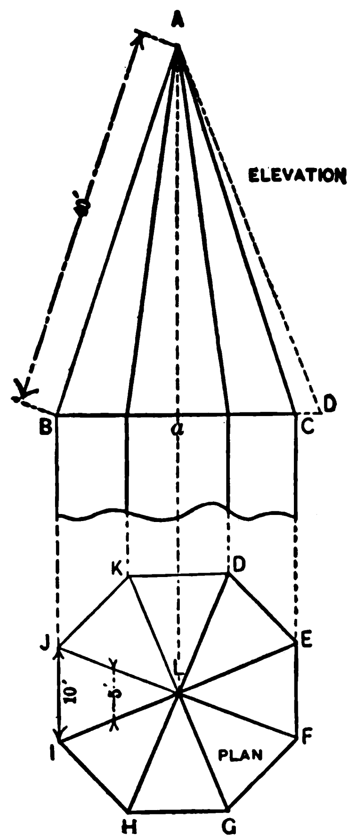


Fig. 10. Finding Quantities in a Tower of Any Shaped Base

it as shown from *a′* to *b′* and drawing the line *b′ c*, which will be the true length of the valley.

In Fig. 10 is indicated the method of finding the quantities in a turret or tower whose base is either square, hexagon, octagon or any other shaped figure. Let A B C represent the elevation of the tower, whose plan on B C is shown by D E F G H I J K. Lines drawn to the center L in plan, as shown, represent the hip lines. Now, assuming that one side of the tower, J I in plan, measures 10 feet, then average the distance between J I and the apex L, which will be 5 feet, as shown. The length of the rafter shown from A to B in elevation being 40 feet, then 40 × 5 feet equals 200 feet, multiplied by 8 sides equals 1600 square feet

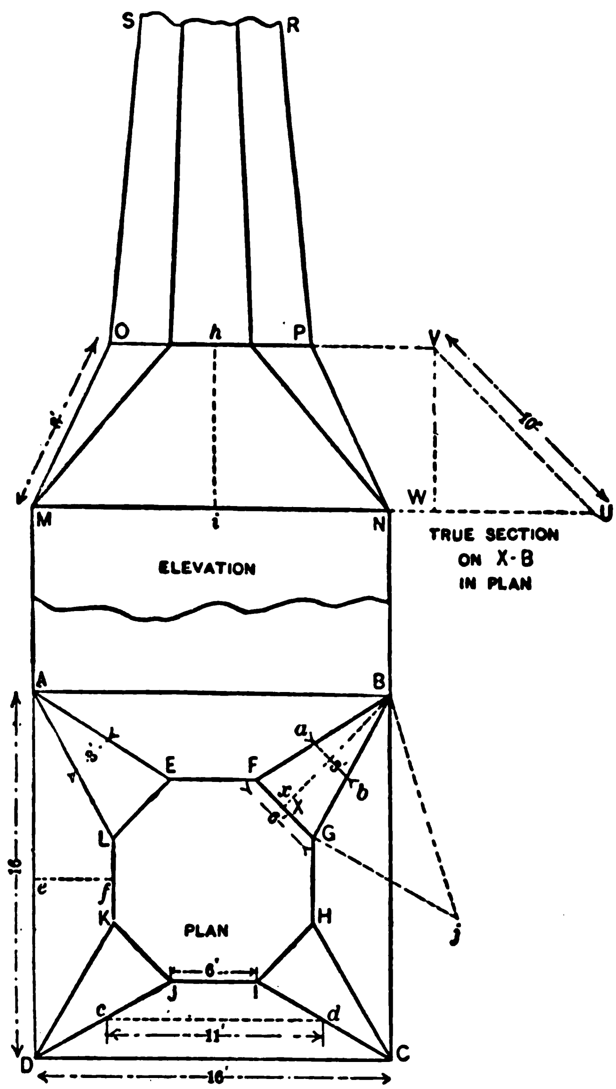


Fig. 11. Octagon Tower with Square Base

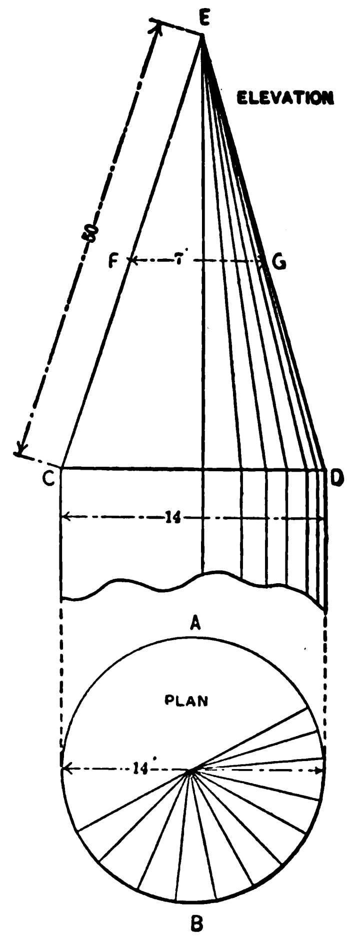


Fig. 12. Plan and Elevation of Conical Spire

surface in the tower of the dimensions given. For the length of the hip draw the center line A L, intersecting the line B C in elevation at *a;* then take the distance of one of the hips in plan, as L D, and place it as shown from *a* to D^1 in elevation. Draw a line from D^1 to A, which is the true amount of the hip, which must be multiplied by 8 for the full amount of the eight hips.

Here is shown a more difficult problem in figuring roof surfaces, as illustrated in Fig. 11. Here A B C D represents the square base of a tower or other object, from which a transition to an octagon takes place, as shown in plan by E F G H I J K L, the elevation of the tower or other subject being shown by M N O P R S. It is this portion, shown by M N P O, which forms our lesson. The length of the rafter from O to M in elevation is 8 feet and is the true section on the line *e f* in plan. As the base line in plan is 16 feet and the top line in octagonal plan is 6 feet, average the distance between the two as follows: 16 feet minus 6 feet equals 10 feet, divided by 2 equals 5 feet, plus 6 feet equals 11 feet, as shown by *c d*. Now multiply 8×11 feet equals 88 feet, multiplied by 4 sides equals 352 square feet for the four sides. For the gore piece F G B in plan it will first be necessary to find the true length of the rafter on X B in plan. This is accomplished by taking the distance X B and placing it on the line M N in elevation extended, as shown by W U.

At right angles to W U draw the line W V until it meets the line O P extended, as shown. Draw a line from V to U, which will be the true section on X B in plan. The distance from F to G in plan measures 6 feet. Now average the distance between these points and the corner B, as shown by *a b*, which is 3 feet. Now, assuming that V U in elevation measures 10 feet, multiply this by 3 feet, equals 30 feet, multiplied 4 times equals 120 square feet for the gores. Add 352 square feet for sides, which will make 472 square feet of roof surfaces in the transition piece shown. The length of the hip is obtained by taking the vertical hight in elevation *h i* and placing it in plan at right angles to B G from G to *j*; then draw a line from *j* to B, which will be the true length of the hip, which must be multiplied by 8 for the full amount for the eight hips.

Fig. 12 gives the method employed when estimating on conical spires or towers. Assuming that the base of the spire, C D in elevation, is 14 feet, as shown by A B in plan, then average the distance between the base C D and the apex E in elevation by dividing 14 by 2, which will be 7 feet, as shown by F G. As the circumference of a circle is found by multiplying the diameter by 3.1416, or, as used in practice, 3 1-7, then multiply 7×3 1-7 feet equals 22 square feet. The length of the rafter being 30×22 feet equals 660 square feet of surface in a spire of the dimensions shown in Fig. 12.

THE PITCH OF ROOFS

There seems to be a diversity of opinion in the trade regarding the question of the proper designation of the pitch of a roof, and in back numbers of THE METAL WORKER the subject has been ventilated to a considerable extent. It is generally recognized that the pitch of a roof is measured in parts of the span. For example, if a building is 24 feet wide and the rise of the rafters is 4 feet, the pitch would be one-sixth, Fig. 13. If the rise was 8 feet the pitch would be one-third; if the rise was 12 feet the pitch would be one-half, and if the rise was 16 feet the pitch would be two-thirds. In some sections it is customary to indicate the pitch in degrees of a circle, which is the most comprehensive and should be universally adopted.

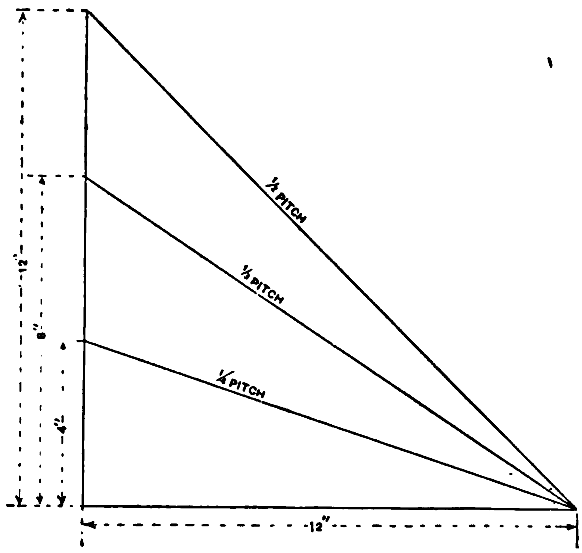


Fig. 13. The Pitch of Roofs

MEASURING ROUGH FRAMING FOR SHEET METAL CONSTRUCTION

In the following article will be described how measurements are taken from rough framing at the building, whether the framing is of wood or angle iron, and how the details are laid out in the shop for the sheet metal covering.

For a practical example, there has been selected a belfry, such as was worked out in the shop, showing how to proceed in a job of this kind. It will be assumed that Fig. 14 is the architect's scale drawing of a belfry, square in plan, sitting over the ridge of a main roof. The base is of slate with copper hip ridges and projecting cornice. The roof of the belfry is also copper, in which a scuttle is provided. The four sides have circular arches with round and square pilasters capped by a projecting cornice, over which the spire is slated, the hips being finished with copper hip tile. Over the apex of the spire a cross not shown is placed.

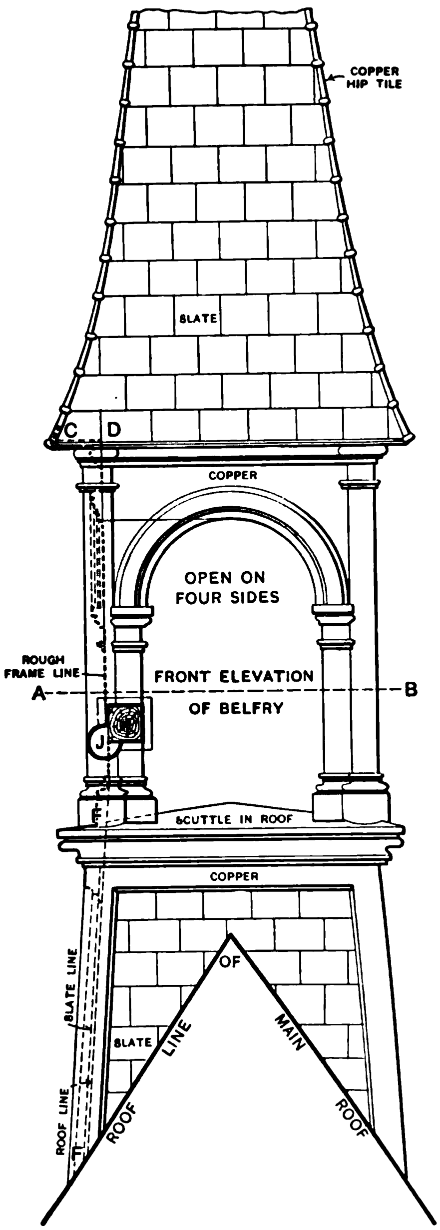


Fig. 14. Front Elevation of Belfry

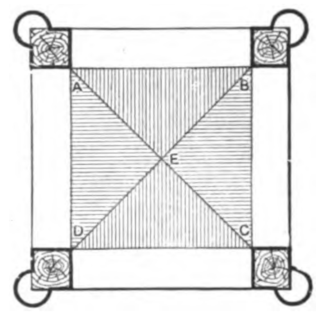


Fig. 15. Section through A B in Fig. 14

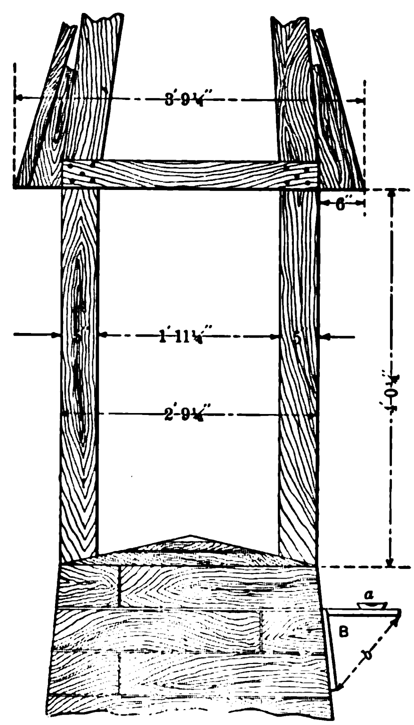


Fig. 16. Taking Measurements from Framing

When receiving a drawing of this kind, we look for a horizontal section through A B, which is shown in Fig. 15, and find that the wooden uprights are incased with metal. This forms the basis for taking measurements at the building.

In work of this kind the framer or carpenter and sheet metal worker work together, so as to avoid any errors. The framing for the belfry looked as shown in Fig. 16. Now all that was necessary to measure was the width of the uprights, which was 5 in., and the distance between the uprights 1 ft. 11¼ in., making the distance from out to out 2 ft. 9¼ in.

The eave of the roof of the spire projects 6 in. on each side, making the total width of the eave 3 ft. 9¼ in. The finial measurement is the hight from eave of spire roof to eave of belfry roof, which is 4 ft. ¼ in. The bevel of the belfry base is now taken by setting the bevel B in the position shown, until the upper arm is in a level position, which is proved by setting on the small spirit level *a*. The distance is now noted between the arms as *b*. The bevel is now closed and can be opened to this distance when making the detail in the shop.

When drawing the detail one-half is all that is required. In Fig. 14 C D E F shows the outline of the frame measurements taken from Fig. 16. Outside of this outline in Fig. 14, the profile of the sheet metal work is drawn as indicated by the dotted lines. A section of a pilaster placed in its proper position is indicated at J. Notice that the curved molding of the arch comes outside of the frame line and that the ceiling of the arch miters as shown in Fig. 15, by A B C D E. Having drawn this one-half face the patterns can then be laid out, finishing two full faces in the shop and joining the other two on the job. When drawing the outline of the metal work around the frame line, play room should be given, so that the metal work will fit easily around the framework, without any cutting of the wood or metal.

TIN ROOFING

The subject of tin roofing has been, as it should be, well ventilated in the columns of the *Metal Worker*. A good sized book could be printed from all that has been said of this important branch of the sheet metal trade.

The lasting qualities of terne plate, and if it is better made than in the time of our fathers, has been argued pro and con. The question of whether a standing or a flat seam is best; cleats or nails through sheets; provisions for expansion and contraction, specification for good tin roofing; paint; the sheathing; whether to use paper or not under tin. All these and many more have been discussed. The gist of these disquisitions is reprinted in these series.

Sheet metal tiles and shingles, are not considered as they are manufactured articles in a variety of styles and the method of application is as varied and will require more space than is here available.

SPECIFICATIONS FOR A TIN ROOF

The language of most architects' specifications is ambiguous and while competition makes it necessary to deviate considerably from the best methods it is well for those who desire to have the best methods or to safeguard the prestige of tin roofing to have a clear, comprehensive specification. Though some may discredit the use of cleats it cannot be gainsaid that nailing through the sheets leaves a weak point at the nails as shown in Fig. 17, for the nail will be almost to the edge of lock and sometimes exposed, and as nails are usually dirty, often rusted, the solder will not take. And of course there is no provision for expansion and contraction when nails are driven through sheets.

From the many discussions on tin roofing and a number of specifications presented the following has been selected as being representative:

SPECIFICATIONS

A sheathing will be provided of good, well seasoned lumber, narrow widths, free from knot holes and of even thickness. The boards will be laid with tight joints, or shall be tongued and grooved; nail heads well driven in. Sheathing shall be white pine or spruce.

All tin used for roofing all parts of this building shall be X, or Y or Z brand. No substitute for the above grade or brand will be allowed, and the same is to be purchased from the jobber or manufacturer in boxes.

The sheets used for standing seam roofing shall be made up into long lengths in shop. The cross seams shall be locked together and well soaked with solder. One coat of paint shall be applied to the under side before laying.

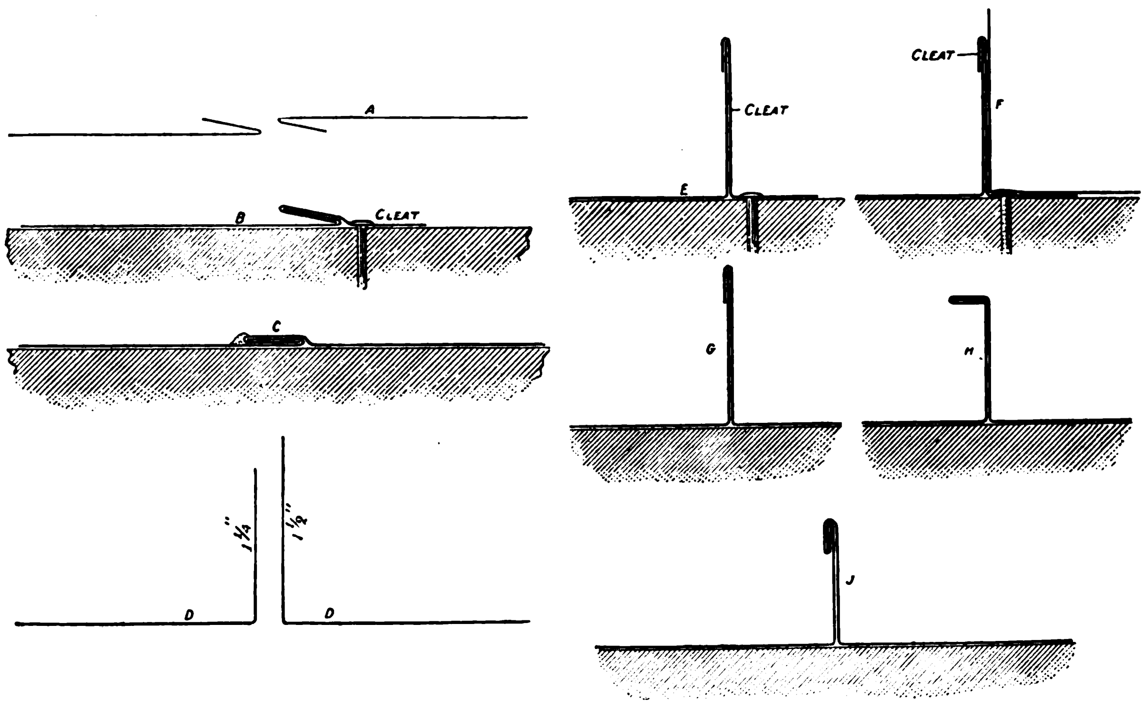
If the sheets are laid singly the size shall be 14 × 20, painted one coat on under side before laying. The sheets shall be fastened to the sheathing boards by cleats, using three to each sheet, two on the long side, one on the short side. Two 1-in. barbed wire nails to each cleat, no nails to be driven through the sheets.

All seams whether locked or standing shall be made according to the accompanying diagrams. No nails shall be driven through the sheets.

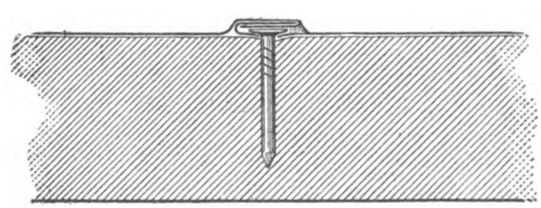
All tin used for standing seam roofing shall be applied the narrow way, fastened to the roof with cleats spaced 8 in. apart. Cleats locked into the seam and fastened with two 1-in. barbed wire nails to each cleat.

All flat seam roofing shall be applied the narrow way, fastened to the roof with cleats spaced 8 in. apart, cleats locked into the seam and fastened to the roof with two 1-in. barbed wire nails to each cleat.

The edges for standing seam roofing shall be turned up not less than 1¼ in. at right angles to the roof when the cleats shall be installed. Then another course



Method of Making Flat and Standing Seams



Weak Points of Seams Nailed Through Sheets
Fig. 17.

with 1½-in. edge turned up. Adjoined edges shall be locked together and the seams so formed shall be flattened to a rounded edge.

The valleys shall be formed with flat seams using sheets the narrow way.

All solder used on this roof shall be of the best grade and guaranteed one-half and one-half solder (one-half tin and one-half lead), using nothing but rosin as a flux. Solder to be well sweated into all seams and joints.

Surface of tin to be carefully cleaned from all rosin before the paint is applied.

All tin shall be painted one coat on the under side and two coats on all exposed surfaces. The first coat shall be applied to the upper side immediately after laying with a hand brush, well rubbed in. The second coat shall be applied in a similar manner in not less than two weeks after the first coat has been put on. All paint used shall be of the best matallic brown mixed with pure linseed oil, japan only as a dryer. No patent dryer or turpentine shall be used.

No unnecessary walking over the roof or using the same for storage of other material shall be allowed. When necessary to walk over the roof, care must be exercised not to break the coating of the tin. Particular care and attention must be given to the laying of the gutters that, when finished, there shall be sufficient pitch to prevent any water standing therein.

No deviation from these specifications shall be made. They must be carried out in every particular. A first-class roof only will be accepted.

When paper is specified the same is to be of the waterproof kind. Paper is not recommended.

Explanation of Diagrams

Flat seam roofing when the sheets are laid in strips or one at a time.

AA shows sheets with edge turned ready for locking.

B sheet or strip laid with cleat locked over turned up edge. The cleat is 1½-in. wide. Two 1-in. barbed wire nails are driven through the cleat into the roof sheathing. These nails must be driven close as possible to the edge of the sheet, otherwise the cleat will have too much play. Cleats must be spaced 8 in. apart.

C, seam or joint completed by locking the two edges A and B together and soldering. The cleat is not shown.

Standing Seam Roofing

DD, edges of sheets or strips turned up at right angles to the roof not less than 1¼ and 1½ in. respectively.

E, sheet or strip laid with cleat locked over upturned edge. Cleats spaced 8 in. apart and fastened with two 1-in. barbed wire nails.

F, opposite sheet or strip laid in place.

G, edges of the two sheets or strips locked together. Cleat not shown.

H, second operation of locking the edges.

J, the standing seam complete.

SOME OBSERVATIONS ON ROOFS

There always has and always will be a large field for roofs made of sheet metal. Copper is the best, when the first cost is not minded, and after years of use is a first-class investment for one who has the money. Terne plates undoubtedly come next, providing they are rightly made and laid. Some makers in this country are making just as good terne plates as were ever made in Wales. The quality of material in the coating mixture, the quality of the oil in the flux, the proper alloying and laying on the base sheet are just as honest now as in any period of previous manufacture. The coating is better applied to the sheet. Every inch of sheet is better covered and protected and worth more than formerly.

If every one who bought terne plate took the trouble to get best plates, with not less than 40 lb. coating per box, there would be less trouble with tin roofs than now, provided the plates were rightly made into a roof on the spot. The best makers will sustain any effort made toward confining consumption of terne plate to the best quality, but when you get it it can be spoiled by the way it is mishandled. It does not purport to be a sheet metal which will withstand nonprotection.

Protection is made by paint. Everybody should know that he should paint a tin roof. Good paint can be had at low prices. Do not make the mistake that the least possible of the cheapest paint is good enough for a tin roof, and do not complain of roof being useless when no paint at all is used. Do not, after laying, leave roof unpainted so long that it gets rusted; some painters claim that paint clings better to a rusty roof, but this is an idea only of theirs—slightly easier and more agreeable to the painter to follow. It is a fact that it is easier if plate is made by palm oil process to wait until by exposure the grease is removed; but such delay cuts short the life of the roof. Put enough paint on both sides, and use it often enough on the upper side, every three years, and use good paint. You will have to do this to counteract disintegration. Give this advice and you will cause those in interest to think well of you and your experience. Saying farther: Do not use acid flux on the seams, but always resin. Solder with an iron hot enough to soak solder well into seams but not so hot as to burn the tin from the plate.

As to fire protection. Metal roofs are the best, returning to tin because it is the cheapest giving same results. You will find parties who are laying roofs with about same material that you take to build your fire. These parties claim and proove to you that their roofs will not burn. Prepared roofs of composition do burn occasionally, and more furiously than a tin roof, no matter what is said about it. The best prepared composition roofing has been known to burn through in less than 7 min. Tin alone takes more than twice the time; and if you want it to stand still longer in fire first put under the tin when laying the same an impervious felt of 11 lb. to the 100 sq. ft. Back this by an asbestos laying of 16 lb. to 100 sq. ft. and you will further reduce conducting of heat by a full half, bearing in mind that such a roof as last named is of great importance in retarding progress of conflagration.

Other advantages. A roof of good tin is extremely durable, weather proof, fireproof, lightning proof. It has a particularly neat, attractive appearance, especially where laid with standing seams. It is clean and sanitary, and therefore especially recommended for use where rain water is collected in cisterns. It is not affected by heat or cold. The slight expansion and contraction of the metal are taken care of by the cleats used to fasten the tin to the roof, which allow a sufficient play. With all these advantages, good tin is extremely light in weight, an important point often overlooked. It is not easily damaged by being walked on.

Finally, a good tin roof is easily repaired in case of accidental damage. These repairs can be made quickly and cheaply without allowing serious damage to the building, no matter what the weather conditions may be.

The foregoing outlines are points that relate to the making of a good tin roof, and if you will frankly tell your customers the facts and show them that final economy is not to be had by cheapest materials or methods it need not surprise you to find that those who are paying the bills want something that will last.

A PRACTICAL TALK ON TIN ROOFING—I

In discussing the subject of tin roofing nearly all members of the trade agree that flat seam roofs put on at the present time do not as a rule give as good satisfaction as those of 50 years ago. While opinions differ as to why this is so, probably a large majority hold to the belief that it is due solely to the difference in the quality of the tin used then and that put on the market now. But any one engaged in this line of work will do well to bear in mind the sentiment of the saying that "a chain is no stronger than its weakest link," for no matter how good the tin used, if the sheathing boards are unsuitable for the purpose or the workmanship poor in any particular, the extra quality of the tin counts for very little.

That there are large quantities of poor tin on the market every one must admit, but it is equally true that well coated sheets are to be had if one will pay the price, and if these are used and the necessary care and judgment exercised in doing the work, tin roofs can be put on to-day that will prove as durable as any in former years. In any discussion as to how to put on good tin roofs or how to avoid poor ones, there is one fact that must not be overlooked and will not be by the most ex-

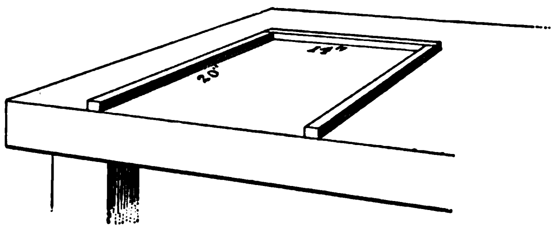


Fig. 18. Frame for Painting Sheets

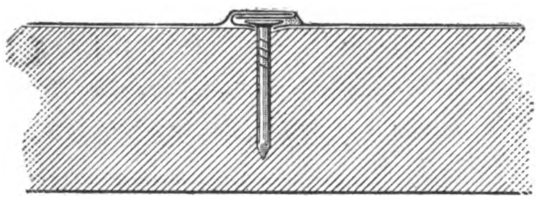


Fig. 24. Weak Point when Nailed Through Seam

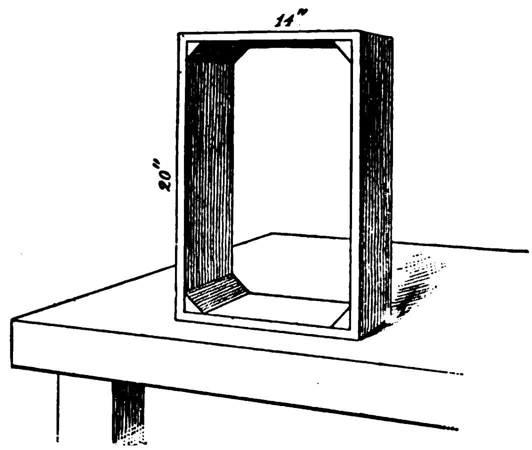


Fig. 19. Guide for Protecting Edges

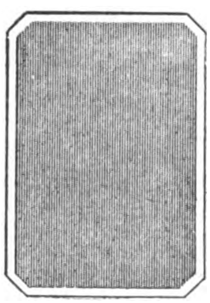


Fig. 20. The Painted Sheet

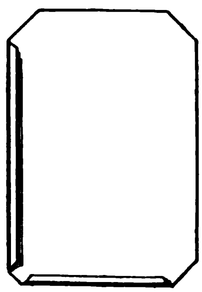


Fig. 21. Improperly Notched Sheet

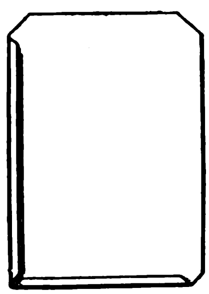


Fig. 22. Properly Notched Sheet

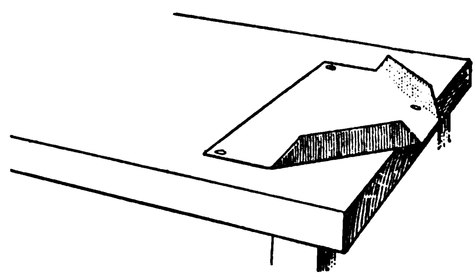


Fig. 23. Guide for Notching Sheets

perienced and observing among the trade, and that is that tin plate as a roof covering is not a success unless conditions under the roof are favorable. If put on a building in which there is steam or gases that are injurious to metals, no tin will last, no matter how good the quality. Again, if put on a kitchen that is not plastered overhead but just ceiled, the steam from the cooking, combined with the condensation, will put out of business the best tin plate ever made, and it will not take very long to do it either.

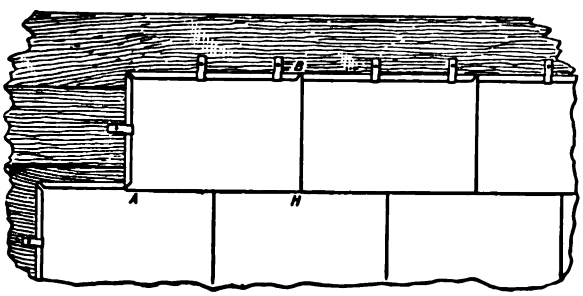
A campaign for better roofing is a much needed one, but it must be a campaign of education or it will avail but little. Nearly every one engaged in this line of work is possessed of the necessary mechanical skill to do good work, but what they lack, or many of them at least, is a knowledge of the theory of it. Just as long as tin is used where the temperature underneath is at times from 60 to 90 degrees warmer than on the outer surface, just so long will complaints be heard about the poor quality of tin. No one need get the idea that the tin made 40 or 50 years ago would stand such conditions, for it never was nor never could be made to stand it.

That there is room for improvement in the quality of roofing tin is manifest to every one in the business of laying roofs, but there is just as much need for a better understanding of the conditions under which tin can be used with success and where it can't. Good sheathing boards, good tin and good workmanship are all necessary, but with all these a short lived roof will be the result unless the under side of the roof is ventilated in every instance where ventilation is necessary to prevent condensation. The average architect thinks his duty done when he has specified a certain brand of tin to be used and then holds the roofer responsible for its lasting qualities, regardless of whether conditions under the roof are favorable or not. It is for this reason, if for no other, that the roofer should look more into the matter of what conditions are favorable to tin plate, and then he is in a position to warn architects, builders and owners of what to expect if they insist upon having tin laid where it is impossible for it to last. It is far easier to fix the responsibility where it belongs before the work is done, and, besides, neither architects nor builders are going to assume any responsibility as long as the roofer quietly submits to having all the blame put on him or on the tin he uses. The first requirement of a good tin roof is good, smooth sheathing boards upon which to lay it. For this purpose boards of an even thickness and thoroughly seasoned should always be used, for if not dry they will shrink after being laid and so strain and break the seams in the tin. Light or springy boards should not be used, as the seams cannot be pounded down as smoothly as when the boards are solid and firm. Very little pitch is required to discharge all the water that falls on a roof, but architects' and builders' specifications often get so near the danger line that any settling of the building allows the water to stand in pools until it evaporates, and when this is the case trouble is pretty sure to follow, for no roof can be expected to do duty as a reservoir. Any less than ½-in. fall to the foot can hardly be considered safe, while on the other hand any more than 3 in. to the foot is too much to allow the solder being well soaked into the seams. It is of course the work of the carpenter to provide proper sheathing boards and lay them with a suitable pitch, but it oftens happens that he, through ignorance or indifference, does this work in such manner that the roofer is handicapped in his efforts to put on a roof that will prove satisfactory.

After the carpenter work, the next step to be considered is the quality of tin to be used. In spite of many opinions to the contrary, the high priced, well coated sheets are probably worth as much more than the cheap ones as is asked for them. The cheap tin is made because there is a demand for it, but the roofer who is really desirous of building up a reputation for doing good work will find it to his advantage to use the very best he can prevail on his customers to pay for. The added cost of a good plate is in the coating, and coating means protection to the plate. All this should be pointed out to prospective customers in an effort to get them to pay the difference between a good roof and one that is likely to make trouble. The difference in the cost is all in the tin plate, for it costs no more to put on the best than it does the poorest.

Just as important as the quality of the tin is the size of the sheets used. It would no doubt seem a ridiculous proposition to most members of the trade to-day to advise the use of sheets 10×14 in. in size, but the fact is that using sheets of this size, as they did largely half a century ago, is the principal reason why roofs gave less trouble than they do now. Small sheets are better than large ones for the simple reason that there is less expansion and contraction on each sheet, and consequently less breaking of the seams. The best flat seam roof the writer ever saw was laid with 10×14 sheets. It had been doing good service for over 40 years, and was in good condition as well as smooth and snug to the sheathing boards and without breaks in the seams. But this small size requires considerable time to put on, and for that reason will probably never be popular with the trade and for general work in this line the 14×20 in. size will be used, and if the method of fastening the sheets to the sheathing boards as hereafter described is followed the 14×20 sheets will make a good, serviceable roof. But sheets of a larger size than these should never be used with any expectation of getting good results.

Painting the sheets on the under side was seldom, if ever, done 50 years ago, and is not generally practiced now except in some localities. In some instances it is not necessary, but the idea is a good one, for in the event of a storm coming on before the roof is finished, the sheets already laid are protected on the under side. And even after it is finished leaks are frequently made by accident and not discovered and repaired until some water has found its way through. When this occurs if the tin is protected by paint there is no danger of its being injured. To judge of the importance of painting the underside, it must be remembered that if moisture once reaches that side of the tin it will begin to rust, and continue to do so until it has eaten through. But if any practical benefit is derived from painting the under side it is necessary to let the paint get dry and hard as well before the work of laying is begun. When the seams are being soldered the paint will be burned just under where the coppers touch the exposed side, but as the solder gives



Fig, 25. Sheets Fastened to Roofs with Cleats Properly Placed

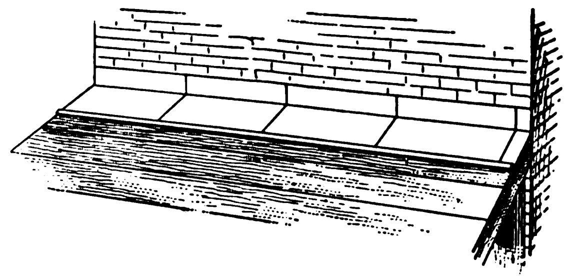


Fig. 26. The Flashing Strip

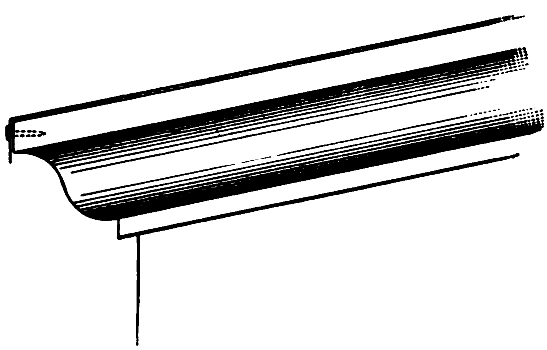


Fig. 27. Finish at the Eaves

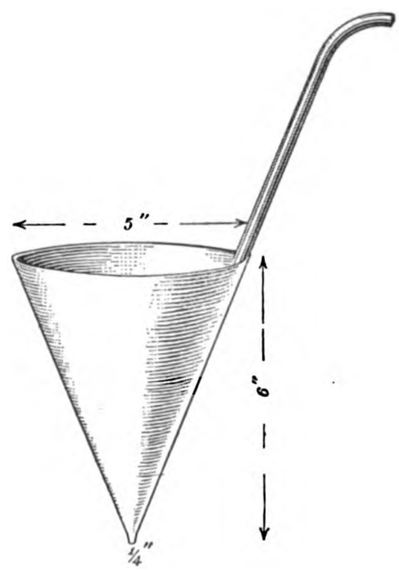


Fig. 28. Rosin Spreader for Seams

an added thickness to the coating it is just there that the paint can be best spared. The expense of painting the sheets is not so great as might be supposed, for it can be done by a boy or other cheap help. The following method will be found both quick and convenient:

Take three narrow strips of wood and nail them on a bench or box of convenient hight, as in Fig. 18, the distance inside the strips to measure 14 in. one way and 20 in the other. Then make a frame of ½-in. stuff and 3 or 4 in. wide, with pieces set in each corner, as shown in Fig. 19; the frame to measure 14 × 20 in. outside. Then after the tin is notched, or clipped at the corners, each sheet can be slipped between the strips on the bench, where it will just fit, and the frame if placed on the sheet inside the strips will enable the painter to paint the whole surface of the sheet except ½ in. on the edge. The sheet after being painted will look like Fig. 20 and not have any paint near enough to the edges to make trouble while soldering.

In making tin ready for the roof it is not necessary as a rule to square the sheets, for if of good quality they are near enough square for all practical purposes in the roofing line. But care should be exercised in notching the corners. As this operation is usually the work of a helper and done with the squaring shear, it is better to have some one more experienced set the machine. Too much clipped off the corner means a waste of time and solder to make tight. The corner looks as shown in Fig. 21 when too much is taken off. It should look as shown in Fig. 22. As it is a difficult matter to cut just enough off each corner without any guide, the use of the device shown in Fig. 23 will be found a great convenience. It is made of tin or sheet iron and can be held in position on the squaring shear by the clamp that belongs with the shear, or if notching is done with the snips it can be tacked on the end of a bench, and while the sheet is held in place with one hand the corner, which will project just the right distance, can be clipped off with the other. As roofing folders do not all turn the same width of edge or lock, it is impossible to state just how much ought to be taken off the corners in every instance, but, as before stated, if the sheet after being folded is as open at the corners and no more so than Fig. 22 it will be found to be about right. It may seem unnecessary to call the attention of any one with any knowledge of the work to a detail so obvious as this, but many who know better make trouble for themselves by neglecting to see that corners are notched as they should be.

In laying flat seam roofing there are two ways of fastening the sheets to the sheathing boards. The one most practiced being that of driving the nails through the sheets just under the lock, is shown in Fig. 24, and it is this practice that causes a lot of trouble with tin roofs, as the solder is not strong enough to hold and leaks around the nails begin the destruction of the roof. In laying metal roofs it must be borne in mind that the expansion and contraction are due to a natural law that no one can prevent being enforced, but if the sheets are fastened in such a manner as to allow the metal to expand and contract without breaking the seams, then the trouble from this source is overcome.

The method of fastening the sheets with cleats is shown in Fig. 25. It holds the sheets firmly and yet yields enough during changes of temperature to prevent the breaking of seams, and even should a break occur, there is no nail hole in the sheet to let water through, as is the case where nails are driven through the sheets. These cleats should be cut about 2 in. long and 1 in. wide. As they can be cut in the squaring shear and the lock turned on them in the shop folder by a boy or helper, their cost is very little, especially as they can be made of odds and ends of scrap tin that would otherwise be wasted.

The use of cleats in laying flat seam roofs is well understood and practiced in some sections of the country, but in others it is not customary to use them. Of course it takes longer to lay sheets when fastened this way, but it is time well invested. The usual practice of laying sheets singly is the most satisfactory except where the tin has to be turned up against another building or a side wall. In a case of this kind it is better to get out a strip the right length and after soldering to turn up as much as is needed, leaving a lock on the surface of the roof to be hooked on to, as shown in Fig. 26.

In laying the first course care should be taken to leave enough projecting over the edge so that when turned down and nailed the tin will extend below the nailing strip and so cause a drip to form at the eaves, as shown in Fig. 27. If this is not done the water will run down the molding and discolor it, and besides a gutter hung under the eaves will be of no use if the water follows the woodwork after leaving the tin.

To insure well locked seams it is necessary to keep the edges of each course straight, and it will be easier to lock the sheets well if after one is laid the seam at the point A and the point B in Fig. 25 is flattened down with a stroke of the hammer before laying the next one. Three cleats are enough for each sheet if placed as shown in Fig. 25.

It is advisable not to lay any more tin than can be soldered each day, but if for any reason it is thought best to lay more it is better not to mallet it down, for it will be just as near tight and if rain falls on it the seams will dry much quicker than if flattened down. Seams that are malleted down smooth are easier to solder and hold better than when uneven.

Rosin makes the most satisfactory flux, and the most convenient way to apply it is to melt it on the seams with the aid of a home-made funnel of about the dimensions given in Fig. 28. In soldering off a roof it is well to use as large coppers as the pitch of the roof will permit, for small coppers both heat and chill too quickly for satisfactory work. If too hot the coating is injured, and if too cold the solder is not sweated into the seams as it should be. For a roof of ordinary pitch or fairly flat, coppers weighing 8 or 9 pounds to the pair should be used, but if the roof has a pitch of 2 in. or more to the foot, lighter ones can be used to better advantage.

The long seams on the roof should be soldered first, and before the rosin is run on the short ones the butt of each seam (see H in Fig. 25) should be tapped down smooth. It pays to use good half and half solder, not only because it makes a better job, but because it flows more freely and so saves both time and solder. If the roofer really wants to do good work in this line he must be willing to take or pay for the necessary time to do it. It is hardly an exaggeration to say that the foolish practice of trying to make or break a record while doing this work is responsible, for as many poor roofs as is poor tin.

PRACTICAL TALKS ON TIN ROOFING—II

To knock out strips in the shop the work can best be done on a special bench about 20 feet or more in length, made of 2-inch or thicker yellow pine or other hard wood planed smooth on the top side. The bench should be 30 inches wide, with a pitch of 1 inch down to the front, so that solder will flow readily. It should be well supported, and some benches are made with iron plates 3 inches wide and ½ inch thick where the locked edges come to stand the wear of the mallet. The back edge must be perfectly straight from end to end, with a hard wood gauge about 3 inches high extending the whole length. This edge may be faced with metal to prevent wear and preserve its trueness as a straight edge.

After the sheets have been edged, with one edge turned up and the other down, a number may be spread along the bench to have their edges locked together to form a continuous strip. This is best done by locking one pair of edges at a time. The first sheet must be held firmly against the straight edge by a gauge fastened to the bench or by a double hook, one end of which catches the sheet and the other catching over the back of the bench. Some men nail the first sheet to the bench with two roofing nails. The other sheets may then be locked on one at a time and have the seam flattened down tight with a mallet, great care being taken to see that the side of each sheet is perfectly in line against the straight edge guard at the back of the bench. A box of tin contains 112 sheets, and in some shops they are put together in four rolls of 28 sheets each and the rolls when soldered weigh about 60 pounds. The seams may be soldered as soon as the locked edges of one strip are flattened down with the mallet and before rolling up, or the roll may be completed and several boxes of tin may be put together and the soldering done at another time.

In soldering an old hand will want coppers weighing eight pounds to the pair, powdered rosin, good solder and a fire pot large enough to heat the coppers quickly. Experienced men are very careful to leave a space ¼ inch unsoldered or very lightly soldered at each end of the seam. This will make it easier to turn the edges and make the locks on the roof. The strips are generally 20 inches wide and 20×28 inch tin is used, owing to there being fewer seams to be soldered than if 14×20 inch tin is used. If 10-inch strips are needed for valleys or flashings it is only necessary to slit the 20-inch tin down the middle. If 14-inch strips are wanted labor is saved by putting the tin together in 28-inch rolls and slitting it down the middle. After the soldering is done the tin is ready to be painted on the under side, if the contract demands it, but in painting a space ½ to ¾ inch wide should be left along each edge, so that no oil or burned paint will interfere with soldering on the roof.

The rolls when finished are about a foot in diameter, and the end is fastened to the roll by tacking with solder lightly so that it can be easily opened with the roofing hammer, or the rolls may be fastened with wire or tin strips.

If the strips are for flat seam roofing, half-inch tongs are used to turn half-inch edges on the strips. The tongs have jaws about 20 inches long, with holes in one jaw and curved pins about 2 inches long in the other jaw which work through the holes, and they are set so that the edge turned on the tin is just ½ inch wide. In laying the tin the first strip is laid at and parallel with the eave and extends over so that is can be turned down and fastened with 1-inch barbed roofing nails about 2 or 3 inches apart. The ½-inch edge is turned on the other edge of the strip, which is fastened to the roof with barbed roofing nails about 4 inches apart, for the closer the nails the easier and quicker it is soldered and the less solder required. The nails must be driven back in under the edge, so that when the edge of another sheet is hooked in and flattened down tight with a mallet the nail heads will be covered. If tinned nails are used the soldering will be more secure. By this method there are no nails in the cross seams, and in consequence some roofers use strips only 14 inches wide, while others use 20-inch strips for all such work.

The soldering should be done with heavy coppers with blunt ends, so they will hold the heat, and the seams should be well soaked with a hot copper so that the solder will sweat into the locks and make the seams surely tight, for any time spent in hunting for and mending leaks is a dead loss, even if no damage is done to the building. For flat seam roofing a sheet at a time the sheets are notched, edged and stacked in lots of 11 sheets for 14×20 tin, and 25 sheets for 10×14 tin. The tin now being ready for use at the building, it will be convenient to provide a box, say 12×16 inches in size and about 4 inches high, made with three compartments and with a circular handle over it. One-inch wire nails, 2½-inch wall hooks and rosin are placed in these compartments. The tools required are eight pound soldering coppers for roofing, as shown in Fig. 29, and six pound pointing up coppers, as shown in Fig. 30; a file, a hammer, shears, a compass, a punch, a cold chisel, a mallet, a scraper, a trowel, and chalk and chalk line. A fire pot 15 inches high and 8 inches in diameter is required for the roofing coppers, a smaller pot 12 inches high and 6 inches in diameter is large enough for the pointing coppers and will consume less coal. Solder, coal, acid for galvanized iron connections, a paint brush, and paintskin, an iron block on which to forge coppers, a rope and wheel to hoist material, a broom, and a small tool box with lock and key to lock up tools and material over night, constitute all that would be required for work on the roof.

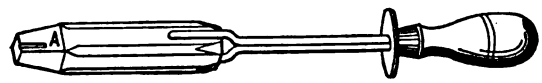


Fig. 29. Square End Roofing Copper

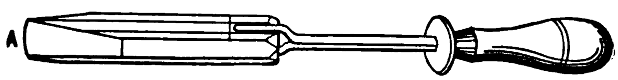


Fig. 30. Pointing Up Copper

The heavy soldering coppers are used for flat seam soldering and the lighter ones to do "pointing up," or soldering upright seams. The file is employed to clean and smooth the coppers. The coppers are tinned with rosin when used for soldering tin work, using rosin as a flux. They are tinned with sal ammoniac for soldering zinc or galvanized iron work, when acid is used as a flux. The hammer and shears are used in laying the tin, the compass for scribing circles or for other purposes. The punch is employed to make holes in double thicknesses of metal, the cold chisel to dig out joints for flashings, the mallet to flatten the seams, the scraper to obtain a smooth, clean surface on old metal joining to new work, and the trowel to paintskin the joints of the flashings connecting with the walls. In starting a small shed roof, Fig. 31, which has no gutter, the water dripping off at A, the tin B is laid sheet by sheet, allowing it to project over the eave about 1 inch, as at A. It is finished at the top, as shown by the last course C, which also projects at D; then with a piece of plank measuring about 4×8 inches and 1 inch in thickness the edges are dressed down well with a mallet,

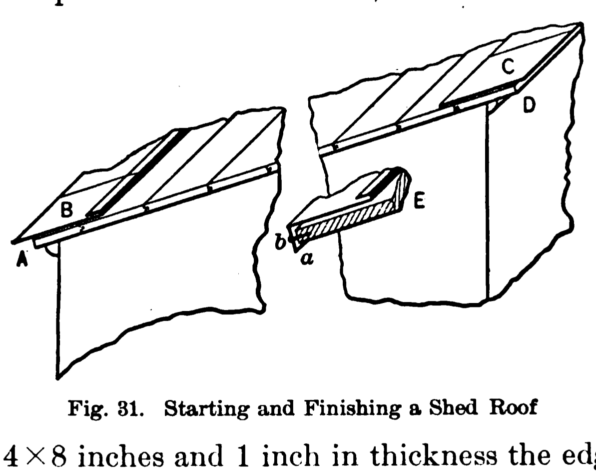


Fig. 31. Starting and Finishing a Shed Roof

as shown in diagram E at *a*, after which it is nailed, as shown at *b*, with 1-inch roofing nails. A mistake which is often made is in dressing the edges with a mallet. This causes the edge to lose its straight line and to show a succession of

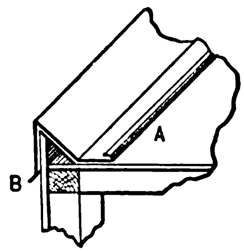


Fig. 32.
Side Strip on a Shed Roof

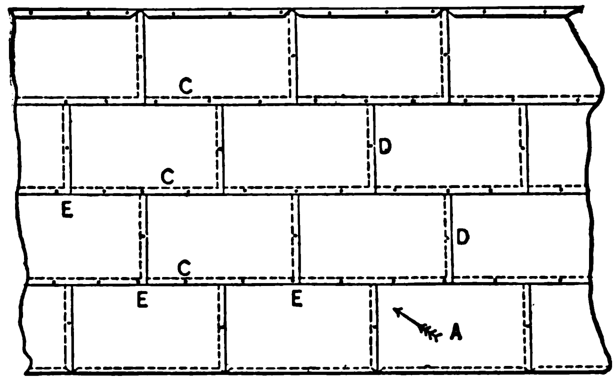


Fig. 33. Laying and Nailing the Sheet

buckles. Occasionally on a shed roof, or other roof of frame buildings, a ledge is built on the gable or side walls, as in Fig. 32. This is the proper form to throw off the water well and avoid acute angles. These strips are put on before the roof is started, having a lock at A, and being turned over the clapboarding or other surface with a drip, as at B. Assuming that the roof is to be covered with 14×20 plate, the sheets are laid as indicated in Fig. 33, the general rule being to lay the sheets in the direction of the arrow A, giving four nails to the sheet; one at the butt, two on the long side and one on the short side, as shown by the dots. This will make

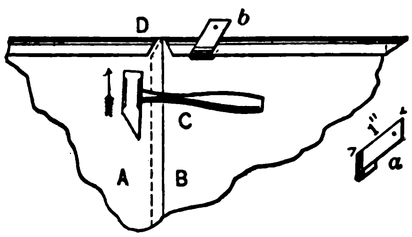


Fig. 34. Driving Edge Back to Place Nail

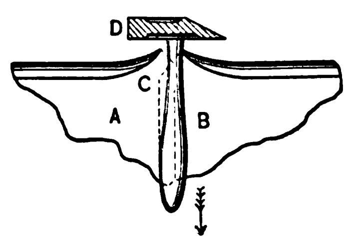


Fig. 35. Replacing Edge

a firm roof, and hold the seams well. If less than four nails are used the tin is apt to buckle, causing a drumming sound when it is walked upon.

While time is saved in the laying, double this time is lost in soldering, for the heat of the coppers will raise the seams, causing a succession of buckles which retard soldering and require 10 per cent. more solder. In laying the sheets the hammer is used, as indicated in Fig. 34, A being the sheet locked into the sheet B. The hammer is held in the position C, and is quickly moved forward in the direction indicated by the arrow, both on sheets A and B. The nail C is now driven into the sheet A at the butt, which holds down the sheets A and B firmly; the hammer is now placed as shown in Fig. 35, and held in the position D, the handle inclined slightly upward. It is then pressed down and drawn quickly forward, which again brings the edge in the position D, as in Fig. 34. The same directions apply to the nailings in the centers of the sheets. If cleats are required instead of nails they are bent as shown, at *a*, Fig. 34, and hooked to sheet as *b*. This is not the proper location of cleat for they should be placed where the nails are shown in Fig. 33. Care should be taken to flatten seams well with a heavy mallet whose face has been rasped to a convex surface, as Fig. 36. A mallet, as Fig. 37, should not be employed, as is often the case, for it will not close the seams evenly. If it is not a windy day the rosin can be ground to a powder and swept against the seams with a clean broom; or the rosin can be melted on the seams by taking a soldering copper which is sufficiently heated to melt the rosin and running the copper along the seam and against the copper, holding a large lump of rosin. As previously shown, soldering coppers for the flat seams are blunt on the ends and are tinned on two sides only.

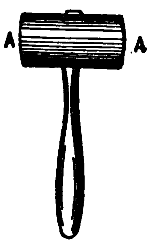


Fig. 36.
Smooth Round Faced Mallet

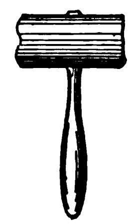


Fig. 37.
A Bad Mallet for Roofing

Some mechanics file a groove A in the copper as indicated by Fig. 38, about ¼-in. from the corner so that when the copper is drawn along the seam this groove acts as a guide and keeps the greater part of the copper B, on the seam, soaking in the solder. When soldering a long surface, all the long seams, indicated by C, C, and C in Fig. 33, are first soldered, then the short seams, indicated by D and D. After this the "butts" E E E are gone over to prevent any leak.

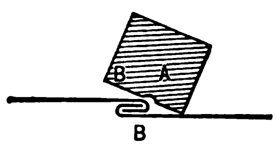


Fig. 38. Soldering Copper with Groove for Guide

Another sheet, edged on the flat seam edger, is illustrated by Fig. 39, and is known as a valley sheet, having the edges A and B turned one way, while the short sides C and D are edged right and left. In some cases where required the short sides C and D are edged one way and the opposite sides A and B right and left. The use of valley sheets is shown in Fig. 40. A roof on which the water pitches towards the center is shown by A, and the tin is laid from both sides, or perhaps one side is worked up to the valley sheet and the edge peened into the edge of valley sheet. Oftentimes a strip is "knocked" out for valleys, same as for flashings, instead of laying sheet by sheet and a bend made with a plank, as described later for gutter lining. In Fig. 41 is shown how a box gutter made of wood is lined with

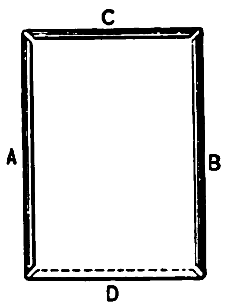


Fig. 39.
A Valley Sheet

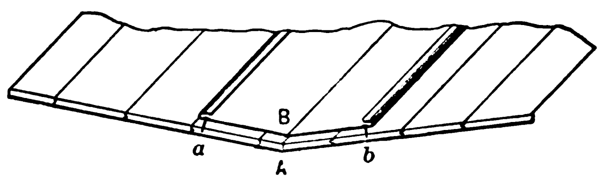


Fig. 40. Laying a Valley

tin. The method which will be described for bending up the tin strips will also apply to the bending of wall and curb flashings, etc. Therefore let A represent the wooden gutter and B the tin lining in place, projecting over the wood molding at C and having a lock on the roof surface at D. When the gutter is in place the tin

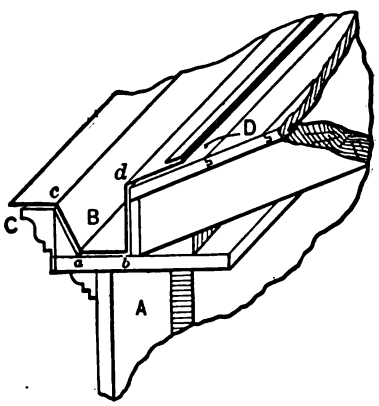


Fig. 41.
Lining a Box Gutter

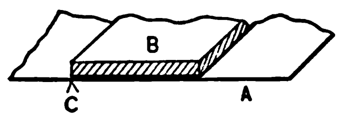


Fig. 42.
First Operation Bending Strips

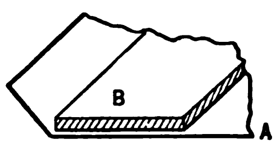


Fig. 43.
Second Operation Bending Strips

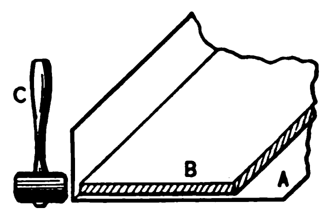


Fig. 44.
Last Operation of Bending the Strip

is turned over at C and nailed, in the same manner as shown by *a b* in E, Fig. 31. Assuming that the gutter is 20 feet long, in Fig. 41, "knock out" 10 feet of tin strips of the required width, being careful to have a straight line; this is most readily accomplished by tacking the first sheet with nails, then following the chalk line or such other line as may be employed, and lock by means of a mallet the required number of sheets.

The short seams are soldered, then the bending is done as shown by the three operations in Figs. 42, 43 and 44, first striking chalk lines where the bends will be; a blue chalk shows better on the tin than white chalk. In Fig. 42, A represents the tin strip and B an ordinary roof plank having a straight edge; C indicates the first bend which is to be made. Now take the board, lay it at the required line, C, and while standing upon it with the legs slightly spread, stoop down with arms stretched, grasp the tin firmly and bend it slightly upward. Then it will appear as shown in Fig. 43. Now grasp the tin again and in the same manner, and bring it over to a right angle, after which use the mallet, as shown in Fig. 44, and dress it well against the board. This will complete the last operation in bending the strip. It should be understood that these operations are for the two bends *a* and *b* of Fig. 41 only, and that the other bends are made when the lining is in place by laying a board in the gutter and standing on this so as to keep the lining well down in the gutter, then with a mallet and board dress the tin over on the roof and over the front of the gutter; turning the seam edge on the roof with tongs.

Connecting roof to wall flashings, etc., will now be taken up. The methods given are strictly correct, therefore a few remarks relative to reversing seams in roofing will not be amiss, as this query has appeared from time to time in the columns of the *Metal Worker*, so it is believed that it is of sufficient importance to reprint here the substance of the remarks relative to the question of having seams against the water.

It is agreed that whenever practical the seams in all types of roofing should be so as to shed water, and that you invite trouble when you have seams the other way, for no matter how strong you solder a seam there is always a likelihood of seam opening, and water would then run into seam, whereas if correctly made it would flow over the open seam.

It is conceded, though, that it is often necessary to have seams reversed. To illustrate—if we have a roof with a gutter and fire, or battlement, walls on the other three sides we would first (after setting gutter) ''knock out'' flashing strips for these three sides. These strips are nailed in place with the edge turned up. Then when laying the sheets we work from the strip on one side to the other and peen the edge of sheet into the flashing; likewise at the top strip the last course of sheets are peened into the strip making a seam against the water. And this method is employed in a good many other cases, around chimneys, etc. The correct methods will now be discussed.

Fig. 45 shows an extension roof which butts against the main building, whose walls are frame. Assuming that the last course of tin is in the position shown, take the distance from lock A to the wall B, bend off the strip as has been explained, being careful that the tin goes high enough to lap at least 4 inches under the clapboard D. If the clapboard is fast it should be loosened to allow tin to go under, and not nailed, as is frequently done, on to the board D and then paintskinned. This will eventually cause a leak. If this main wall were of brick or stone the tin would be let into the joints, as indicated in Fig. 46. This engraving represents a side strip on a flat roof with lock attached, to lay on the roofing. A shows the brick wall and B the tin strip, having a 1-inch edge turned into the joint, then wall hooked and paintskinned. It is usual to turn up side strips to the fourth course of brick over the finished roof. When building the wall it is customary for the masons to clean out the mortar where the tin is to turn in the wall. Should they fail to do this, then the first thing to do before laying the roofing is to dig out this joint with a hammer and chisel or an old saw. Fig. 47 shows a cap and base flashing, which allows for expansion and contraction of the metal. When the wall has been carried up to the required hight, or four courses above the finished line of

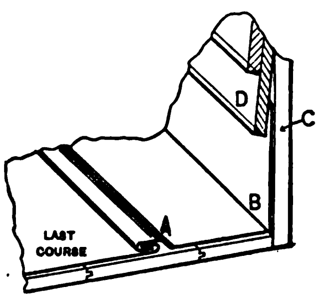


Fig. 45.
Flashing under Clapboarding

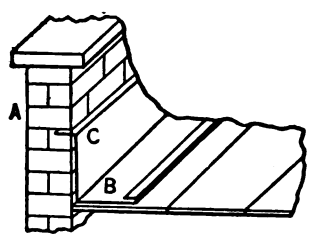


Fig. 46.
Side Strip Inserted to Connect Roof with Wall

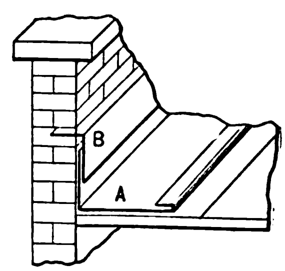


Fig. 47.
A Cap and Base Flashing to Allow Expansion and Contraction

the roof, the cap flashing B is placed in position, as shown, after which the mason completes the wall and sets the coping. The base flashing A, having a lock as indicated, is turned up under the cap B to within ½ inch of the top of the cap flashing.

It often occurs that a skylight or scuttle is placed in a roof, the curb of which must be flashed and the corners double seamed, as shown in Fig. 48, A representing the scuttle opening and B C D E the curb, the water running in the direction of the arrow. Then the corners should be double seamed, as shown in diagram F, and the locks made so that when closed, as at *a*, the water coming in the direction of the arrow H, will pass over the seam. If the seams were made in the opposite manner the water would run into the joints. This shows how to seam the corners and flash around a curb or bulkhead or any other structure on a roof. The method of obtaining the correct seam lines on the front, sides and back is shown in Fig. 49, and is applicable to curbs, scuttles, chimneys, etc. A B C D represents a bulkhead over a roof around which flashing must be placed, the sides and top to be covered with tin. E represents the last course of tin, which is laid before reaching the bulkhead. To put in the strip F G, assuming that the distance from the lock to the bulkhead indicated by F is 10 inches, bend off 10 inches on the strip, as shown in Fig. 42, making the distance of G in Fig. 49, 4 inches, using 14×20 inch tin. When the strip is bent up it is notched at the corners to allow for double seaming, as shown at F in Fig. 48, notching the corners, Fig. 49, so that the portion H forms

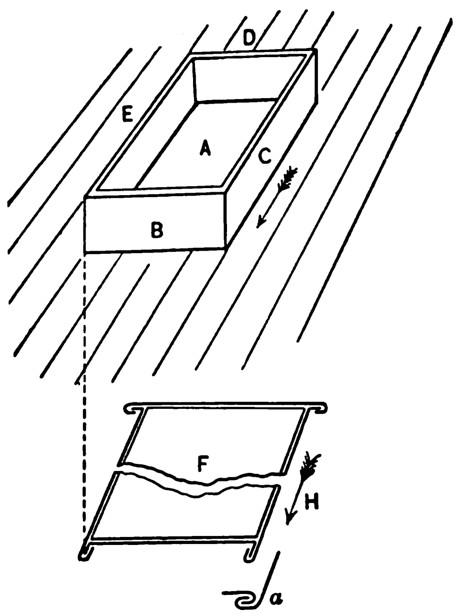


Fig. 48. Double Seaming Corners

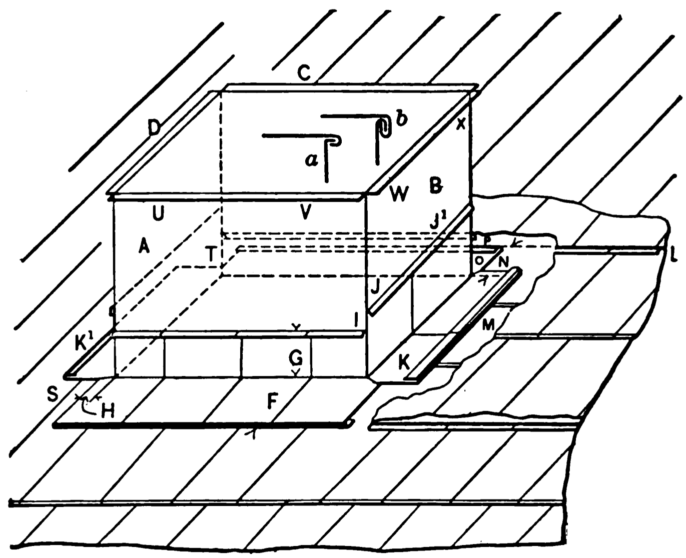


Fig. 49. Flashing Around a Structure on a Roof

a lap on the roof, and to be pieced out later. The side strips K and K^1 are now put in position, care being taken that the lock J of the side strip K runs above and breaks joints with the lock I of the front strip F G.

The tin roof is now continued up to L, or the first seam above the bulkhead, the flat portion at M being broken in the diagram to better illustrate the locks. The line of the seam L is now extended with pencil, as shown by the dotted line, so that the proper measurement of the distance from the bulkhead to the lock L can be obtained, as at N. Bend off the rear strip O so that the lock P will be in line with the lock L, exercising care that the lock J^1 on the strip turned up against the bulkhead will break joints with the lock J on the side strips. The roofing is now continued from the locks L P, after which the corners N R S T are pieced out and soldered.

The sides of the bulkhead are tinned up in the usual manner, allowing edges for double seaming at the corners, and allowing a single edge at the top, as indicated by U V W X C D, Fig. 49. Then, when covering the top of the bulkhead, the roof is locked into the single edges U V W X C and D, as shown at *a*, and is then turned over to form a double lock, as at *b*. The corners are now double seamed, soldering the lower part 6 inches above the roof line, while the balance of the seams at the corners and sides are painted with a thick coat of red lead. After this they are flattened or closed with the mallet, which insures a tight joint.

We will now consider the soldering of upright seams, which becomes necessary when cross seams occur in side or wall flashings or when the corners of curbs or chimneys have to be soldered. Fig. 50 illustrates a cross seam in a side wall flashing, A B indicating the metal flashings fastened to the wall joint by the wall hooks *a*, *b* and *c*. The seam being properly locked and closed, it should be soldered in the following manner: First, prepare or forge the soldering coppers, as in Fig. 30; the front A is wedge shaped, ¼ inch thick by about 1¼ inches wide, and is used for upright seam work. This style of soldering coppers should be tinned on one side and on the end only; if tinned otherwise the solder, instead of remaining on the tinned side, would flow downward; by tinning the copper on one side only the remaining sides will be black and will not tend to draw the solder downward. The soldering copper being thus prepared, solder the upright seams in the manner indicated in Fig. 50, holding the copper in the position shown by C. This allows the solder to flow forward, while if the copper were held as shown by the dotted line D, the solder would flow backward and away from the seam. First the seams are tacked, in order that they will lie close; then the seam is thoroughly soaked with solder, after which ridges of solder are placed across to strengthen it. In "soaking" the seam the copper should be placed directly over the lapped part, so that the metal is thoroughly heated. This enables the solder to flow between the seams of the metal, making a tight joint. The same method applies to any other upright seam.

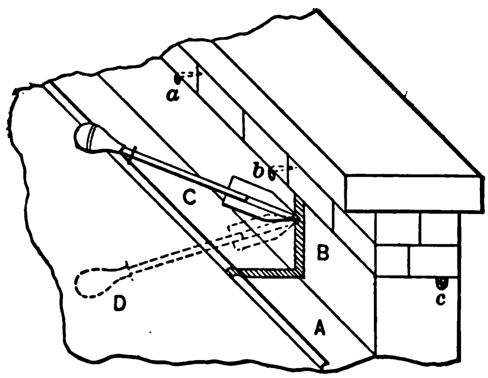


Fig. 50.
Soldering Upright Seam

PRACTICAL TALKS ON TIN ROOFING—III

We will now give attention to the method of laying standing seam roofing, in which the cross horizontal seams are locked as in flat seam roofing and whose vertical seams are standing and locked, as will be described in connection with Figs. 53 and 54. Assuming that the pitch of the roof is 18 feet long, the tin is edged on the 14-inch side only, right and left, and as many sheets are locked together as are required for the 18-foot pitch. Some men prefer to "knock out" long strips and cut off as much as needed.

After the necessary number of strips have been locked and soldered, the standing seams are bent up with the tongs, or, what is better and quicker, the roofing edger for standing seam roofing. This is a machine into which the strips of tin are fed, being discharged in bent up form as required and as shown in Fig. 51, 1 inch on the one side and 1¼ inches on the other, or they can be bent 1¼ inches on the one side and 1½ inches on the other, as is most desirable. This gives a ¾ inch finished seam in the first case and 1 inch in the second when completed.

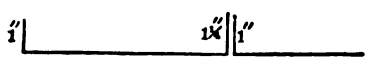


Fig. 51. Edged Strips Laid for Lock Seam

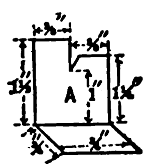


Fig. 52. Cleat for Fastening Strips to Roof

In laying the strips they are fastened by means of cleats, shown in Fig. 52, with full size measurements. These cleats allow for expansion and contraction of the metal, and are applied as shown in Fig. 53, which also shows the first operation in applying standing lock roofing. Some roofers use cleats which are not notched out, as is indicated at A in Fig. 52, but cut the cleat square at the top, and instead of turning the cleat right and left, as in Fig. 53, they only turn the cleat over the strip B, the strip C not being secured until the second operation is performed, as in Fig. 54. However, by turning the cleat as shown in Fig. 53 both sides of the strips are held down and trouble from the wind is avoided.

Assuming that all the strips have been bent up 1 and 1¼ inches, apply them to the roof boards as follows: Let A represent the hanging gutter at the eave of the pitch roof, having a lock bent on it, as at D. Take a strip of tin, B, having a lock at the bottom, as at E E, and lock it well in the lock of the gutter, as shown. Then with a cleat made of scrap tin, Fig. 52, place it as indicated in Fig. 53 by F. Lay it tight against the upright bend of the strip B and fasten it with a roofing nail at *d*. Now turn the edge of the cleat F over the tin strip, as shown at *a*; this holds the strip B in position. It is usual to place these cleats about 20 inches apart, and in some cases they are placed closer, as desired; sometimes two cleats to a 28-inch sheet. The next strip, C, should have a 1-inch bend. Lay it tight against the 1¼-inch bend of the strip B, lock it well into the lock D of the gutter, press it down well at the corner of the roof, and turn over the edge of the cleat, as

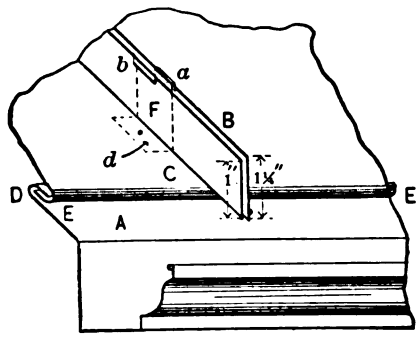


Fig. 53. First Operation

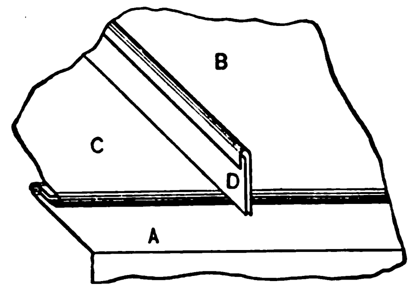


Fig. 54. Second Operation

at *b*. This holds the strip C in position. It will be noted that no nails have been driven into the standing seam strip, the entire roof depending on the cleats to hold it down and prevent rattling.

The next operation is shown in Fig. 54. By means of the hand seamer and mallet, or with the roofing double seamers, the first or single seam is turned over, as shown at D. If the hand seamer is used it is held in the left hand and the single edge is turned over with the mallet. Roofing double seamers are widely used, and two constitute a set to finish a seam. One of the seamers does the bending and the other the squeezing. Both can be made adjustable for the first or single seam and for the double seam. The operations are performed by the foot treadle, the handles being used to clamp the edges. Much time is saved in the use of the double seamers over that expended in the use of the hand seamers.

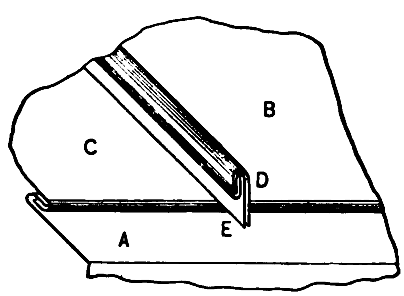


Fig. 55. Last Operation

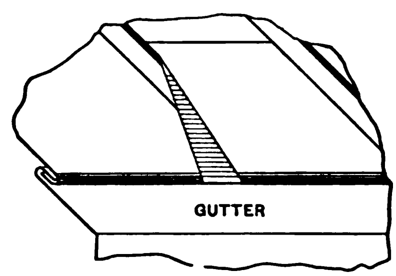


Fig. 56. Finishing a Standing Seam Roof at Gutter

When the seam D has been tightly closed the double seam is made, as shown at D in Fig. 55, involving the same operations with both the hand and roofing seamers. This is explained in connection with Fig. 54.

If desired the seam E, in Fig. 55, can be soldered, but this is unnecessary on a steep roof, as the water will not back into the seam. While the three operations shown in the three preceding figures indicate the method of double seaming, another method of locking the standing seam roof into the gutter edge is shown in Fig. 56, in which the standing seam is flattened and locked into the gutter, as shown.

Fig. 57 illustrates a roof starting at the eave and having a hanging gutter and gable wall flashing. A indicates the gutter flanged to the roof, as shown at B, allowing the flange B to extend under the side flashing F, as at C. At the front of the parapet wall notch out the flange of the gutter, and bend it up against the wall, as indicated by the dotted line D. When the gutter is in position and the gutter braces fastened to it the side wall or step flashing E F G is put in position, stepping double courses of brick, as shown, and flanging into the joints of the brick work or other wall and fastened with wall hooks and paintskins, and overlapping the gutter flange D, as at H.

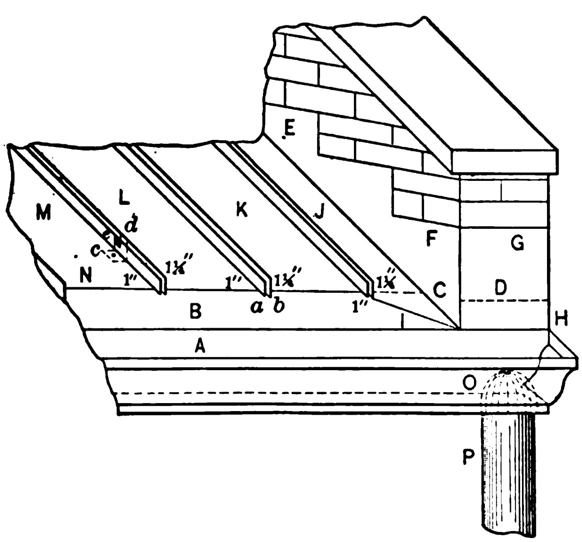


Fig. 57. Standing Seam Roofing, Laying the Strips

The strip is flanged outward on the roof, as shown at J, Fig. 57, about 7 inches, or as much as the width of the tin strip will allow, and on this strip the 1¼-inch bend is made, mitering the flange J over the flange B of the gutter, as shown at I. The strips K L M are now placed in the positions indicated, using the cleat N, as in Fig. 53, and also shown by *c d e* in Fig. 57. Care should be taken to lock the strips well at the bottom into the lock of the gutter flange B, as is indicated by *a b*. O is the wire strainer or basket placed over the leader P. The entire roof is finished in the manner indicated, when the double seaming is done, as previously explained.

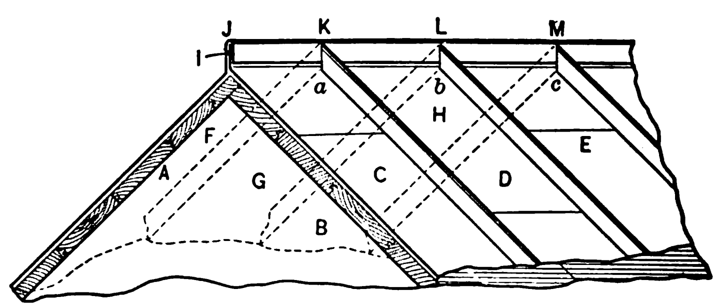


Fig. 58. Finishing with a Comb Ridge

Fig. 58 illustrates a finish made at the ridge of a standing seam roof. This is known as a comb ridge. A B indicates a section of the roof boards, C D and E are strips of tin having a single edge at the ridge, as shown by I, while the opposite strips F G and H have a double edge at the ridge, as at J. The standing seams K L M are mitered and are soldered from K to *a*, L to *b* and M to *c*. When the comb ridge is not required it can be double seamed, as at A in Fig. 59, leaving the standing seam miter at B C and D, and soldering from B to *b*, C to *c* and D to *d*.

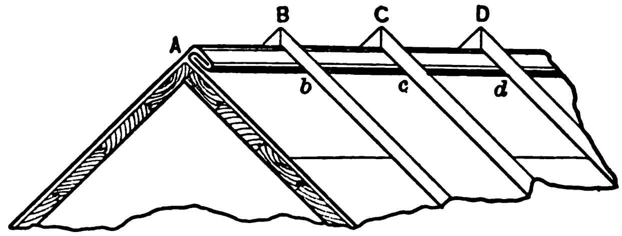


Fig. 59. Double Seaming the Ridge

When mitering the standing seams at the top it is better and quicker to make a small "gauge" with which to mark each strip at the top after the standing seams are turned up. This "gauge," or shape, can be made as follows: In Fig. 60, A represents a piece of the tin strip in use before being bent up and about 12 inches long. Obtain the angle of the roof at the ridge, as in diagram B C. Parallel to C and B measure off a distance of 1¼ inches and draw the lines D E and E F; then draw a line from E to H, after which take a tracing of H E F J, to be placed as shown by L M K; repeat the operation at N. Allow for the vertical seam O, as shown. The dotted line P indicates the allowance for the double seam. Then all the tin strips for one side of the roof should be cut without laps, as shown by L M O N. The tin strips for the opposite side should have laps for seaming, as in Fig. 61. This figure exhibits the top of the strip bent up

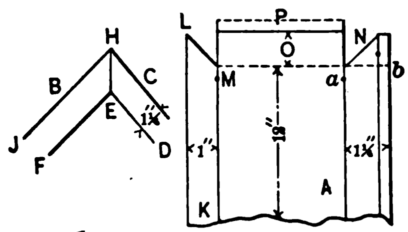


Fig. 60.
Gauge for Cutting End of Strip to Fit Comb

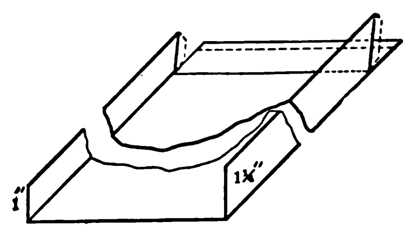


Fig. 61.
Roofing Strip Cut to Fit Comb

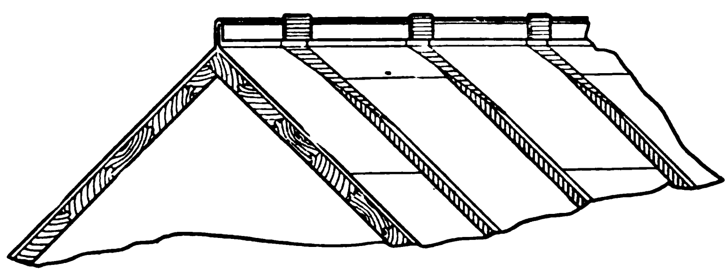


Fig. 62. Ridge Comb Finished with Standing Seam

and having laps. In Fig. 62 is shown another form of comb ridge, in which the standing seams are flattened and then turned up the same as in standing seam work, by means of tongs, and double seamed with the hand seamer, as shown in the illustration. Fig. 63 shows the method of finishing the standing seam when it butts against the wall and it is desired to put in a flashing. In this case proceed as follows: A represents the roof boards, B and C tin strips put in position, and having a lock as at E and D, the distance from the wall to the lock being as desired. It will be noticed that the standing seam H is turned over by means of a mallet, as shown at J, after which the flashing F G is locked into it, as at K. Then the seam K is tightly closed with the mallet and the seam K H soldered. If the roof is steep the soldering is not necessary. The top of the flashing is flashed into the wall and fastened with wall hooks, *a b c* and *d*, and is then paintskinned or cemented.

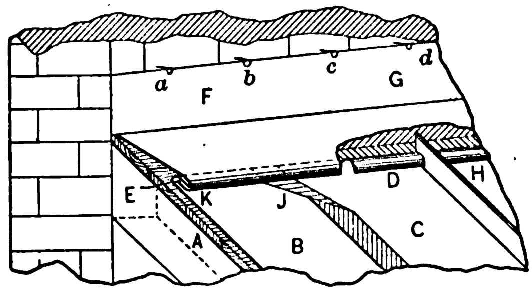


Fig. 63. Flashing Against a Wall

The method of turning over the double standing seam H, as shown at J, is sometimes employed where the seams meet at the ridge, as at B C and D in Fig. 59. Then they should be cut square, as at *a b* in Fig. 60, and turned over, as shown by J in Fig. 63. Double seam and solder at the ridge, as at A in Fig. 59.

It is not out of place here to remark that for a tile roof that abuts a gable wall as in Fig. 57, the flashing would be bent and put in as the strip J. Though most likely it would be bent up straight, with the wall and roof and covered with a cap flashing, E F, still giving the same appearance as Fig. 57.

PRACTICAL TALKS ON TIN ROOFING—IV

There is a question with some roofers as to whether it is best to use a revolving roofing edger in preference to ordinary roofing tongs in turning up edges for standing seams. While it is true that the revolving edger is very much more rapid than tongs, so far as turning out edged courses goes, careless use of the edger will leave the tin in such shape that the extra time consumed in doing the double seaming goes far to offset any gain over tonging. If the edger is not firmly secured to the roof and the tin passed perfectly straight through it the result will be much variation in the width of the edges turned up. It is a common practice when putting on roofing requiring long courses for one man to start one end of a roll of tin through the edger located at the high point of the roof, and for another man to take hold of the tin as it emerges from the edger and draw it through rapidly instead of winding it through by turning the handle. In pulling the tin through in this manner the operator is almost certain not to walk straight down the roof, or the machine may slip a little so as to cause feeding of the strip too much to one side of the machine. If the pressure favors the wide edge side, the result will be too much tin to fold into the double seam on that side, as indicated at *a*, Fig. 64, and too little tin on the other to stand up high enough to be folded into the double seam, as indicated at *b*. If the pressure favors the narrow edge side the result will be too little tin on the wide edge side to double seam, as indicated at *c*, and so much on the narrow edge side as to necessitate triple seaming, as indicated at *d*, which adds unnecessarily to the labor of double seaming. A course of tin thus improperly edged is indicated in Fig. 65, and it will be seen that the edges not only vary in width but the course is made slightly crooked.

In edging tin with a revolving edger, the machine should be firmly secured on a portable base, and this base should be provided with forked standards for carrying the axle, which in turn carries the roll of tin which is being run through the machine. Fig. 66 gives an idea of this arrangement. The tin should be started through the machine and the lower end slightly turned up as indicated, so that it will slide down the roof without catching against the edges of boards, etc., and it should be forced through by turning the handle of the machine. The tin should not be pulled through independently of the handle. Care should also be taken to see that the axis of the rolls is exactly paralled with the ridge, or perpendicular to the rafters of the roof, so that the weight of the course after it has been passed through the machine for some distance will not tend to pull the tin one sided. The uprights *a* should not be located so as to interfere with a true entrance of the tin into the machine.

If the revolving edger is worked in this manner fairly reliable results can be depended upon as regards width of edge, but experience has shown that the average roofer is not content to grind the tin through the machine in this comparatively slow manner, when he can take hold of it and pull it through on a run, though he is almost certain to hamper the double seaming operation and cause badly finished work in the end. While even the grinding through method in using the revolving edger is considerably quicker than tong work, there still remains a slight disadvantage, in the stretching of the tin, which causes the standing edge to be somewhat

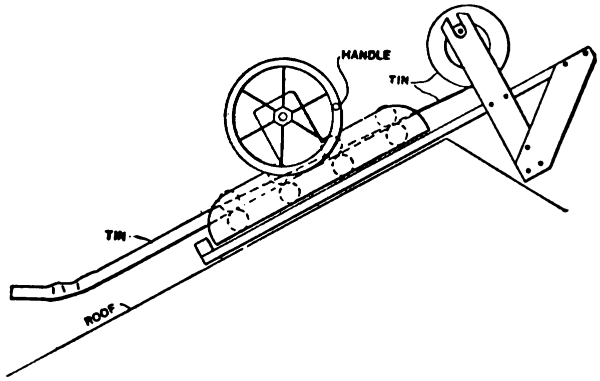


Fig. 66

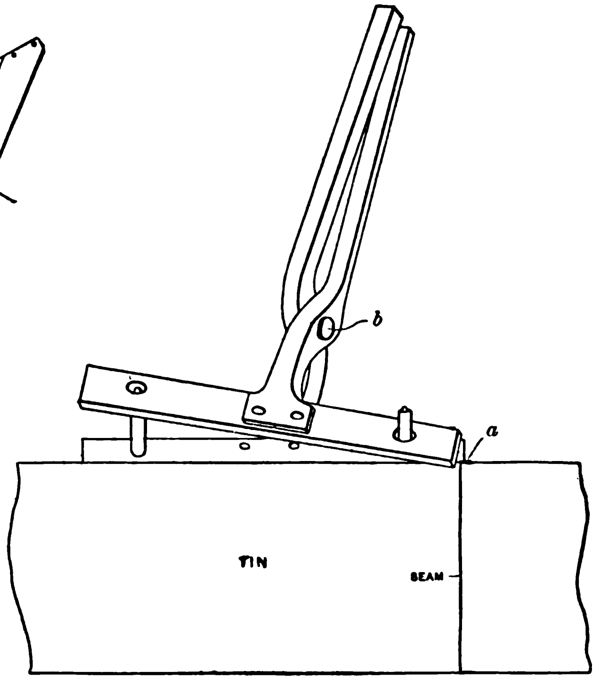


Fig. 69

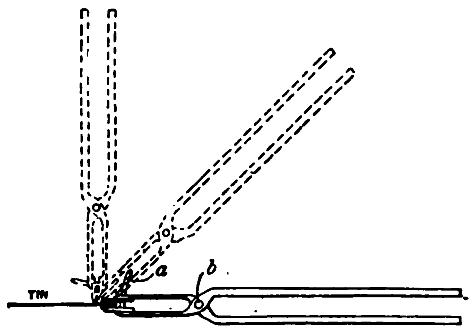


Fig. 68

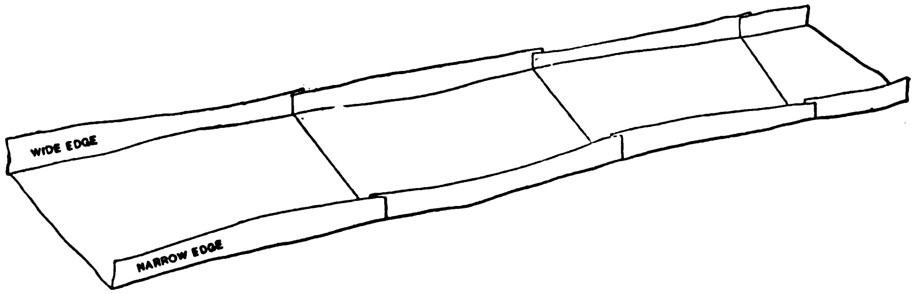


Fig. 65

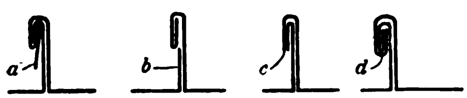


Fig. 64

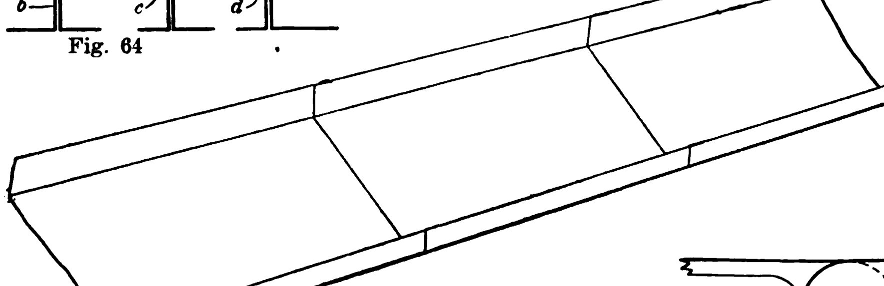


Fig. 67

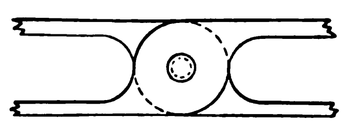


Fig. 70

PRACTICAL METHODS OF LAYING STANDING SEAM TIN ROOFING buckled or wavy, making the first operation of the double seaming comparatively difficult.

Fig. 67 shows a course of tin as it appears when edged up with roofing tongs. Fig. 68 shows how the tongs grasp the edge, and it will be seen that the width of edge turned is entirely governed by the gauges *a* and the method of operation is such that varying widths of edge are not likely obtained. These roofing tongs

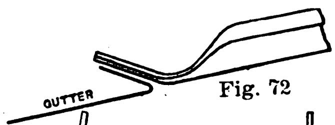


Fig. 72

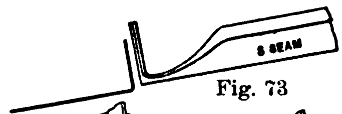


Fig. 73

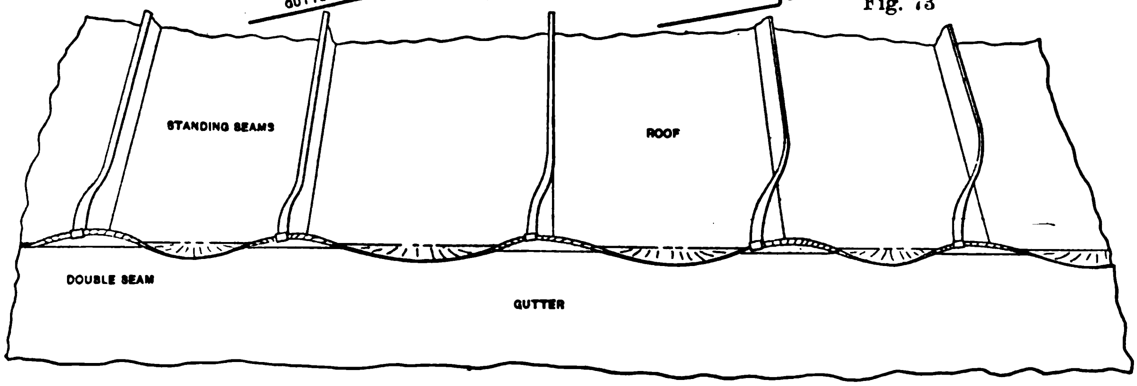


Fig. 71. Standing Seam at the Gutter Line

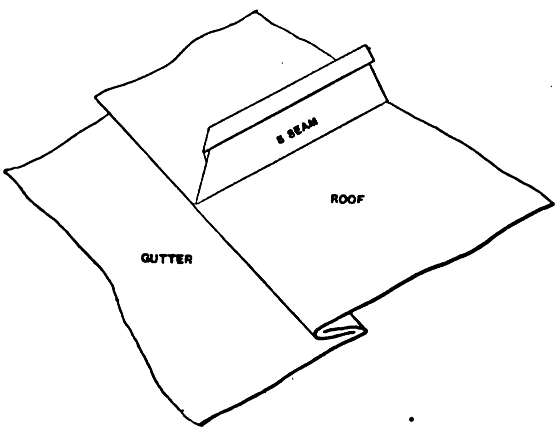


Fig. 74. Gutter Connection

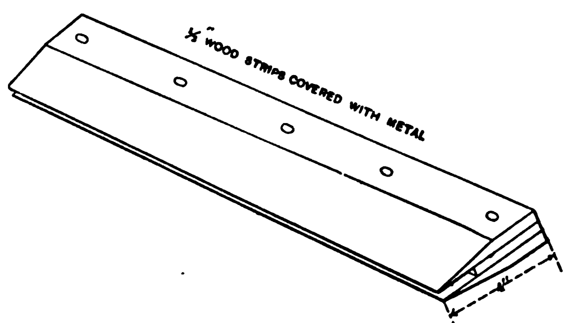


Fig. 75. Edge Turner

being usually 14 to 20 inches long and thus turning up that length of tin at each bite, the stretching of the edges is almost entirely avoided, and the finished result is a course with straight and rigid standing edges, as indicated in Fig. 67, so that when they are brought together for double seaming the first operation is much easier than if the edge had been stretched and buckled.

In tonging it is necessary to go over the edge twice—the first time turning it half way up, or to an angle of 45 degrees, and the second time finishing it as indicated in Fig. 68. In passing, attention is called to a defect in most roof tongs, viz., lack of bearing surface around the pivot bolt *b*. The result of lack of this bearing surface is seen in Fig. 69. When the handles are operated to open the tongs, one side or the other of the blades, from some cause, such as being held by friction against the gauge, etc., may remain nearly closed, while the other side is opened much wider than necessary, and in sliding the tongs along the edge of the tin the

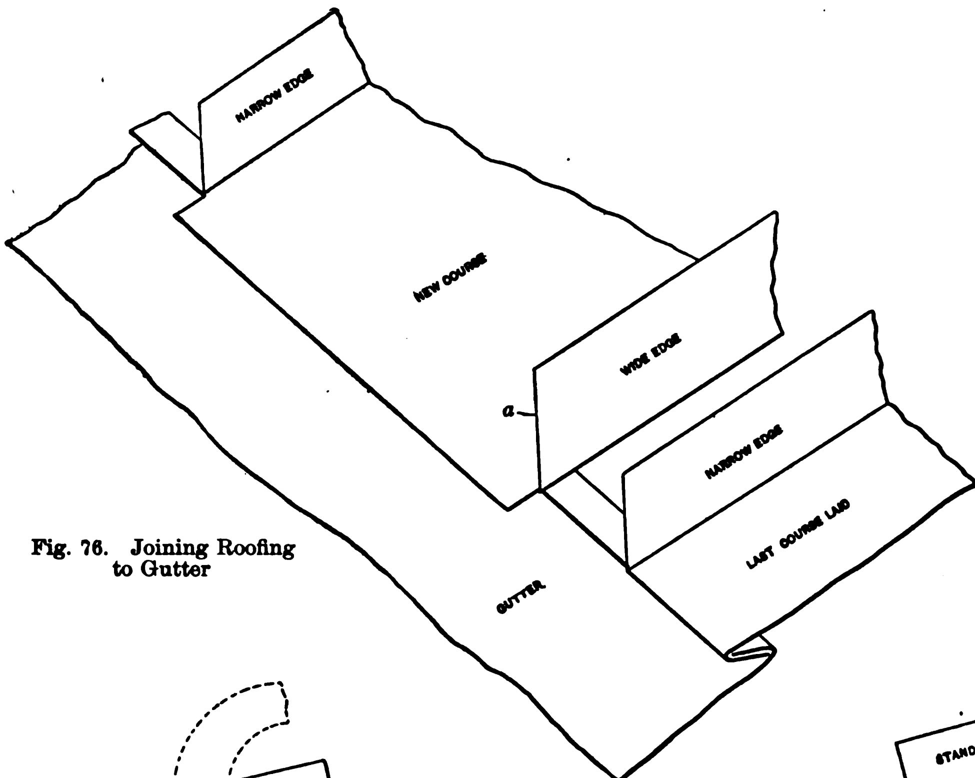


Fig. 76. Joining Roofing to Gutter

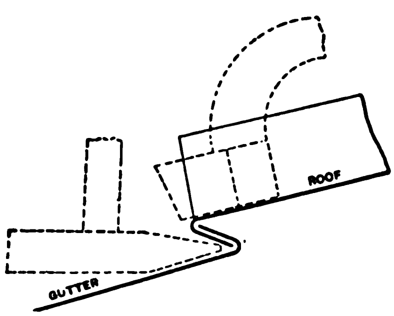


Fig. 78. Peening Edge into Gutter Flange

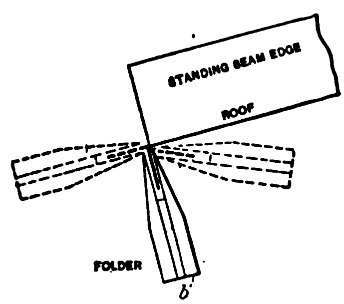


Fig. 77. Turning Edge on Roofing

side thus remaining nearly closed is liable and in fact does usually strike against the seams, as indicated at *a*, causing annoyance and delay. The tongs shown in Fig. 69 are as they are usually made, *i. e.*, with scant bearing surface around the rivet bolt *b*. Fig. 70 indicates how this working part should be made. When thus made and the bolt is kept as tight as possible without making the tongs work hard, the blades will be held parallel in opening and closing the tongs.

Where the gutter conditions are such that snow and ice are not likely to lie or water to back up on the roof, a good and cheap method of joining the courses to the gutter is shown in Fig. 71. The first operation in producing this joint is shown in Fig. 72, a 1¼-inch edge being turned on the gutter, the roof courses being cut off so as to project a scant ¼ inch over this edge, and the bottom ends of the double seams being flattened over, as shown. The second operation is indicated in Fig. 73, the two edges having been turned up perpendicular to the roof with the 1½-inch gauge roofing tongs. The edges thus turned up are then double seamed, after which this gutter double seam is malletted over flat in the center of the courses, allowing that portion at the bottom ends of the double seams to stand nearly perpendicular as indicated in Fig. 71. This gutter seam is not hammered down at the last named points, for the reason that the tin folded into the double seam would be likely to break when straightened out again, and furthermore when left standing at the point shown the seam is better drained and less likely to leak.

Where there is some possibility of water being backed up to the level of the gutter seam, the method of joining indicated in Fig. 74 is best. In making this connection a hand folder, as indicated in Fig. 75, is very useful. A ½-inch edge is turned on the edge of the gutter, and the course is cut just long enough to project ½ inch over this edge, as indicated in Fig. 76, the standing seams being notched just flush with the edge of the gutter as indicated at *a*. The bottom end of the course is then raised about 6 inches above the roof, and the hand folder, Fig. 75, slipped on to the edge and the edge turned as indicated in Fig. 77. If the course has not been cleated or secured in position, the edge can be turned under to the point *a*, and then the course let down low enough to allow hooking on to the edge of the gutter and then drawn up taut and secured, but if the course has been clamp tongued into position and is being cleated, the edge should only be turned down square as indicated at *b*. The course is then pressed down on the gutter edge, and has its edge held down by a weight (a hand seamer is very convenient for this purpose) and the edge tucked under with a hammer as indicated in Fig. 78, after which it can be malletted down.

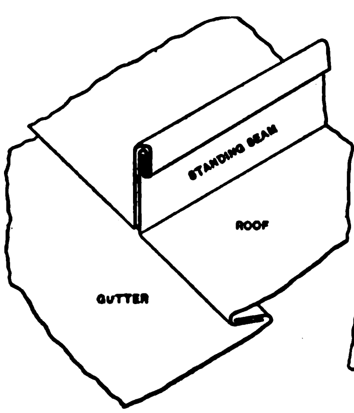


Fig. 79. Finish of Butts

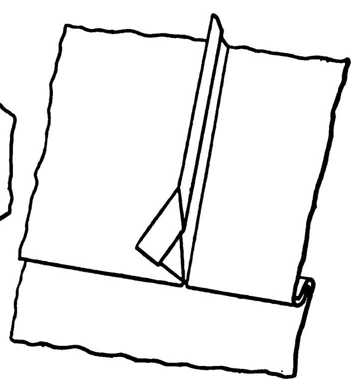


Fig. 80

Attention is called to the advisability of refraining from tightly malletting down such lock edges until they are about to be soldered, as the sharp bending of the material, resulting from tightly malletting down, opens up the pores, so to speak, of the tin coating and one night's exposure to the atmosphere causes rusting and the surfaces of the tin in the lock being brought close together, capillary attraction holds considerable moisture in the seam, which fact, together with the rust, makes soldering very much more difficult than if the seams had been left open with rounded unbroken edges and separated surfaces, as in the latter case neither corrosion nor capillary attraction takes place to amount to anything, even if the seams are left in this condition for several days and are subjected to rainstorms.

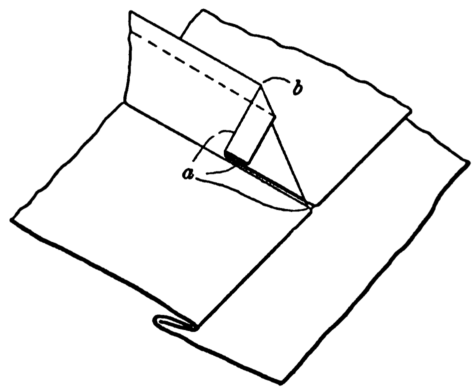


Fig. 81. Butt Finish Complete

A good method of finishing the butts of double seams is indicated in Fig. 74. The operations involved are as follows: First the double seam is left as shown in Fig. 79; the end of the seam is then turned by means of a hammer and heavy

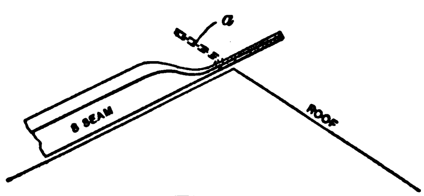


Fig. 82

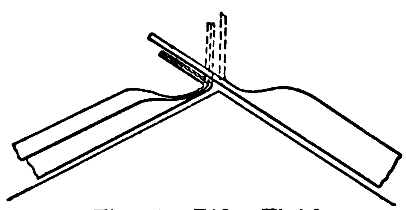


Fig. 83. Ridge Finish

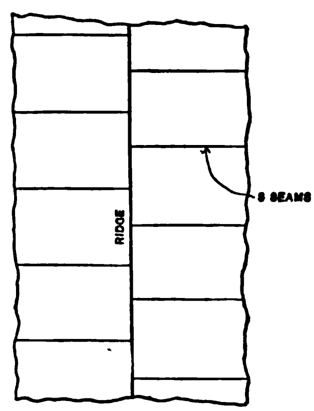


Fig. 84. Adjoining Standing Seam

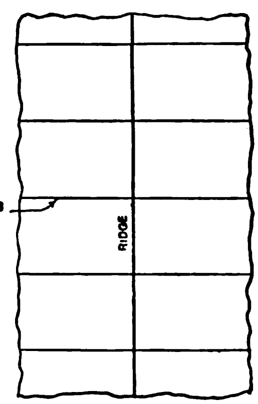


Fig. 85

chisel, as indicated in Fig. 80, and finished as indicated in Fig. 81. The butt is well soldered at the points *a*, Fig. 81, making a perfectly tight roof surface up to the top of the double seam at the point *b*. All that has been said about joining the roof to the gutter also applies to joining the roof to valleys.

A good method of finishing the ridge is by double seaming. When covering the first side of the slope the tin should be left projecting 1¼ inches above the ridge and the double seams finished and flattened down as indicated in Fig. 82, after which this 1¼ inch edge is turned back parallel to the second slope of the roof, as indicated by dotted lines *a*, Fig. 82. When the other slope of the roof is covered the tin should be left projecting a scant ¼ inch above the last named edge and the double seams finished and flattened down at the ends as indicated in Fig. 83. Both edges are then turned up vertically, as indicated by dotted lines, Fig. 83, and double seamed together.

In laying the two slopes of roof care should be taken to have the double seams

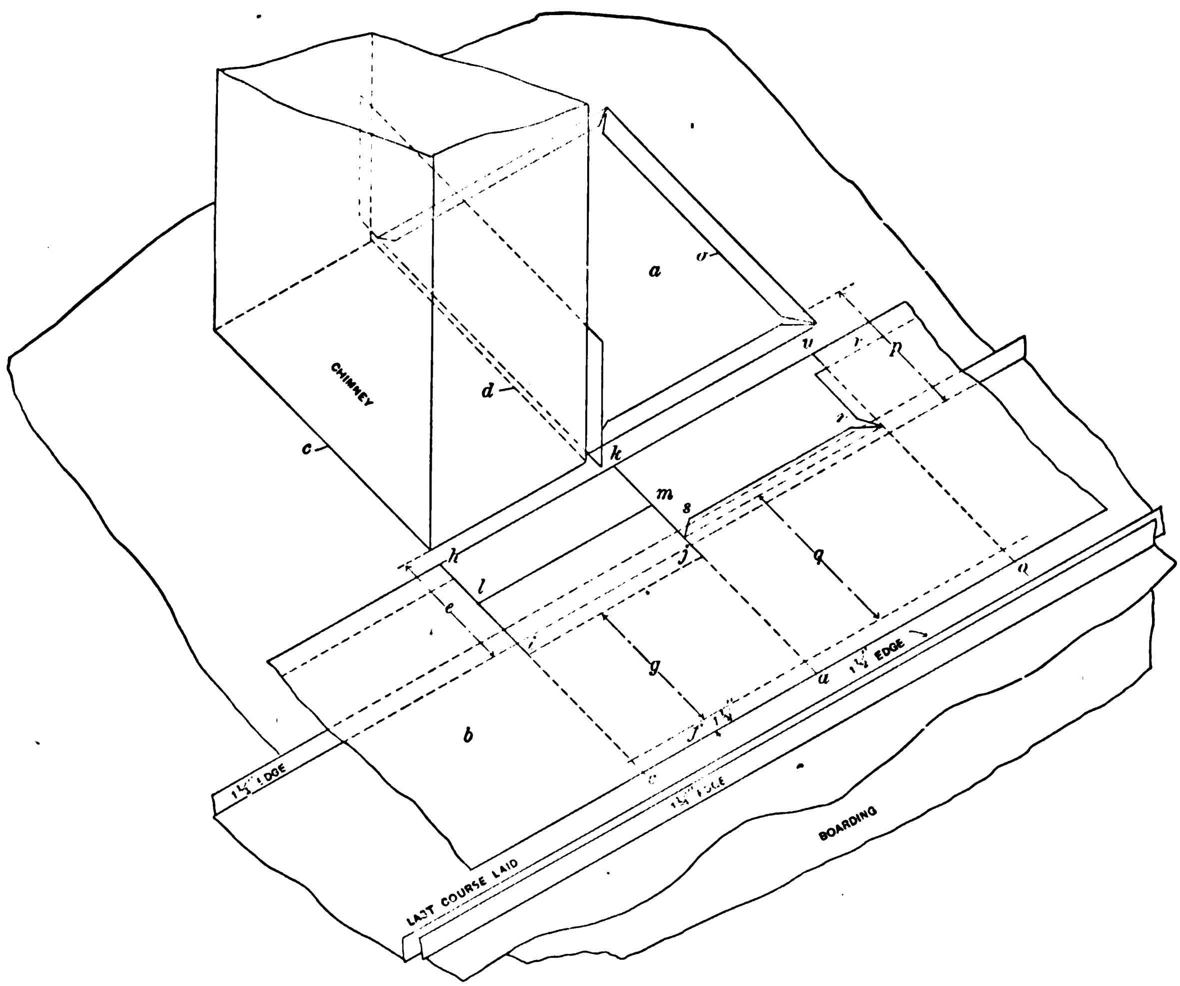


Fig. 86. Laying a Standing Seam Roof Around a Chimney

dodge each other, as indicated in Fig. 84, even though it should be necessary to start the second half of the roof with a half width course cut especially for this purpose. If the double seams hit each other as indicated in Fig. 85 it will be found a practical impossibility to double seam the ridge. What has been said about ridges also applies to hips.

We will assume that a roof has been started and a chimney is encountered.

Assuming the chimney to be of average size, the first thing to do is to lay a cricket behind the chimney, as indicated at *a*, Fig. 86, extending well up on the chimney sufficiently high to insure against water running over it when snow is banked behind, and extending up the roof far enough to bring the edge on a level with the top edge of the tin against the chimney. Cricket *a* should have a ½ inch lock turned on its upper edge and sides.

Supposing the tin to have been laid up to within a half course or so of the chimney, the next course *b* is laid alongside of the chimney before being edged up.

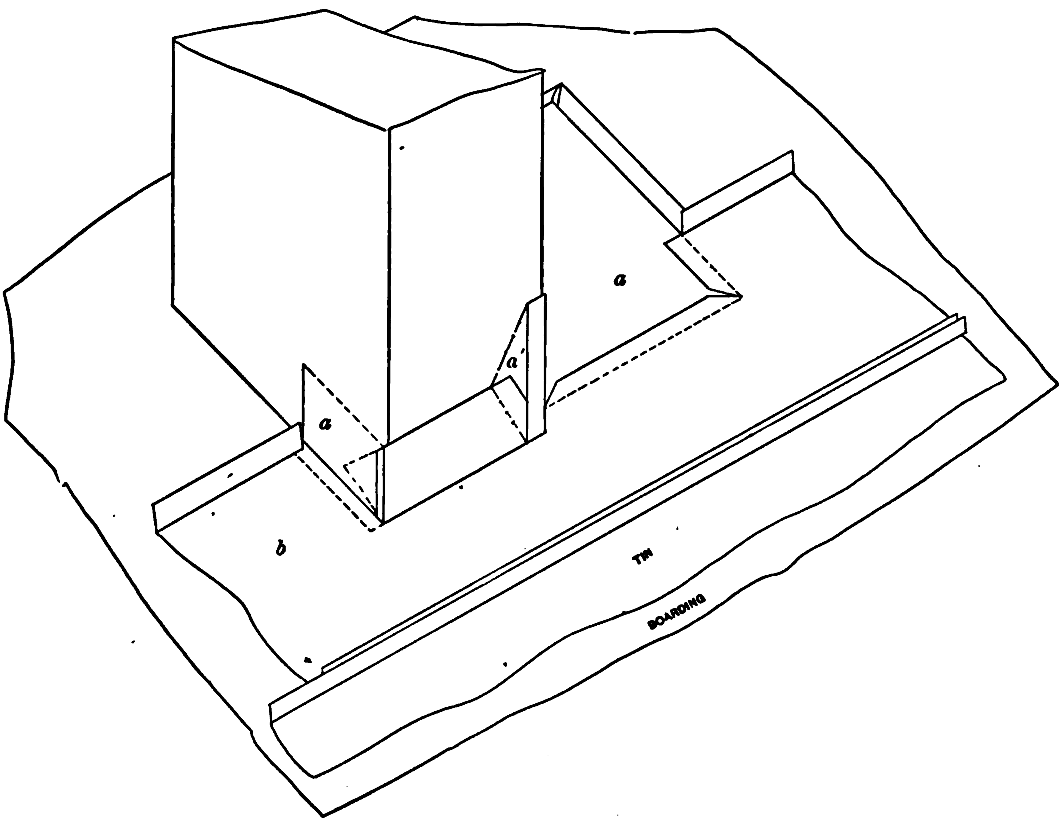
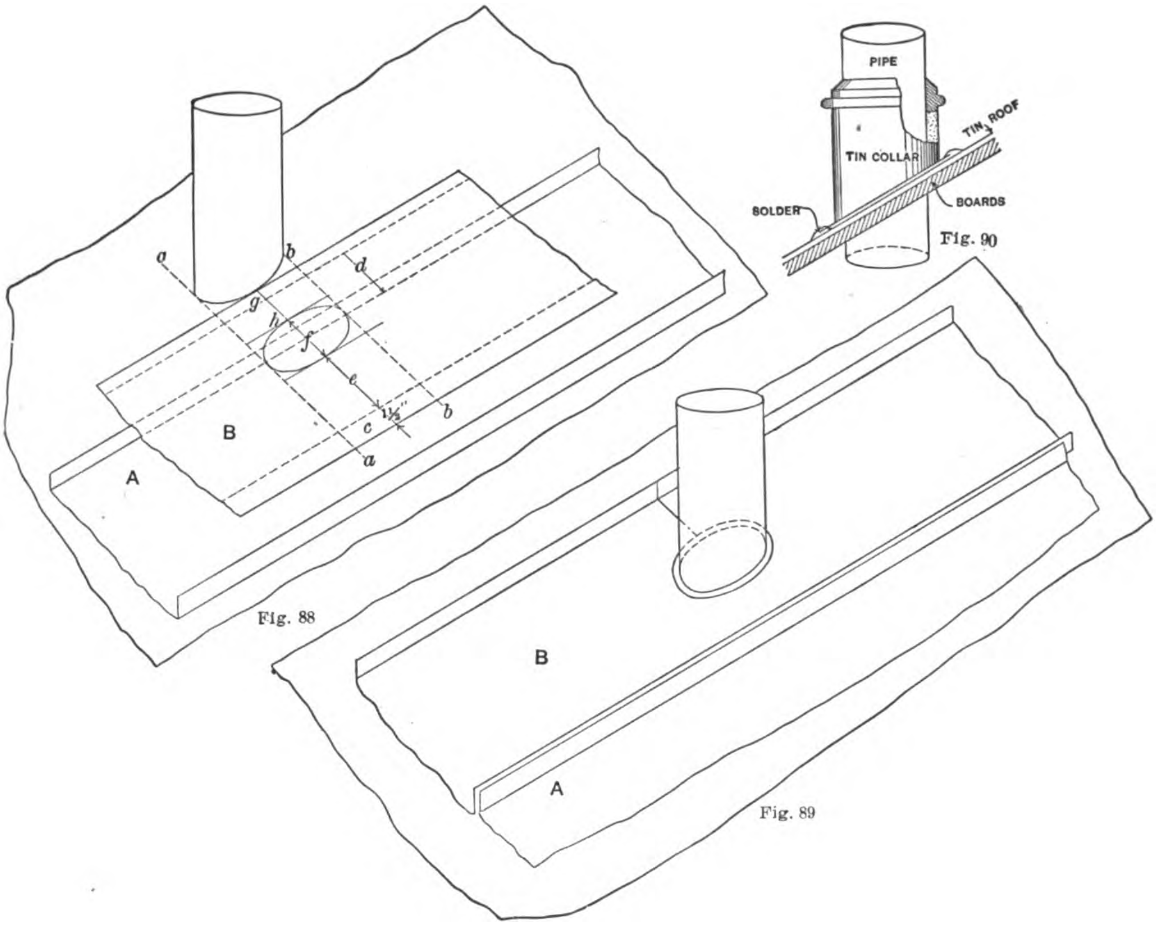


Fig. 87. Laying a Standing Seam Roof Around a Chimney

A straight edge is then laid along the bottom edge of the chimney at *c*, extending across course *b* and a line struck. The straight edge is then shifted to the top edge of chimney, as indicated at *d*, and another line struck. The last course laid usually has its 1¼-inch edge next the chimney, so that the edge to be turned on the new course to be double seamed with said edge should be 1½ inches wide. Therefore measure 1½ inches in from the edge of *b*, as indicated at *f*; and then take the distance *e* from side of chimney to the side of last course laid and set it off as indicated at *g*. Thus the lines *h i*, *j k* indicate the opening which must be made in the new course to slip by the chimney. As the tin should turn up at least 6 inches against the side of chimney, measure off 6 inches from line *i j*, as indicated by the line *l m*.

The straight edge should now be laid against the lock edge of cricket piece, *a*, in the position indicated by dotted line *o*, and a line struck across the course. The distance from the edge of the side lock of the cricket piece to the side of last course



Laying a Standing Seam Roof Around a Pipe

laid, as indicated by *p*, should then be laid off at *q*, and ½ inch allowed for locking onto the top and side edges of the cricket piece.

Now cut lines *h i*, *k j*, *l m*, *s t*, *u*. Edge up the course and bend the tin up square on line *i j*, which fits against the side of chimney. Course *b* is then ready to place in position, as indicated in Fig. 87, after which the edges which lock upon top and sides of cricket at *a* are turned with the fingers and the peen of the hammer in the usual way. The course on the other side of the chimney is laid out and handled in a similar manner. The back of chimney then has the piece *a* and *a'*, indicated by the dotted lines in Fig. 87, soldered in place, after which the chimney is ready for counterflashing in the usual way.

When a pipe is encountered, as indicated in Fig. 88, an opening is cut in the tin through which it is to pass in the following manner: Strike lines across the course from a straight edge placed against the top and bottom surface of the pipe next the roof, as indicated at *a* and *b*. Lay off 1½-inch edge *c*, then lay off distance *d* at *e;* make *f* equal to diameter of pipe, and trace an ellipse within the rec-

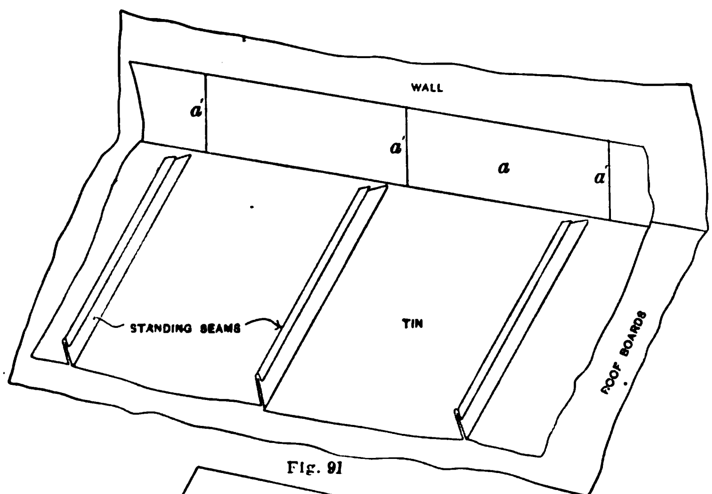


Fig. 91

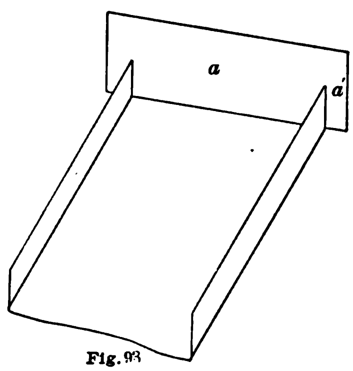


Fig. 93

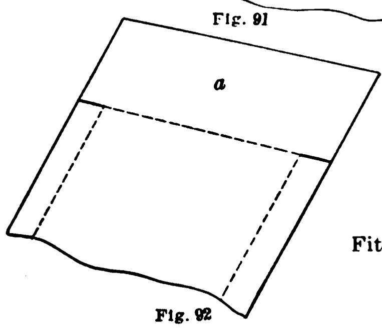


Fig. 92

Fitting a Standing Seam Roof Against Upright Wall

tangle thus laid out, as indicated. If the pipe extends up too high to allow of raising the course up and slipping it down over the pipe, cut into the ellipse from the side of the course, as indicated by *g h*, and cut out the ellipse. Now turn up the 1½-inch edge on the new course and open up the cut *g h* to allow of slipping the tin by the pipe. Then the 1¼-inch edge can be turned and the course cleated and double seamed into position, as indicated in Fig. 89, and cut *g d* soldered up. If the pipe never gets hot a very good finish around it can be made by simply providing and soldering a collar around the pipe, calked with oakum and elastic cement, as indicated in Fig. 90. A stout copper wire should be twisted around the collar near the top edge and be drawn tight before the lap is soldered, which will keep the collar perfectly tight against the piece of calking.

Fig. 91 shows a good way to finish the top of the courses against a monitor or other upright wall. Assuming that the tin is to be turned up 6 inches the top of the courses should be notched, as indicated by the solid lines of Fig. 92, 6 inches from top end. After the course is tongued up and the 6-inch flashing part turned up it looks like Fig. 93. The butts of the double seams are finished as indicated

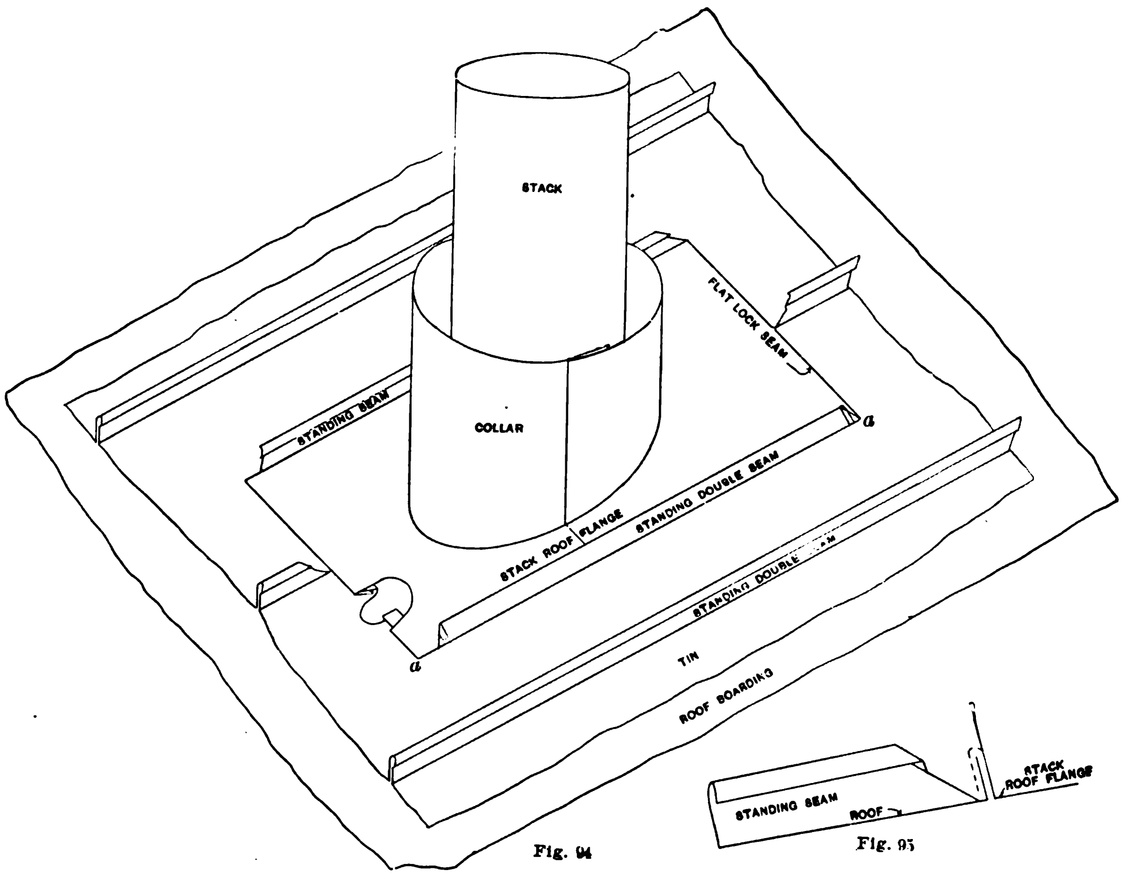


Fig. 94 Fig. 95

Finishing a Standing Seam Roof Around Smokestack

in Fig. 81, page 46. The laps *a*′, Fig. 91, as well as the butt ends of the double seams, are of course well soldered. If it be a clapboarded monitor or side wall against which the top of the courses finish the boarding of course simply laps down over the upturned tin, but if it be brick work the upturned flashing edge is counterflashed in the usual manner.

A good method of finishing around smoke stacks is shown in Fig. 94. It was shown how the roof flange of the smoke stack should be provided with lock edges for joining on tin roofs. Where the stack is of such size as to make the distance *a a* considerable it is advantageous to double seam the roof flange to the tin roofing, along the sides, instead of locking and soldering. All flat soldered seams that run parallel with the rafters should be avoided, so far as possible, as the soldering is sure to break sooner or later and cause leaks, whereas the standing double seam is just as cheap to make, if not cheaper, and will never leak.

The roofing should be locked to the top edge of the roof flange and butts of double seams finished in the same manner as previously described and illustrated in Fig. 81. The connection between the lower edge of the roof flange and roof is finished in substantially the same manner, except that the process of making the connection differs. The seam should be made so as to shed the water downward. Solid lines of Fig. 95 indicate the operation, which consists of, first, turning a 1-inch edge perpendicular to the roof on the bottom of the roof flange and preparing the top portion of the course that connects to it, as indicated in Figs. 92 and 93, the only difference being that ½ inch is turned up instead of 6 inches. The double seam is then finished, after which the roof flange is single seamed over the top edge of the course, as indicated by the dotted line of Fig. 95, and then the seam is malleted down, as shown in the broken view of Fig. 94. This seam, as well as the lock seam at the top of the roof flange and all butts, are soldered.

If a roof has sufficient pitch there is little or no danger of standing seams leaking. If they should even after they have been gone over with a mallet they may be soldered where necessary by turning seams over enough to permit soldering after which they can be straightened up square again or seams can be painted with white lead by means of a small brush.

It might be stated that while the soldering of cross seams was advised, some roofers claim it is best not to solder these cross seams, saying it allows for a free movement of the metal when expanding and contracting.

For a large class of roofing—*i. e.*, when a particular brand or quality, which cannot be had except in loose sheets, boxed, is not required—the entire question of putting tin together in strips or rolls is best solved by purchasing it already put together in rolls, painted or unpainted. Tin in this form is to be had from a number of concerns, some of it being put up in rolls consisting of 20×28 sheets locked together, soldered and painted in the usual manner by hand. While other brands consist of long sheets, some as long as 10 feet, the completed rolls being produced by a machine something like 80 feet long. As a general proposition, for ordinary roofing the long sheet answers very well.

ROOF CLEATS FOR FLAT SEAM

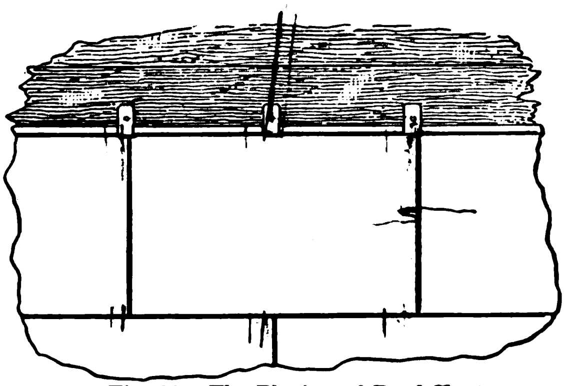


Fig. 96. The Placing of Roof Cleats

Another method of cleating to that recommended in Fig. 25, page 23, is to place a cleat on the top of the two sheets where their edges come together, as shown in Fig. 96. This covers the two laps and holds tightly down in its place the sheet which covers this lap. When the cleats are placed in this way the sheet is not apt to buckle when soldering, as it will invariably rise up slightly owing to the expansion caused by the hot copper.

USE OF PAPER UNDER TIN ROOFS

Paper used under a tin roof deadens the noise and protects the tin from the effect of unsatisfactory sheathing boards. Some insist that a waterproof paper should be used and others prefer a soft felt. There are others who think that the tin should be painted on the under side and then there is no occasion for the use of any kind of paper. They hold the opinion that should there happen to be a leak in the tin roof waterproof paper will keep a pool of water under the tin to help in its destruction. If a sufficient quantity gets there it will run for some distance on the paper before it makes itself manifest underneath, which adds to the difficulty in locating the leak when repairs are to be made. At times a felt has been used containing destructive chemicals in its makeup, which have been detrimental to the durability of the tin plate. When the tin is heavily coated, whether protected with a coat of paint afterwards or not, there are those who believe that there is no need for paper under it, if it is laid on well seasoned dry sheathing boards, laid smoothly, and if an air space is provided underneath the roof to prevent condensation on the under side.

If paper is used under the tin it must be paper that has in its composition nothing injurious to the tin, as tar, sulphur, etc. Many cases have been cited of entire roofs being destroyed owing to this.

COVERING A CONICAL TOWER WITH SHEET METAL

One of the most difficult jobs in flat or standing seam roofing is that of covering a conical tower. As the roof in question is round in plan and tapering in elevation, it is necessary to know the method for cutting the various patterns. In Fig. 97, let A B C be the elevation of a tower to be covered with flat seam roofing, using 10×14 inch tin at the base; the tinning to be laid on two-ply felting, and each sheet nailed with four ⅞-inch wire nails, the sheets being edged not less than ⅜ inch to insure a good lock. Assuming that the tower at B C is 10 feet 6 inches in diameter, we will, at any convenient place at the building, strike a quarter plan, as for example that indicated by J E F, which will be used when getting out the pattern for the bottom of the gutter shown by dotted lines at B and C. The straight part of the gutter requires no pattern, and the slant part is obtained the same as for flaring work. As the diameter of the tower is 10 feet 6 inches and equals 126 inches, the circumference is obtained by multiplying this amount by 3 1-7, which equals 396 inches. As 10×14 inch tin plate is to be used at the base of the tower, the nearest width which can be employed and which will divide the base in equal spaces is 13 1-5 inches without laps, thus dividing the circumference into 30 equal spaces. This width of 13 1-5 inches and the length of the rafter A B or A C in elevation will be the basis from which to construct a triangle, in which all the patterns for the various courses will be laid off.

To obtain the patterns for the various courses proceed as follows: It should be understood that the diagram which will now be constructed will be enlarged so as to better show the methods involved. At any convenient place at the building stretch a piece of tar felting of the required length, tacking it at the four corners with nails to keep it from slipping. Upon the center of the felting strike a chalk line, as A B of Fig. 98, making it equal to the length of the rafter A B or A C of Fig. 97. At right angles to A B, Fig. 98, at either side, draw the lines B D and B C, each equal to 6 3-5 inches, being one-half 13 1-5 above referred to. From the points C and D draw lines to the apex A. As the width of the sheet used is 10 inches, and as ⅜-inch edges are put on each side, thus leaving 9¼ inches, measure on the vertical line A B 9¼ inches in succession, until the apex A is reached. Through the points thus obtained on A B draw lines parallel to C D intersecting the lines A C and A D, as shown. Then will the various patterns 1, 2, 3 and 4 be the net patterns for courses having similar numbers.

Take the shears and cut out the patterns on the felting and number them as required. For example, take the paper pattern number 1, place it on a sheet of tin, as shown in Fig. 99, and allow ⅜ inch edges all around, and notch the corners, as shown by A, B, C and D. Mark on the tin pattern No. 1 29 more, as 30 are required to go around the tower. Treat all the paper patterns from 1 to the apex in similar manner.

Of course where the patterns become smaller in size, as at the top, the waste from other patterns can be used.

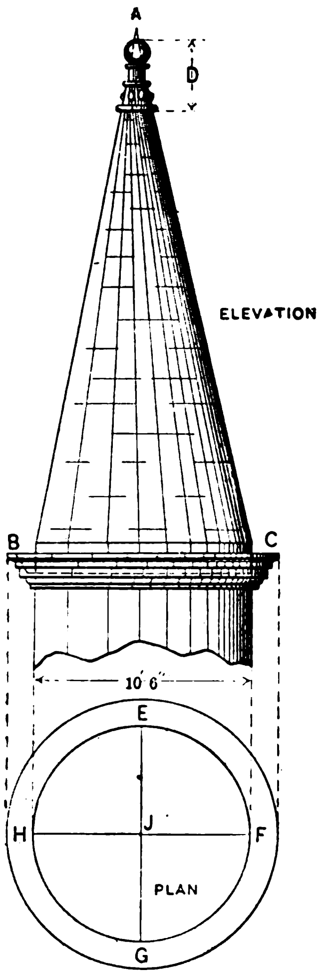


Fig. 97. Plan and Elevation

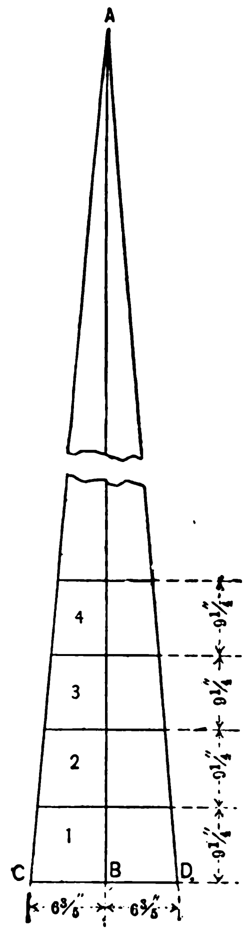


Fig. 98. Obtaining Patterns for the Various Courses

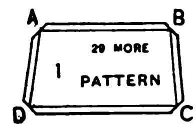


Fig. 99. Showing Edges to Patterns

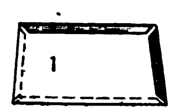


Fig. 100. An Edged Sheet

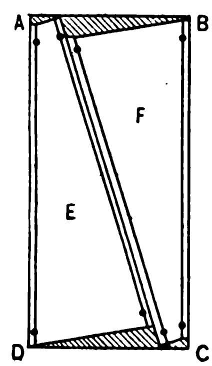


Fig. 102. Showing How to Cut the Metal

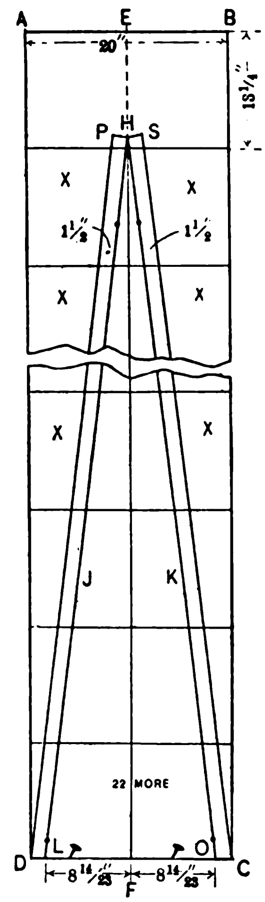


Fig. 101. Obtaining Patterns for Standing Seam Strip

In Fig. 100 is shown how the sheet should be edged, always being careful to have the narrow side toward the top, with the edges at the narrow and right hand side toward the outside, while the lower and left hand edges are edged toward the inside, all as shown in the diagram. Lay the sheets in the usual manner, breaking joints as in ordinary practice. As the seams are not soldered, be careful to avoid making "busters"—in other words, failing to interlock the joints.

After the entire roof is laid, and before "pounding down," or closing the seams with a mallet, take a tool brush and paint the locks with thick white lead, then close with the mallet. This will make a tight job.

The roof being covered, put the finial, D of Fig. 97, in position, when the job is ready for the painter. As the method used for obtaining the patterns for the various sheets in Fig. 98 is based upon the principle used in obtaining the envelope of a right cone, some readers may say that in accurate patterns the line from C to D should be curved, and not straight, as shown. To those it is said that the curve would be so little on a small pattern where the radius is long that a straight line answers the purpose just as well in all practical work, for it would amount to considerable labor to turn edges on the curved cut of the sheet, and there is certainly no necessity for it. Supposing now that the tower shown in Fig. 97 were to be covered with standing seam roofing, the method of obtaining the pattern would be a little different. As the reader knows, standing seam roofing, when required in single sheets, is prepared by locking together sheets of the required number, the cross seams being soldered, the side edges then being bent up on each side 1¼ and 1½ inches respectively by means of the roofing tongs. Care should be taken when bending the standing seams that the cross seams do not crack, and to examine same before laying on the roof, as this is very often the cause of leaks which are very hard to find afterward. As the circumference of the tower at its base is 396 inches, and assuming that 14×20 inch plate is to be used at the base of the tower, the nearest width which can be employed and which will divide the base into equal spaces is 17 5-23 inches, without edges, thus dividing the circumference into 23 equal parts. Then will this width of 17 5-23 inches and the length of the rafter A B or A C in elevation be the basis from which to construct the pattern for the standing seam strip, for which proceed as follows: Let A B C D in Fig. 101 represent a 20-inch strip "knocked out," or locked together and soldered, using ⅜-inch edges; through the center of this strip draw the line E F. Now measure the length of the rafter A B or A C in Fig. 97, and place it on the line E F in Fig. 101, as shown, from H to F. At right angles to H F on either side draw the lines F O and F L, making each side equal to 8 14-23 inch, being one-half of the 17 5-23 above referred to. From points L and O draw lines to the apex H. At right angles to H L and H O draw the lines H P, equal to 1¼ inches, and H S, equal to 1½ inches, respectively. From points P and S and parallel to H L and H O draw the lines P D and S C respectively. Then will P S C D be the pattern for the standing seam strip, of which 22 more will be required. When getting out the balance of the 22 strips it can be accomplished in the quickest way as follows:

Take the pattern just cut, lay it upon the roof or bench, and scribe a chalk line around the entire pattern; remove the pattern. Now start with a 14×20 inch sheet and tack it with nails at its lower end to keep it from slipping, as at L and O; then, having the chalk line just scribed as a guide, lay the following sheets, being careful to use the waste as the apex is reached. After having "knocked out" 22 of these strips and soldered the same, the pattern is laid over each one and accurately marked, cut and bent up. It is then laid on the tower, fastened with cleats and doubled seamed with the hand seamer and mallet in the usual manner. If the tower was done in copper or galvanized sheet iron, where 8-foot material could be used, as many sheets would be locked together as required; then metal could be saved and waste avoided by cutting the sheets as shown in Fig. 102, in which A B C D shows the sheet of metal and E and F the pattern sheets, the only waste being shown by the shaded portion.

Where the finial sets over the tower, as at D in Fig. 97, the standing seams are turned over flat as much as is required to receive the finial, or small notches would be cut into the base of the finial as to allow it to slip over the standing seams. Before closing the standing seams take a brush and fill seams with white lead, then close up tight, which will make a good joint.

ROOFING OF A LARGE DOME

The tin work on the dome, Fig. 103, was laid as follows: After finding the exact center or axis of the dome on top a large wood template was made shaping the under edge to conform with the curve of the dome. A line was then struck at the base of the dome, drawing a circle all around to start the tin straight; then dividing this line up into exact number of equal spaces, the first row of sheets was cut in the shape of a triangle and the locks turned on same, always with the idea of having the water to run over the seams, and not against them. The sheets of the next row were cut perfectly square, with one corner up, the opposite corner down, and locked the joints. Each following row was cut square and of the correct size to circle

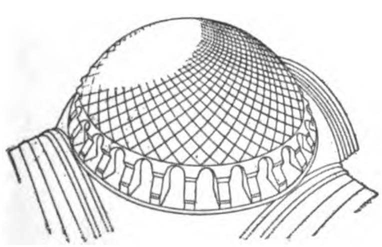


Fig. 103. Roofing a Large Dome

the dome. This allows the bending of the sheets to fit the shape of the dome, and make a perfect, smooth roof, conforming with the curve of the dome without a wrinkle. The seams were all hammered flat and smooth, and at a distance it looks like a concrete roof.

As the illustration shows, the sheets are laid diamond-shape, reducing the size of the sheets as they near the top, and laying them so that every edge on the sheet overlaps the lower edge, to shed water perfectly. The flat portion on the top of the roof was laid like any flat roof would be laid and soldered.

QUANTITY OF TIN FOR ROOFS—Continued

GIVING THE NUMBER OF BOXES AND SHEETS REQUIRED TO COVER ROOFS OF VARIOUS SIZES, RANGING FROM 10 TO 10,000 SQUARE FEET

SURFACE OF ROOF TO BE COVERED	FLAT SEAM								STANDING SEAM															
	Edged ¼ in.				Edged ⅜ in.				Single Lock								Double Lock							
									¾-in. seam.				1-in. seam.				¾-in. seam.				1-in. seam.			
	Covering space 13 x 19 in. Exposing surface 247 sq. in.		Covering space 19 x 27 in. Exposing surface 513 sq. in.		Covering space 12⅞ x 18⅞ in. Exposing surface 243 1/64 sq. in.		Covering space 18⅞ x 26⅞ in. Exposing surface 507 17/64 sq. in		Covering 228 17/32 sq. in. Edged 1 and 1¼ in.		Covering 477 1/32 sq. in. Edged 1 and 1¼ in.		Covering 222 3/32 sq. in. Edged 1¼ and 1½ in.		Covering 463 19/32 sq. in. Edged 1¼ and 1½ in.		Covering 220 63/64 sq. in. Edged 1 and 1¼ in.		Covering 471 31/64 sq. in. Edged 1 and 1¼ in.		Covering 216 45/64 sq. in. Edged 1¼ and 1½ in.		Covering 458 13/64 sq. in. Edged 1¼ and 1½ in.	
	14 x 20		20 x 28		14 x 20		20 x 28		14 x 20		20 x 28		14 x 20		20 x 28		14 x 20		20 x 28		14 x 20		20 x 28	
Sq. ft.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.
10	0	6	0	3	0	6	0	3	0	7	0	4	0	7	0	4	0	7	0	4	0	7	0	4
11	0	7	0	4	0	7	0	4	0	7	0	4	0	8	0	4	0	8	0	4	0	8	0	4
12	0	7	0	4	0	8	.0	4	0	8	0	4	0	8	0	4	0	8	0	4	0	8	0	4
13	0	8	0	4	0	8	0	4	0	9	0	4	0	9	0	5	0	9	0	4	0	9	0	5
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15	0	9	0	5	0	9	0	5	0	10	0	5	0	10	0	5	0	10	0	5	0	10	0	5
16	0	10	0	5	0	10	0	5	0	11	0	5	0	11	0	5	0	11	0	5	0	11	0	6
17	0	10	0	5	0	11	0	5	0	11	0	6	0	12	0	6	0	11	0	6	0	12	0	6
18	0	11	0	6	0	11	0	6	0	12	0	6	0	12	0	6	0	12	0	6	0	12	0	6
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20	0	12	0	6	0	12	0	6	0	13	0	7	0	13	0	7	0	13	0	7	0	14	0	7
21	0	13	0	6	0	13	0	6	0	14	0	7	0	14	0	7	0	14	0	7	0	14	0	7
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36	0	21	0	11	0	22	0	11	0	23	0	11	0	24	0	12	0	24	0	11	0	24	0	12
37	0	22	0	11	0	22	0	11	0	24	0	12	0	24	0	12	0	24	0	12	0	25	0	12
38	0	23	0	11	9	23	0	11	0	24	0	12	0	25	0	12	0	25	0	12	0	26	0	12
39	0	23	0	11	0	24	0	12	0	25	0	12	0	26	0	13	0	26	0	12	0	26	0	13
40	0	24	0	12	0	24	0	12	0	26	0	13	0	26	0	13	0	26	0	13	0	27	0	13
41	0	24	0	12	0	25	0	12	0	26	0	13	0	27	0	13	0	27	0	13	0	28	0	13
42	0	25	0	12	0	25	0	12	0	27	0	13	0	28	0	14	0	28	0	13	0	28	0	14
43	0	26	0	13	0	26	0	13	0	28	0	13	0	28	0	14	0	28	0	14	0	29	0	14
44	0	26	0	13	0	27	0	13	0	28	0	14	0	29	0	14	0	29	0	14	0	30	0	14

QUANTITY OF TIN FOR ROOFS—Continued

GIVING THE NUMBER OF BOXES AND SHEETS REQUIRED TO COVER ROOFS OF VARIOUS SIZES, RANGING FROM 10 TO 10,000 SQUARE FEET

SURFACE OF ROOF TO BE COVERED	FLAT SEAM								STANDING SEAM															
	Edged ¼ in.				Edged ⅜ in.				Single Lock								Double Lock							
									¾-in. seam.				1-in. seam.				¾-in. seam.				1-in. seam.			
	Covering space 13 x 19 in. Exposing surface 247 sq. in.		Covering space 19 x 27 in. Exposing surface 513 sq. in.		Covering space 12¾ x 18¾ in. Exposing surface 243 1/64 sq. in.		Covering space 18¾ x 26¾ in. Exposing surface 507 17/64 sq. in.		Covering 228 17/32 sq. in. Edged 1 and 1¼ in.		Covering 477 1/32 sq. in. Edged 1 and 1¼ in.		Covering 222 3/32 sq. in. Edged 1¼ and 1½ in.		Covering 463 19/32 sq. in. Edged 1¼ and 1½ in.		Covering 220 63/64 sq. in. Edged 1 and 1¼ in.		Covering 471 31/64 sq. in. Edged 1 and 1¼ in.		Covering 216 45/64 sq. in. Edged 1¼ and 1½ in.		Covering 458 13/64 sq. in. Edged 1¼ and 1½ in.	
	14 x 20		20 x 28		14 x 20		20 x 28		14 x 20		20 x 28		14 x 20		20 x 28		14 x 20		20 x 28		14 x 20		20 x 28	
Sq. ft.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.
45	0	27	0	13	0	27	0	13	0	29	0	14	0	30	0	14	0	30	0	14	0	30	0	15
46	0	27	0	13	0	28	0	14	0	29	0	14	0	30	0	15	0	30	0	15	0	31	0	15
47	0	28	0	14	0	28	0	14	0	30	0	15	0	31	0	15	0	31	0	15	0	32	0	15
48	0	28	0	14	0	29	0	14	0	31	0	15	0	32	0	15	0	31	0	15	0	32	0	16
49	0	29	0	14	0	30	0	14	0	31	0	15	0	32	0	16	0	32	0	15	0	33	0	16
50	0	30	0	15	0	30	0	15	0	32	0	16	0	33	0	16	0	33	0	16	0	34	0	16
51	0	30	0	15	0	31	0	15	0	33	0	16	0	34	0	16	0	33	0	16	0	34	0	17
52	0	31	0	15	0	31	0	15	0	33	0	16	0	34	0	17	0	34	0	16	0	35	0	17
53	0	31	0	15	0	32	0	16	0	34	0	16	0	35	0	17	0	35	0	17	0	36	0	17
54	0	32	0	16	0	32	0	16	0	35	0	17	0	36	0	17	0	35	0	17	0	36	0	17
55	0	33	0	16	0	33	0	16	0	35	0	17	0	36	0	18	0	36	0	17	0	37	0	18
56	0	33	0	16	0	34	0	16	0	36	0	17	0	37	0	18	0	37	0	18	0	38	0	18
57	0	34	0	16	0	34	0	17	0	36	0	18	0	37	0	18	0	37	0	18	0	38	0	18
58	0	34	0	17	0	35	0	17	0	37	0	18	0	38	0	19	0	38	0	18	0	39	0	19
59	0	35	0	17	0	35	0	17	0	38	0	18	0	39	0	19	0	39	0	19	0	40	0	19
60	0	35	0	17	0	36	0	18	0	38	0	19	0	39	0	19	0	39	0	19	0	40	0	19
61	0	36	0	18	0	37	0	18	0	39	0	19	0	40	0	19	0	40	0	19	0	41	0	20
62	0	37	0	18	0	37	0	18	0	40	0	19	0	41	0	20	0	41	0	19	0	42	0	20
63	0	37	0	18	0	38	0	18	0	40	0	20	0	41	0	20	0	41	0	20	0	42	0	20
64	0	38	0	18	0	38	0	19	0	41	0	20	0	42	0	20	0	42	0	20	0	43	0	21
65	0	38	0	19	0	39	0	19	0	41	0	20	0	43	0	21	0	42	0	20	0	44	0	21
66	0	39	0	19	0	40	0	19	0	42	0	20	0	43	0	21	0	43	0	21	0	44	0	21
67	0	40	0	19	0	40	0	20	0	43	0	21	0	44	0	21	0	44	0	21	0	45	0	22
68	0	40	0	20	0	41	0	20	0	43	0	21	0	45	0	22	0	44	0	21	0	46	0	22
69	0	41	0	20	0	41	0	20	0	44	0	21	0	45	0	22	0	45	0	22	0	46	0	22
70	0	41	0	20	0	42	0	20	0	45	0	22	0	46	0	22	0	46	0	22	0	47	0	22
71	0	42	0	20	0	43	0	21	0	45	0	22	0	47	0	23	0	46	0	22	0	48	0	23
72	0	42	0	21	0	43	0	21	0	46	0	22	0	47	0	23	0	47	0	22	0	48	0	23
73	0	43	0	21	0	44	0	21	0	46	0	23	0	48	0	23	0	48	0	23	0	49	0	23
74	0	44	0	21	0	44	0	22	0	47	0	23	0	48	0	23	0	48	0	23	0	50	0	24
75	0	44	0	22	0	45	0	22	0	48	0	23	0	49	0	24	0	49	0	23	0	50	0	24
76	0	45	0	22	0	46	0	22	0	48	0	23	0	50	0	24	0	50	0	24	0	51	0	24
77	0	45	0	22	0	46	0	22	0	49	0	24	0	50	0	24	0	50	0	24	0	52	0	25
78	0	46	0	22	0	47	0	23	0	50	0	24	0	51	0	25	0	51	0	24	0	52	0	25
79	0	47	0	23	0	47	0	23	0	50	0	24	0	52	0	25	0	52	0	25	0	53	0	25
80	0	47	0	23	0	48	0	23	0	51	0	25	0	52	0	25	0	52	0	25	0	54	0	26
81	0	48	0	23	0	48	0	23	0	52	0	25	0	53	0	26	0	53	0	25	0	54	0	26
82	0	48	0	24	0	49	0	24	0	52	0	25	0	54	0	26	0	53	0	26	0	55	0	26
83	0	49	0	24	0	50	0	24	0	53	0	26	0	54	0	26	0	54	0	26	0	56	0	27
84	0	49	0	24	0	50	0	24	0	53	0	26	0	55	0	27	0	55	0	26	0	56	0	27
85	0	50	0	24	0	51	0	25	0	54	0	26	0	56	0	27	0	55	0	26	0	57	0	27
86	0	51	0	25	0	51	0	25	0	55	0	26	0	56	0	27	0	56	0	27	0	58	0	28
87	0	51	0	25	0	52	0	25	0	55	0	27	0	57	0	28	0	57	0	27	0	58	0	28
88	0	52	0	25	0	53	0	25	0	56	0	27	0	58	0	28	0	57	0	27	0	59	0	28
89	0	52	0	26	0	53	0	26	0	57	0	27	0	58	0	28	0	58	0	28	0	60	0	28
90	0	53	0	26	0	54	0	26	0	57	0	28	0	59	0	28	0	59	0	28	0	60	0	29
91	0	54	0	26	0	54	0	26	0	58	0	28	0	60	0	29	0	59	0	28	0	61	0	29
92	0	54	0	26	0	55	0	27	0	58	0	28	0	60	0	29	0	60	0	29	0	62	0	29
93	0	55	0	27	0	56	0	27	0	59	0	29	0	61	0	29	0	61	0	29	0	62	0	30
94	0	55	0	27	0	56	0	27	0	60	0	29	0	61	0	30	0	61	0	29	0	63	0	30
95	0	56	0	27	0	57	0	27	0	60	0	29	0	62	0	30	0	62	0	30	0	64	0	30
96	0	56	0	27	0	57	0	28	0	61	0	29	0	63	0	30	0	62	0	30	0	64	0	31
97	0	57	0	28	0	58	0	28	0	62	0	30	0	63	0	31	0	63	0	30	0	65	0	31
98	0	58	0	28	0	59	0	28	0	62	0	30	0	64	0	31	0	64	0	30	0	66	0	31
99	0	58	0	28	0	59	0	29	0	63	0	30	0	65	0	31	0	64	0	31	0	66	0	32

QUANTITY OF TIN FOR ROOFS—Continued

GIVING THE NUMBER OF BOXES AND SHEETS REQUIRED TO COVER ROOFS OF VARIOUS SIZES, RANGING FROM 10 TO 10,000 SQUARE FEET

SURFACE OF ROOF TO BE COVERED	FLAT SEAM								STANDING SEAM															
	Edged ¼ in.				Edged ⅜ in.				Single Lock								Double Lock							
									¾-in. seam.				1-in. seam.				¾-in. seam.				1-in. seam.			
	Covering space 13 x 19 in. Exposing surface 247 sq. in.		Covering space 19 x 27 in. Exposing surface 513 sq. in.		Covering space 12⅞ x 18⅞ in. Exposing surface 243 1/64 sq. in.		Covering space 18⅞ x 26⅞ in. Exposing surface 507 17/64 sq. in.		Covering 228 17/32 sq. in. Edged 1 and 1¼ in.		Covering 477 1/32 sq. in. Edged 1 and 1¼ in.		Covering 222 3/32 sq. in. Edged 1¼ and 1½ in.		Covering 463 19/32 sq. in. Edged 1¼ and 1½ in.		Covering 220 63/64 sq. in. Edged 1 and 1¼ in.		Covering 471 31/64 sq. in. Edged 1 and 1¼ in.		Covering 210 45/64 sq. in. Edged 1¼ and 1½ in.		Covering 458 13/64 sq. in. Edged 1¼ and 1½ in.	
	14 x 20		20 x 28		14 x 20		20 x 28		14 x 20		20 x 28		14 x 20		20 x 28		14 x 20		20 x 28		14 x 20		20 x 28	
Sq. ft.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.	B.	S.
100	0	59	0	29	0	60	0	29	0	64	0	31	0	65	0	32	0	65	0	31	0	67	0	32
200	1	5	0	57	1	7	0	57	1	15	0	61	1	18	0	63	1	18	0	62	1	21	0	63
300	1	63	0	85	1	66	0	86	1	78	0	91	1	83	0	94	1	82	0	92	1	88	0	95
400	2	10	1	1	2	14	1	2	2	29	1	9	2	36	1	13	2	35	1	11	2	42	1	14
500	2	68	1	29	2	73	1	30	2	92	1	39	2	101	1	44	2	99	1	41	2	109	1	46
600	3	14	1	57	3	20	1	59	3	43	1	70	3	54	1	75	3	52	1	72	3	63	1	77
700	3	73	1	85	3	79	1	87	3	106	1	100	4	6	1	106	4	5	1	102	4	18	1	108
800	4	19	2	1	4	27	2	3	4	57	2	18	4	71	2	25	4	69	2	21	4	84	2	28
900	4	77	2	29	4	86	2	32	5	8	2	48	5	24	2	56	5	22	2	51	5	39	2	59
1000	5	23	2	57	5	33	2	60	5	71	2	78	5	89	2	87	5	86	2	82	5	105	2	91
1100	5	82	2	85	5	92	2	89	6	22	2	109	6	42	3	6	6	39	3	0	6	59	3	10
1200	6	28	3	1	6	40	3	5	6	85	3	27	6	107	3	37	6	103	3	31	7	14	3	42
1300	6	86	3	29	6	99	3	34	7	36	3	57	7	59	3	68	7	56	3	62	7	80	3	73
1400	7	33	3	57	7	46	3	62	7	99	3	87	8	12	3	99	8	9	3	92	8	35	3	104
1500	7	91	3	86	7	105	3	90	8	50	4	5	8	77	4	18	8	73	4	11	8	101	4	24
1600	8	37	4	2	8	53	4	7	9	1	4	35	9	30	4	49	9	26	4	41	9	56	4	55
1700	8	96	4	30	9	0	4	35	9	64	4	66	9	95	4	81	9	90	4	72	10	10	4	87
1800	9	42	4	58	9	59	4	63	10	15	4	96	10	48	5	0	10	43	4	102	10	77	5	6
1900	9	100	4	86	10	6	4	92	10	78	5	14	11	0	5	31	10	108	5	21	11	31	5	38
2000	10	46	5	2	10	66	5	8	11	29	5	44	11	65	5	62	11	60	5	51	11	97	5	69
2100	10	105	5	30	11	13	5	37	11	92	5	74	12	18	5	93	12	13	5	82	12	52	5	100
2200	11	52	5	58	11	72	5	65	12	43	5	105	12	83	6	12	12	77	6	0	13	6	6	20
2300	11	110	5	86	12	19	5	93	12	106	6	23	13	36	6	43	13	30	6	31	13	73	6	51
2400	12	36	6	2	12	79	6	10	13	57	6	53	13	101	6	74	13	94	6	61	14	27	6	83
2500	13	2	6	30	13	26	6	38	14	8	6	83	14	53	6	105	14	47	6	92	14	94	7	2
2600	13	60	6	58	13	85	6	67	14	71	7	1	15	6	7	24	15	0	7	11	15	48	7	34
2700	14	7	6	86	14	32	6	95	15	22	7	32	15	71	7	55	15	64	7	41	16	3	7	65
2800	14	65	7	2	14	92	7	11	15	85	7	62	16	24	7	86	16	17	7	72	16	69	7	96
2900	15	11	7	31	15	39	7	40	16	36	7	92	16	89	8	5	16	81	7	102	17	24	8	16
3000	15	69	7	59	15	98	7	68	16	99	8	10	17	42	8	36	17	34	8	21	17	90	8	47
3100	16	16	7	87	16	45	7	97	17	50	8	40	17	106	8	67	17	98	8	51	18	44	8	79
3200	16	74	8	3	16	105	8	13	18	1	8	70	18	59	8	98	18	51	8	82	18	111	8	110
3300	17	20	8	31	17	52	8	41	18	64	8	101	19	12	9	18	19	4	9	0	19	65	9	30
3400	17	78	8	59	17	111	8	70	19	15	9	19	19	77	9	49	19	68	9	31	20	20	9	61
3500	18	25	8	87	18	58	8	98	19	78	9	49	20	30	9	80	20	21	9	61	20	86	9	92
3600	18	83	9	3	19	6	9	14	20	29	9	79	20	95	9	111	20	85	9	92	21	41	10	12
3700	19	30	9	31	19	65	9	43	20	92	9	109	21	48	10	30	21	38	10	11	21	107	10	43
3800	19	88	9	59	20	12	9	71	21	43	10	28	22	0	10	61	21	103	10	41	22	62	10	75
3900	20	35	9	87	20	71	9	100	21	106	10	58	22	65	10	92	22	55	10	72	23	16	10	106
4000	20	92	10	3	21	19	10	16	22	57	10	88	23	18	11	11	23	8	10	102	23	82	11	26
4100	21	39	10	31	21	78	10	44	23	8	11	6	23	83	11	42	23	72	11	21	24	37	11	57
4200	21	97	10	59	22	25	10	73	23	71	11	36	24	36	11	73	24	25	11	51	24	103	11	88
4300	22	44	10	88	22	85	10	101	24	22	11	67	24	101	11	104	24	89	11	82	25	58	12	8
4400	22	102	11	4	23	32	11	18	24	85	11	97	25	53	12	23	25	42	12	0	26	12	12	39
4500	23	48	11	32	23	91	11	46	25	36	12	15	26	6	12	54	25	107	12	81	26	79	12	71
4600	23	107	11	60	24	38	11	74	25	99	12	45	26	71	12	85	26	59	12	61	27	33	12	102
4700	24	53	11	88	24	98	11	103	26	50	12	75	27	24	13	4	27	12	12	92	27	100	13	22
4800	24	111	12	4	25	45	12	19	27	1	12	105	27	89	13	35	27	76	13	10	28	54	13	53
4900	25	57	12	37	25	104	12	48	27	64	13	24	28	42	13	67	28	29	13	41	29	9	13	84
5000	26	4	12	60	26	51	12	76	28	15	13	54	28	106	13	98	28	93	13	72	29	75	14	4
6000	31	27	15	5	31	84	15	24	33	85	16	20	34	83	16	72	34	67	16	41	35	67	16	94
7000	36	50	17	62	37	4	17	84	39	43	18	98	40	59	19	47	40	41	19	10	41	60	19	72
8000	41	73	20	7	42	37	20	32	45	1	21	63	46	36	22	21	46	15	21	92	47	52	22	51
9000	46	95	22	65	47	70	22	91	50	72	24	29	52	12	24	108	51	101	24	61	53	45	25	29
10000	52	6	25	8	52	102	25	89	56	30	26	107	57	100	27	83	57	74	27	81	59	87	28	7

BASIS OF CALCULATION

FLAT SEAMS EDGED ONE-QUARTER INCH

This table is calculated on a basis of $\frac{1}{4}$-inch edges on 14×20 and 20×28 sheets, consuming about 1 inch, covering a space 13×19 and 19×27 inches and exposing a surface of 247 and 513 square inches respectively.

FLAT SEAMS EDGED THREE-EIGHTS INCH

This table is calculated on a basis of $\frac{3}{8}$-inch edges on 14×20 and 20×28 sheets, consuming $1\frac{1}{8}$ inches, covering a space $12\frac{7}{8}\times18\frac{7}{8}$ and $18\frac{7}{8}\times26\frac{7}{8}$ inches and exposing a surface of $243\frac{1}{64}$ and $507\frac{17}{64}$ square inches respectively.

STANDING SEAM, SINGLE LOCK

This table is calculated on the basis of $\frac{3}{8}$-inch single lock cross seams, consuming $1\frac{1}{8}$ inches of tin and covering $228\frac{17}{32}$ square inches when edged 1 and $1\frac{1}{4}$ inches and giving a finished seam $\frac{3}{4}$ inch high, and covering $222\frac{3}{32}$ square inches when edged $1\frac{1}{4}$ and $1\frac{1}{2}$ inches and giving a finished seam 1 inch high, with 14×20 tin. With 20×28 tin edged in the same way with a $\frac{3}{4}$-inch finished seam $477\frac{1}{32}$ square inches are covered, and with a 1-inch finished seam $463\frac{19}{32}$ square inches are covered.

STANDING SEAM, DOUBLE LOCK

This table is calculated on the basis of the amount of tin consumed by double lock machines, which is $1\frac{7}{16}$ inches by measurement for cross seams and covering $222\frac{63}{64}$ square inches when edged 1 and $1\frac{1}{4}$ inches and giving a finished seam $\frac{3}{4}$ inch high, and covering $216\frac{45}{64}$ square inches when edged $1\frac{1}{4}$ and $1\frac{1}{2}$ inches, giving a finished seam 1 inch high, with 14×20 tin. With 20×28 tin edged in the same way with a $\frac{3}{4}$-inch finished seam $471\frac{31}{64}$ square inches are covered, and with a 1-inch finished seam $458\frac{13}{64}$ square inches are covered.

DIRECTIONS FOR USE

Look for the number of squares nearest the required surface. Note the quantity of tin opposite in the column for the kind of roof to be put on, whether it be **1-4 inch or 3-8 inch Flat Seam or 3-4 inch or 1 inch Standing Seam, Single Lock or Double Lock,** and set down the amount. Then, in the same manner, determine the quantity of tin for the odd feet and add this to the former amount. Reduce the sheets to boxes by dividing by 112.

FLAT SEAM EXAMPLE

How much 14×20 tin edged ¼ inch covering 13×19 will be required to cover a roof 4,665 square feet flat seam?

First look for 4,600 square feet (=46 squares) and set down the quantity opposite, thus:

	23 boxes 107 sheets
Then for 65 square feet and set down	38 sheets
Making a total of	23 boxes 145 sheets

which is equal to 24 boxes 33 sheets.

SINGLE LOCK STANDING SEAM EXAMPLE

How much 14×20 tin will be required to cover a roof of 3,752 square feet with single lock cross seams and 1-inch standing seams?

First look for 3,700 square feet (=37 squares) and set down the quantity opposite, thus:

	21 boxes 48 sheets
Then for 52 square feet and set down	34 sheets
Making a total of	21 boxes 82 sheets

DOUBLE LOCK STANDING SEAM EXAMPLE

How much 20×28 tin will be required to cover a roof of 2,987 square feet with double lock cross seams and ¾-inch standing seams?

First look for 2,900 square feet (=29 squares) and set down the quantity opposite, thus:

	7 boxes 102 sheets
Then look for 87 square feet and set down	27 sheets
Making a total of	7 boxes 129 sheets

Dividing 129 by 112, they are found to be equal to 1 box and 17 sheets, which added to 7 boxes

Give a total of	8 boxes 17 sheets

RUNNING A TIN ROOF OVER A FIRE WALL

In the accompanying illustration, Fig. 104, are shown the methods of lining the fire walls and connecting them to the main roof and to the cornice roof. Let A B C represent the cornice roof, fire wall and main roof respectively, and D E and F the sheathing line. Now, assuming that the tinning has been started below G, the courses are carried as far as H, when the distance is measured from H to I. A regular strip is now laid out, soldering the short seams, before bending up to the required width H I, after which it is locked into the lock H, and will appear as shown by J K. The courses L M N, etc., are laid in the regular manner, as on the flat roof, leaving the last course N to project over the cornice roof, as shown by O. If the fire wall is level all round the projecting tin plate O is turned over on the cornice roof with a mallet, as shown by the dotted line P. The course R S, etc., are again laid in the regular manner, cutting off the last course S to within an inch of the line of the cornice, as shown at T; this allows for turning over and nailing.

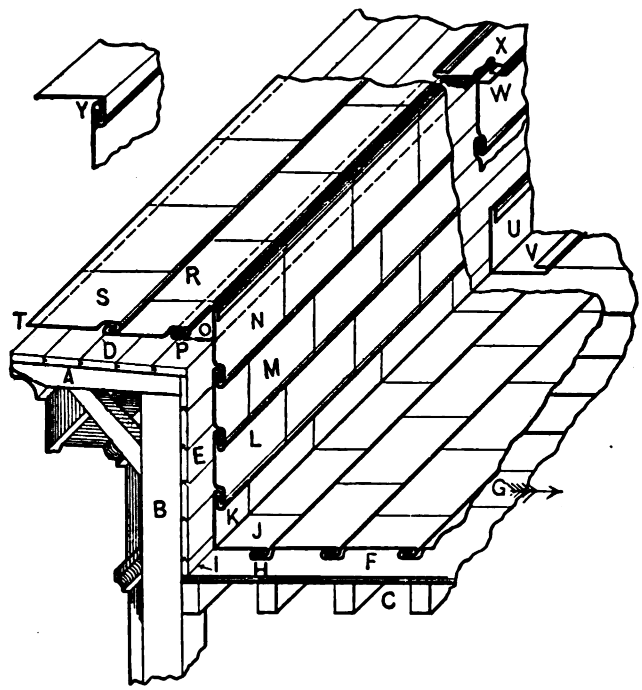

Fig. 104. Sectional View of Cornice and Roof

If the fire wall shown in the sketch was the back of the roof against which the water would run, then a valley flashing would have to be put in first, as shown by U V, which allows the water to run over and not against the seam. If the fire wall was unequal in hight and the tin was to be turned over the cornice roof as just described, we would not be able to obtain a straight course on the cornice roof. To obtain a straight course in this case the last course N could be flanged out 1 inch, as shown at W, after which the top courses are laid as shown at X, which are afterward turned down and double seamed, as shown at Y. The cornice roof is now soldered, being careful to solder down the fire wall about 4 inches, while on the main roof the strips against the fire walls where the joints are made should be soldered up about 8 inches. The seams on the fire wall are left unsoldered and are made water tight by painting them, before they are malleted down, with a good thick coat of white lead in oil, after which they are tightly closed with the mallet and then "white leaded" again. Assuming that the fire wall was of brick, stone or terra cotta, the same rule is observed for covering, except that the fire wall is covered with standing seam, locked into the strip K at the bottom and double seamed as at W X and Y at the top.

A roof covered with IC terne plate will make a good roof, but certainly not as good as IX tin, because the IX is heavily coated and of thicker gauge metal and will or ought to outlast the IC brand.

JOINING A COPPER CORNICE WITH A TIN ROOF

For buildings of a first-class character, there is a growing demand for copper cornices, in many cases the roof being of tile or concrete. In some instances, however, the cornice maker is called upon to connect the copper cornice with a tin roof, and all who have had experience with the use of copper in connection with tin roofing plate are aware of the action which takes place between the two metals when exposed to the atmosphere, which results eventually in destroying the tin plate. It is remarkable how quickly the tin plate can be destroyed on occasion, though in some cases no disadvantage has resulted from the connection for a considerable time. In order to prevent, as far as possible, the destruction of the tin plate, use an oil burlap or canvas between the two metals, as shown in the accompanying view, Fig. 105.

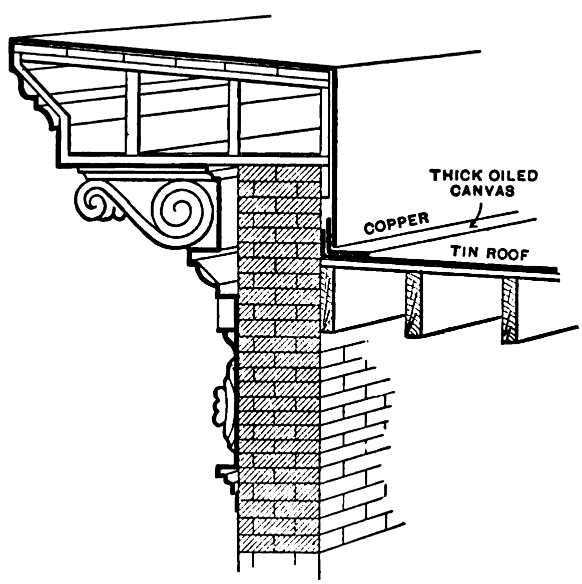

Fig. 105. Sectional View Showing Method of Applying the Canvas

Make it a point to run the flashing from the tin roof up behind the copper for a considerable hight and fasten it securely to the battlement. This portion of the tin work is given a heavy coat of good paint. Over this is placed a piece of oiled canvas running up above the tin flashing and extending down on the roof so that the copper of the cornice cannot possibly come in contact with it. After the oiled canvas is in place it is also given a coat of paint and the copper work fastened to the battlement in a secure manner. It has been proved by experience that the use of the oiled canvas, even in other methods of connecting the tin and copper, has greatly prolonged the life of the tin plate.

A FEW REMARKS ABOUT FLASHINGS

Flashings are of vital importance in roof construction. It is seldom that a leak occurs in the clear body, or surface, of a roof, be it of tin, slate, tile, or composition. In most cases, the leaks are in connection with the flashings, or finish around uprising walls, chimneys, pipes or other structures. To thoroughly describe and illustrate all the various forms of flashings would require so much time and space that it will be necessary to dismiss the subject with a few general remarks upon principles.

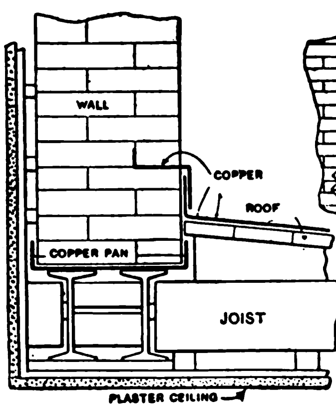

Fig. 107

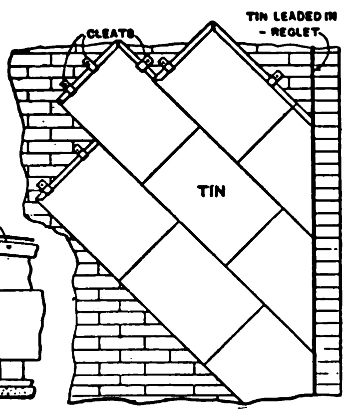

Fig. 106

The best material for use in flashings is sheet lead; the next is copper, then zinc, tin and galvanized iron, in the order named. The same piece of flashing should never be attached to both roof and wall. The flashing should be in two parts—namely, the "under flashing," which is lapped on and nailed, locked or soldered to the roof and turned up against the wall or rising surface, and the "cap flashing," which is built in, let in or secured to rising wall or surface, and which laps down over the upturned part of the under flashing.

The reason for avoiding the use of flashing made of one piece, permanently attached to both roof and wall, is that the uneven settling of the roof and wall, or the relative difference in the expansion and contraction of the roof and wall, will inevitably injure the connection between the flashings and the wall, or the roof, as it is strained between the two contending forces; whereas, if the flashing is in two parts, one attached to the roof and the other to the wall, and connected by an adjustable lap only, ample provision is made for the independent movement of both roof and wall without injury to the flashing.

The hight of flashing and the depth it should extend in the wall are matters of latitude. What would be a matter of first-class flashing in New Orleans would prove entirely inadequate in Boston. Ignoring wind, a Southern roof seldom has anything more serious to take care of than rain water, the gutters and conductors, being free of obstruction, allowing the water to drain off as fast as it falls; whereas, a Northern roof is liable to have its outlets clogged with ice, and water to accumulate until the roof is, in effect, a small lake. Or snow will drift and ice form at the junction of the roof and the wall, forming obstructions that will lead the water over the top of the under flashing, if it does not extend well up against the wall.

In New England, the winter rains are driven, or soak, entirely through exposed 12-inch walls if the bricks are not of good material and thoroughly burned. The writer knows of a number of instances in Boston where it was necessary to entirely cover exposed party walls with tin, from the ground to the roof, the tin being laid flat lock, secured with cleats, and the sheets laid "diamond style," leaving the seams at an angle of 45 degrees, as shown in Fig. 106, thus avoiding all vertical seams.

The method of providing for the water that soaks into an ordinary wall that is exposed to a considerable sweep of the wind and is pierced by an opening for a bay window is shown in Fig. 107, the opening being spanned by I-beams which carry the wall. In addition to the flashing shown, copper pans of the same length as the beams, about 1 inch wider than the thickness of the wall and 2 inches deep, are set on the top of the beams and the wall is built in the pan. Drains are provided at each end of the pan to carry off the water as it soaks through the wall into the pan. But for these pans the ceiling of the bay window would, in wet weather, be constantly dripping when the direction of the wind is such as to drive the rain against the wall.

On high grade jobs such as churches, under the copings and sills of the windows, etc., it is advisable to place copper, inasmuch as, in the majority of cases, these sills, coping and the like are of a porous stone permitting the percolation of water which often times finds its way into the building, giving the impression that the roof leaks and entailing an expensive controversy between either the architect or the owner, and the roofing contractor. It is, however, well to bear in mind that, unless cap flashing was built in during the construction of the wall, even, in which case it would be advisable to see that the joint is thoroughly cemented, the paintskinning of the joint should be done with extreme care, packing it in until it oozes out.

COPPER FLASHING ON THE MODERN FIREPROOF BUILDING

On modern fireproof buildings the roof is either supported on terra cotta or reinforced concrete arches. A cinder concrete fill is placed on these arches; and as arches are level throughout, this fill is graded to the outlets.

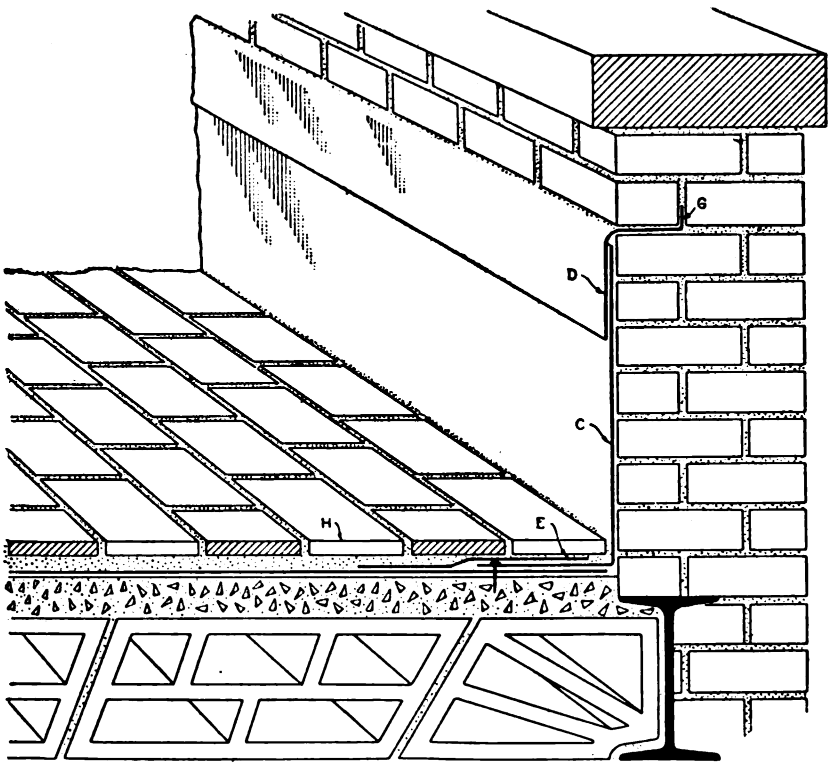

Fig. 108. Copper Flashing on the Modern Fireproof Building

On this fill five ply, more or less, of waterproofing is applied. Then the copper flashing C, Fig. 108, is fitted and nailed in place. As the cap flashing D was built in the wall it is necessary to raise it a little, so that base flashing C may be slipped under the cap flashing. This cap flashing is dressed back with a piece of smooth board about a foot long and nailed to another stick for a handle, which is used like a mallet. It is to be noted that the edge G of the cap flashing is turned upward in the wall; this secures the cap to wall and is required on most public buildings.

The waterproofing men lay a felt strip, swabbing it with tar, over the nails of the base flashing at E and coat entire roof with a generous amount of tar.

Bricklayers can now lay the flat tile roof H in this manner. They first spread the cement (sand and Portland cement) over a small area, then, just as in bricklaying, they set their tiles. After all the tiles have been laid a thin grout of cement is broomed over the tiles filling in the joints.

FLASHINGS FOR SLATE OR SHINGLE ROOFS

In Fig. 109 A is the roof surface, B the side or gable wall and C D the half round hanging gutter, which last should be flashed up under the shingles or slates at least 8 inches, as indicated by the dotted line E F, and against the end of the gable wall, as at G. A corner flashing should be joined to G and E E, as shown by the dotted line E[1], on the side of the wall. This being done, the braces H I, etc., are fastened to the front of the gutter and screwed to the roof board.

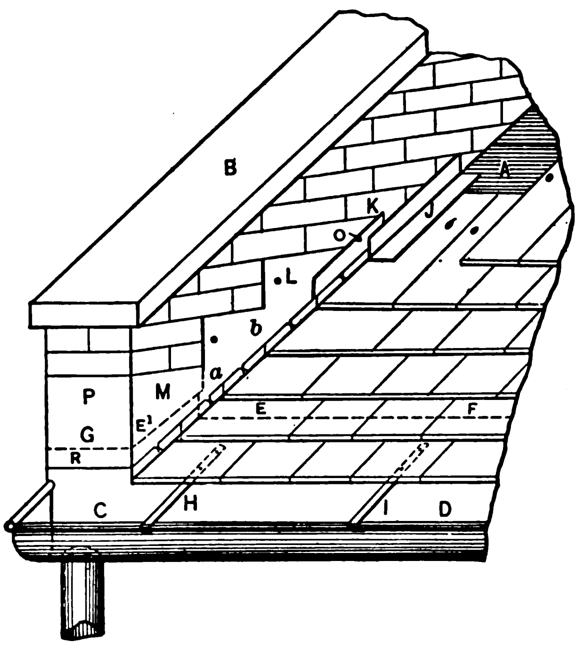

Fig. 109. Putting in Step and Counter or Cap Flashing for Shingle or Slate Roof

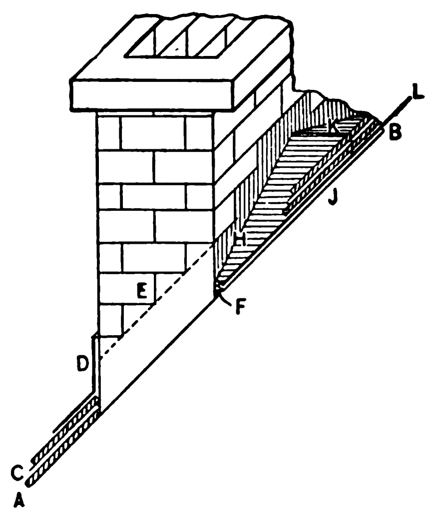

Fig. 110. Flashing Around a Chimney on a Shingle Roof, Showing Cant Board in Rear

The slater or shingler then lays his eave course, the tinner furnishing him with shingle flashings, which are made of tin and painted before being applied. They are to be bent up 2½ inches on each side and in length 2½ inches more than the slates or shingles are laid to the weather.

The shingle flashing is laid on the eave course and over the same. The courses are then laid in order, the flashings being put in with every course, as indicated by X X, etc., or as is better shown at J, which illustrates the flashing overlapping the previous flashing K, the bottom O of the flashing J running within ½ inch of the bottom line of the slate or shingle R.

When the roof has been covered the tinner puts on the counter or cap flashing L M, flashing into the joints of the brick work and continued around the end of the brick wall P, overlapping the shingle and gutter flashings. If desired the cap flashing can be made in small pieces, having seams at *a* and *b*, which saves material.

Fig. 110 shows the flashing just around a chimney or other structure passing through the roof, where the covering is slate, tile or shingle. This method also applies to metal roofs, with the exception that the flashing is locked and soldered on the metal roofing, while in this case it is flashed over and under the roof covering of slate or shingle.

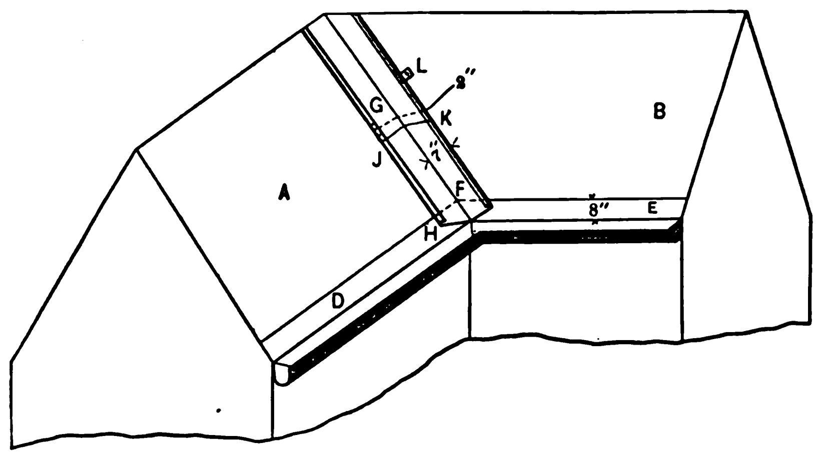

Fig. 111. Laying a Valley on a Pitched Roof

Referring to the diagram, A B represents the line of the roof, and C the last course of slate or shingle, butting against the bottom of the chimney. The flashing D is now put in, the lower flange being made wide enough to cover the nail heads, and the top is flanged into the joints of the brick work. The roof covering being continued, the side flashing E is put in, using shingle and cap flashing, in the same manner as described in connection with Fig. 109.

When the back of the chimney is reached a cant board or saddle is put in by the carpenter, in order to throw the water to either side. This board is then covered with metal, as shown by H K, stepping into the brick joints and flanging upward on the roof at least 18 inches above the top of the saddle K, to prevent any leaks resulting from a snow storm. A chimney in a roof, as illustrated, always forms a pocket when the snow slides; and if the flange F J L is not carried high enough the snow in melting will suck under the flashing and cause a bad leak.

A valley is put in on a pitched roof, the covering of which is not of metal as shown in Fig. 110, A and B representing the roof surface; D and E, the gutter, flanged on the roof 8 in. and F G the valley, flanging 7 in. on the roof each side, and having a water lock or drip H and I. The valley is laid from the bottom up, overlapping the gutter flanges, as at H and I, if it is laid in lengths as is usual say from 8 to 10 ft. the joint should be overlapped 2 in. as at J K, running the valley to the top of the ridge. Care must be taken in fastening the valley not to nail through it. Otherwise a leak will occur. Cleats should be used as at L, so that when the slates or shingles are laid over the valley and the water flows down the lock prevents the water from going sideways and causing a leak, whereas if nails were driven direct into the valley a leak would occur at once.

PLACING BLOCKS ON ROOFS TO WHICH ARE FASTENED PLATFORMS, BRACING RODS, ETC.

In Fig. 112 is shown a piece of joist called blocks, covered with tin or other metal, the joist being cut to any desired hight. In this case it is 3×4, and 8 inches in hight. A flange 1 inch in width projects all around the bottom of block, as shown in Fig. 112, and is used to solder water tight to the roof. The dotted line shown at the side at B, and top at A, indicates how the laps are placed, and over the top of the laps, as shown at A, a piece of metal is soldered water tight. These blocks are now set in their proper positions on the metal roof, say about 6 feet apart, and soldered water tight to the tin or galvanized iron roof. This keeps the water from soaking under the block and rusting out the metal roof. After all of the blocks have been properly placed, cross joists are set on top of same. Then spruce strips of $1\frac{1}{4} \times 3$ inches in thickness are nailed at right angles to the cross joists not over 2 inches apart. In making the platform it should be made in such sections that it can be easily removed in case the roof needs repairing or painting. If the roof was very large quite a number of blocks would be required, and as there may be some objection to the expense of covering the blocks, Fig. 113 shows how the covering could be avoided. A in Fig. 113 represents the wooden block of the same size as shown in Fig. 112. If the wooden blocks were set direct upon the tin or galvanized iron roofs it would be found after each rain, even after the roof was dry, that it would be quite wet between the wooden block and metal roof, because the air could not circulate, and in time the tin or galvanized iron would be rusted through. Therefore, to avoid the rusting of the tin or galvanized iron, and still not cover the blocks, proceed as follows: In Fig. 113 B represents a piece of 18 ounce sheet copper tinned on both sides, projecting 2 to 3 inches all around the entire block, as shown in Fig. 113, and is then soldered water tight to the roof. On top of this sheet copper the wooden block is set. The water soaking between the wooden block and sheet copper would have no effect in destroying the copper, as would be the case if placed direct upon the tin or galvanized iron, as before explained. The sheet copper is tinned on both sides, so as to avoid any

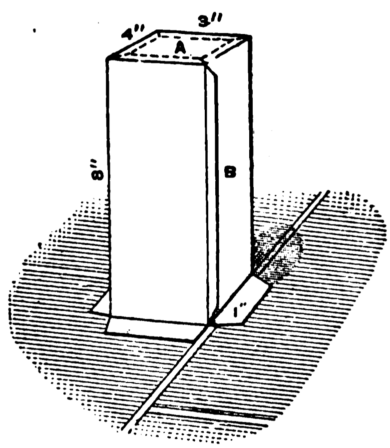

Fig. 112. Showing Block Covered with Tin

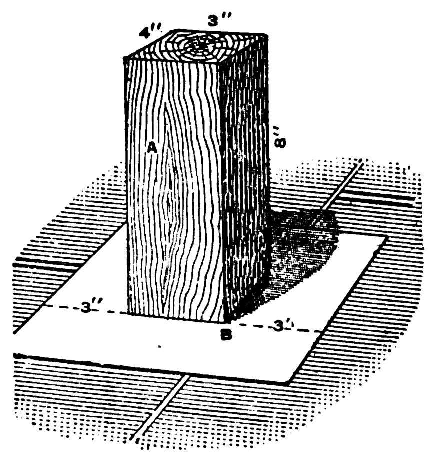

Fig. 113. Showing Block Resting on Sheet Copper

electrical action between the two metals that would eventually destroy the tin or galvanized iron.

The method first described is often used as a means to fasten stay rods, etc., for various purposes, such as a brace for signs, smoke stacks, and the like.

A block is first nailed to the roof and then covered as explained, and then the rod is secured to the top of this block in a bed of white lead.

In many cases on steep roofs there is a chimney at the eaves; and to provide a perfect draft, the chimney is built quite high—sufficiently so, to have its top above the ridge of the roof. In this case the chimney is braced by passing a wrought iron belt around it, about midway, and guyed to the roof with stiff rods. The rods are higher at the roof end than at the chimney and are simply flashed with sheet metal for, say a distance of six inches, inasmuch as any water on the rod would flow away from the roof.

SHEET LEAD FOR ROOF FLASHINGS

A knowledge of how to properly handle sheet lead is of considerable value to any roofer who has anything to do with the work on many of the artistic suburban and country homes now being built. Flashings are necessary, but when unduly prominent are objectionable features in the architecture of a building, and the nature of lead is such that it can be satisfactorily used where harder metals can not with any degree of neatness, as on a round tower, for instance.

Straggling, prominent flashings and aprons which attract the eye to various chimneys, instead of to the more important parts of the house, are not likely to

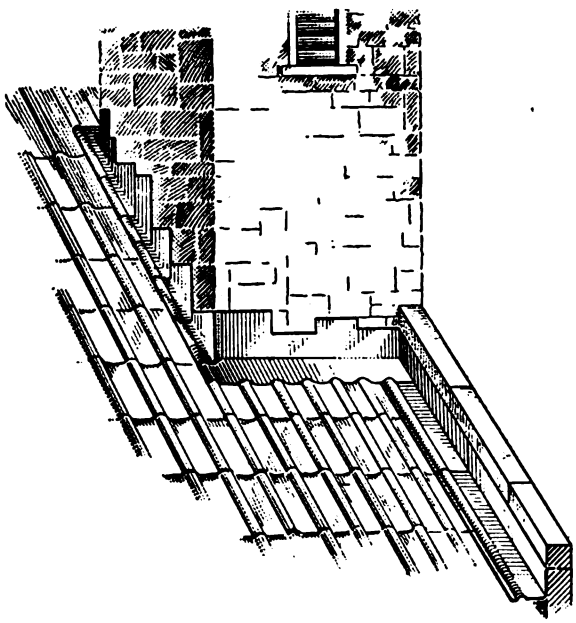

Fig. 114. Unattractive and Conspicuous Appearance of Lead Flashings Let Into Irregular Joints in Stonework

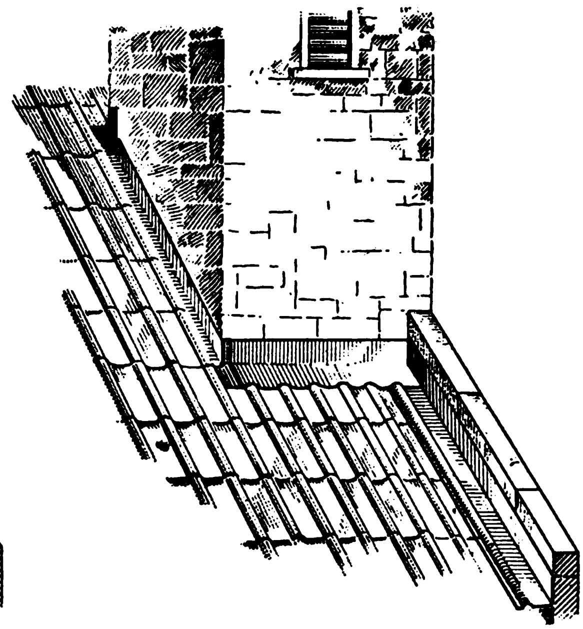

Fig. 115. Neat and Inconspicuous Appearance of Lead Flashings Let Into Groove in Stonework

meet with favor from the owner or designer, however well they may serve their purpose. The use of lead will often make all the difference between success and failure in getting a desired effect.

The workman who has not had an opportunity of learning how to handle this material, however, will probably not be any more successful than if he had used tin. This may be seen in the job shown in Fig. 114, which is a tower on a church recently built, with lead flashings around it put on in such a manner that they are the most prominent features of the roof. The roof is of red tile and the stone of tower is laid in irregular courses, the blocks being of somewhat large size.

The flashings have been put on piece by piece with the sections of tile, and the upstands have been fixed into the nearest vertical and horizontal joints. These being at irregular hights and sometimes 12 to 14 in. above the roof, give the whole job a patchy appearance. The battered and wrinkled lead at the corners, due to inexperience of the man who laid it, does not make it look any better, and this part contrasts unfavorably with the excellent workmanship on the rest of the building. By laying the lead on the plan shown in Fig. 115 a much superior job would have been obtained, and it would have been inconspicuous. The nature of the building stone will not always admit of turning the upstands into cut grooves or "raglets," but in this case it would.

Where a very hard stone is used the upstands are sometimes set up as shown in Fig. 116 and fixed with spikes to convenient joints. The head turned on the upstand about 1 in. from the upper edge provides a rest for the cement pointing, and this also covers the spikes used in fastening.

In laying lead flashings, as shown in Fig. 115, the lead is cut into strips of the desired width, say 12 in., and dressed flat on a smooth plank. A groove or raglet about 1 in. deep and ¾ in. wide having been cut in the stonework 5 in. up from the roof, and the point under the cap stone having been cleaned out to a similar depth, work is commenced at the eaves and carried upwards.

A bead is turned on the side of the strip of lead by dressing over the straight edge of a plank. This is shown at B in Fig. 117. This is to fit into the joint and raglets, so that a water-tight joint will be made when pointed and also to provide fastening. Whatever hight may have been decided on or is necessary, 5 in. more or less below this head, the lead is dressed over and carried to its position, where it is carefully dressed into place and the head set back in its groove. It is there firmly fastened by driving the lead wedges in and calking them. The wedges may be made from strips of lead tightly rolled, and about 1 in. wide.

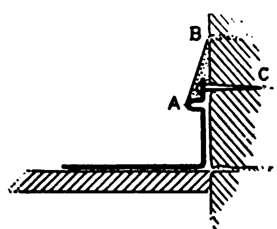

Fig. 116

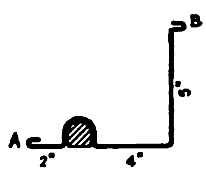

Fig. 117

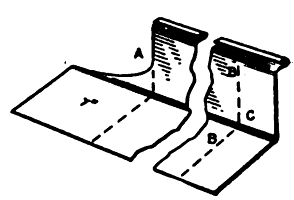

Fig. 118

DETAILS OF FORMING LEAD FLASHINGS

The side flashing is turned up about 1 in. on reaching the breast of the tower by beating up the lead into a "corner." The breast flashing is set up similar to the side flashing except that it is not turned over square, but to suit the pitch of the roof. Then at the cap-stone end it is turned up 5 in. and another outside corner worked on it. When this has been completed and squared up neatly to fit the angle the piece is fastened in position. It must be allowed to project from 5 to 7 in. by the tower and a portion of the upstand is cut as shown at A in Fig. 118 to admit of being dressed closely down.

The tower side flashing is then put on in a similar manner and stopped at the floor of the gutter behind the tower. It can also be laid in the manner shown in Figs. 117 and 119. This is fitted under the tile or slate and has a roll formed about 3 or 4 in. from the wall, which prevents the water from the gutter spreading. This side flashing 3 in Fig. 119, comes out on top of the tile or slate at the breast line of the tower and continues to the lower edge of the breast flashing as cover, the roll

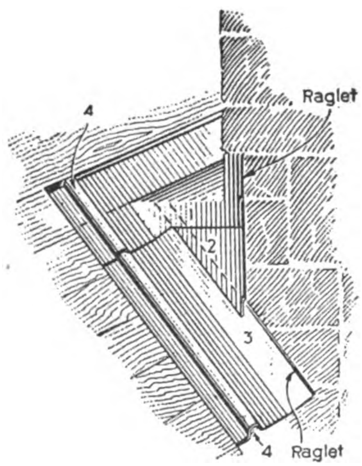

Fig. 119. Flashing at Top

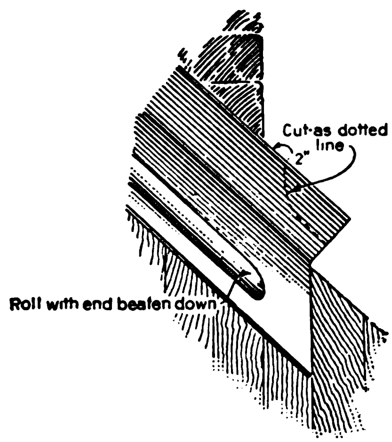

Fig. 120. Flashing at Bottom

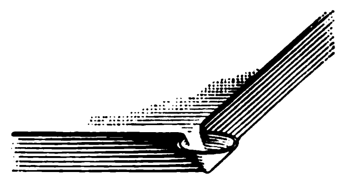

Fig. 121. Pig Ears

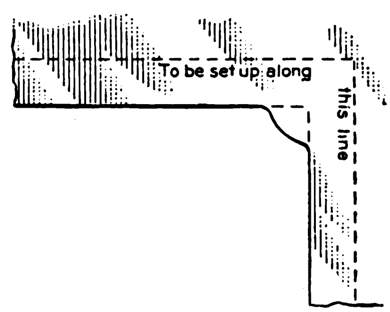

Fig. 122. Pattern of Flashing

4 being stopped at the line of stone and the lead beaten down over a rounded end as shown in Fig. 120. The upstand is worked around the face of the tower about 3 in. and neatly trimmed off. Before working this upstand it should be cut as shown by the dotted line in Fig. 120. This allows it to come down with less chance of thinning and tearing the lead.

The upper end of this flashing is finished by beating the roll down flat at the level of the gutter floor or a little above it, and the lead in the gutter is allowed to project so that when beaten down it will make a complete cover across the flat part of the side flashing. This corner must also be cut out before commencing to beat it down, leaving sufficient to cover well the vertical part when it has been beaten back. The corner must be kept round until it is almost completed, then it can be squared up, care being taken to avoid tearing.

The upper edge of the lead in the gutter on the roof side should be set up half an inch and a fillet of wood of triangular section nailed behind it to carry the weight of the tile or slate. The tile may fit closely over the roll on the side flashing, or if slate is used a fillet nailed down the side will tilt the slates and butt the edges against the roll, leaving a clear waterway from the gutter.

The wall upstand of the gutter may be turned into the raglet if not very long, or an apron may be fitted over it and fixed in the same manner. This is to allow of movement in expansion and contraction. Binding firmly on all sides will lead to trouble through the permanent enlargement of the metal by expansion forming bulges and, eventually, cracks.

A gutter behind a chimney might have each end dressed down to a side flashing as shown or have one end open and the other set up against a wall or stone cap as in this case. This entails the working of two outside corners on the gutter and the method of doing so may be briefly explained here. The lead having been marked off at the correct floor lines of the gutter, is set up to its proper angle.

On setting up the end upstand two wide pig ears are formed as shown in Fig. 121. Holding a pear-shaped mallet inside the pig ear the lead is gradually drawn up from the corner. A round dresser or bossing stick is used for this, the strokes tending upward to draw the lead up and outward to dispense with the extra thickness caused by contracting the lead at the angle. Keep the corner round until the correct pitch has been gained. Only when it has reached this must it be squared up.

To work an inside corner cut the lead as shown in Fig. 122 and use the round dresser with inward tending strokes, as the tendency is for the lead to thin and tear at the corner. Draw the lead towards the corner by bulging out the upstand and dressing towards the corner against a flat piece of wood, and do not attempt to square the angle until it has been worked into the correct position. Do not rush, either, too much, as nothing will be gained, and do not let the lead form into wrinkles. Dress these out immediately if they appear.

Nails should never be driven through lead where exposed to the weather, as the lead soon loosens up around them. Where flashings lap, tails should be left on the lower sheet when trimming and dressed over the upper to prevent blowing up. Use clips for fasteners instead of nails, and use only wooden tools to work lead, as a hammer will cut into and seriously impair its life.

Lead of fair weight, 5 or 6 lb., will last a very long time if properly laid, as it is practically proof against corrosion from acids contained in soot, etc., and quickly forms an oxydized surface that effectually protects it from the influence of the weather.

COPPER SIDING FOR PENT HOUSES

On practically every building of fireproof construction there are on the roof smaller structures known as bulkhead or pent houses for the housing of elevator machinery, tanks, etc. Perhaps one or two additional stories are built above the roof line of the building proper and the pent-house method of construction is employed by reason of the lightness of material, as it adds but the minimum of weight to the steel structure and foundation.

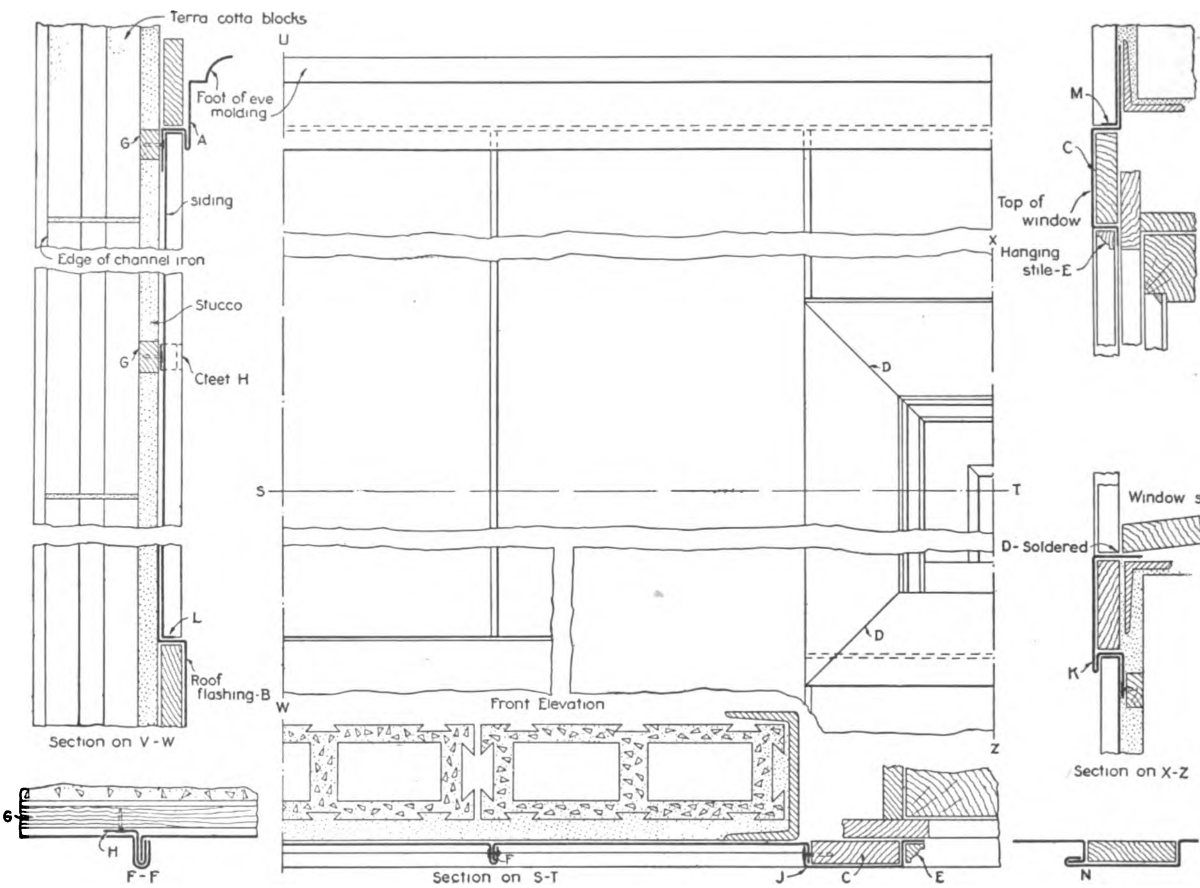

Fig. 123. Details of Copper Siding for a Pent House

The scheme of construction makes use of a structural steel framework, with terra cotta blocks for the walls. To prevent the ingress of the elements, sheet metal is utilized for exterior finish. As this is a story of the siding, the many details of eave finish, flashing, etc., may be passed over, except to say the eave generally has some sort of cornice molding, perhaps just a molded hanging gutter.

The sheet metal contractor has nothing to do with the structural details, but as it is practically impossible to attach the siding to the terra cotta blocks, he should reason with the architect and insist on a proper surface and wood grounds to nail cleats to, Fig. 123. The modern method of obtaining a true surface is to secure boards to the terra cotta at the base of the wall for the flashing B, which connects with the main roof of the building.

A board at the lock of the eave molding A, together with a furring strip ground, is provided as shown. The furring strip grounds are spaced about 2 feet from base to eave to nail cleats to for holding the siding. The entire surface is plastered flush with the wood grounds. Likewise around all windows and doors a board is fastened as indicated by C, to which is attached the sheet metal casing. There is a similar provision at corners of pent houses.

As it is usually imperative to make buildings weather tight as quickly as possible, the flashing, eave moldings, etc., are set long before the siding; for this can be done when the need of the other work is not so pressing. Hence to facilitate the applying of the siding a pocket is made in the bottom of eave molding, as at A. The siding is cut to average 18 inches from seam to seam. This seam is the single and double standing edge style as shown at F. At F F is a horizontal section of the seam to show the cleat H nailed to woodground G.

When the siding connects with the window or door casing, it has a single edge as at J. At all pockets, A and K, an edge is bent on the siding the same width as the standing seam. At the flashing B and at the top of windows or doors a $\frac{1}{4}$-inch edge is turned out and soldered to the flashing, as shown, for example, at the top of windows or doors at M. The siding over windows and doors is erected after casings are put on. The siding is crimped to obviate buckles as much as possible, while the casing is plain metal. When siding up to windows and doors has been erected, the casing is fitted and put in place, beginning with the sill, then the sides and last the top. The sill is soldered and also the miters D. Carpenters can now renail into place the hanging stile E. The windows and doors are of wood covered with copper or perhaps hollow metal.

If it is desired that no nails show as at J, for instance, then the method shown at N can be employed; also the double seam, as in tin roofing, can be used for siding having cleats to keep the siding in place.

If the hight from the roof flashing to the eave pocket is such as to require a cross seam in the siding, the flat seam like that used in flat-seam tin roofing is used and soldered on the back before erecting.

FLASHING LARGE SMOKE STACKS AND FLAG POLES

The method of flashing large smoke stacks and flag poles, etc., is shown in Fig. 124, where A B represents the roof, C the smoke pipe, D D the roof flange, and E E the vertical collar soldered to the roof flange around *b* C. Care should be taken that the collar is a trifle larger than the pipe, which allows the pipe to move without breaking the joint between the collar and the flange. The hight of the collar E at the highest point of the roof should be not less than 8 inches, and overlapping this collar a flaring apron, F F, is set, as shown, overlapping the collar about 4 inches. To hold this apron in position a flange shown at *a a* rests on the ring H H, which is made in two halves from 3-16×1 inch band iron, as shown in Fig. 125, in which the inner circle represents the pipe, around which the ring H H is bolted at J J. This ring should be made a trifle smaller than the pipe, so that

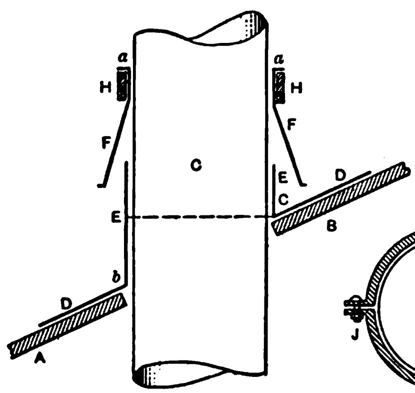

Fig. 124. Method of Flashing

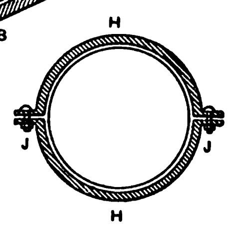

Fig. 125. The Ring

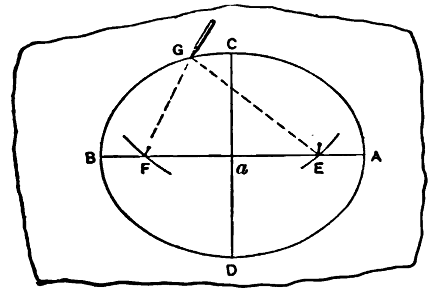

Fig. 126. Method of Obtaining Roof Range

when the flaring apron is placed inside of same, and the bolts fastened, it will secure the flange of the apron tightly against the pipe. Before fastening the band roofing cement is placed between the apron flange, band iron ring and pipe, which makes a tight job when the bolts are fastened.

The method of obtaining the opening in the roof flange D D, in Fig. 124, is shown in Fig. 125, which can be accomplished without the use of a draughting board, as follows: First draw the line A B equal to the slant opening *b* C in Fig. 124. Bisect A B in Fig. 126 and obtain *a*. Through *a* draw the vertical line C D, making *a* C and *a* D each equal to one-half the horizontal distance E C, in Fig. 124. Take the distance B *a*, in Fig 126, in the dividers, and with C as center intersect B A at F and E, through which points drive a nail as shown. Fasten the ends of a piece of spool wire to the nails, making the loop as long, so that when a pencil or prick punch draws the wire taut the point will meet C. With the pencil G in position describe the ellipse as shown. Allow 8 in. around the ellipse for the flange D D, in Fig. 124, which acts as a roof flashing.

PATTERN FOR A ROOF FLANGE

In the accompanying illustration, Fig. 127, are shown the principles employed in obtaining a roof flange for a round pipe, the roof having an angle of 45 degrees. In this connection it may be proper to remark that no matter what may be the shape of the pipe, or what the pitch of the roof, the principles described are applicable to any case, whether the flanges are made of copper, zinc, galvanized iron, tin or sheet lead. Referring to the illustration, let A B represent the pitch of the roof and C D E F the round pipe fitting on it. In its proper position above the pipe place the profile, as shown, which divide into equal spaces, as indicated by the small figures 1 to 5. From these small figures, at right angles to 1 5, drop lines intersecting the roof line A B, as shown.

From these intersections and at right angles to A B draw lines indefinitely, as shown. Now parallel to A B draw the line 1° 5°.

Now, measuring in each instance from the line 1 5 in the profile, take the various distances to points 2, 3 and 4 or 2′, 3′ and 4′, and place them on similar numbered lines in the pattern, measuring in every instance from the line 1° 5°, thus obtaining points 2, 3 and 4 or 2′, 3′ and 4′. A line traced through these points, as shown by the shaded portion, will be the pattern for the opening to receive the pipe. The width of the flange, however, will vary according to the style of roof in use. If the roof is of metal, which allows soldering, a flange of 2 inches all around is sufficient, while if the roof is slate, tile or shingle an 8-inch flange is usually made. The flange is obtained by simply setting the dividers to the desired width and scribing around the opening, as is shown by G H I J.

For the pattern for the pipe mitering on the roof A B, extend the line D E of the pipe, as shown by D K, upon which place the stretchout of the profile of the pipe, as shown by the small figures on D K, at right angles to which and from these small figures draw lines indefinitely, as shown, which intersect with lines drawn at right angles to E F from intersections on A B. A line traced through intersections thus obtained, as shown by L M N O, will be the desired pattern, the seam being placed on E F to avoid leakage. In diagram P is shown the method of flanging the pipe and flange. R R shows the edge turned upward on the flange,

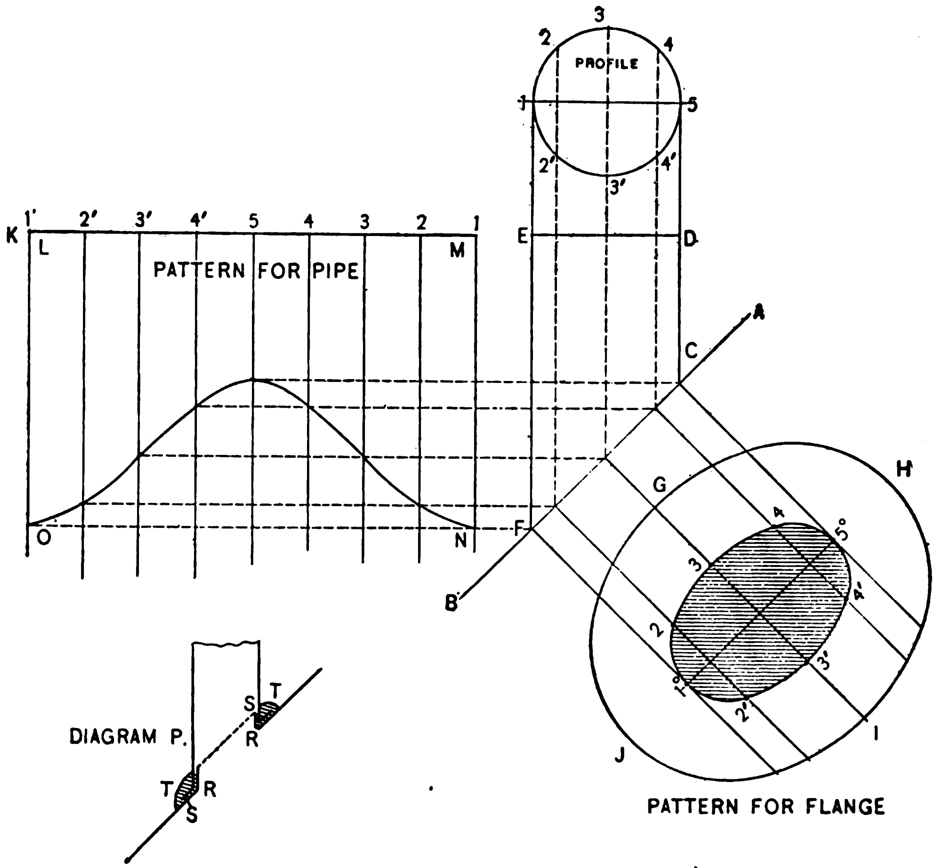

Fig. 127. Making Roof Flanges

while S S shows the edge turned outward on the pipe. The flange and pipe fit snugly and are then "sweated" with solder, as shown by T T, which completes the job

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COLLAR AND FLANGE FOR SMOKE STACK

There are various methods of constructing the connection between a smoke stack and roof. It is, of course, necessary to make the connection weather proof, but in addition to this it should permit of ventilation or provide for a circulation of air between the hot stack and the roof boards. There should be no rigid connection between the stack and roof, as the vibration of the stack would break seams and cause leaks. The opening in the roof should be at least 8 inches larger in diameter than the stack if the roof is of wood construction.

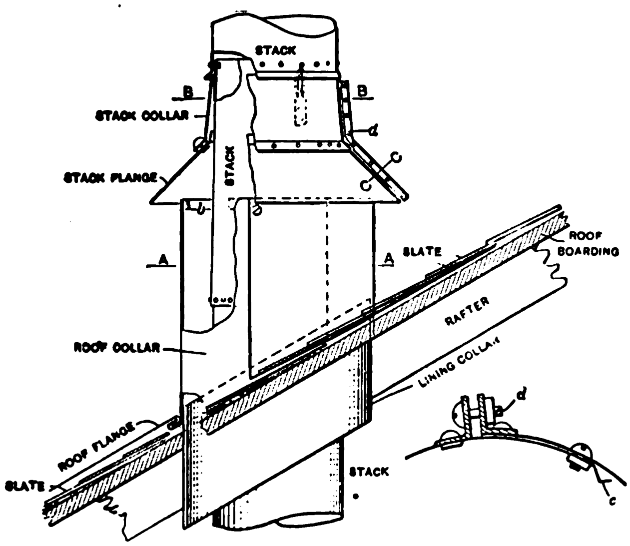


Fig. 128

Fig. 133

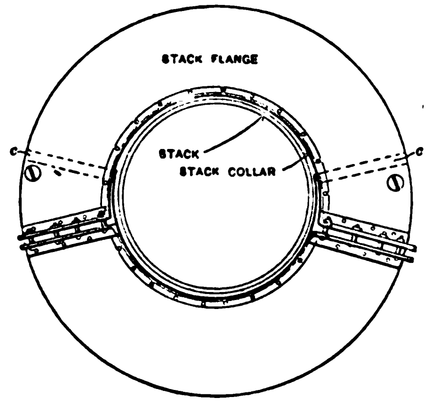


Fig. 130

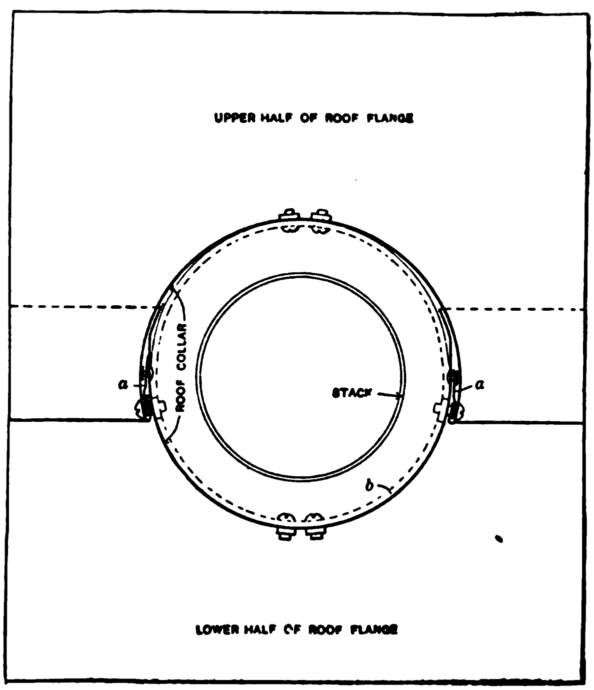


Fig. 129

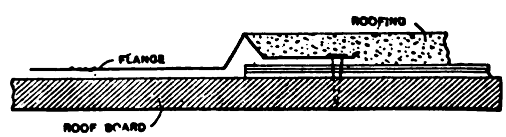


Fig. 131

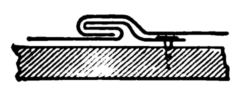


Fig. 132

CONSTRUCTING THE CONNECTION BETWEEN A SMOKE STACK AND A ROOF

Fig. 128 shows a sectional side view of a very good form of connection. Fig. 129 is a section on A A, Fig. 130, a section on B B and Fig. 133 a section on

C C. Fig. 128 shows a stack piercing a slate covered roof, in which case the roof flange can finish with simple raw edges, as indicated in Fig. 129. This also holds good in the case of a shingle or tile roof, except that in the latter case the flange should be fluted to conform to the profile of the tiles. If the roof is covered with tar and gravel the edges of the roof flange should be finished with a gravel stop, as indicated in Fig. 131. If the roof is covered with tin the flange should be provided with simple lock edges and be joined to the roofing as indicated by Fig. 132 and the seam soldered.

The roof collar should be double seamed and soldered to the roof flange, as indicated at the broken section, Fig. 128. The roof collar and flange is made in halves to allow placing it around the stack, and when the roof is covered with slate, shingle or tile, and consequently has considerable pitch, the two sections of the collar and flange can be joined as indicated in Fig. 129, cleats *a a* being riveted to the lower half of the collar and the upper half locked around same as shown. Ample lap should be allowed between the upper and lower halves of the roof flange and collar. The slate, shingle or tile work should be finished up as far as the lower half of the flange will extend and the latter then placed in position over the roof covering, The upper half of the flange is then put in position and the roofing laid thereon. If the roof is flat cleats *a a* should be omitted and the joint in the roof collar well riveted and soldered, the lap joint of the roof flange also being well soldered. The roof collar should project at least 12 inches above the roof at its upper side, and when the stack is large the upper edge of the collar should be stiffened with an iron band *b*, made in two parts and bolted in place after the collar is in place.

The stack flange and stack collar should be joined as indicated in the broken sectional view of Fig. 128, and also made in halves and connected as shown in Fig. 133. The small gutter crimp *c* takes care of any water that may drive in between the laps. The length of the stack collar is entirely dependent on the location of the most available joint in the smoke stack. This joint should be opened up with a cold chisel, so that the upper end of the stack collar can be inserted under same. The stack collar and flange can be drawn tight around the stack by bolts *d*, so that it will not be likely to slip down; but for large stacks a few lugs (one of which is indicated in dotted lines) should be riveted to the collar and secured by wires to the joint in the stack. Holes can be made in the outer thickness of this joint by driving a punch up underneath same and then using a cape chisel on the outside.

In the case of wood roof construction a lining collar for protecting the wood should be inserted through the roof boards into the roof collar and project downward below the bottom edge of the rafters. This completely shields all wood work around the stack. In no case should any wood work be allowed within 4 inches of the stack, and when the roof is low and near the boiler there should be at least 6 inches of clear space all around the stack.

The gauge of metal to be used is dependent upon the size of stack, temperature, etc., but generally the roof collar and flange should be of No. 20 gauge galvanized iron and the stack collar and flange of No. 18 gauge. For small stacks, where the collar is located at a considerable hight above the boiler, lighter material can be used.

ROOF FLANGES FOR SOIL OR VENT PIPES

The base sheet should be large enough to give ample flashing all around and should be designed to suit the roofing material. On first-class work the flange should be of copper, but occasionally for some patterns of tile used for roofing lead will be found easier to work, as it can be formed into the depressions in the tile better than any other material and will lay closer.

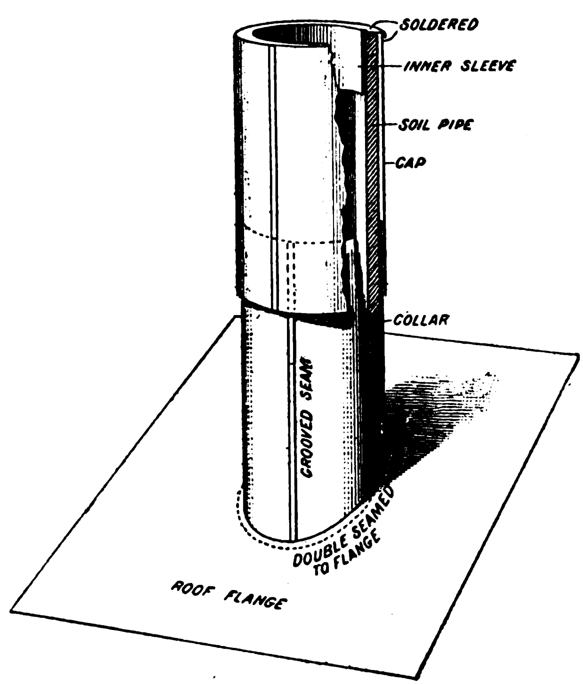


Fig. 134. Roof Flange for Short Stacks

The size should be ample but vary to suit the roofing material. A metal roof, affording a surface to solder the base plate to, will require a smaller flange than any other roofing material. A slate, a shingle or a paper roof will require a larger flange and a tile roof will require a still larger. In every instance the roofer should be consulted if possible, and on new work, if he is on the job and will make a reasonable price for the work, he should be engaged to do it, as his contract generally requires him to guarantee all roofing for a fixed period of time, and unless he does this work he cannot under his guarantee be made responsible for it.

The collar should be double seamed into the base flange, and the seam heavily soldered on the outside. The vertical seam of the collar should be on the lower side of the pipe, so the water from the roofing above the pipe will not run against the seam. The collar should be enough larger than the pipe to allow same to slide through easily. In making it the collar should be about ¼ in. larger in diameter, or ⅞ in. larger in circumferenc, than the outside of the pipe of which it is to go outside, for it will be found that if this allowance is not made the double seaming of the collar to the flange loses some of the clear opening and will cause the collar to bind if it is not made large. There should be no binding whatever and the collar should drop over the pipe and slide down into place of its own eight. Absolute freedom is necessary because the expansion and contraction of the pipe is always causing it to move up and down, and if the pipe is long this movement is considerable. The settling of the building, or of the rafters, or the shrinkage of the roof timbers and floor joists often cause an inch or more of a variation. In either contingency a flange fitting the pipe tightly is almost sure to cause trouble by buckling and cracking, breaking the seam where the collar joins the flange or by breaking the roofing material.

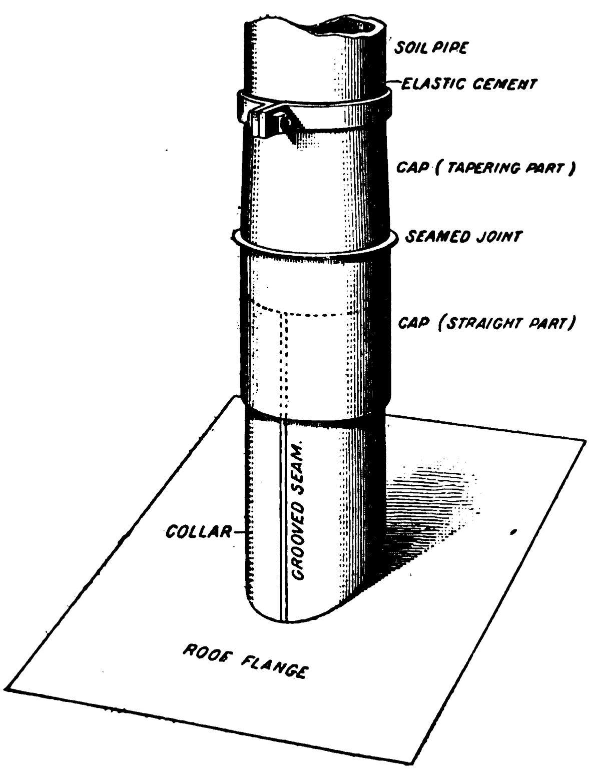


Fig. 135. Roof Flange for Tall Stacks

The collar should be at least 12 in. high, and 18 in. would be better, Fig. 134. The above method provides a practical and not very expensive way of making a tight connection at the roof, and the connection to keep the water from getting down into the building between the collar and the pipe is simple, especially if it is not necessary to run the pipe more than 2 or 3 ft. above the roof.

A cap should be made ½ or ¾ in. larger in circumference than the collar and long enough to reach from a point 6 in. lower than the top of the collar to the top of the pipe. This is nothing more or less than a piece of round metal leader with a grooved seam. Then a sleeve 2 or 3 in. long should be formed of sheet metal into a cylinder just a little larger than the inside of the pipe which passes through the roof. This should be put into the pipe and opened up as much as possible until it fits snugly and is tight inside the pipe, and then the seam should be soldered.

A circle should be cut of metal large enough to have a burr turned all around the outside edge and then leave it the proper size to snap onto the cap and be soldered. Then cut a hole in this circle just slightly larger than the inside diameter of the soil pipe. Turn a 1/8-in. edge out square all around on one end of the little sleeve made to fit into the soil pipe, drop it through the hole in the circle and solder it. Then the cap dropping down over the soil pipe is held snugly in place by the inner sleeve and the lower end laps down over the collar, forming a cap flashing that is water tight but which will allow free play to the pipe and the collar.

Of course, if the pipe must extend too far above the roof to make the above cap impracticable, some other arrangement must be made. The best would be to make the lower 8 in. of the cap the same as described above and then to double seam to this a tapering piece about 5 or 6 in. long with only enough taper to make it just the size of the outside of the pipe at a point 1 in. below the top of this tapering piece, Fig. 135. Then run it through the thick edge and form a slight depression clear around it and 1 1/8 in. below the top edge.

From this depression to the top edge stretch the metal gently on the conductor stake or on a piece of pipe with a hammer until it is parallel with the lower straight piece of the cap. It should fit the pipe snugly.

If it cannot be soldered to the pipe a metal band of 3-16 $\times$ 1 in. galvanized steel should be made to go around the top flange of the cap, formed to fit snugly with both ends turned out square and so that they will have a space of 1/4 in. (or 1/2 in. if the pipe is very large) between them. There should be a hole in each to take a bolt used in drawing the band tight to the pipe. To place the cap, drop it down over the pipe and over the collar of the flange to the proper position.

It should not have the top edge of the straight piece at the bottom of the cap closer than 1 in. to the top of the collar of the flange and 2 in. would be safer. Force elastic cement down between the flange of the cap and the pipe, put on the band, screw it up tight and then put elastic cement over the top and against the pipe and smooth it off with the cement beveled away from the pipe.

This connection allows absolute freedom of the pipe within the collar and of the collar within the cap, and is a perfect method except for the joint where the top flange of the cap hugs the pipe, but if this is properly and carefully made it should never give any trouble.

If the vent pipe does not extend very far above the roof and lead is required, this flange is made by forming a pipe of sheet lead slightly larger than vent pipe and with one end trimmed to suit pitch of roof and long enough to dress into vent pipe as shown by Fig. 136. This sleeve is soldered to a suitable base sheet.

A good method for screw pipe vents is to have a coupling reamed which covers the sleeve. Fig. 137 illustrates this method. This coupling is screwed on after flange has been set. It is best to make this flange of stiff metal—say cold rolled copper. A popular manner of making the roof tight around vent pipes is

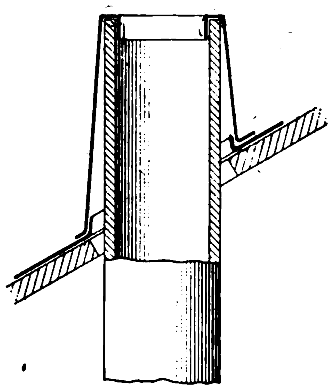


Fig. 136. Lead Sleeve Turned into Vent Pipe

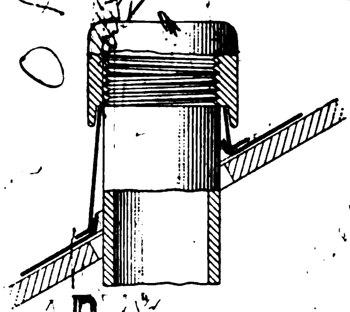


Fig. 137. Sleeve Fitted Under Recessed Coupling of Vent Pipe

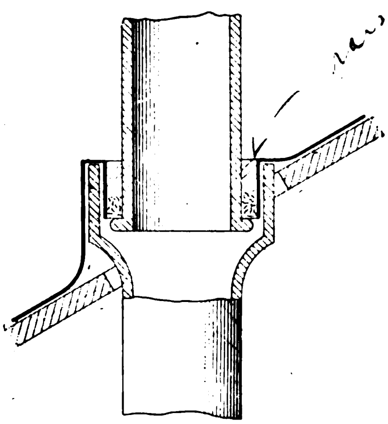


Fig. 138. Lead Base Calked into Vent Pipe Joint

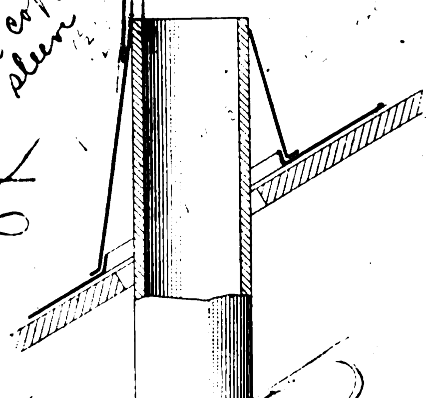


Fig. 139. Sleeve Fitted Snug Around Vent Pipe

shown by Fig. 138. The top of the hub of the soil pipe is almost flush with the roof and before calking the upper joint of vent pipe in this a sheet of lead with a hole cut out considerably smaller than the hub is dressed in the hub.

The usual way for roofers to make these flanges is as illustrated in Fig. 139. Though this is not recommended it is used more than any other method. A hole is cut in a piece of metal, for the base, somewhat larger than vent pipe, and the shape of the hole is guessed at. If impossible to drop this base piece over the top of pipe it is slit in the front. Previous to doing this an edge is hammered up, on the coping stone generally as shown. A tapering piece of sheet metal pipe is fitted around this flange and pipe and a mark made on the seam. It is taken from pipe seam tacked with solder on the mark and an edge hammered out as shown. Then this collar is placed around the pipe again and while held tightly against pipe seam it soldered, also collar soldered to base, and to vent pipe. If it cannot be soldered to vent pipe it is paintskinned.

TINNING EDGES OF COPPER SHEETS FOR ROOFING

When laying a flat seam copper roof of either soft or cold rolled copper it is necessary to have the edges tinned about 1½ inches around the entire sheet on both sides, so that when soldering the sheets the solder will be thoroughly "sweated" into the seam. While this can be done at the mill, or with the soldering coppers, a much cheaper and thoroughly practical method will be shown

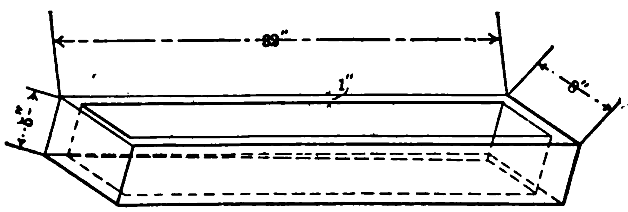


Fig. 140. Tinning Edges of Copper Sheets for Roofing—Copper Lined Box for Acid Bath

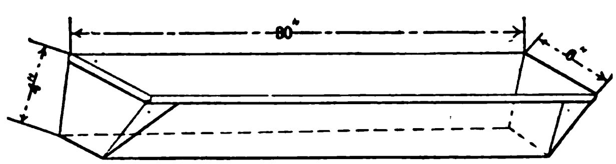


Fig. 141. Heavy Metal Pan for Tin Bath

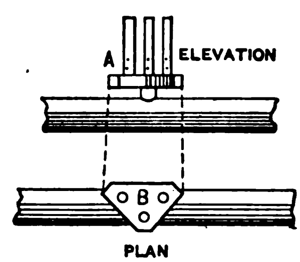


Fig. 143. Plan and Elevation of Burner Enlarged

herewith by which the sheets can be tinned to any required width, of any size, by any bright boy. When ordering sheet copper for this purpose a mistake is often made by taking large sheets and cutting them to the required size. This adds time and labor to the job which is not necessary, because the sheets can be ordered direct from the mill of the size and number required.

Assuming that this has been done, the first step required before tinning the edges is to notch the corners off the sheets, the same as in tin roofing. The scrap from the copper sheets will then bring full price when sold for copper scrap, while if the sheets are tinned first the scrap is covered with tin and brings less money and uses more tin. When the sheets are all notched they are ready for the tinning, which is accomplished as follows:

First construct a wooden box of 1-inch stuff, of the dimensions shown in Fig. 140, or large enough to admit the size sheet in use. This box is then lined out with cold rolled copper, flanging and nailing along the top edge of the box. If the sheets are to be tinned around the edges to a distance of 1½ inches, fill the box with muriatic acid to a hight of 1½ inches, into which place zinc clippings, which will start the acid "boiling," the proper quantity of zinc being known when the acid stops "boiling." Care should be taken, in putting the zinc in the acid, not to add too much at a time, otherwise the "boiling," will be so violent that the acid will run

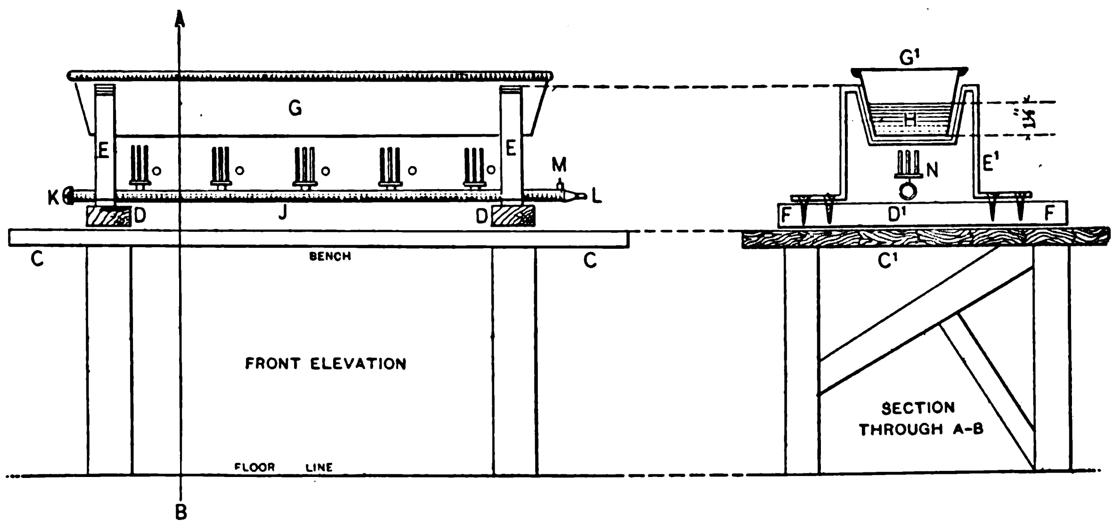


Fig. 142. Front and Sectional Views of Tin Bath in Position

over and be lost. Only small quantities of zinc should be put in the acid at a time, and when consumed more should be placed in until the acid stops "boiling." This is known as the "acid bath."

For the tin bath construct a heavy sheet metal pan, say of No. 16 black sheet iron, with wire edges, the corners constructed the same as in a drip pan, with additional rivets in the laps, and of the size shown in Fig. 141, or large enough to admit the sheet in use. This pan should be made tapering, so that when the tin becomes cold the pan can be tipped and contents removed. A general view showing the use of this pan is shown in Fig. 142, in which are also shown the arrangements by which the tin is melted by gas. If desired pure tin need not be employed, but a mixture of 50 per cent. tin and 50 per cent. lead can be used. The arrangement of the gas and pan support is as follows: Let C C in elevation be the bench or any other support, shown in section by C^1, and D D in elevation two pieces of joist as long as shown by D′ in section, upon which the two iron brackets E E in elevation are fastened, as shown by F F in section. These brackets are made from ¼ × 1¼ inch band iron, bent so as to receive the pan, and of sufficient hight, as shown by E^1 in section, to allow the burners to go under. The pan G in elevation, or G^1 in section, is placed into the brackets, as shown, the wire edges keeping the pan rigid at the top. The pan G^1 should be always filled with molten tin to a hight of 1½ inches, as shown by H, always placing in a bar of tin or mixture of one-half tin and one-half lead, so as to keep the required 1½ inches of metal in the pan.

For the gas connection obtain from a gas fitter a piece of gas pipe of the required length, as shown at J in elevation, with a stop-plug at K and a gas hose fitting at L, or a stationary connection can be made with a stop-cock at M. Holes are then tapped into the gas pipe and air burners having three tubes each are placed about 7 inches apart, as shown by O, O, O, etc., and as shown in section by N. In Fig. 143 is shown an enlarged view of the burner, showing the air holes in the three tubes at A in elevation, while B shows the plan view of the tubes. It is possible, though, to buy Bunsen burners complete.

When tinning the sheets the acid and tin baths are placed in convenient positions and the copper sheets placed in a position between them. Then two adjacent edges only, of a sheet are immersed in the acid bath; holding the sheet with a pair of tongs or protecting the hands with a heavy pair of gloves. Holding the sheet a few seconds with the corner in a vertical position to allow the acid to drip off, immerse it in the tin bath, leaving it in the bath a few seconds that the portion which is to be tinned will have the same temperature as the molten tin; then tip it slightly to allow the tin to run off toward the corners, and tin the other edge in the same manner. The sheets are now laid on one pile, which allows them to cool, when the other two edges are tinned. In this manner a boy can easily tin 300 sheets of 16 × 20 inch copper in a day. Care must be taken that the tin bath has the right temperature, otherwise the dripping becomes cold on the edges of the sheet and cannot be inserted into the roofing edger when edging. In case some sheets have become dirty or stained and will not tin, immerse them in raw muriatic acid first, then into boiled, then tin. When the sheets have all been tinned they are edged or folded in the usual manner, and laid on the roof by means of cleats, so as to allow for the expansion and contraction of the metal.

REMARKS ON COPPER ROOFING

Copper is a material which nearly always gives satisfaction as a roofing material when it is properly applied, and complaint is rarely made except where it is traceable to poor or careless workmanship. A few points to observe in using this material are to take the utmost pains to provide for the expansion and contraction of the metal, which has a greater latitude of expansion and contraction than any other roofing material.

For this reason it is desirable wherever possible to have the roof put on with the regular standing double seam, such as is used for tin roofing, using the wide gauge tongs and seamers, or else have the roof put on with the sides of the sheets turned up against wood ribs which are run up and down the roof and which are then covered with strips of copper locked over the sheets on each side of the wood rib and these seams malleted down against the ribs. Of course the sheets are cleated to the ribs, and the finished rib, in section, then looks like the accompanying sketch, Fig. 144. A like finish is made against the hips and ridges.

All cross seams should be heavily tinned before the copper is put together in rolls, preferably by dipping the end of the sheet into cut acid ½ in., and then dipping into melted solder about 2 in., leaving in for 5 or 10 sec. and then removing. A slight shake should be given the end of the sheet to shake off just a little of the surplus solder, but the remainder of the solder should be left on the sheet. When this is done a good seam can be made, because when the seam is locked together and closed down tight, preferably on a cross lock seamer, the solder left on the ends of the sheets by this tinning operation is remelted when the seam is soldered and makes it practically solid all the way through, whereas if the extra solder had been brushed off or wiped off immediately after the tinning operation there would not be enough left on the sheets to help make the joint solid, and it would have no strength except that given it by what solder could be soaked into the seam by the iron.

The upper sketch in Fig. 145 shows a seam made by the former method. The seam is shown solid, with nothing to indicate which is the copper and which the solder except the difference in the color. The lower sketch shows a typical seam made where the solder soaked in by the iron is depended on. In the upper, with a ½ in. lock, the solder has a bearing surface of 3 in., while in the lower, with the same size lock, there is a bearing surface of only 1 in., and that only at the point where it is the hardest to resist the strain.

If it is impossible on account of the roof not having sufficient pitch to use the wood rib or the standing seam construction, a flat lock roof is necessitated and good results can be obtained, but the sheets should be tinned along all edges by dipping and leaving the solder on the sheets. The tin can be tinned on the ends of the sheets, put up in rolls, and then have the edges tinned by dipping the rolls (rolled loosely) in acid and then in the melted solder, leaving them in for 10 or 15 min. so the edges will get hot enough to let the solder flow off the edges and not stick them together. The roll should be shaken up and down to remove the surplus solder and then quickly unrolled on a bench or the floor, or the edges will stick when the solder gets cold. This method will be found much quicker than tinning with a soldering iron.

To facilitate the handling of the rolls a wire should be slipped through the hole in the center of the roll with a piece of rod or gas pipe through a loop at the bottom end and with a loop at the top end, through which a piece of gas pipe or a wood handle 6 or 8 ft. long can be slipped. A man and a helper pass the small piece of pipe through the hole in the center of the roll, and after it is through turn

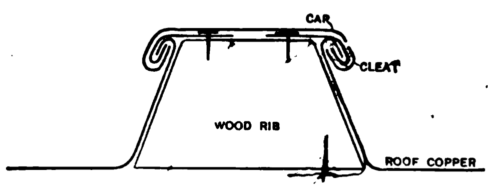


Fig. 144. Copper Roofing with Wooden Ribs

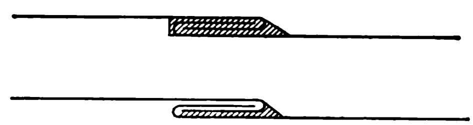


Fig. 145. Soldered Seams in Copper Roofing

it at right angles with the roll. They then slip the gas pipe or wood handle through the upper loop, raise the roll, dip it into the acid and then set it down into the hot solder, which is deep enough to come up on the roll 2 in. It is left in there about 10 min., while the men are putting in one or two more rolls, or taking out one or two others. They then remove it, giving it a few shakes over the solder to remove the surplus metal, and then they quickly unroll it, and after it is cooled it is rerolled and the operation repeated on the other edge.

In laying copper on the roof whether flat lock, standing seam or wood rib construction is used, the copper should be secured only by cleats, never under any circumstances using nails driven through the copper, though it is permissible to use a nail through the sheet at the top of a course on a steep roof to hold it in position until the cleating and seaming is completed. In this case the nail should not be driven down tight and should be pulled out and the hole soldered. The nail should not be driven down and soldered, as the sun will surely draw it up through the solder, no matter how heavily it is soldered.

If the roof is larger than 20 or 30 ft., either way expansion seams should be put in. A regular standing seam might be put in, turned down, heavily soldered, and then turned up again. Another point to observe is that when the roof is put on during hot weather more attention should be paid to providing for the expansion and contraction, especially to provide for the contraction, as that is what breaks the seams. Contraction will put considerably more strain on a roof laid in hot weather than on one put on in cold weather, because the expansion is at or near the maximum when the roof is laid, so that it is rigidly fastened at all edges the contraction will have its maximum effect. On the other hand, if the roof is laid during very cold weather but little attention need be given to providing for the contraction beyond seeing that no nails are driven through the sheets, as the contraction being already at or near the maximum, it is plain that it will put no strain on the sheets.

It is necessary to be careful that no buckles are formed in the sheets on the roofs or in the valleys or gutters, as these will, from the extreme contraction and expansion, soon cause the copper to break at the point of the buckle. The writer has seen this trouble experienced a number of times, and great care should be taken to avoid it. By tinning all seams heavily before sheets are put together, providing for expansion and contraction, putting in expansion seams where necessary, soldering all seams heavily with real half and half solder, and using cleats as the only method of fastening, there should be no trouble in securing a good piece of work.

Some may object that the method outlined herein are too expensive, but the writer can only say that copper being an expensive material no man is justified in failing to use any precaution to secure a satisfactory and durable job, especially when the extra cost of $1 or $2 a square forms such a small percentage of the total cost of the roofing. On a tin roof, costing $5 to $8 a square, the matter of $1 or $2 added to the cost would be serious, as it would be a handicap of from 20 to 40 per cent., but on a copper roof, costing $35 to $50 a square, it is a comparatively small handicap and one which is justified.

PRACTICAL TALKS ON ZINC ROOFING—I

A roofing which has special advantages for covering light structures, inasmuch as it can be laid on zinc without any boarding whatever beneath it, is what is known as the "Italian corrugation." It consists of sheets of the usual dimensions with one central semi-circular corrugation longitudinally, and a curved lap at each side. This stiffens the sheet, so that in the case of large spans, the principals and framing may be lighter than usual, and, as a consequence, less in cost. The purlins may be as much as 10 ft. apart, if desired. The patent embossed hole and screw is very handy for fixing this style of corrugation; in fact, the work in connection with it is very little. Referring to the engravings, it may be stated that in Fig. 146 is given a longitudinal elevation of a portion of the wooden roll A, with the corrugation B, and laps C, which should be about 4 in.; D being the bossed

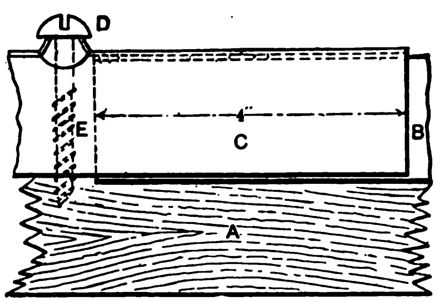


Fig. 146. Longitudinal Elevation of Wooden Roll

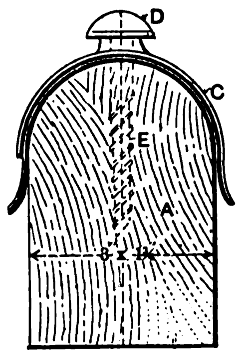


Fig. 147. Section Through Roll and Cap

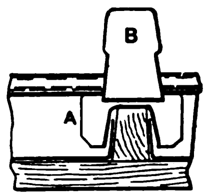


Fig 148. Elevation Drip for Common Roll Cap

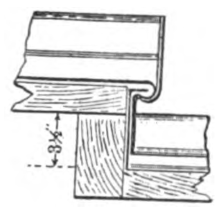
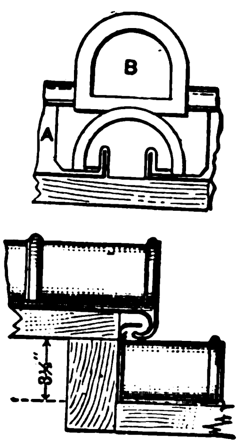
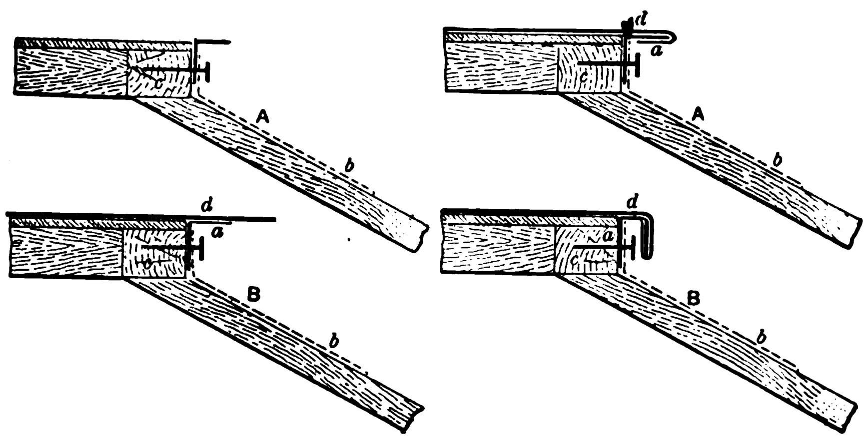


Fig. 149. Section of Drip for Common Roll Cap



Figs. 150 and 151. Drip for Patent Roll Cap



Figs. 152 and 153. Method of Treating the Edges of the Zinc in Covering Flats or Platforms

hole, and E the screw. Fig. 147 is a section through the roll and cap, showing the extent of laps. The screw should never be permitted to penetrate both sheets.

The wood rolls or battens may be $1\frac{3}{4} \times 3$ in. Where drips are necessary in zinc covered roofs they are arranged similarly to those on which lead is laid. Those for the style of common rollcap, which has been spoken of, are shown in elevation at Fig. 148, and in cross section at Fig. 149, A representing the extremity of the lowermost cap in each case, and B the stop end of the upper roll. A fall of 3 in.

from bottom to bottom is usually sufficient. The drips for the patent roll caps are given at Figs. 150 and 151, the reference letters being the same as in Figs. 148 and 149. In consequence of the upturn of the lowermost roll, a fall of 3½ in. must be given to the boarding of the roof.

The application of zinc for the purpose of covering flats or platforms of pavilions or temporary structures is also useful. In roofing, the carpenter will of course give the platform the slight necessary fall, and fix in its center, between two slopes, a stout batten of about 3 in. square, to do a somewhat analagous duty to the ridge pole of an ordinary roof, unless the roof is of very small extent. Of course, where, on the contrary, the surfaces are very large, the carpenter will have to make provision for drips. That being arranged, the first thing is to secure the edges of the platform by nailing (preferably with end-headed nails) a strip of zinc or lead 4 in. wide along each edge. The sheets of zinc must also have an upstand at each side against the wall as far as the roof, and a similar set-up of 3 in. at their top ends, which butt on the central ridge or batten. The upstand of these ends should be soldered to that of the sides at each corner.

The edges of the zinc at the boundaries of the platform have now to be turned over the projecting strip of zinc or lead, as shown in Fig. 152. In the sketches the strip or clip of lead or zinc is indicated by a dotted line. Of course the zinc of the flat is cut level with the strip before turning in. The set-up against the roll should be slit at the level of the roof, so that it projects on each side of the roll, and a small piece of zinc, of size sufficient to project as much, say 1½ in. beyond edge of pavilion top, should be soldered over the same. The roll being then slipped on the wooden rolls, and clasping the two upstands of the zinc sheets, a small piece of the zinc roll, sufficient to cover the projecting pieces soldered on should be mitered and soldered to the end of the roll, thus completing it and carrying it over the edge of the platform, as shown by B in Figs. 152 and 153. The end of the zinc roll, which butts on the central batten, should also have a small piece of zinc soldered to it, in the same way that the roll terminating at a ridge pole has. The central ridge, or batten, may be made in two pieces as described for the wood rolls, only larger, say 5 in. or $6 \times 1\frac{1}{2}$ in. or 1¾ in. This is best covered with lead, well dressed down over the top upstand of the zinc sheets, and the zinc soldered to the ends of the rolls.

Of course, any of the other forms of roll cap, etc., which can be used for roofs, are also capable of employment for flats, and equally of course, the distance of the wood rolls apart will vary according to circumstances and to taste. Thus the zinc may be either used of its full breadth, or cut down the middle and applied in half sheets. So, too, the rolls may differ in size, and of necessity the zinc roll caps with them, according to locality of roofs, etc. Where bold effect is desired, the large size will be used, and they are more impervious to wet where the fall is slight, or exposure to wind or snow likely to be great.

It is essential in external zinc working, as in that of lead, to leave the metal, so far as possible, free, and with plenty of play. Separate sheets should on no account be soldered together, although, of course, (as it is not possible the lengths of the sheets as obtained should fit every roof) occasionally a sheet must be lengthened by soldering a piece to it. Zinc for flats and platforms of pavilions should always be of tolerable substance. Zinc pavilion roofs are frequently, at the present time, enriched to a great extent by oval and variously formed louvres, window openings finials, etc.; and even in some cases the metal is used in imbricated plates similar to fancy roofing tiles. This is an old fashion revived, for similar forms were given to lead in the seventeenth and eighteenth centuries, especially in France.

Zinc is of course not inflammable. It is therefore a safe covering for any building, including the private residence. There is a current belief among architects that zinc will burn. It is true, that a very high temperature sufficient to make iron red hot or crack slate would cause zinc to vaporize giving the appearance of burning by throwing off a bright green flame, but no ordinary temperature will do this.

PRACTICAL TALKS ON ZINC ROOFING—II

There are several reasons why zinc has not been generally used in this country for roofing purposes: It is more expensive than roofing tin. It requires more careful handling. It expands and contracts more than any other metal used in roofing, so that if unskillfully laid it will not give satisfactory service. It will not give long service near the sea, or in the vicinity of chemical or iron works where fumes from the processes of manufacture are discharged into the air, the condensation and precipitation of their components corroding the zinc very rapidly. A large roof in Newcastle-on-Tyne, England, covered with 22-oz. zinc was corroded so badly in 18 months that it had to be stripped and re-covered with sheet lead, but this case is exceptional.

Given proper conditions and careful workmanship the metal will undoubtedly give long service. There are hundreds of roofs "on the other side" which are perfectly sound after 30 and 40 years' service, and there is no reason why it should not do as well here. The important thing to bear in mind in laying it is its high co-efficiency of expansion. In a climate where the variation in temperature may be 120 degrees there must be ample room left for the sheets to expand without "bulging" and cracking, and to contract without pulling away clips, fastenings and soldered seams. This is easily accomplished, as the sketches will show.

In covering a roof with a fairly steep pitch the procedure is much as in using tin or galvanized sheets with standing lock. The lateral seams, however, are not soldered. The turnover at the top of the sheet is 2 inches, while the lower end of next sheet is turned in 1 inch only. This gives ample lap, and when put into place the seam is flattened by a soft wooden dresser. Zinc clips 2 inches wide, two

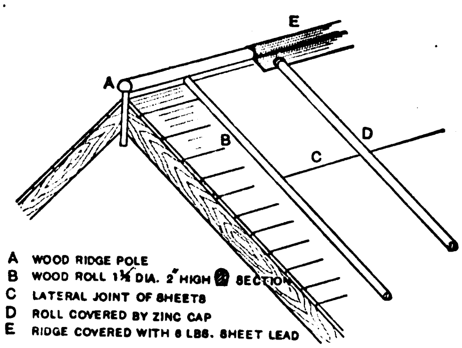


Fig. 154. General Scheme of Zinc Roofing Work

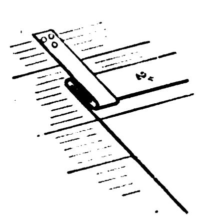


Fig. 155. The Use of Clips or Cleats

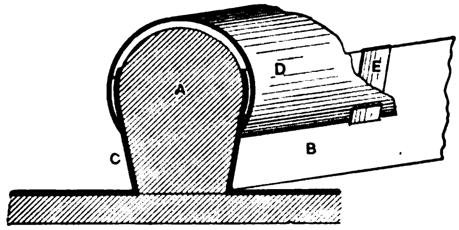


Fig. 156. Section of Roll and Cover

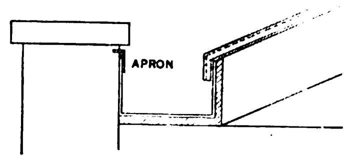


Fig. 157. Arrangement at Gutter

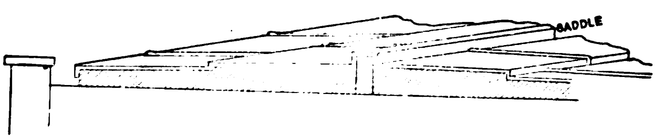


Fig. 158. Flat Roofs with Drips and Saddle

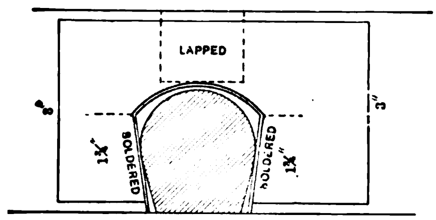


Fig. 159. Lapping of Upstands at Drip and Saddle

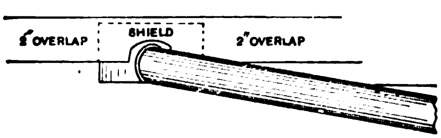


Fig. 160. Roll Cap Shield at Drip

to each sheet, are folded and nailed into place as in Fig. 155. These prevent the sheets slipping down the roof. The lower edge of the bottom sheet and the end sheets are prepared and fixed over an edging strip same with tin roofing, or set up against a coping or wall 3 inches or more should the roof require it.

The side next to the wood roll for the longitudinal seam is set up 1¾ inches, as shown in Fig. 156. This is dressed a little beyond the square, as the roll is narrower at the bottom than at its upper part. Then the wooden roll is nailed down with strips of zinc 9 inches long about 1 inch wide fixed under it. These strips are bent over the upstand or the turned up edge of the zinc and then up on the edge of the cap when fitted, where they are soldered, thus preventing the cap from slipping and dispensing with any necessity of nails through it. The top sheet next to the ridge should be set up 1½ inches and the corners soldered. A clip may be soldered to the under side of the sheet and nailed to the ridge pole to support this sheet, or it may be nailed to the lower side of pole as the lead will give ample lap over the nails. When all the sheets have been laid, the zinc cap is slipped on from the lower side, taking care not to expand it so it will lose its close grip on the upstands. The clips are then trimmed off and soldered and the ridge covered with 5 or 6 pound lead, snugly dressed over the rolls and close in to the roof proper. The caps may be finished at the eaves with a blank end soldered in, or returned, if the roof delivers into a gutter as in Fig. 157.

Covering a flat roof or a roof with little pitch with zinc is rather more troublesome, as it has to be laid in steps. Commencing at the eaves in the usual way, or by dripping it into a gutter, the sheets are set up as before described for the edges and roll seam; but instead of making a flat or lock seam at the lateral junction, a drip must be formed—that is, where the length of roof requires more than one 8-foot sheet. The rise to the next flat should be 3 inches, and the first sheet is set up that hight at the upper end. At 1¾ inches up the upstand is notched and the lower part bent around the longitudinal upstand and soldered, while the upper part is allowed to lap over the top of the roll onto the next sheet, Fig. 159. When the roll cap is slipped on a shield about $2\frac{3}{4} \times 3$ inches is fitted to the end pushed close up to upstand and soldered to cap, as in Fig. 160. The next sheet being turned down 2 inches covers this, so that sufficient room is left for each sheet to move. The sheet should never be turned down over this drip more than 2 inches, or at most 2½ inches, or trouble through capillary attraction may be experienced.

The caps are tied down in the same manner described. The saddle, if one is necessary, may be covered either with zinc or lead, making provision for clips below the apron part to prevent its blowing up, and making any necessary joints, if zinc with roll and cap or if lead, by working a hollow roll seam.

Zinc flashings, aprons, etc., are commonly used now, and all that can be said about them is that proper provision must be made likewise for expansion. Zinc is a hard metal to work in cold weather and should always be warmed before a sharp bend is attempted. It is well to lay the sheets out on a flat surface before using them. They can be much more easily handled if this is done. Zinc requires no painting. Where no other influence than the weather acts on it the oxidization tends to preserve it, but should there be any possibility of damage through sulphurous fumes, etc., a good coat of lead paint will protect it.

PRACTICAL TALKS ON ZINC ROOFING—III

The information here given was secured at first hand during a residence in Germany. Sheet zinc was first used for roofing purposes in Germany about the year 1800, and it has continued in popularity and has given entire satisfaction ever since. It is estimated that, at the present time, 35 per cent. of the total output of the German zinc mines is used for this purpose. A roof made of No. 16 gauge zinc is guaranteed to last from 30 to 40 years without repair. Thus its value is obvious.

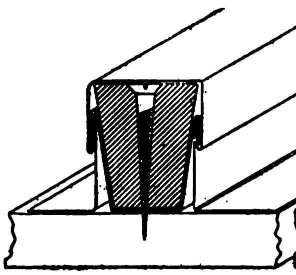


Fig. 161. Belgian System

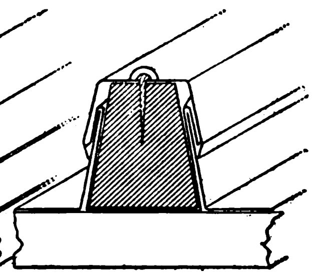


Fig. 162. French System

Zinc is a metal that expands and contracts through climatic changes to a greater extent than any other known metal. If proper allowance is not made for this expansion and contraction, when constructing a roof, the zinc will buckle and bend, and finally tear, and the older it gets the more brittle it becomes.

The chemical action of zinc, it is, well to note, is under ordinary circumstances, similar to the oxidation of iron. Under the action of air and water, an oxide of zinc covers the material, which, however, can easily be brushed off in the early stages. In a few weeks' time, however, this oxide will become so settled that it cannot be brushed off. Even water will not affect it. It is this oxide that protects the zinc from all ordinary influences. This oxide, however, will not, of course, withstand the action of acids, such as are emitted from chimneys, nor of the salt air from the ocean. Lime, as used in mortar, and cement in concrete also have their influence upon zinc, especially upon new zinc. This, of course, refers only to fresh mortar and concrete. The chemical action in this process, while very slow, lasting nearly two years, is a sure one.

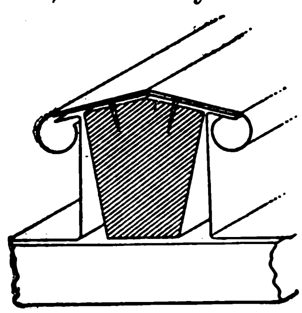


Fig. 163. German System

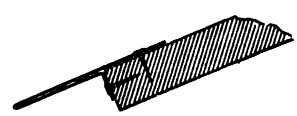


Fig. 164. Eave Strip

Soot that may lie on the zinc will form electric currents, if the same is wet through rain or moisture. These currents, no matter how weak, will act upon the oxide and seek the weakest spots in the sheets, so that holes will soon appear that have been eaten through the body of the zinc. The same result will happen if copper or iron comes in direct contact with the zinc. This is one reason why all cleats used on zinc roofs must be tinned. All iron work, too, that comes in contact with zinc should be galvanized or tinned.

The different systems of zinc roofing are in use in Europe, known respectively as the Belgian, the French and the German systems. All have been in use a good many years, and they are, with a few minor variations, nearly identical in

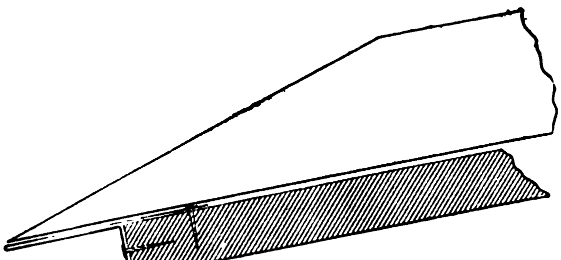


Fig. 165. End of Strip at Eave

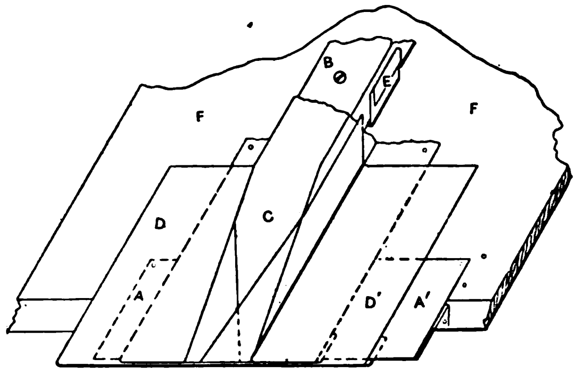


Fig. 166. Finish at Eaves—Showing Metal Cap

construction. Each kind has its own peculiar shape, but all strive for one point—allowance for expansion and contraction. In Fig. 161 is shown the Belgian system, which is the one we describe below. Figs. 162 and 163 represent, respectively, the French and German systems. In all three systems cleats are nailed to wood strips about 9 inches apart, before the strips are nailed to the roof.

As above stated, zinc is a metal that expands with the heat and contracts with

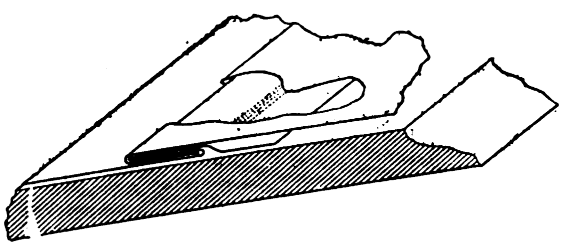


Fig. 167. Broken View of Cross Seam—Showing Cleat

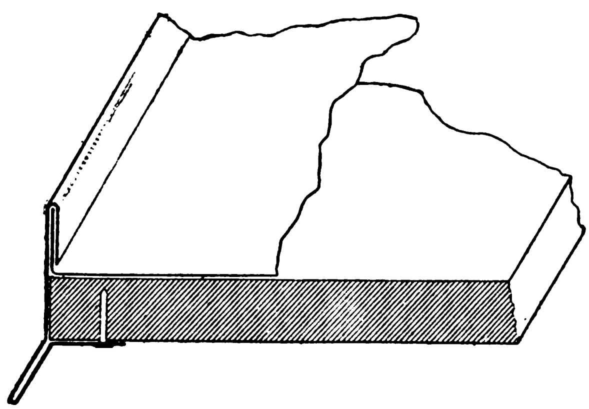


Fig. 168. Finish at Gable

the cold, and for this sufficient allowance must be made when the roof is being laid. A sheet of zinc 36 inches wide and 72 inches long will expand at least 1/8 inch in width, and nearly 1/4 inch in length in hot weather. Nails should never be driven into the sheet. Nothing but cleats should be used. If nails are driven into the sheets, the heat will cause the zinc to buckle, and it will pull away from the nails, leaving a hole, which will cause a leak. This point, and that of expansion and contraction, must be carefully considered in laying a zinc roof. The action of the expansion and contraction is somewhat different on the Belgian system from that of the other systems. The zinc, in the Belgian system, moves into the bottom of the wood strips, whereas, in the French, it moves up the sides of the strips. In forming the edges of the sheets, care must be taken always to get them as round as possible. If this is not done, the zinc, in a few years, will crack at these points.

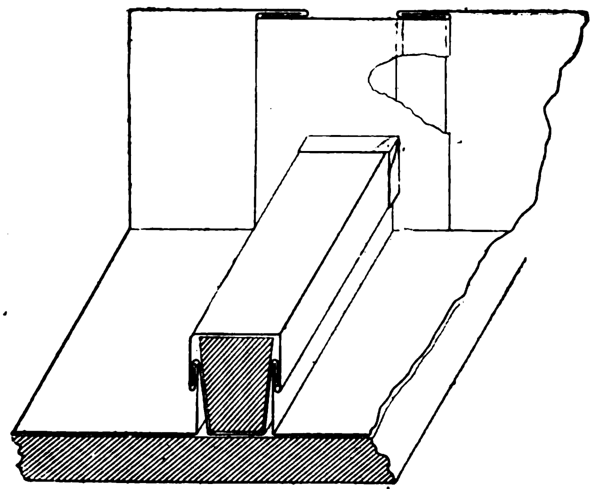


Fig. 169. Wood Strip Butting Against Wall

To lay the roof an eave strip of iron is formed as shown in Fig. 164. In using sheets of zinc that are 36 inches wide, the wood strips must be 34½ inches from center to center. Before the wood strips are nailed to the roof, the cleats, as shown in Figs. 161, 162 and 163, must be nailed to the bottom of the strip. The lower end of the wood strip is cut off as shown in Fig. 166.

The wood strip is then nailed to the roof, and over the end of the wood strip is placed a metal cap, formed as shown in Fig. 166. This cap is nailed to the roof

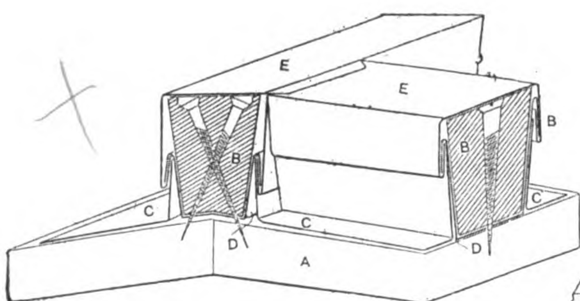


Fig. 170. Showing Ridge Strip and Common Strip

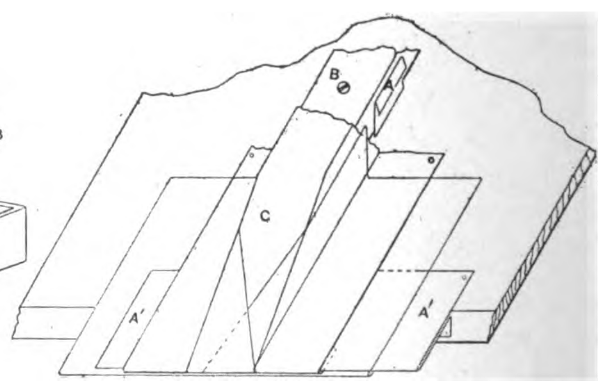


Fig. 171. Showing General Construction of Zinc Roof

and not to the wood strip. If there are any valleys in the roof, 12 inches should be allowed on each side of the same and the strips be cut to this line. The same should be done at the eaves. The same shaped cap as is used at the eaves should be used at the valleys, and should hook into the seam of the valley, which should not be less than 1 inch wide. The wood strip at the ridges and hips can be made twice as large as the longitudinal strips. They can also be made of one size.

After the strips are all nailed to the roof, the same is ready to be covered with zinc. The cross seams are the first to be formed. These are formed as shown in Fig. 167, which gives a broken view of the cross seam, showing the cleat. After these seams are turned, the sides can be turned in this manner. Take a piece of leather or sheet lead and shove it in the cross seam, turning the sides up 1½ inches. Turning seams in this manner does away with soldering. After the sheet has been

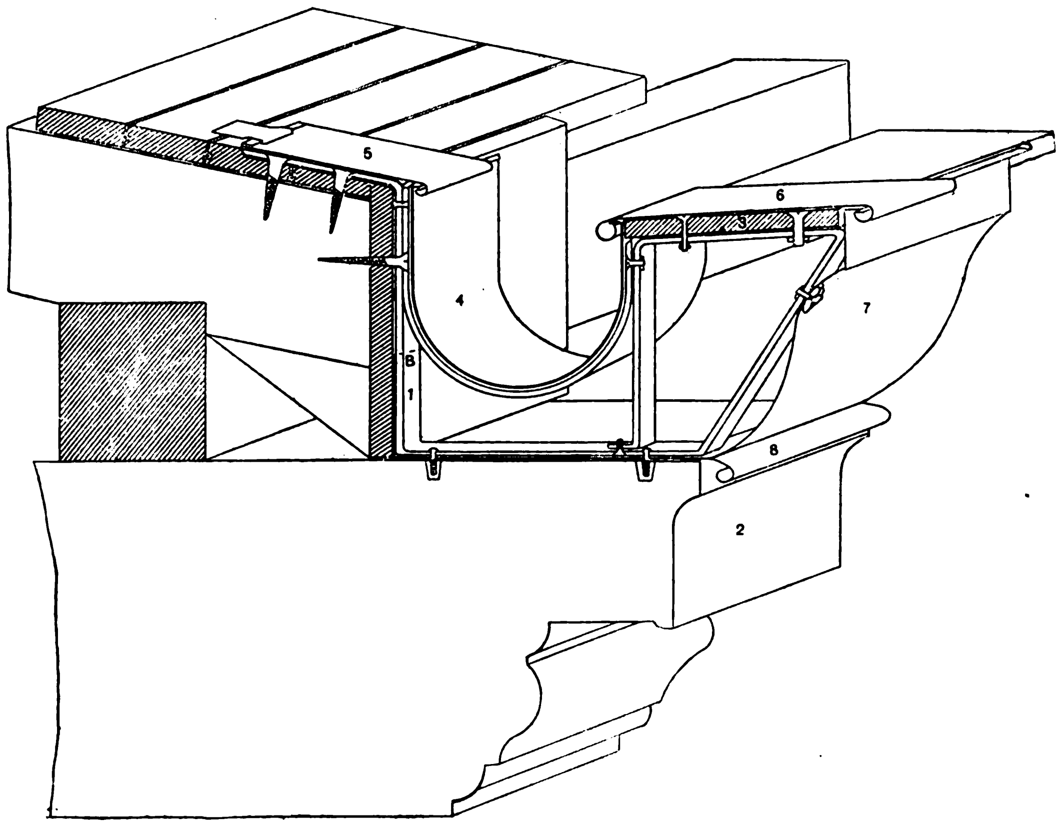


Fig. 172. Construction of Gutter

laid in its place, nail two cleats in the upper cross seam. As the sheets are laid in place, turn the cleats down over the sides. These cleats must all be of a uniform hight, so that when a cap is shoved over the ridge strip it will not be too loose.

The finish at the gable is indicated in Fig. 168. If there is a wall to be flashed that runs paralled with the wood strips, the same may be flashed in the usual manner. When a wood strip butts against a chimney or wall, however, flash as shown in Fig. 169. The sheets in this case are turned up from 4 to 6 inches against the wall, with the seams turned as shown, and the piece of zinc is shoved down over the wood strip. The cap is then placed over the wood strip and soldered. Fig. 170 shows the method in which this work is carried out, with a ridge strip and a common strip.

When the entire roof is laid and ready for the zinc caps, the bottom of each wood strip is already cut off in the manner shown in Fig. 166. The zinc sheets are then turned over the wood strips, as shown in Fig. 171. From this, it will be seen that it is necessary for the zinc cap that goes over the wood strip to be formed on a slant at the lower end, so as to cover the entire strip. In Fig. 171 A and A′ are the eave strip, as shown in Fig. 164; B the wood strip, cut as shown in Fig. 165; C is the zinc cap; D and D′ zinc sheets, with the ends turned over the zinc eave cap; E the copper cleats and F F the roof boards.

Gutters, such as are used with zinc roofs, are of numerous shapes and styles. In Fig. 172 is shown the construction of a false bottom zinc gutter, which is one of a type generally used. In this sketch 1, is a band iron frame, 2 the sandstone cornice, 3 a running board, and 4 the gutter proper; 5 is the eave strip, 6 the cover for the running board, 7 a crown molding of zinc, and 8 a zinc strip that goes as far as B, to guard against condensation or leaks. There is not much need of going into details in describing these gutters, as the cut plainly shows the method of constructing them. If the gutter is very long, it is well to have expansion joints, so that the zinc can contract and expand at will. Fig. 173 shows the finished zinc roof, indicating the different sections.

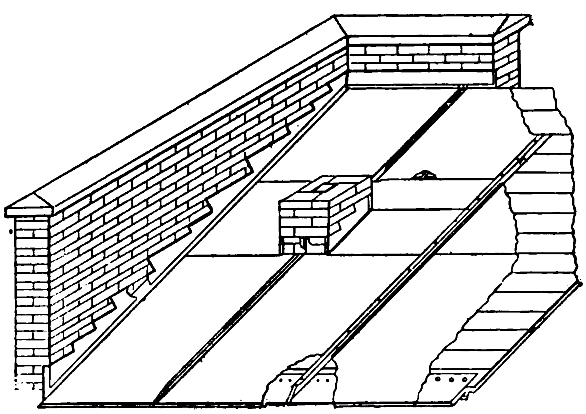


Fig. 173. Finished Roof—Showing Different Sections

In laying a zinc roof certain points should be kept in mind. In working zinc on cold days it is well to warm the metal to keep it from cracking. Cross seams are the only seams that are to be soldered, and then only when the roof has a pitch of less than 15 degrees. All cleats should be made of heavy copper and tinned thoroughly. Never drive nails into a sheet of zinc. Always see that there is room enough for the zinc to expand between the wood strips. Never use a sharp instrument in marking the zinc, as this is liable to cause cracks. When cross seams are not soldered, they should never be hammered flat. The cross seam on the lower sheet should be at least ¼ inch wider than the cross seam of the upper sheet.

Nos. 14 and 16 gauges of sheet zinc are generally preferred for roofing purposes, and nothing lighter than No. 12 gauge is ever used.

Where zinc is exposed to chemical action, as referred to at the beginning of this article, it can be painted, but, before any painting is done, the zinc must have a rough surface, such as is caused by the oxide or made by mechanical means. A good time to paint zinc—probably the best time—is when the roof has a thorough coating of oxide. The paint then takes a good hold and will remain for some time. Zinc can be painted at once if it is desired, but, as before stated, it must be on a rough surface. The rough surface can be gotten by either sandpapering the roof or scrubbing it with sand. The latter method is preferable, because it is the easiest. This will cause a roughened surface, to which paint will readily adhere. It is better, however, to wait until the roof has its own coating of oxide. The paint will crack and peel off if the zinc has not this rough surface. Silicate of zinc is the best mineral paint that can be used for this purpose.

LAYING TAR AND GRAVEL ROOFS

The sheathing can be laid with the pitch of the roof, or diagonally, or parallel with the eaves, for it makes absolutely no difference which way it is laid, so long as it is of even thickness and the joints are closed.

The roof will probably be a 3-ply, 4-ply, or 5-ply roof. In this connection, ''ply'' means ''thickness,'' 3-ply means three thicknesses of the paper, 4-ply means four thicknesses, and so forth. The paper, or tar felt, comes in rolls. This paper is usually 3 feet wide, and a roll contains either 108, 216 or 324 square feet. This lays one, two or three squares of finished roof, 1-ply, or one square of 3-ply roof. This paper is generally sold by the ton, although it is sometimes sold by the roll. It weighs about 14 pounds per 100 square feet.

At the eave of the roof should be nailed a gravel guard of galvanized iron or copper, made as shown in the accompanying sketch, Fig. 174. Before it is put on, one course of paper should be rolled out parallel with the gutter, doubled over, and this double thickness laid on the sheathing, with the edge flush with the outer edge of the sheathing. The gravel guard is then put on, as shown, and the upper edge carried about 4 inches over the paper and nailed 3 or 4 inches apart. The outer edge is nailed also to the edge of the sheathing to hold it down.

The preparations, up to this point, are the same for a 3-ply, 4-ply or 5-ply roof, but differ somewhat from this point on. If a 3-ply roof is wanted, the roofer rolls out a strip parallel with the eave of the roof and stretches it along with the lower edge just touching the ¾-inch projection above the roof on the gravel guard. On top of this, 12 inches higher up, the roofer should roll out another course of paper, and then as many succeeding courses as may be required to cover the roof, each course covering 24 inches of the preceding one and leaving 12 inches showing to the weather. At the top end, sufficient is put on to insure that three thicknesses of paper is over all the sheathing boards. As each course is rolled out, it is nailed along the top edge with 1-inch barbed roofing nails, driven through flat tin caps, these nails and caps being about 12 inches apart.

In the meantime, the pitch has been heated in a kettle over the fire, and mops made of mop yarn tied to handles like broom handles. The pitch is drawn up onto the roof as needed in 5-gallon buckets. One man now starts along the edge of the roof and turns back the paper and holds it while another dips a mop in the hot pitch and runs it along on top of the gravel guard and the double course of paper under the same, the object being to give a liberal coat of tar, so that the metal will be firmly cemented to the paper under it, and there will still be enough pitch to thoroughly cement the first course of paper when it is released. If the courses are very long, the man holding the paper will soon get the knack of letting the paper fall over on the hot pitch, so that it will lie down smooth. Each succeeding course is turned back in the same way and the course next below it mopped for a distance of about 12 inches up under the course just turned back.

After this is done, the roof is usually covered with a thick coating of pitch poured out of a long handled dipper and deftly spread over the surface, care being taken to see that it is spread over every inch of the surface of the roof. Though some roofers spread the tar with the mop.

While this is being done, another man is busily pushing gravel, or slag, into the pitch just spread before it has a chance to cool. This gravel, or slag, should be dry, and if the weather is cool it should be heated, so that it will bed in the pitch before the same cools. If gravel is used, it should be screened and nothing used that will not pass through a ⅜-inch mesh, and nothing that will pass through a smaller than ¼-inch mesh. The whiter and cleaner the gravel, the cooler the roof will be and the better it will look. Gravel is generally used, but slag is sometimes substituted, although it is generally not considered so desirable by roofers, and is not so easily manipulated. The roof is now gone over with a broom and swept lightly, so that not too much loose gravel is left on it.

To flash around chimneys, walls, etc., copper is generally used. The roof should be laid and the flashing put down on top of the same, running up on the wall to the hight desired, and turning out on the roof 4 inches and nailed 3 inches apart. It is then thoroughly mopped over and a double thickness of paper laid over it. Especial care should be taken at these points particularly to see that the laps, etc., are all thoroughly cemented with the pitch. Many roofers put some dead oil in the tar used for flashing to keep tar from becoming brittle and thereby having a firmer hold on the metal; especially in cold weather. A 4-ply roof is laid the same as above, except that the paper laps 27 inches instead of 24 inches on each course next below, and each course shows nine inches instead of 12 inches to the weather. It can readily be seen that this insures four thicknesses of paper at every point on the roof, thus the term 4-ply.

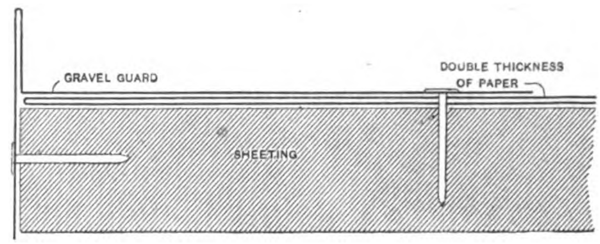


Fig. 174. Laying Tar and Gravel Roofs

A 5-ply roof can be laid the same way, showing 7 inches to the weather and lapping 29 inches, or it can be laid like a 3-ply roof, mopped over and then a 2-ply roof put on. This is the general practice and is the better method. When a 5-ply roof is laid in this way, the gravel guard is not put down until the 3-ply is laid and mopped over. This mopping over is done by spreading the hot pitch all over the surface of the roof with a mop, instead of pouring it on with a dipper, as explained above, when gravel is to be shoved into it.

The gravel guard is now put on on top of the 3-ply paper, and any flashing needed is put on and nailed and well mopped with hot tar. Then a course of paper is rolled out at the eave of the roof and 12 inches doubled under it, another course rolled out on top of it, 12 inches higher up the roof, and then succeeding courses are rolled out 18 inches higher up, each course lapping 18 inches over the one below and showing 18 inches to the weather. This is mopped along the edges, as described for the 3-ply roof, the pitch spread on and the gravel pushed in as described. When this is properly done by men who understand the business, a first-class roof is obtained at a minimum cost.

In this section of the country, thousands of acres of these roofs are put on annually. These roofs are often guaranteed for ten years. If a more durable roof is desired, asphalt should be used instead of the straight run American coal tar pitch, as it is more elastic and less likely to get brittle with age and cold weather. The use of asphalt adds about 50 cents per square to the cost of the job.

CANVAS ROOFING

Ten-ounce canvas is to be laid over a tongued and grooved floor which has been previously covered with a heavy waterproof paper. One object in using the paper is to provide a resilient cushion for the canvas, so that the impinging of the canvas against the edge of any obtruding board will not be cut or abraded by such edge or surface.

Wet the canvas before laying and paint the under side of the canvas while it is still wet with a heavy coat of white lead ground in linseed oil; lay the canvas while the paint is still wet; stretch the canvas as tight as possible, nailing closely with 4-ounce brass tacks; after being laid paint the upper face of the canvas with two coats of best white lead.

By proper care of the roof is meant the keeping of its upper surface covered with paint. In the course of a few years the paint oxidizes, scales off, irregular cracks and seams appear, and sometimes patches appear, which, if touched by the finger, crumble into dust. Whenever any of these defects appear it is time to go over the roof with another coat of paint, taking the precaution to remove all the old paint possible without injury to the canvas. Roofing canvas should always be mildew proof.

If a cement covering is to be used for a porch roof, first lay down a matting of wire mesh, or metal lath and fasten down firmly with galvanized iron staples, then apply a coating of Portland cement mortar in the proportion of 1 of cement to 3 of sharp, coarse sand. The sand is to be entirely free from loam or dirt of any sort, and the layer should be not less than 1 inch thick. A lesser thickness would be liable to crack under repeated strain of persons walking over its surface. The wire or metal lath furnishes a good bond and backing for the cement. Of the two, wire mesh is greatly superior to metal lath as to durability.

COLORING COPPER ROOFS GREEN

The best color is obtained by age, but for those who wish to obtain the effect quicker we reprint the following: The one method used most generally for turning copper green is a solution of sal ammoniac and water. Add about 1 pound of powdered sal ammoniac to 5 gallons of water, dissolve it thoroughly and let it stand about 24 hours at least before putting it on the copper. Apply to the copper with a brush just as paint would be applied, being sure to cover every place. Let it stand for one day at least and sprinkle it with water, using a brush and splashing it on lightly, for if the water is put on too freely it will run the color and streak it. The next morning the color will be all that could be desired. The same effect will be produced by using vinegar and salt instead of sal ammoniac, using about ½ pound of salt to 2 gallons of vinegar.

THE BEST PAINT FOR GALVANIZED IRON

As to the paint for first coating galvanized iron, beware of white lead, because it remains soft and eventually peels; of zinc white, which will crack and flake; of any of the light carbon paints which require much oil to spread, because these will wrinkle and later on part. The cheap, ordinary mineral paints will not serve the purpose either, because these are most liable to peeling. Red lead, as a base for an all-oil paint, has given best service, but it, too, has given away at times, and the cause of the trouble appears to be that in an all oil paint the oil is attacked by the metallic zinc. A paint made from a heavy pigment that requires a small percentage of thinner for spreading will serve the purpose of first coating galvanized iron after, either leaving the surface to oxidize or by washing with dilute muriatic acid. Thus a mixture of equal parts by measure (not weight) of dry red lead and first-class mineral brown, ground together dry and then mixed by hand with equal parts of pure raw linseed oil and pure spirits of turpentine, without the use of any japan or liquid drier, has given the most durable and effective results. Over this priming any good oil paint may be applied and permanent adhesion may be looked for.

The reason for employing dry red lead is to let the paint oxidize on the surface rather than to have it saponify the oil in the pot, as there is ample proof that such paint is most liable to peel, it having lost its cementing qualities. Let it be noted, however, that this semi-flat, yet fairly elastic paint is to be used for first coat only and not as a finish. It is intended to isolate the oil paint from the metallic surface, to prevent the latter from acting on the oil. And under no consideration should boiled oil be used in mixing this first coat for galvanized iron. If a good grade of mineral brown cannot be had, a fine, chemically pure oxide of iron, such as Indian red, may be used in its place and serve the purpose even better. And no more of the paint should be made at any time than can be used the same day.

PAINTS FOR SHEET ZINC

A very durable weather resisting paint for zinc sheets is made by mixing oxide of zinc with a fluid silicate, such as water glass and potash of soda, to which the required pigments are added. The proportion should be about three-quarters of a pound zinc white to every pound of silicate, with or without water. This zinc-silicate paint becomes insoluble in water in about 24 hours. It is equally useful for interior and outside work, but it should not be applied to greasy surfaces, nor to old coats of paint. New zinc, not being oxidized, should first be prepared by the application of a solution of 1 part of soda in 10 parts of water, and then be washed thoroughly with water only.

To obtain a white color only pure zinc white should be used, but an excellent imitation of stone may be prepared by first mixing the proper coloring substance with water to the consistency of a thick paste, and then adding this to the mixture of silicate and oxide of zinc. The mixed paint can be kept in a closed vessel for 24 to 48 hours, provided it is put in a cool place.

Another quick drying, weather resisting paint of a dark color is made by mixing 6 pounds of graphite (plumbago) with 1 gallon of vinegar. The oxidized surface of the zinc, previously well brushed, is painted with the above, one coat giving a sufficiently dark color. New sheet zinc, however, requires two coats, and must first be oxidized by the following application, which is not strong enough to cause any deterioration of the metal: One part each of chloride of copper, nitrate of copper, and sal ammoniac, dissolved in 64 parts of water, and 1 part of hydrochloric acid added to the solution.

These paints should only be applied in warm weather, as they are best kept free from moisture for at least 24 hours.

PAINTS FOR ROOFS

A new hand who is sent out to paint a new tin roof is not apt to appreciate the importance of the work he has in hand, neither is he apt to be as fully equipped for the work as old hands who have been set to a similar task frequently. Whether it is a flat seam roof or a standing seam roof there are sure to be some places where soldering has been done. If the weather is good the older hand will immediately hunt the soldered places and scrape off all the rosin that is along the seam or around the solder. If he is very careful he may have an old dust brush and a sheet of tin to take up this rosin and throw it over the eave, so that it can in no way become mixed with the paint to do any harm. After he has been careful with the scraping work, if the roof has laid a few days, he may have provided himself with a broom and will sweep all the dust off of the tin, so as to allow the paint to come in direct contact with the surface to be protected, with no foreign matter to interfere.

While the workman may have little to do with the character of the paint he is to apply he will have a great deal to do with the mixing of it and keeping it of the proper consistency while the work is being done. A great deal has been said about the kind of paint that is best adapted for painting tin roofs. Fortunately, for the avoidance of any monopoly, there are several kinds of paint which are very good. Venetian red and the metallic browns of the best grades are equally good. Unfortunately there are many metallic browns on the market and some have very little to recommend them, but whichever body is used, if it is ground in oil and mixed with good oil and then properly applied it will stand the ravages of time without a great deal of detriment. Many roofers may not be well qualified to discriminate in the selection of their paint, and under such circumstances they may safely rely on the paints which bring a cent or two more per pound before mixing as being better than those which sell at a lower figure and have little but the price to recommend them. The same may be said of oil. A good oil is rather expensive, but in experience the covering qualities are greater, and the difference in cost is not so great as the difference in the covering quality of the materials.

If it was possible to have good weather until the paint dried firmly the addition of some material to facilitate the drying would be neither necessary nor advantageous. Owing to the uncertainty of the weather, however, and from the fact that a small proportion of a good dryer is not detrimental, most men who provide paint for roofs will mix in a small proportion of something which will quicken the drying or hardening process. It is when improper materials are used in excessive quantities to the exclusion of good oil or form too great a proportion of the mixture that there is a positive objection to their use. When the workman has been furnished with the right kind of raw materials and appreciates the necessity of stirring the paint occasionally to prevent settling in the bottom and to keep the mixture of the same consistency he is ready for the tools to apply the paint.

If the roof is flat enough, so that he can walk around on it with safety, men differ as to whether a hand brush should be used or whether a broader brush may be used on the end of a pole with good results. Some incline to the opinion that the brush on a pole cannot be made to do as good work in rubbing the paint in well and at the same time out so as to cover a large surface as when a hand brush is used. Certainly the workman with a wide brush on a pole can cover more ground with less labor and without tiring himself out as he would in the use of a hand brush. Old roofers who enjoy an excellent reputation for good work and the long service of the roofs do not require their men to use the hand brush, but are particular to see that the tool equipment is kept in good order. It is quite probable that some of the cheapest tin plates used by these experienced and careful men have rendered quite as good service as when high grade plates have been used by other men who have not appreciated the destructive effect of some kinds of painting material.

Some of the black paints contain a considerable amount of sulphur, and where a tin plate has a comparatively light coating the importance of the paint question will be more readily understood when roofers generally are aware of the fact that manufacturers have been devoting considerable attention to the careful study of the effect with different paints freely advertised have when applied to tin roofs. Their observations are corroborated by the experience of old and successful roofers. The conclusions are that some paints will aid in the quick destruction of plates that are heavily coated with tin, no matter what their base may be. These investigations have been going on quietly for a long time, with the certainty that some who have complained of the durability of the tin roof are more responsible than they know for the early destruction of their work. With these facts before them for refutation or verification it remains for the conscientious roofer to discover whether or not the painting materials he is using are likely to cause trouble to his customer, and a complaint for which he is entirely responsible.

ROOF PAINTING

There is money to be made out of roof painting if it receives the attention which its importance entitles it to receive. Too often it is looked on as only a step higher than whitewashing, is done largely for appearance sake and is expected to last only a short time. If roof painting is to be made a branch of a business the same care should be taken to make it do its share in building up a reputation for good workmanship and serviceable materials as is given to the roof itself, or the heater work, plumbing or anything else that is done by the shop.

The men who do it should be encouraged to feel that their work is important, must be done well; they must not be allowed to think that it is cheap work and "any old way" will do providing they smear over enough surface in a day. They should be required to take care of the materials and tools just as carefully as the bright tin plate is taken care of and the best tools of the other mechanics are cared for. A place and proper provision should be made for storing them so the oil will not waste, the paint cannot harden and the brushes become ruined by drying.

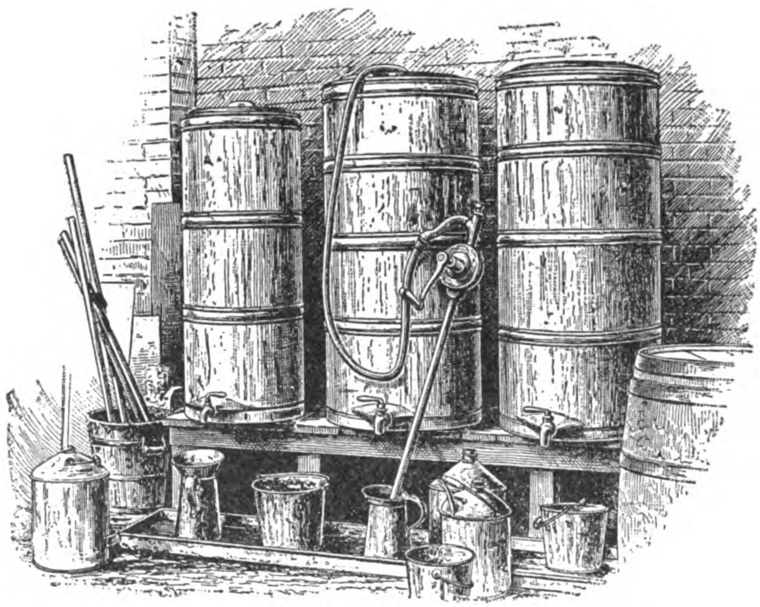


Fig. 175. Roof Painting

The provision made for this purpose, as shown by Fig. 175, has much to recommend it and a view in the part of a shop devoted to the roof painters, which is given herewith, will with the description be sufficient hint to those who make a specialty of roof painting to profit by the example. A strong platform is built about 14 inches high, carried by legs made of 3×4 inch timbers supporting a frame made of the same size of timber, on which the floor of the platform is laid. The legs should be placed so that there will be a space of about 3 feet between them. The platform should be about 30 inches wide and long enough for the oil barrels or tanks.

Tanks made of galvanized iron take up less room, as they can be made higher and of less diameter than barrels and can be kept cleaner. The iron should be of 24 gauge, and if 24 inch iron is used two widths will give ample hight to hold a barrel when the diameter is 20 inches. The bottom can be double seamed on before the upper body is put on to the lower one. A flaring cover should be double seamed to the upper body and should have a round hole with cover about 8 inches in diameter in the center. Where the upper and lower body slip one over the other at the center a few rivets should be put in to hold them firmly together and then the joint should be heavily soldered inside and outside. A finish and strength is given by putting a swedged band at the top, bottom and between, also well soldered. A brass oil cock large enough to let oil be drawn quickly should be soldered into the body within ½ inch of the bottom and bosses should be soldered on each side to brace it.

The number of tanks required depends on the views held by the roof painter and three will be enough in any case, one for boiled linseed oil, one for raw linseed oil and a smaller tank for Japan drier. Some men mix the two kinds of oil or buy it mixed, and then two tanks are enough. On the floor in front of the oil tank platform a galvanized iron tray or pan should be placed to hold the measures and funnels and catch any dripping. The pan, heavily wired around the top, should be about 1 inch deep and about 14 inches wide and as long as the platform. This will allow the paint can to be placed in the pan while the mixing is done, and will afford a place where paint cans can be kept from marking the floor when in the shop.

A substantial wooden tub or half of a barrel should be kept full of water at one end of the platform, in which the paint brushes may be placed when not in use. They should be kept covered with water so that they cannot dry out and harden, for to do good work in painting the brush must be of good material and soft and pliable, so that the paint can be well rubbed in. A specially made brush on the pattern of the whitewash brush but of better material and thicker is best for the work.

In mixing the paint there is room for some judgment to be displayed and for the body any of the good paints sold by the roofing supply houses will give good service if ground fine. The mixing depends on the time of the year. In the summer a drier is unnecessary if the weather is clear long enough for the paint to set well before a rain comes. Only good linseed oil should be used in summer and for painting it should be mixed in the proportion of 3 gallons of boiled oil to 2 gallons of raw oil, and if for the first coat on a new tin roof it should be mixed thin, so that this coat will dry out thin and hard after it has been well rubbed in. Every part of the roof should be thoroughly covered and care taken to leave no pools or thick coat at any place. If the work is done in cooler months or winter, when a skin will form before the paint can thoroughly dry out, a drier may be used in the proportion of 1 quart of the drier to 5 gallons of oil, more or less according to the weather; less oil when very cold.

A cheap and poor drier should never be used, but always a good drier. After a roof has had a first coat of this kind of paint it should stand six months and then be painted again. For the second coat the paint should have more body but should be rubbed in with the same care, using the drier only when the paint is put on in cold weather. The roof will now stand for three years, when it should receive another coat of paint applied in the same careful manner.

Another important point that must be considered is the condition of the roof at the time it is painted, particularly a new roof. If one of the cheaper, lighter coated tin plates is used it must stand a few days, so that the grease and rosin will come off, and then it must be swept with a stiff broom to get off all the grease, rosin, dust, and particularly rust. If there are any rust spots they should be swept till all rust has disappeared and a clean surface is presented; then the roof is ready for painting. If one of the better old style heavy coated oil flux plates is used the roof may stand a shower or two before the metal is exposed, so as to take the paint properly.

If roofs are treated in this way a guarantee against leaks for a period of time may be given if the roofer has put on the tin with the same care. This guarantee carries a great deal of weight with those who look after the properties of estates and costs nothing if good materials are used throughout with good workmanship and under intelligent supervision. This branch of business can be built up by keeping before those who own roofs the fact that leaky roofs destroy plaster, spoil paint and ruin furniture, besides making the house damp and unhealthy. Leaky roofs destroy themselves, but roofs kept in repair and painted honestly with honest materials will last indefinitely.

EFFECT OF EXHAUST STEAM ON TIN ROOFS

Of the many subjects which have been discussed in the columns of the *Metal Worker* this has received considerable attention.

In a condition of this kind the trouble is probably as much underneath as on top, for perhaps excessive condensation owing to the heat of the boilers keeps the underside of the tin wet and again there may be destructive gases from the furnaces.

On top the constant dripping of water from the exhaust pipe keeps the tin in the vicinity of the pipe saturated and in due time the paint cracks and naturally then the tin rusts away.

A positive remedy would be to use copper for the environments of anything which is destructive to tin. Of course the connecting of this copper to the tin roof should be in way to insure no galvanic action between the two metals—tinning this copper on both sides or making the connection by means of lead strips.

TIN ROOFS FROM OUR OFFICE WINDOW

Since so much has been said about the lasting qualities of the tin roof, our attention is given to the roofs which can be seen from our windows, particularly whenever men can be seen on these roofs. Within the recent past we have noted men with steel shovels cleaning the snow from parts of tin roofs, and cannot but wonder whether or not this work done by porters and other laborers is not likely to bring a complaint to the roofer. It is a very natural thing when snow sticks to a shovel for the man to strike the shovel forcibly on the surface cleaned, whether it is a flagstone sidewalk or an IC roof. The marks on the sidewalk very clearly show that even the flagstone has indentations made upon it, and it is reasonably safe to assume that the tin roofs that we are looking down upon have many indentations. Even if there is no hole as the immediate result of the treatment by the snow cleaner, quite probably these indentations will hold moisture which will eventually lead to something more than pin holes when rust gets in its work.

On another roof with a box gutter a young man was seen with a coal hod and a small shovel removing the accumulated dirt from the gutter. Whether this attention to the gutter is the result of a leak or whether some observing man has seen the necessity of it is a matter for conjecture. On the flat roofs in New York City a great deal of cinder ashes and coal dust is carried up from the chimneys and collects on the roof and is washed in the gutter, where it lies to hold moisture for long periods. It is certain that the tin roofer never expected a gutter to withstand such an exposure, even though it may be frequently painted with the best of materials. The suggestion comes to our minds that roofers might frequently find profitable work by calling the attention of owners to the possibilities for trouble and be employed to remove them. There is no doubt but that owners would be saved much needless worry and expense if a few simple precautions such as these were observed. While the instances referred to occurred in New York, the same slow processes of destruction are doubtless going on in all Northern cities where there are flat roofs.

Several weeks after writing the above we see that sheet metal workers are engaged in patching up the roof in question. From the appearance of the tin where the paint was scraped off there is no fault to be found, but the holes in the plates showed that they were made with a sharp instrument and that burst seams had been hit rudely or stepped on. This is no new thing, but it only serves to show how much needless blame is laid on tin roofing.

A FEW REMARKS ON LEAKS, ETC.

Tin roofs, comparatively flat ones especially, develop leaks not attributable to age and sometimes not to lack of care, thus leaving the roofer open to suspicion as to the quality of material used.

Many of these unexpected leaks are caused by thoughtless boys throwing at random small, sharp-edged rocks and other things with weight enough to cut through the sheet. Some are due to paint blisters breaking and exposing the metal, generally just after a careless person has painted over old blisters instead of breaking them. Some are due to a piece of flashing working out and allowing water to drive behind and under where the metal cannot be repainted, destroying the sheet by corrosion from below. Some are caused by standing seams being malleted down in the direction that throws the inaccessible pocket on the side from which most falling water drives, allowing moisture and dust to collect and cake, which facilitates corrosion. Some are caused by soot and dust, which quickly beds in chimney flashings; and, some result from not thoroughly painting dents, name-stamp depressions, etc., or painting at a time when rain washes off the paint or either dew or frost checkers or pits the surface, destroying the gloss and leaving a surface adapted to retaining moisture.

To insure satisfaction with a tin roof or a valley on a shingle roof, use good material to begin with. Paint the underside and let it dry, then paint it again just before laying in place on the roof. This second painting covers scratches due to handling and causes the sheet to slip without scratching through the dry coat when laying. Use cleats freely and nail them close to the angle. On shingle valleys place a feather-edge wood strip at each side, so the shingle edges at the valley will project over the strip and be held off the metal an inch or more. This avoids much capillary dampness, allows repainting back under the shingle ends and admits air where it is most needed. Paint valley tin on both sides and dry and paint again below before laying. Give all tin work a coat of paint as soon as the work is done. A roof should have the second top coat when the first is thoroughly dry.

If any holes are found, made by something falling on the roof or by nail-heads wearing through from below, and no tinner is convenient, paint the places and nail trunk or tar-paper roof washers over them, well bedded with putty. This is shown in Fig. 176. Two methods of placing the strips for valleys mentioned before are illustrated in a conventional manner in Figs. 176 and 178, the former being adapted to old work where the roof or valley is to be renewed. The valley shingles may be raised from the tin, as shown in Fig. 178, by using thinner boards for the valley than those of the regular sheathing.

To repair a roof with paint skins clean off the roof by removing all peeled paint, dirt, etc. Over the defective spot give a coat of metallic paint. With a

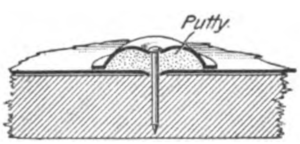


Fig. 176. A Temporary Patch on a Tin Roof

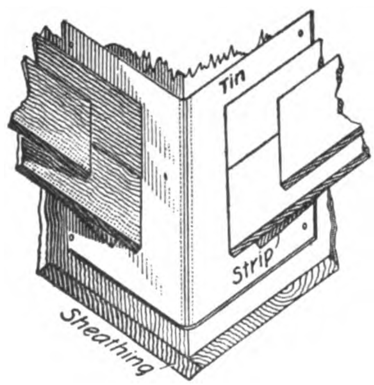


Fig. 177. Wood Strips on Valley to Raise Shingles and Prevent Tin from Rusting

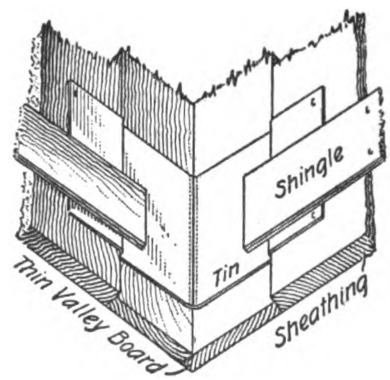


Fig. 178. Thin Valley Strip to Raise Shingles off Tin

trowel spread on one side of a piece of unbleached muslin of the required size a layer of paint skins or roofing cement, and place it over the defective spot, pressing it down firmly. Spread another layer of cement on top and smooth it down to the lines of the roof. Over all this give a liberal coat of paint.

The only way to make a good job of relining the valleys on a slate roof is to remove the slate, take up the old valley and lay the new one under conditions which will facilitate good work being done. It is a matter of little importance whether tin or galvanized iron is used if the sheets in both cases are heavily coated and well protected. It would be practically impossible to slide a new valley lining in over an old one, so as to avoid buckling and make a good job of it.

TIN ROOF REPAIRING

Roof repairing is not a pleasant task, by any means, and a good mechanic usually dislikes such work. Too frequently, however, this work is entrusted to the poorer class of workmen and to the younger hands, with results that are satisfactory neither to the employer nor to the house owner. Too much of such slighting of work will result in loss of custom, most of which pays better than new work. It will not be denied that job work, roof and gutter repairs included, returns a larger and more certain percentage of profit than contract work, for which perhaps several have competed.

Such custom, then, should be cultivated, and it is not enough merely to advertise "Repairs Carefully and Promptly Done." It is necessary to convince people of that fact by actual experience. The proof of this has been demonstrated many

Jonesville, N. J., Sept. 1, 1903.

Mr. Wm Jones

DEAR SIR:—Wet snow and melting ice will find leaks in a roof which is impervious to a shower of rain. It takes longer and costs more to repair roofs and conductors in cold weather than in mild weather. Are YOUR roofs and rain spouts ready for the winter?

A coat of good paint at the proper time will often save the price of a new roof. We employ the BEST MEN and the BEST MATERIALS. Both Phones.

Respectfully yours,

Plumbing, Heating, and Tinning. J. TINNER & CO., 63 B. St.

Fig. 179. A Timely Hint

times by such directions as the following: "Now, Mr. Tinner, your competitor, Mr. Roofer, sent two boys up here two weeks ago, and although he has sent me a big bill, the roof leaks worse than ever." They always say the roof leaks worse, although it would be safe to assume that it doesn't. But let that pass; the real point is to do your work so that it can't leak.

A disagreeable feature of roof repairing, and one which cannot be entirely overcome, is that the orders for such repairs are most plentiful when autumn is changing into winter, and there is little desire for an out of door life high up in the air. Moreover, this overplus of repair orders conflicts with other work which is seasonable at this time, such as heater, furnace and steam work. In order that this embarassment of good fortune may be a little more evenly distributed, a form like that given in Fig. 179 may be printed on postal cards in typewriter style.

Emphasis is placed on this style of type, as we believe a plain announcement of this kind is more effective than a display "ad." of the same size. It will be easy to suggest variations from the form presented, such as a letter sheet inclosed in an envelope, with a good engraving of a scene representing water dripping through a handsomely painted ceiling on to a carpeted floor, etc.

It sometimes happens that a customer insists on knowing the cost of repairs before the work is begun. The uncertainty of such work requires that an average section, comprising one-third or one-fourth of the entire roof, be laid off, and this section be carefully gone over, one sheet at a time, and the leaks located plainly with chalk. By counting the leaks thus marked and adding to the number to allow for the portion not marked, a fairly safe basis for calculation may be obtained. A good price for the work should be set, as it is safe to infer that your competitor is not in the game, particularly if he has been ineffective in a former attempt at repairs.

It is poor policy, as well as dishonest, to induce a customer to repair a roof which the judgment of the mechanic would condemn; and if the nature of the leaks is such that a definite guarantee of a useful life for a reasonable time cannot be given, the customer should be plainly informed of that fact. For instance, if the leaks are mainly split seams, caused by the expansion and contraction of the tin, the conclusion is obvious that, although the roof may be tight for a time, other seams will open and cause new leaks from the same cause. The owner should be apprised of that fact; and the better way to do so is by letter, retaining a carbon copy to guard against future trouble.

A good and trustworthy mechanic should be given full charge of the job, and furnished with sufficient help to run the job along with speed enough to prevent its becoming a distasteful burden. A good plan is to have the best man hunt for and mark all the leaks, taking one sheet at a time in regular courses across the roof; another tinner to repair the leaks, and a boy to prepare them for soldering. It will be found that the best tinner will find the leaks much faster than they can be repaired. Two sets of soldering tools on the roof will, therefore, be necessary. If the boy does the work of preparation well the three will be kept busy, as he will be able to prepare the leaks as fast as the two tinners can solder them.

Taking it for granted that the roof is old and protected with several coats of paint, a gasoline blow torch should be used to burn off the paint where it is necessary to scrape for soldering. This makes the work of preparation quick and easy, although the one using the torch should be cautioned not to poke the hot blaze into a hole in the tin. The writer was once compelled to hold down the metal capping of a ridge on a row of fine dwellings, the sparks meanwhile traveling along the tinder like dry rot under the metal, while the boy who caused the mischief went down two sets of ladders after a bucket of water. As the boy was instructed not to hurry while in sight of the servants, nobody else knew of the danger.

To prevent the flame of the torch from scorching the paint on the tin further than necessary, a strip of asbestos cardboard should be cut, with a slot of the proper width, as shown by the cut in Fig. 180, and the heat applied to the unprotected portion only long enough to permit of the easy removal of the paint by the scraper. When no blow torch is at hand a paint burner can be used. This device is shown in Fig. 186 which readily explains itself. It is made of black sheet iron, with ⅜ in. holes punched as shown. To this is riveted four legs of band iron so as to raise the bottom of the burner about one inch from the tin. The heat is obtained by using charcoal. A few hot coals are first taken from the fire-pot and placed in the

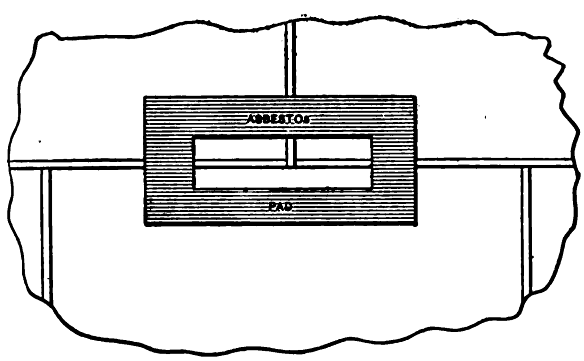


Fig. 180. A Torch Pad for Paint Burning.

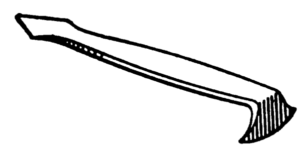


Fig. 181. A Cleaning Scraper

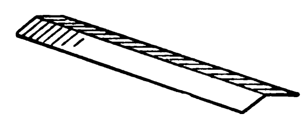


Fig. 182. A Seam Cap

paint burner, after which other charcoal is broken into pieces the size of a hen egg and placed over the hot coal, the burner being filled with these to the top. The draft which is created through the perforations soon has the coal in a blaze. The burner is then set over the spot to be repaired. In a few minutes the paint blisters and can be cleaned off with a cloth. A good scraper for the purpose may be made from an old 10 or 12 inch flat file, shaped as shown in Fig. 180. Both edges of the spear shaped end and the curved edge of the hoe shaped end should be sharpened. It is important that the ends of the split seam leak be well cleaned and scraped, as carelessness in so doing will result in the entrance of water beneath the new repair.

The method so often followed of piling on solder to cover a leak in a split seam is unsatisfactory in several respects. The leak is likely to open again through the solder, on account of bubbles blown in by the moisture during the soldering; and if the leaky seam occurs in the gutter the raised ridge of solder holds back the water. Less solder is required and a better repair is made by capping the split seams with strips of good tin cut about $\frac{3}{4}$inch wide and slightly bent lengthwise through the middle in the folders, as shown in Fig. 182. The edges of the tin need not be nailed down or prepared in any way, except that the strips should not be kept on hand long before they are used, as they solder much better with the edges freshly cut.

A leak caused by a nail head pushing up through the tin should be covered with a cleat nailed down over it with a single nail as shown in Fig. 183. Where it is necessary to fasten down tin which has bulged up and broken away from its fastenings, screws should be used, with the same kind of cleats.

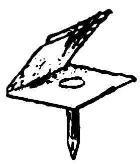


Fig. 183. A Nail Cap

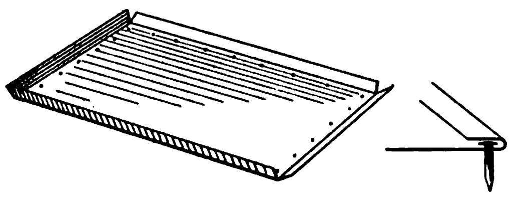


Fig. 184. Fastening Down a Patch

Where it is necessary to place a large patch, the old tin should be cut away nearly to the size of the new patch and building paper placed under the new tin. The new patch should be blind nailed and soldered carefully. For a reasonably flat roof the ordinary method of blind nailing is to turn up the edges of the patch on all sides, nailing through the tin just inside the turned up edge and battering down the turned up edges so as to cover the nail heads, as shown in Fig. 184. For a long patch near the edge of a roof, where a good appearance is an object, or on a steep roof, the upper side of the patch may be blind nailed so that the edge presents the same appearance as a lock seam, as shown in Fig. 185.

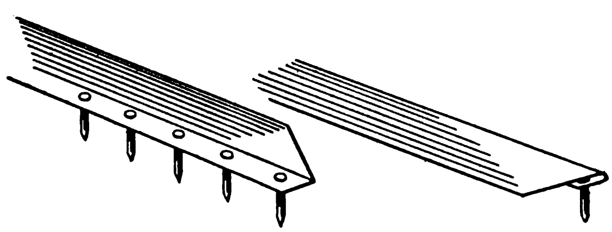


Fig. 185. Blind Nailed Edge Patches

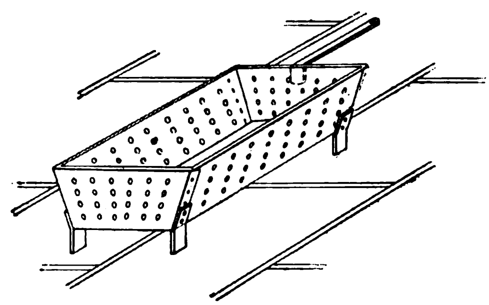


Fig. 186. A Substitute for the Blow Torch

After the marked leaks have been repaired it is well to give the roof another close examination, remembering that the customer pays for the time, while, if called back to repair a forgotten leak, there is likely to be a dispute as to who should pay for the extra time, with the added humiliation of "taking two bites at a cherry." When the repairs are satisfactorily completed the acid may be washed from the places repaired and the patches painted.

It is not a fool's job to locate the leaks in a tin roof, and combinations of timbers, boarding and roofing papers are sometimes found which will tax the ingenuity of a smart man. The place where the water enters through the ceiling may be, and often is, at some distance from the actual leak in the roof. When a troublesome leak cannot be located by the ordinary method of measuring above and below, the tinner is justified in cutting up the tin at the suspected spot, when an examination of the under side of the tin may reveal the trouble in numerous small pin holes, or at least lead to a search in the proper direction.

An interesting chapter might be written by almost any roof repair man on peculiar leaks. An instance was when called upon to locate a leak some time ago where two stories intervened between the ceiling where the leaked showed and the roof. A quantity of fine cutlery was injured by it. There was a steam radiator directly over the goods damaged, but the family renting the flat stoutly insisted that the air valve had not been touched, and pointed to the dust on the floor as an evidence of the truth of their statement. The dust certainly did look natural, but after a search, which covered every possible source of trouble from roof or cornice, cutting up the floor it was found that the plastering, joists and even the under side of the flooring was thoroughly soaked with water from the radiator. While all roof leaks cannot be attributed to radiators, here is evidence that the roofer may be called upon to discover the cause of water damage or have his reputation and the roof suffer by imputation.

CONDENSATION TROUBLES—I

One of the most common of the many troubles of the roofer is condensation on the under side. It often causes the utter ruin of the tin in an amazingly short time. Many times the roofer is called to stop puzzling leaks which are nothing else than the drip of the condensing interior atmosphere. And it is hard to convince the average person that the roof is tight and the leak (?) nothing else but aforesaid drip. Again, spots appear on plastering which is not due, though always blamed on the roof, to a leak but the chemical composition of the plaster and exceptionally humid condition of the air.

Much has been said relative to this phaze of the roofing business and a few of the remarks from experienced men are reprinted here. From the opinion of many experts expressed in the columns of the *Metal Worker* it is well to remember the following rules when doing roofing work:

Always see to it that the space under the roof is thoroughly ventilated.

If because of the purposes of the use of the building there is a likelihood of the air being in a continuous saturated condition and will come in contact with under surface of the tin, then lay on the sheathing a dependable waterproof paper absolutely free from anything in its composition injurious to the tin. This paper to be laid from the top down so should there be a leak it will run under the first seam of the paper and become manifest underneath instead of being held by the paper and be apt to start rusting of the undersurface of the tin.

Protect a tin roof already down by covering the underside of sheathing with a waterproof paper thereby protecting the tin and perhaps obviating condensation by keeping the inside air from striking a cool surface.

CONDENSATION TROUBLES—II

The superintendent of the building called up to-day, and said one of the copper decks was leaking around the ventilator. Went up and looked it over. We were careful to have the copper turned up 3 in. all around the vent opening, and the corners carefully soldered before the vent, a 24 in. one of standard pattern, was set. It was held in place by stays on the inside and to insure against snow blowing into the vent was soldered to the roof all around.

The small space between the copper flashing turned up inside the vent and the sides of the vent base had filled with condensation, and finally overflowed into the building. A nail hole was made in the vent base on each side to let the water out, and a small piece of copper bent in a semicircle and soldered outside the holes, with the top and bottom edges free, allows egress for the condensation and prevents snow blowing in.

Had a lively argument with the superintendent of the job, when we told him there was no leak, and he triumphantly asked why the vent on the other end of the building did not "leak," as had been the case with the one he complained of. We replied that it was because the other end of the building was not being plastered. Therefore there was less moisture in the air to condense, and we took him to the other end of the building and showed him where the water was slowly dropping from the weep holes we had made, and he had to admit that he was learning a few things about roofing that he did not know.

ROOF CONDENSATION TROUBLES—III

The architect had an argument with me last week and could not be convinced that there was no leak in the valley on the north wing of a building where we did the work.

This wing is several feet lower than the main building, and the ridge of the roof of the wing runs into the slope of the roof of the main building, but most of the roof below the ridge stops against the wall of the main building. A valley starts 15 ft. out on this ridge and finishes at the bottom at the corner of the main building, making a triangular section of roof running to a point at the low end where the valley intersects the corner of the main building, and for 10 or 12 ft. up the roof we put on a copper watershed.

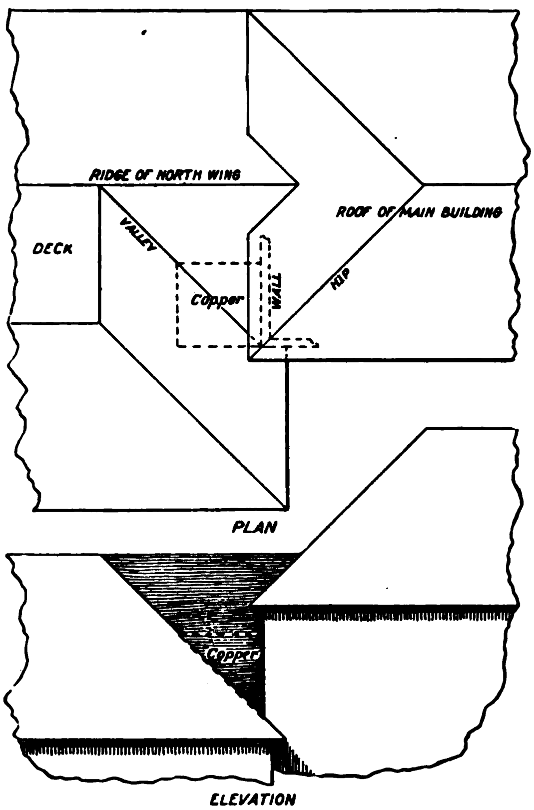


Fig. 187. More Condensation Troubles

This sketch, Fig. 187, shows the layout of the roof and valley. Near the bottom of the valley the sheathing was wet inside the attic, but there was no snow, ice or water outside, and had not been any for several days as I had noticed this and formulated my theory before the architect kicked about the "leak." Several days earlier the sheathing had been wet underneath this valley all the way down, and also underneath the whole of the copper watershead, the wet section following the lines of this work because of the facility with which copper conducts heat away and therefore cools off the warm air inside and causes condensation when the air outside is very cold and the warmer air inside is very moist.

In this case these two extremes existed as the weather was very cold and the air in the building very moist from escape at air valves in the steam heating system and the drying of the plaster, so the sheathing became wet from the condensation. Naturally this followed down the rafters, and the sheathing at the low points became saturated while that near the top of the valley and the top lines of the watersheds did not get so wet and soon dried out when conditions improved, while that near the bottom remained wet longer and it was the dampness at that point which was reported as a "leak."

I explained this to the architect, but he would not believe it entirely, and said he would have to see a rain on the roof before he would believe the condensation theory. I then examined the watershed, valley and roof thoroughly, and was firmly convinced that there was no leak. The rain this morning showed the architect conclusively that there was no leak, as a very heavy rain, continuing for several hours, failed to let any water through, and he had to admit that he was wrong.

ROOF CONDENSATION TROUBLES—IV

A complaint made by the superintendent of a large building in course of construction, and being plastered, was that there were some leaks in the roofs on one side of the building beyond the wall line. The roof is of slate, over single ply tarred felt, and the eaves project beyond the building about 4 ft. The weather was quite cold; the building is heated and the air is very wet from the drying out of the plaster and a number of open valves from the heating radiators.

The openings into the attic are large and numerous, allowing all the moisture and saturated warm air to rise to the attic, from which there was little chance for egress, as nearly all the ventilator dampers were closed. In the attic we found that on the east side of the building, the overhang of the eaves outside the wall line between the rafters, was wet, except about every tenth space, which would be found to be dry. We then examined the eaves on the west side of the build- and found them all dry.

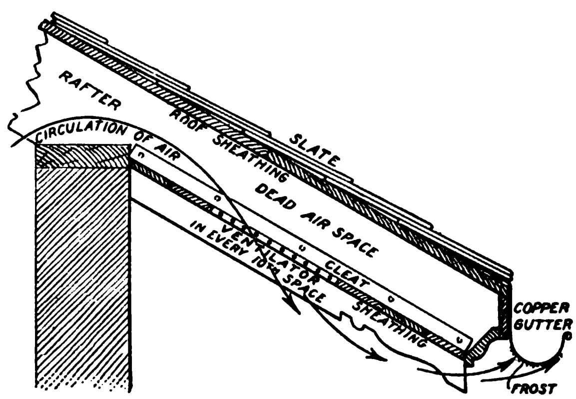


Fig. 188. Explanation of Alleged Roof Leakage in Attic

As stated, the eaves extend beyond the walls of the building about 4 ft., and there is dead air space between the rafters about 6 in. high and the distance of the overhang, as cleats were nailed to the sides of rafters as shown in accompanying sketch, Fig. 188, and to these cleats were nailed sheathing boards, as shown. To the tops of the rafters, about 6 in. above, was nailed the roof sheathing. The lower side of the space was closed by the molding nailed to the ends of the rafters. The upper side, on a line with the inside of the wall, was open.

My theory was that the dead air spaces shown condensed the moisture from the saturated air, because extending beyond the wall line, this space was much colder than the rest of the attic. The superintendent derided this theory and asked why every tenth space was dry. I replied that this was one proof of my theory, as this tenth space was the one in which a perforated ventilator was placed in the lower sheathing just outside the wall line and the circulation of the air in this space prevented the condensation of the moisture.

Then we went outside and I pointed out to him proof No. 2 of my theory. There was frost on the copper gutter just outside each ventilator opening where the warm, moist air from the vent opening struck against the gutter and was condensed on it in the form of frost. Proof No. 3 was that there was no snow, ice or water on the roof, and had not been for several days.

A fourth proof was that on the west side of the building, where the construction was just the same, there was no complaint of "leaks" and no moisture showing on the under side of the roofing sheathing. This was because the sun was shining on that side of the building and the air in these spaces was warm enough to hold the moisture in suspension. The superintendent and the architect are beginning to think that they will not be able to catch us with the "goods on us" on any leaks on the job, for whenever they have complained their complaint, like this one, has been traced back to condensation and proved to their satisfaction to be due to that cause.

There will be no trouble from that cause after the building has been in use, because, first, the attic will not be nearly so warm, as the openings into it will be closed, and second, the air will never be nearly so wet as the drying out of the plaster and the leakage from open radiator valves has kept the air saturated.

A ROOFING CLEAT BENDER

A roofing cleat bender which in one motion bends the roofing cleat ready for use on the roof, turning a ¼-inch edge on one end and making another turn 1¼ inches from this end is shown by Fig. 189. When the cleat is to be used on the roof, all that is to be done is to place the ¼-inch edge on the cleat over the 1¼-inch edge which has been turned on the course of tin for the standing seams and to drive the nails through the wider end at the bottom of the cleat. Take a piece of hard wood 1 inch thick, 3 inches wide and 6 inches long. To this secure another piece of hard wood 1¼ inches wide by means of a small wrought iron hinge at each end. To the 1¼-inch piece fasten with screws a handle with an offset in it at the center. To the wider piece of wood fasten by means of wood screws an upright piece of wood at each end, and to these uprights is secured a piece of hard wood, the bottom side of which was placed just 1¼ inches above the top of the pieces to which the hinges were fastened. Then fasten by means of wood screws two piece of heavy sheet iron to the bottom piece, one piece 1 inch wide and the other 1¼ inches. The holes are drilled in these pieces of sheet iron so that the edges of both are fastened even at the back. Fasten them to the wood so that the narrower piece of iron is on the under side and the front edge of the wider piece is flush with the front edge of the board. Now, by putting the piece of tin that was cut off for a cleat under the edge of the sheet iron and bringing the handle of the cleat bender in an upright position, the two bends are made and the cleat formed in one movement.

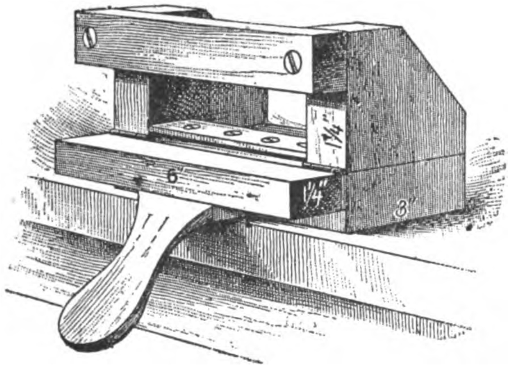


Fig. 189. A Roofing Cleat Bender

ROOFING LADDER

This ladder known in trade parlance as a "chicken ladder," has its convenience enhanced by the adjustable bracket. The bail makes the bracket secure, while the bolt prevents it from dropping from the ladder when moving about on the roof. The slotted plate through which the bolt passes is placed under a smaller slot cut in the top of the bracket. Only a round hole large enough to pass the bolt should be bored in the ladder, thereby holding the bolt firmly in the ladder, while the slot allows enough play to the bracket to prevent the leg of the bracket from climbing the roof, as ladders with a fixed bracket will do while working upon them.

By removing the thumb screw the bracket will be free to slide upon the ladder, and the bail can be lifted and placed under any cleat desired to move the ladder up out of the gutter, and the bracket is refastened by putting the bolt through one of the other holes which have been previously bored for the purpose. Fasten the cleats to the ladder with No. 8 wire nails, setting the clinches well up in the wood so as not to scratch the roofing plates. The cleats are fastened 12½ inches apart. In Fig. 190 is shown the finished ladder with the bracket at the top, and Fig. 191, shows the bracket. It will be noticed that by means of a hole under the different cleats the ladder can be adjusted to different lengths of rafters. It is

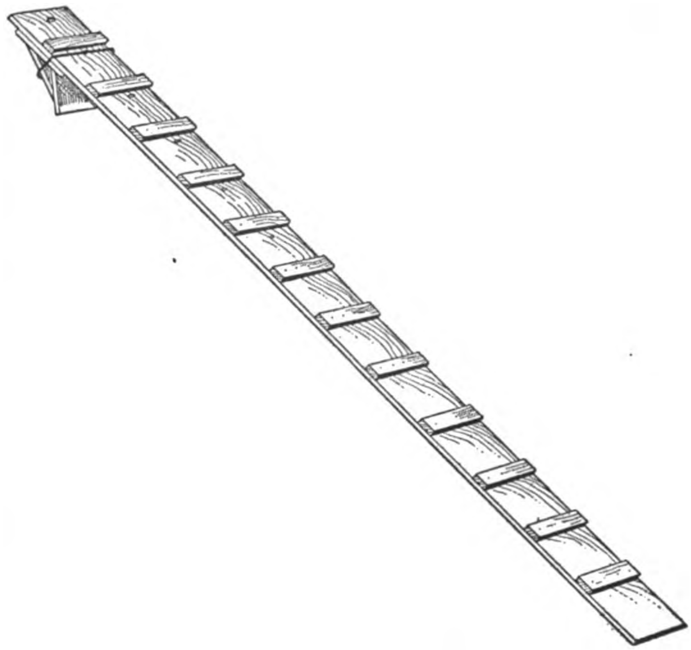


Fig. 190. Roofing Ladder—Ladder Complete

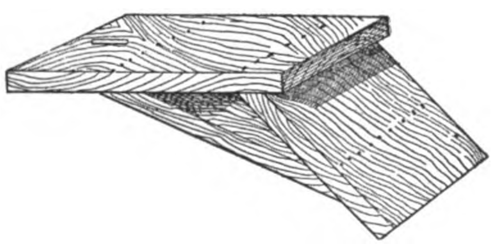


Fig. 191. Ladder Bracket

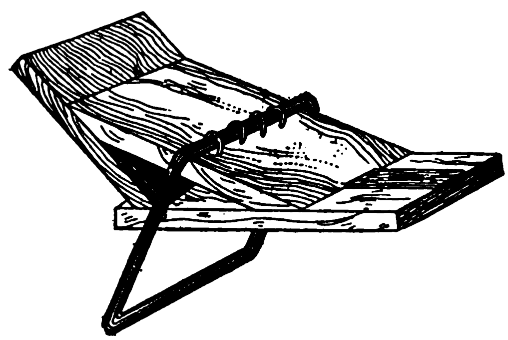


Fig. 193. Bracket and Bail

made from pine board 16 feet long, 7⅞ inches wide and ⅞ inch thick. The cleats are 7⅞ inches long, 2½ inches wide and 1 inch thick. The bracket top is 12 inches long, 7⅞ inches wide and ⅞ inch thick, while the bracket leg is 8 inches long, 7⅞ inches wide and ⅞ inches thick, and the bracket brace, connecting the two parts is 11 inches long, 7⅞ inches wide and ⅞ inch thick. The bail, Fig. 192, is 8 inches square, formed of 5-16 rod, welded solid. The bail is stapled to bracket brace,

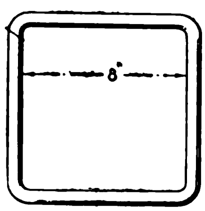


Fig. 192. Bail

Fig. 194. Bolt and Thumb Nut

as shown in Fig. 193, with barbed wire fence staples. Fig. 194 is a carriage bolt 5-16×2½ inches, which is used for fastening the bracket to the ladder, as previously mentioned. The iron plate shown in Fig. 193 is 2×4 inches, screwed to the underside of bracket, with slot in both plate and bracket through which the bolt passes down from the ladder, the thumb nut, Fig. 194, being screwed up next to the iron plate.

ROSIN SCRAPER

In the accompanying illustration, Fig. 195, is shown what is known as a wire brush, which is used in practice as a rosin scraper. Before the seams in tin roofing are soldered the rosin is usually burned on the seam, and after soldering the rosin flows considerably. It is often the case after painting a tin roof, where the rosin had not been scraped off, that the rosin cracks and exposes the tin plate and causes it to rust.

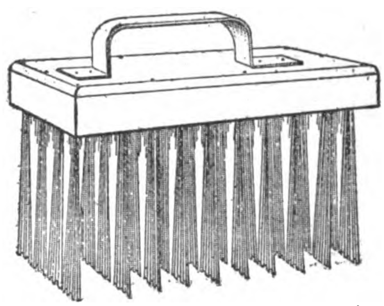


Fig. 195. Rosin Scraper

To avoid this after the roof is soldered, and before painting, use a wire brush, as shown in the illustration. The brush has a wooden top and a leather handle into which the hand is slipped. By working the brush backward and forward with little force the rosin is removed, making the roof ready for painting. By using the brush a considerable amount of time is saved compared with using a penknife or flat scraper.

SHEET STEEL MORTAR SAW

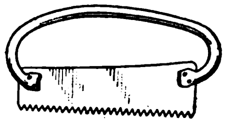


Fig. 196. From an Old Carpenter's Saw

The general custom of cutting the joint in brickwork for the insertion of the edge of the flashing is to cut away the mortar with a hammer and chisel. A quicker method is to make a saw as shown by sketch, Fig. 196. It is operated back and forth in the joint. Oftentimes these saws are just made from heavy scrap iron with the top folded round shape to act as a handle.

COMBINATION SCRAPER AND TIN CUTTER

When repairing tin or galvanized iron roofs, after the defective sheets have been found, it is usual to use a chisel and hammer and cut out the defective spots, and then use a scraper with which to scrape a smooth, bright surface on the old tin or iron, so that a joint can be made with the new metal.

Or a case may arise where an old tin roof is being ripped up to make place for a new roof. Before cutting, the old tin roof is usually divided into sections, cut and measured, rolled up and tied and the size number of square feet in each roll marked on the outside, so that in case a piece is wanted of a given size, it will

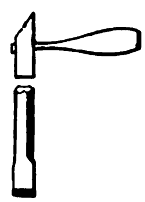


Fig. 197. Slow Method of Cutting a Tin Roof

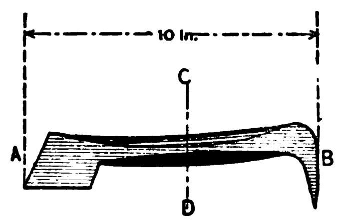


Fig. 198. Side View of Combination Scraper and Tin Cutter

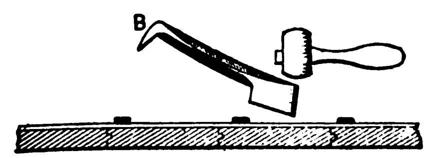


Fig. 202. Section through Tin Roof Showing Cutter in Use

not be necessary to open the roll again for measurement. If defective sheets, or an old tin roof, were to be cut out, using the hammer and chisel shown in Fig. 197, a great amount of time and labor would be lost. To avoid this, and have the scraper and cutter combined in one, there is shown in Fig. 198 a side view of a combination tool for the purpose. The cutter shown at A is used to cut out the old sheets, and the scraper shown at B is used to obtain a bright surface on the old

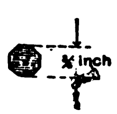


Fig. 199. Section through C D

Fig. 200. End View of Cutter at A

Fig. 201. End View of Scraper at B

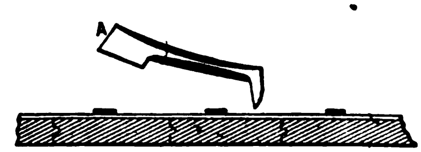


Fig. 203. Section through Tin Roof Showing Scraper in Position for Use

metal. The scraper is made from ¾-inch octagon steel, and, as shown in Fig. 198, should be 10 inches long when finished.

Any blacksmith or tool maker can make the scraper to order, Fig. 198 giving a good idea of how the tool should look when finished. Fig. 199 shows a section at the line C D shown in Fig. 198; Fig. 200, the end view of the cutter shown at

A, and Fig. 201 the end view of the scraper, shown at B. Fig. 202 is a section through a tin roof with the cutter in position when in use.

It will be noticed that the end B is raised so that the point of the cutter touches the roof. In practice the tool is grasped near the end B with the left hand, and taking in the right hand an old mallet, which has already done its duty in pounding down locked seams in tin roofing, the blows are struck as indicated in Fig. 202, moving and striking the gutter alternately.

Fig. 203 also shows a section through a tin roof with the scraper in position for use. In using the scraper, the end A, Fig. 203, is raised as shown, and, taking the scraper in both hands, a downward pressure is exerted, at the same time drawing the scraper backward and forward until a smooth, bright surface is obtained.

ROOFERS' ELEVATOR

Here is an illustration, Fig. 204, and description of a roofers' elevator that can be used with satisfaction in the absence of something better for hoisting rolls of tin to a roof instead of carrying them up a ladder. It should be made of oak, 1½ inches thick and 6 inches wide, one part 3 feet long and the other part 2 feet long. Buy a 14 inch extra heavy strap hinge, a pulley wheel 4 inches in diameter with a ½-inch hole in it, and a ½-inch bolt, 6½ inches long. In the short piece of oak at one end saw a slot in the middle of the 6-inch side, 6 inches long and wide enough for the pulley wheel to turn easily. Bore a hole for the bolt to hold the pulley wheel and secure them in place. Fasten the two parts together with the strap hinge and it is ready for use. A strap made of band iron with holes in each end for screws or nails to hold it on the roof should also be provided when a considerable quantity of tin is to be raised. Standing on the long part will answer for raising a few rolls. In use, all of the short part hangs beyond the edge of the roof and a rope runs over the wheel to the ground, with a hook on the end for fastening to the roll of tin. By pulling on the rope on the roof it works easily over the pulley, raising the tin until the roll strikes the short part of the elevator, when an up pull will make the hinge double back and drop the tin on the roof.

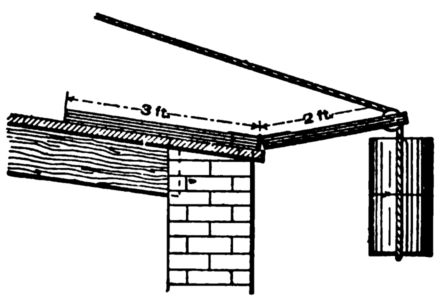
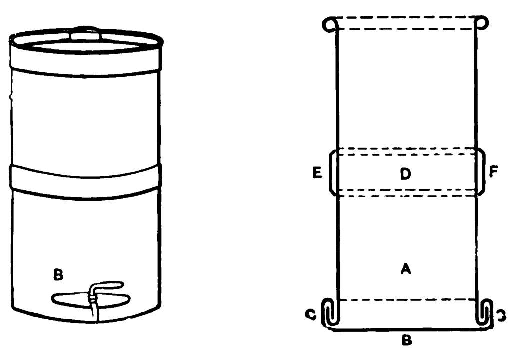


Fig. 204. Elevator in Operation

CONSTRUCTING AN OIL TANK

In Fig. 205 is shown a perspective view of an oil tank. The constructive view is shown in Fig. 206, in which A is the body, double seamed to the bottom of B at C C. A heavy wire edge is placed at the top, as indicated. Galvanized sheet metal bands are soldered at intervals around the tank, in this case only one, D, being shown. They are made as shown at E F, a ¼-inch edge being bent at an angle of 45 degrees at each side of the strip, and the strip being equal in length to the circumference of the tank. These beveled edges are now soldered direct to the tank, to prevent buckling and to secure stiffness.

The patterns for the tank are all rectangular pieces, excepting the boss, which secures the faucet shown by B in Fig. 205. This pattern is obtained as shown in Fig. 207, which shows a quick, accurate rule which requires no triangulation, the



Figs. 205 and 206. View and Section of Tank

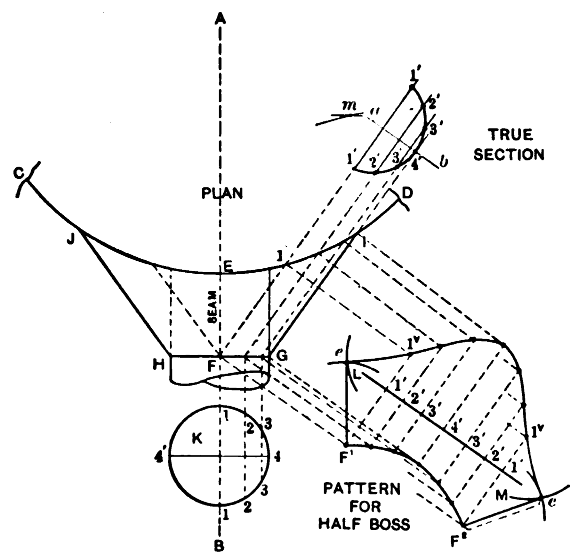


Fig. 207. Pattern of Boss for Faucet

pattern being developed by means of parallel lines. First draw the line A B, and with A on this line as center, having the required radius of the tank, describe the part plan C D. Locate the hight of the boss as E F and draw the diameter of the faucet G H. Locate the distance that the boss should project on either side of the tank as at J and I, and draw the lines J H and G I.

In its proper position below the line H G draw the profile of the outside of the faucet, as indicated by K, one-half of which divide into equal parts, as shown from 1 to 4 to 1, because in this case a seam will be placed along E F, and therefore in practice only one-half plan is required. From the various intersections in

K erect vertical lines intersecting H G as shown. From these points parallel to G I draw lines indefinitely intersecting the curve C D, as shown. While K represents the true profile on the line H G, a true section must be found at right angles to G I as follows:

At right angles to G I draw the line *a b*. Now measuring from the line 4 4′ in the section K take the various distances to points 1, 2 and 3 and place them on similar numbered lines, measuring in each instance from and on either side of the line *a b*, as shown from 1′ to 4′ to 1′, which is the true section required.

For the pattern take the girth of the section just obtained and place it on the line L M, drawn at right angles to G I, as shown from 1′ to 1′. Through these points draw the usual measuring lines, intersecting them by lines drawn at right angles to G I from intersections on F G and E D, and resulting in the shape F^1 1^v 1^v F^2 The triangular piece shown by E 1° F in plan is transferred to the pattern as follows: With radii equal to F E and 1° E in plan, and F^1 and 1^v, respectively, in the pattern as centers, describe arcs intersecting each other at *e*. Now with A E in plan as radius, and 1^v and *e* in the pattern as centers, describe arcs cutting each other at *m*. Using *m* as center and using the same radius draw the arc 1^v*e*. Then F^d *e e* F^2 will be the pattern for the half boss, which must be formed after the true section shown.

This is presented for those who may desire to make the tanks shown in the article on Roof Painting, as receptacles for the oil and dryer necessary for roof painting.