CHAPTER III.

Cutting Material, Bending, Forming, Seaming, Grooving and Bracing

Gauge of Iron for Ducts

No. 20 gauge best bloom galvanized iron is used for ducts or flues in which one dimension is 48 inches and over. This is to be braced with 1½" × 1½" × ¼" angle iron. No. 20 gauge is used for flues and ducts of 30 inches and over, without angle iron bracing. No. 22 gauge can be used for 12 inches and over, and No. 24 gauge for the smaller sizes.

Sizes of Heat and Vent Ducts

The sizes of the ducts for given requirements are governed by the dimensions of the rooms, the number of people they will contain and the exposure presented by doors, windows and outside walls. Their areas are usually computed by heating and ventilating engineers, the sheet metal worker simply following the sizes shown on the plans.

Shapes of Ducts

Square or rectangular ducts, shown in Fig. 34, are usually employed, but sometimes, owing to the construction of the building, a triangular shape is used, as shown in Fig. 35.

The round duct, shown at A in Fig. 36, the oblong shape with semicircular ends shown at B and the oval shape C, offer the least resistance to the flow of air.

The style of seams usually employed in ducts, flues and piping is shown in Fig. 37, in which A shows a riveted seam, B a grooved seam, and C a standing seam.

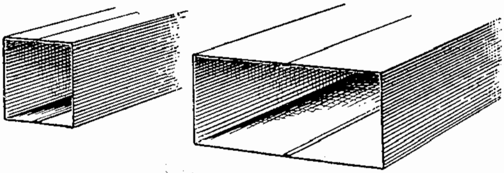

Fig. 34—Square and Rectangular Ducts

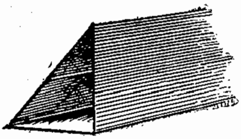

Fig. 35—Triangular Duct

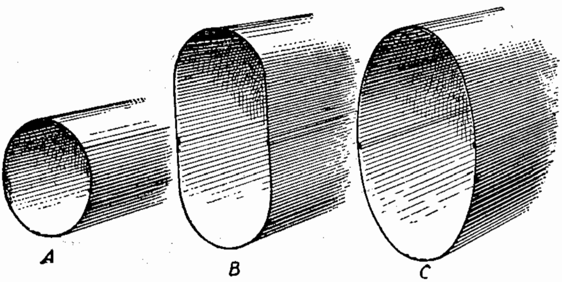

Fig. 36—Pipes Offering the Least Resistance to the Flow of Air

Cutting to Avoid Waste

Assuming that a rectangular duct must be made, say, 12 × 20 inches in size the seams should be so located that the metal is not cut to waste. This is shown in Fig. 38, where, by a little computation, it is found that the duct can be made from one 30 and one

36-inch wide sheet, by, usually, 8 or 10 feet long; all according to the size of brake in use. This places the seam on the wide side of the duct, 8⅝ inches from

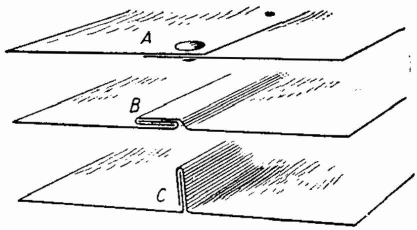

Fig. 37—Various Styles of Longitudinal Seams

one end and 11⅜ inches from the other. A grooved seam is used as shown. As a ¼-inch edge is used in

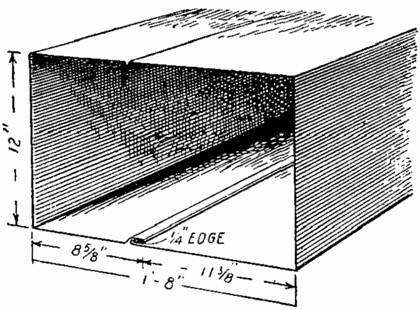

Fig. 38—Locating the Seams in Duct Work to Avoid Waste of Material

grooving, a single edge is put on the 8⅝-inch side and a double edge on the 11⅜-inch side.

Prick Marking the Sheets

The sheets are prick marked for bending in the brake by means of a narrow strip of metal, say ½-inch wide. It is cut 30 inches long, as shown in Fig. 39, and the measurement laid out thereon as shown. This allows for a single ¼-inch edge, making a total of 29¾ inches. As the sheet is 30 inches wide, it is trimmed straight and true on the large squaring shears to its desired width of 29¾ inches. Then the

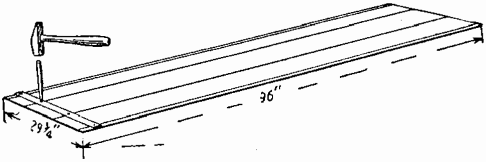

Fig. 39—Locating the Brake Marks

strip is laid on at each end of the sheet, and by means of the prick punch and hammer the prick marks shown are put into the metal sheet.

Preparing the Marking Strip

The marking strip is prepared for the double edge as shown in Fig. 40. Here a single edge of ¼ inch is

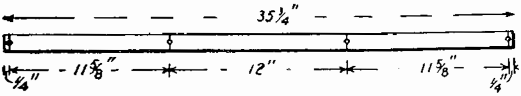

Fig. 40—Allowing for the Double Edges

allowed, as shown by the prick marks, but the extra ¼ inch has been added to the 11⅜ inches shown in Fig. 38, as indicated by 11⅝ inches in Fig. 40. This gives a total of 35¾ inches, which allows the 36-inch

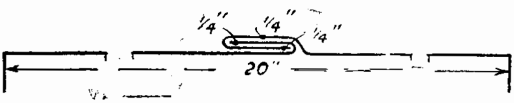

Fig. 41—Extra Material to Be Added in All Grooved Work

sheet to be trimmed straight on the large shears. From the foregoing it will thus be seen that the extra material for each seam to be added to the width of the pipe in all grooved work is three times the width of the lock. Thus, if the pipe is 20 inches wide, as shown in Fig. 41, and the locks are to be ¼ inch, then add three-quarters of an inch to the width of the pipe, making the girth of the side 20¾ inches.

Bending the Ducts

Fig. 42 shows the sectional views of a brake in which A represents the top clamp and A^1 the bend-

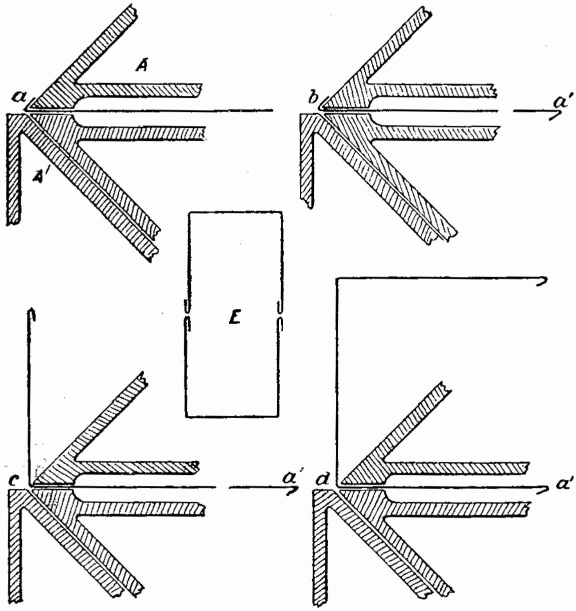

Fig. 42—The Various Operations in Bending the Duct

ing leaf. The sheet is placed in the brake and the top clamp closed on the first prick mark; then by raising the bending leaf A^1 the edge **a** is bent. The sheet is now reversed, as shown by the second diagram, and the block **b** bent in a similar manner. Leaving the sheet still in the brake it is drawn out to the next prick mark **c**, as shown in the third diagram, and a square bend is made. Again drawing out the sheet to the next prick mark a square bend is made as shown at **d.** Thus it will be seen that the sheet is reversed but once, when the locks are bent right and left. Bearing it in mind to always bend the locks right and left, the duct will always be in proper position for grooving, as shown in diagram E.

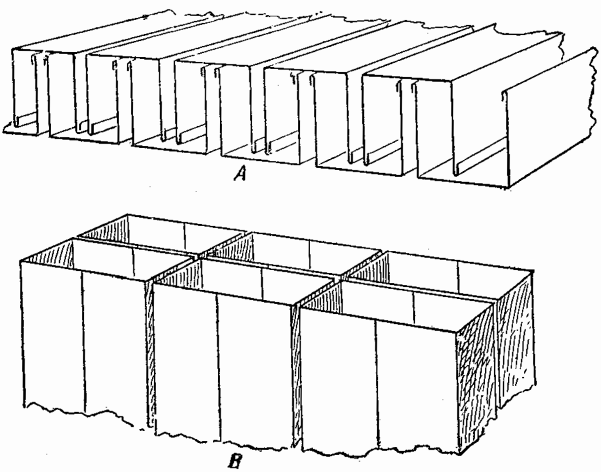

Fig. 43—Method of Transportation

Grooving the Ducts

If large power groovers are in use, it is an advantage to groove the ducts in the shop, owing to the saving in time and labor; if, however, they are to be grooved by hand on a grooving bar, it is an advantage to do the work at the job, because the saving in transportation on a large job will be quite an item, especially when the job is at a distance from the shop. When the ducts are grooved on the job, the partial ducts are nested in transportation, as shown at A in Fig. 43, while if the ducts are finished in the shop, but a few of the larger sizes could be carted at one time, as shown by B.

A grooving bar made of a steel rail, as shown in Fig. 44, is used for outside work. To make one obtain a section of a car rail and have the flat side planed smooth by a tool maker, and a channel A cut in to suit the edges or locks bent on the sheet metal. The rail should be about 12 feet long, with the channel cut in about 9 feet, this being figured for an eight-foot sheet of iron.

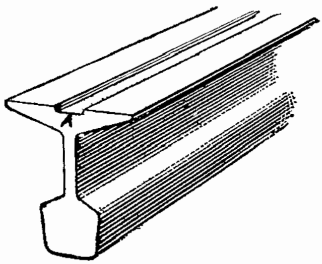

Fig. 44—Grooving Bar or Rail

As shown in Fig. 45, the grooving bar is set upon a wooden trestle, or support, B, of a height to suit the size of pipes to be made. A shelf, located at C, is to hold any necessary tools and keep them from getting lost about the building. A brace D is set over the rail and under the ceiling, so that the rail is level, and braced as shown at **a** and **a**, stops being used at **b** and **b**. To prevent the rail from wobbling additional braces, not shown, are fastened at X and X. An additional support, E, may also be

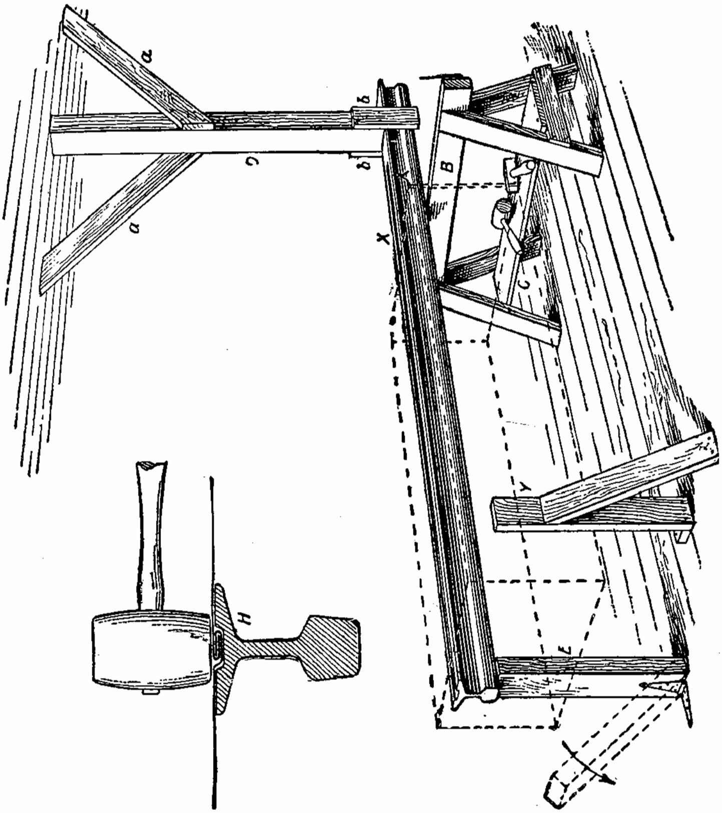

Fig. 45—Method of Using Grooving Bar

hinged to the floor, as shown, thus allowing it to fall to the floor when not in use. When grooving the duct, set up the brace E, set the locks of the duct over the groove in the rail, tap each end with the mallet, to keep it from slipping; then, by means of mallets in the hands of two men, one on each side of the bar, mallet down the seams. This will make a smooth surface on the outside, as shown at H. When a large quantity of ducts are to be made, a gauge is constructed by means of four braces, one of which is indicated by Y, two being on each side. The distance between the inside of the braces is made to equal the required width of the ducts. This saves time in grooving, as it is only necessary to

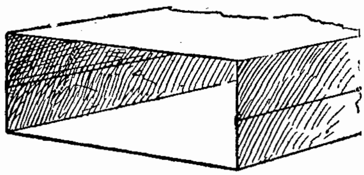

Fig. 46—Full Area

slide the pieces between the braces, when the locks will come directly over the groove, ready to be malleted down.

Bracing the Ducts

The bracing and construction of ducts should be such that the full area of the duct will be maintained, as shown in Fig. 46, and not give the surfaces a chance to buckle inward, as shown in Fig. 47, which decreases the area, as shown at A. The small size ducts are braced as shown in Fig. 48. The band iron which secures the sheets in a bundle can be used for this purpose. A flange of $1\frac{1}{2}$ inches at each end is riveted to the pipe at **a** and **a**, the flat way of

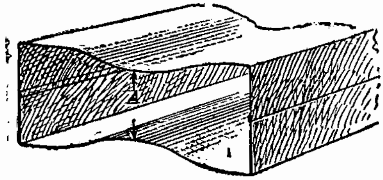

Fig. 47—Decreased Area

the band running parallel with the duct, so as to offer the least resistance to the flow of air. Ducts

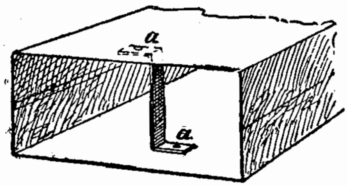

Fig. 48—Bracing Small Ducts

which are 30 inches in width and over, but still not wide enough to receive angle iron bracings, are

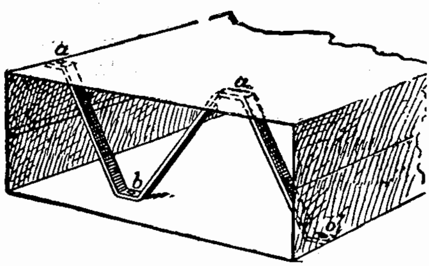

Fig. 49—Diagonal Bracing

braced by means of diagonal bracings, as shown in Fig. 49. These braces are made from band iron, not less than 1 inch wide and 1/8 inch thick, and are riveted to the duct at **aa** and **bb**. Flues or ducts which have a dimension greater than 48 inches are braced by means of angle iron frames, spaced not over 4 feet apart, as shown in Fig. 50. With this construction no diagonal bracings are required, as the angle iron frames keep the duct true and rigid.

Angle Iron Frames

These angle iron frames are laid out as shown in Fig. 51, where two methods are shown. In the first,

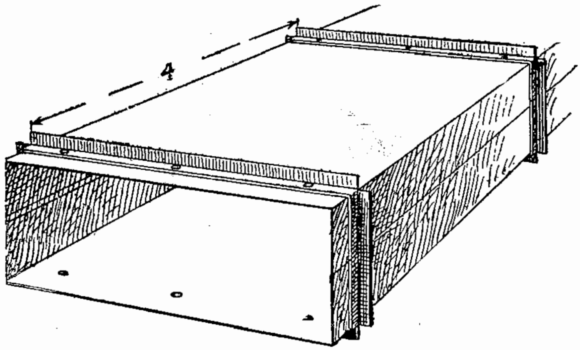

Fig. 50—Angle Iron Bracing and Stiffeners

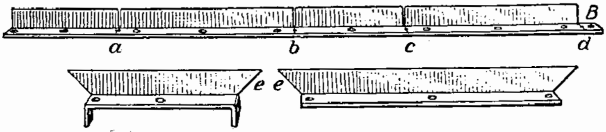

Fig. 51—Preparing the Angles Previous to Bending

in which the corners remain open, the notches are made with the heavy slitting shear, where the corners will be bent, as indicated by the center punch marks at **a b c** and **d**. A flange is allowed at B for joining at one corner. All holes should be punched before bending. The second method, in which the corners miter, is shown below. In this case each side of the angle iron frame must be cut separate, and each leg mitered as indicated by **e** and **e**. Flanges are allowed on the two opposite sides for riveting, as indicated. The first method is preferable and much quicker, and is rigid enough, even though the corners show open as indicated in the previous figure.

Large Size of Ducts

The construction known as longitudinal and horizontal bracings, shown in Fig. 52, are used on spe-

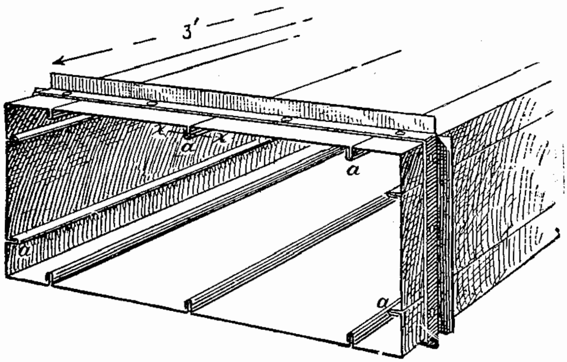

Fig. 52—Longitudinal and Horizontal Bracing

cially large sizes. In this construction the widths of the sheets are carefully computed to avoid any unnecessary waste, and the longitudinal joints, made like standing seams, as indicated by **a a**, etc. These seams are tightly closed and riveted at intervals, as indicated at **x x**. In addition to this, angle iron bracings, spaced about 3 feet apart, are riveted on the outside of the duct, as indicated. This gives a firstclass rigid construction for exhaust and heat ducts, the standing joint on the inside causing hardly any resistance to the flow of air.

Ducts with Outside Seam

When it is desired to have the standing seam on the outside of the duct, it is braced by placing the angle iron frame on the inside of the duct, as shown in Fig. 53, the angle frame being indicated by **a.** As the area of the duct is decreased by the placing of the angle on the inside, care must be taken to enlarge the duct, so that the inner opening of the

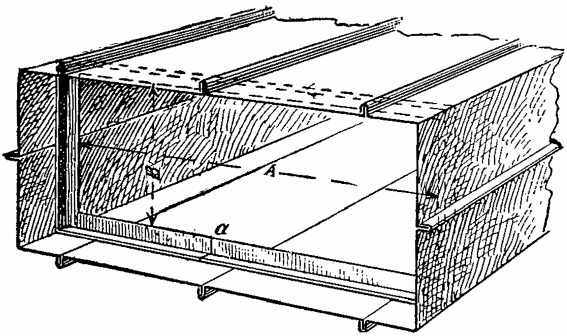

Fig. 53—Standing Locks Outside

angle iron frame shown by A and B will have dimensions to correspond with the area required.

Other Flues and Ducts

Standing joints are also used on square duct work in which the sheets can be used to advantage by seaming the corners and riveting through **a b,** as indicated in Fig. 54. This standing joint, bent on the diagonal of the duct, gives great rigidity and strength to the entire run. When vertical flues are to be placed inside of enclosing shafts, the shafts to be lined in sections, the joints are made by using longitudinal cup joints, as shown in Fig. 55. This joint

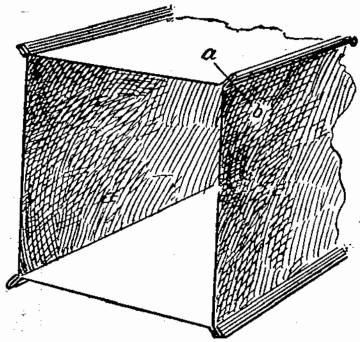

Fig. 54—Duct With Corner Seams

clamps and holds firmly. Special care must be taken that the distance between the inside of the flange **b** and the outer edge of the flange **a** is not any more

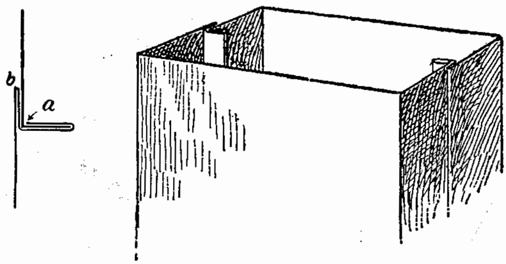

Fig. 55—Longitudinal Cup Joint in Shaft Work

than the thickness of the metal used will allow, so that both parts will slide tightly, but easily into place.

Bending Cup Joint in Brake

This cup joint is bent in the brake, as shown in the various operations of Fig. 56, in which the bends

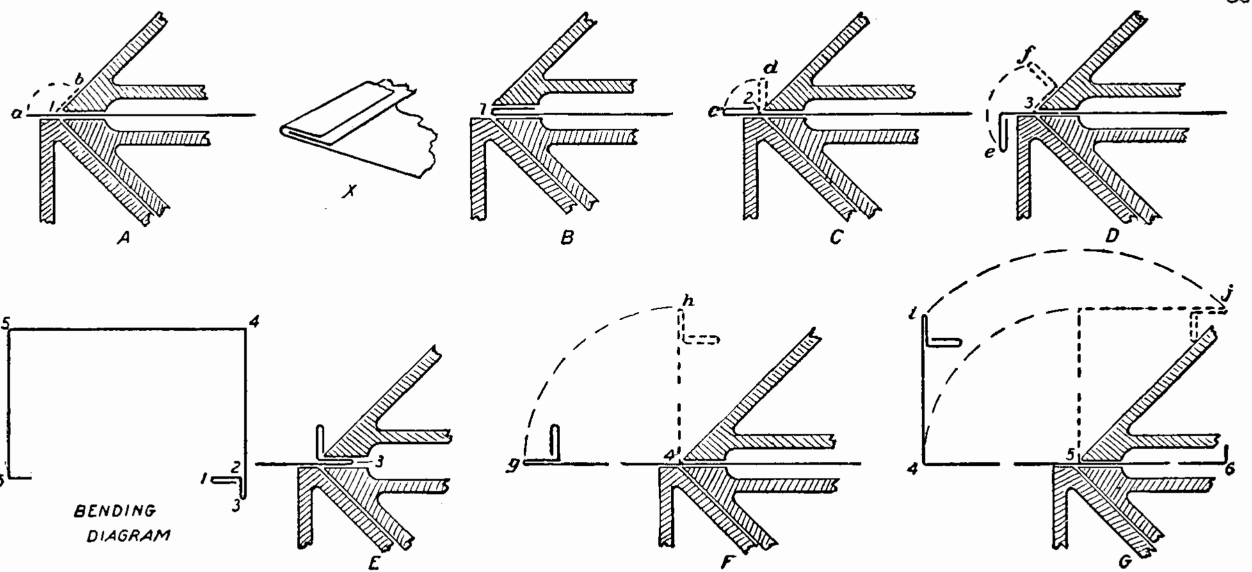

Fig. 56—The Operations Required in Bending Longitudinal Cup Joint

are numbered from 1 to 6. The first operation is shown in diagram A, in which the top clamp is closed on dot 1, and the edge **a** turned over as far as the bending leaf will turn it, as shown by **b.** The jaws of the brake are then opened and the edge is placed between same, when by slowly but firmly closing the top clamp as shown in diagram B, the lock 1 is produced. Care must be taken not to completely close the lock, and if the operator is in doubt about doing this correctly, a strip of iron slightly thicker than the metal in use is previously laid into the lock, as shown in X. This prevents the lock from being closed entirely. The lock 1 in B is now drawn out and the top clamp closed on dot 2, as shown in C and a square bend made, as shown, from **e** to **d.** The metal sheet is then reversed and the top clamp closed on dot 3 in D, and **e** is turned over as far as the bending leaf will turn it, as shown by **f.** The bend 3 is now closed tight, as shown in E, the sheet placed in the brake, as shown in F, and the top clamp closed on dot 4 and a square bend made as indicated from **g** to **h.** The next bend in order is 5, but before this bend is made, bend 6, shown on the bending diagram, should be made. If the jaws of the brake are not wide enough to admit the edge turned at 6, the top clamp is raised and the edge 6 is placed between the jaws of the brake and the top clamp is closed on dot 5, as in G, and a square bend made. This completes the bending of the cup joint.

Exhaust Ducts for Acid Fumes

In large buildings, where electrical plants are in operation, provisions must be made to carry off the fumes of sulphuric acid from the battery rooms. Any metal, such as iron, tin, brass or copper, would be destroyed by the acid fumes, so that experience has shown that sheet lead is the best metal to use. The duct is constructed as shown in Fig. 57, in which

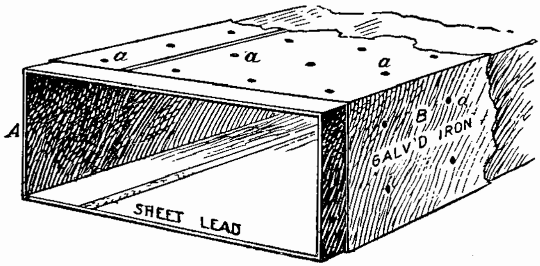

Fig. 57—Exhaust Duct for Battery Fumes

B is a heavy galvanized iron duct, having one-half-inch holes punched at intervals as indicated by **a, a, a,** etc. Inside of this galvanized iron duct a sheet lead lining A is placed, made of 3-16-inch thick sheet lead, and secured to the galvanized iron duct by soldering through the perforations at **a, a,** etc.

Precautions in Soldering

In order to avoid burning holes in the sheet lead it must first be scraped bright and clean, then a wooden or other brace, is placed on the inside of

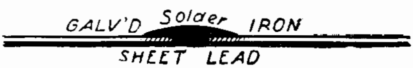

Fig. 58—Soldering the Sheet Lead to the Galvanized Iron

the duct to keep the sheet lead from sagging. "Killed" acid is used as a flux, and is applied with a small brush. By using the soldering copper the solder is sweated in between the two metals, as shown in Fig.

58, in which the black portion between the two metals represents the hole punched into the galvanized iron. The shaded portion represents the solder, which has been sweated between the two metals, while the button on the galvanized iron represents the amount of solder which should remain, to insure a good stiff hold. The soldering copper should not be too hot, otherwise holes will be burnt into the sheet lead. Experience will show when the copper has the right temperature, and it is well to have a scrap piece of sheet lead handy, on which the copper can be tried. If the solder used is composed of 50 per cent. each of tin and lead, it will melt at 370° F., while sheet lead requires 621° F. Thus with a little experience in soldering one will become proficient.

Preparing "Killed" Acid

To prepare "killed" acid, take any glass or earthenware dish and fill it one-fourth full with muriatic acid. Then use small clippings of clean zinc, and drop in one after another, when bubbles of gas will arise. The quantity of zinc required is determined when the acid stops boiling. The acid has now become chloride of zinc, and it is strained through a linen cloth and kept corked in a bottle for future use.