

CHAPTER I.

TOOLS, MACHINERY AND MATERIALS

It may be presumed that some of our readers are not wholly familiar with shop practice and equipment and have not had free access to the catalogues of manufacturers and dealers in sheet metal workers machinery. For the benefit of those who are not fully acquainted with the tools, machinery and material in a fully-equipped plant which turns out heating and ventilating pipes, we present the following lists, which though not necessarily complete, are suggestive of the equipment of shops making a feature of heating and ventilating duct work.

Hand Tools.

Breast drill.	Handy tongs.
Buffalo shears.	Hand drill.
Cold chisel.	Hand punch with changeable punches and dies.
Cross cut and rip saw.	Hand drill for stone.
Circular shears.	Hand drill for brick.
Center punch.	Hand vise.
Combination screw driver and reamer.	Iron clamp.
Clamp vise.	Left handed shears.
Compass saw.	Mallet.
Double cutting shears.	Malleable iron ladle.
File.	Melting pot for lead.
Flat plyers.	Oil stone.
Four and eight foot steel straight edges.	Oilers.
Grooving Tool.	Prick punch.
Grindstone.	Pointed plyers.
Hollow punch.	Plumb line.
Hack saw.	Riveting hammer.
	Right handed shears.
	Rasp.

- Round faced dolly.
 Rivet or solid punch.
 Rivet set and header.
 Ratchet brace and bits.
 Setting hammer.
 Slitting shears.
 Steel tape measure.
 Small steel square.
 Small wrench.
 Small spirit level (3 inch).
 Screw driver.
 Soldering coppers.
 Scratch awl.
 Small lead cakes for punching purposes.
 Small blacksmith's hammer.
 Seamless stove pipe stake.
 Square faced dolly.
 Two-foot rule.
 Twenty-inch spirit level.
 Twelve-inch spirit level.
 Two-foot steel square.
 Universal French shears.
 Vise plyers.
 Wire chisel.
 Wing dividers.
 Wire gauge.
- Machines.**
- Anvil.
 Bench shear holder.
 Beading machine.
 Blacksmith's punch.
 Bench shears.
 Bench plate.
 Brace bender.
 Bar rest.
 Bevel mandrel stake.
 Charcoal furnace.
 Crimper and beader combined.
 Combination punch and shears.
 Deep throat lever punch.
 Deep throat lever shears.
 Double seaming stake with four heads.
 Eight or ten-foot squaring shears (according to the length of sheet iron used in stock).
- Eight or ten-foot giant groover, operated by hand.
 Eight or ten-foot giant groover, operated by power.
 Eight or ten-foot cornice brake.
 Four, six, eight and ten-foot grooving bars, made from steel rails.
 Floor machine, standard.
 Gas furnace.
 Gasoline furnace.
 Hollow mandrel stake.
 Heavy beading machine.
 Machine, standard.
 Mechanic's vise.
 Plain forming rolls.
 Portable lever punch.
 Revolving bench plate.
 Set of machines for beading furnace pipe.
 Slip roll former.
 Small size blacksmith forge.
 Screw punch.
 Square head stake.
 Small turner.
 Sheet iron folder.
 Thirty-six-inch groover.
 Thirty-six-inch squaring shears.
 Three-foot cornice brake.
 Twenty-inch groover.
 Upright drill.
- Materials and Stock for Heating, Ventilating and Exhaust Work.**
- Asbestos paper.
 Asbestos paper paste.
 Black sheet iron.
 Black and galvanized band iron.
 Black and galvanized angle iron.
 Black galvanized iron rods.
 Black and tinned iron rivets, with different shaped heads.
 Black and tinned iron burrs.
 Black and galvanized iron stove bolts, with different shaped heads.

Black and galvanized iron expansion bolts, with different style heads.	Corrugated air cells asbestos sheathing.
Black and galvanized iron washers.	Galvanized sheet iron.
Brass safety chain.	Galvanized iron wire.
Brass and steel wood screws.	Galvanized iron turn buckles.
Brass machine screws, with different shaped heads.	Galvanized hoop iron.
Black and galvanized iron wall hooks.	Galvanized and brass pulleys.
Black and galvanized round and square dampers.	Half and Half solder.
Black and galvanized wind or blast gates.	Hard brass strips and angles.
	Hoop brass.
	Planished sheet iron.
	Sheet lead.
	Steel wire nails.

Sizes and Standard Gauges of Black Sheets, Etc.

The following table gives the United States standard gauge for all uncoated sheets and plates of iron and steel.

The stock sizes of the sheets are usually from 20 inches to not over 36 inches wide and in lengths from 72 inches to not over 144 inches. However, special sizes can be obtained from the mill if a sufficient quantity is required. The sheets are usually delivered in about 150 to 160 pound bundles, the number of sheets to a bundle being regulated according to the gauge of iron.

Special Pointers

The illustrations following from Figs. 1 to 12 inclusive, show some of the more important handy equipment about which further mention will be made. The tool shown in Fig. 1 is a combination screw-driver and reamer turning on the pivot at the center so that either the screw-driver or reamer may be used as desired, for reaming out holes or screwing in bolts. The plumb bob and line shown in Fig. 2 is

employed to obtain true perpendicular erections of duct work. The plumb bob is used as indicated in the cut to the right. Fig. 3 shows a handy knock-about telescope tool chest made of number 24 galvanized

The U. S. Standard Gauge
For all Uncoated Sheets and Plates of Iron.

Number of Gauge	Thickness in Fractions of an Inch	Thickness in Decimal Parts of an Inch	Weight per Sq. Ft in Oz	Weight per Sq. Foot in Lbs.
0000000	1-2	.5	320	20.
000000	15-32	.46875	300	18.75
00000	7-16	.4375	280	17.50
0000	13-32	.40625	260	16.25
000	3-8	.375	240	15.
00	11-32	.34375	220	13.75
0	5-16	.3125	200	12.50
1	9-32	.28125	180	11.25
2	17-64	.265625	170	10.625
3	1-4	.25	160	10.
4	15-64	.234375	150	9.375
5	7-32	.21875	140	8.75
6	13-64	.203125	130	8.125
7	3-16	.1875	120	7.5
8	11-64	.171875	110	6.875
9	5-32	.15625	100	6.25
10	9-64	.140625	90	5.625
11	1-8	.125	80	5.
12	7-64	.109375	70	4.375
13	3-32	.09375	60	3.75
14	5-64	.078125	50	3.125
15	9-128	.0703125	45	2.8125
16	1-16	.0625	40	2.5
17	9-160	.05625	36	2.25
18	1-20	.05	32	2.
19	7-160	.04375	28	1.75
20	3-80	.0375	24	1.50
21	11-320	.034375	22	1.375
22	1-32	.03125	20	1.25
23	9-320	.028125	18	1.125
24	1-40	.025	16	1.
25	7-320	.021875	14	.875
26	3-160	.01875	12	.75
27	11-640	.0171875	11	.6875
28	1-64	.015625	10	.625
29	9-640	.0140625	9	.5625
30	1-80	.0125	8	.5
31	7-640	.0109375	7	.4375
32	13-1280	.01015625	6½	.40625
33	3-320	.009375	6	.375
34	11-1280	.00859375	5½	.34375
35	5-640	.0078125	5	.3125
36	9-1280	.00703125	4½	.28125
37	17-2560	.006640625	4¼	.265625
38	1-160	.00625	4	.25

iron; the working dimensions for its construction being shown in Fig. 4. For punching rivet holes in sheet metal previous to bending or rolling, use is sometimes made of small lead cakes. The cakes are cast in various sizes, in the shop, by means of beveled black iron

pans of the required size as shown in Fig. 5. The sizes of the various lead cakes in use are indicated in Fig. 6. For double seaming elbows, whether curved or angular, "dollys" are used, two styles of which are shown in Figs. 7 and 8. For bending band or angle iron braces for the large ducts, a bar rest is employed



Fig. 1—Combination Screw Driver and Reamer

as shown in Fig. 9, the upper horizontal rod turning on a pivot, thus allowing the band or angle to move along at will for bending or forging the braces. The set screw shown, allows the standard to be raised or lowered as required. Fig. 10 shows a grooving bar

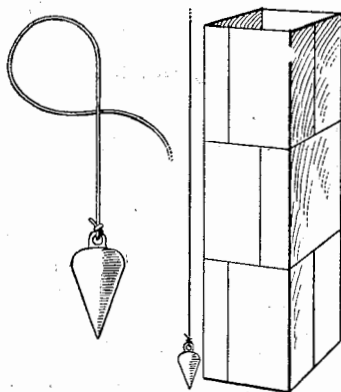


Fig. 2—Plumb Bob and Line

made from a steel rail, with a perfectly smooth surface along the top B, with the proper groove cut in same at A. The method of using this bar will be ex-

plained further along. Fig. 11 shows the type of stationary bench usually employed in the shop where plenty of room is available. When the space is limited, movable benches may be used as shown in Fig. 12 where the bench is laid on wooden horses as shown.

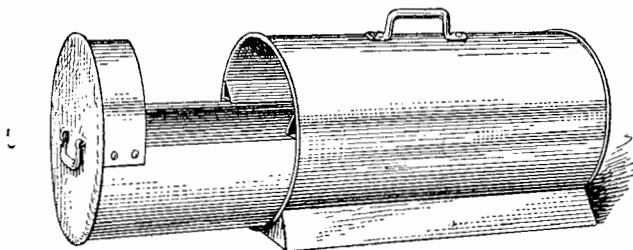


Fig. 3—Sheet Metal Telescope Tool Chest Partly Opened

When opening the bands around a bundle of sheet metal, a cold chisel and hammer should be used, as shown at A in Fig. 13, as this method will not impair the smooth surface on the sheet. The bands should not be opened, as is usually done, by driving the pean

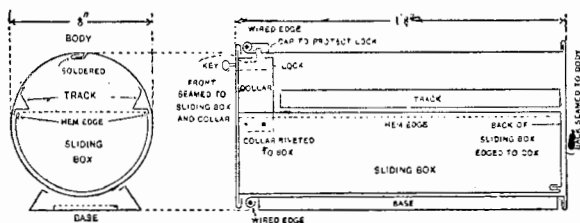


Fig. 4—Working Measurements for Round Tool Chest

of the hammer under the band as indicated at B, which dents the surface of not only the top sheet, but sometimes three or four sheets below it.

The lighter gauges of the metal are used for stove-pipes, pans, etc.; while the heavier gauges are em-

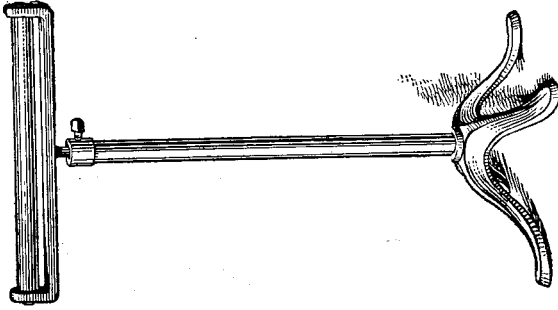


Fig. 9—Bar Rest Used in Connection with Forging and Bending

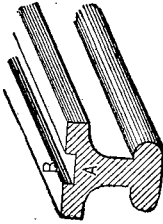


Fig. 10—Grooving Bar Made from Steel Rail

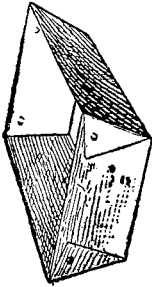


Fig. 5—Pan with Beveled Sides for Casting Lead Cakes

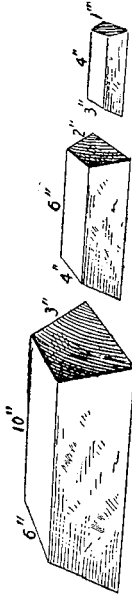


Fig. 6—Sizes of Lead Cakes from Melted Scrap for



Fig. 8—Round Faced Dolly



Fig. 7—Square Faced Dolly

ployed for making boilers, large smokestacks, ducts, drums, etc.

Planished Sheet Iron

Planished sheet iron is made from genuine charcoal hammered bloom iron; has a dark blue glossy surface,

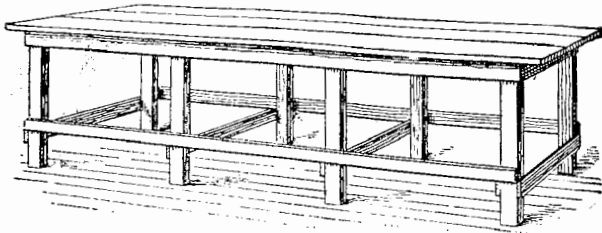


Fig. 11—A Stationary Bench

which is practically impervious to oxidation. Planished sheet iron is equal to the once famous Russia sheet iron. It is used for high-grade ranges, radia-

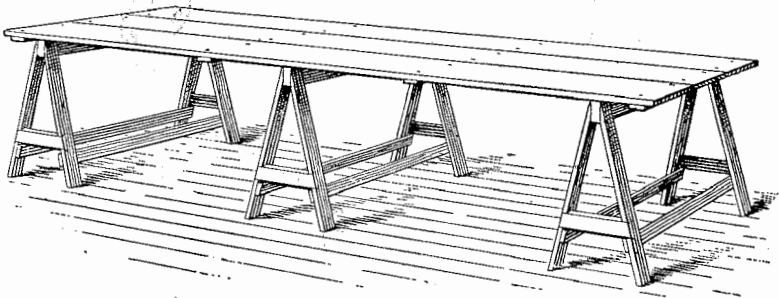
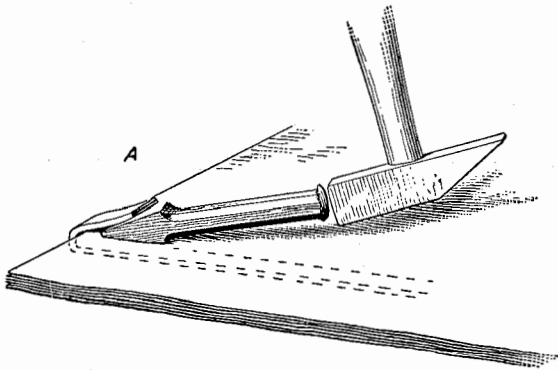


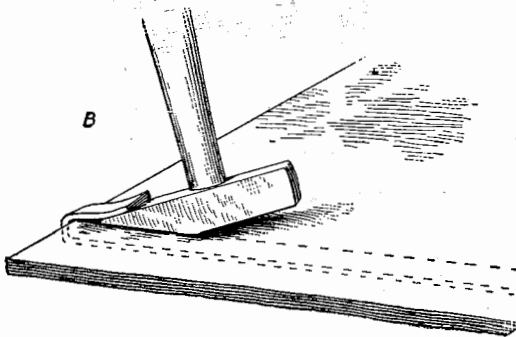
Fig. 12—A Movable Bench

tors, locomotive jackets, automobile seats and hoods, as well as other work in which appearance is considered. When it is used in connection with brass trimmings, a handsome appearance is secured. A table

giving the standard gauges and sizes may be found in handbooks and catalogues furnished by several manufacturers.



The Right Way



The Wrong Way

Fig. 13—Opening the Bundles of Sheet Iron

Galvanized Sheet Iron

Galvanized sheet iron can be obtained in similar gauges and sizes as given in the table for uncoated

sheets. The usual gauges used for constructive pipe work are from Nos. 14 to 24, inclusive, the weight per sheet, number of sheets to the bundle and weight per bundle being given in a table of average weights of standard sizes (covering 24" \times 72" to 36" \times 120", inclusive), also to be found in all of the manufacturers' catalogs.

Storing the Sheets

After the bundles have been opened in the shop, the stock sheets are stored on shelves constructed for the purpose, as shown in Fig. 14, the shelves being

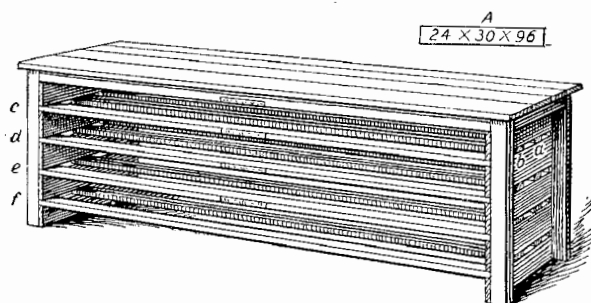


Fig. 14—Combined Bench and Sheet Metal Rack

open as indicated by *a b* and run through the entire length of the bench, the outer strips being shown by *c d e f*. To indicate the various gauge and size of the sheet on each shelf, galvanized iron tags, with the number and size marked thereon, are nailed over each shelf similar to *A*, which reads: No. 24 gauge, 30 in. wide, 96 in. long.

Sheet Lead

Sheet lead is used in constructing the exhaust ducts, which carry away the fumes of sulphuric acid from the battery rooms in large buildings in which batteries

are used, the ducts being similar to Fig. 15, whose construction will be explained in course. Any other metal

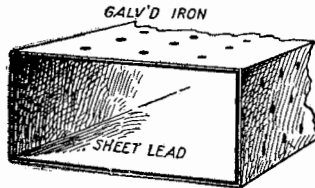


Fig. 15—Sheet Lead Exhaust Duct

such as galvanized iron, would be destroyed by the fumes of the acid. The following table gives the approximate thicknesses and weights of sheet lead:

Approximate thickness.....	1/64,	1/43,	1/32,	1/25,	3/64,	1/16,	5/64,	3/32,	1/8,	1/4 in.
Weight per sq. foot	1,	1 1/2,	2,	2 1/2,	3,	4,	5,	6,	8	16 lbs.

Brass Bands and Angles

Brass bands and angles are used as trimmings on

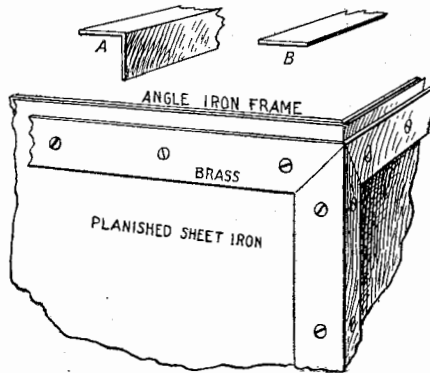


Fig. 16—The Use of Angles and Brass Bands

any piece of work made from planished sheet metal, as shown in Fig. 16.

Band and Angle Iron

Black and galvanized band and angle irons are



Fig. 17—Band Iron Hangers

used to make braces, hangers, etc., as shown in Fig. 17. The band iron or steel should be soft, so as to

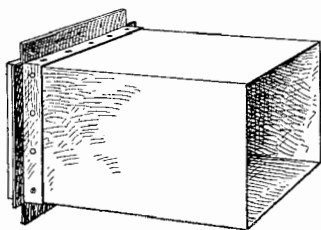


Fig. 18—Angle Iron Stiffeners

allow the bends to be made cold, i.e., without heating. Any desired thickness and width can be obtained.

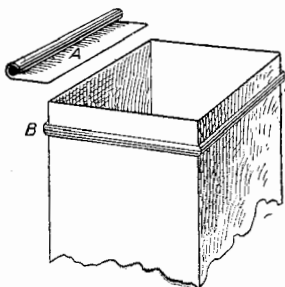


Fig. 19—Iron Rod Stiffeners

Angle iron is used chiefly for stiffeners around large size ducts to keep the middle of the duct from sagging, as shown in Fig. 18.

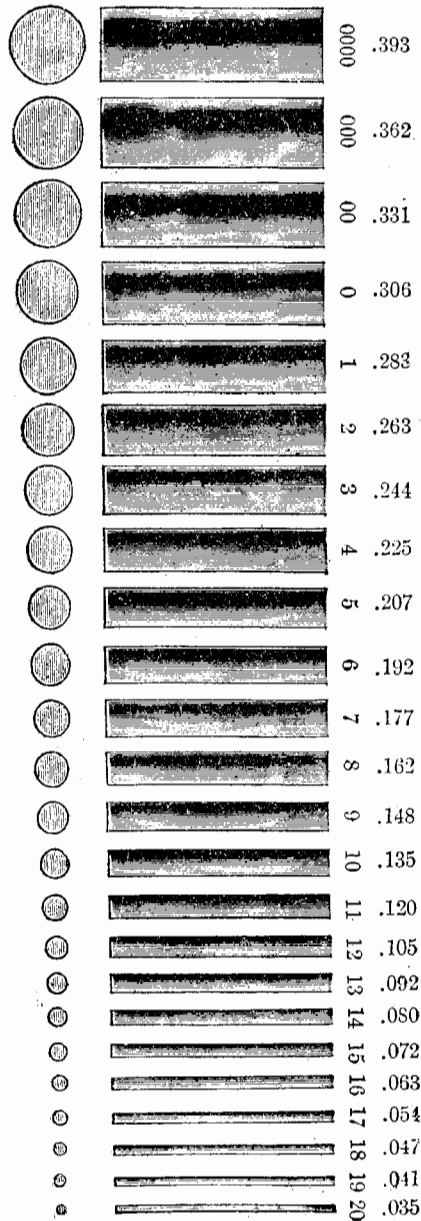


Fig. 20—Stubb's Wire Gauge
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Black and Galvanized Iron Rod

Black and galvanized iron rod is used for hanging heavy round ducts, as well as for a stop edge in the slip end of the duct B in Fig. 19, the rod being encased as shown in diagram A.

Tinned or Galvanized Wire

is used to hang small size pipes, etc. The standard sizes of wire and rod by Stubb's wire gauge with their various thicknesses are shown in Fig. 20.

The Brass Safety Chain

is used for operating over pulleys, the various slides, dampers, registers, etc. A safety chain such as is



Fig. 21—Brass Safety Chain

shown in Fig. 21 has links which are practically indestructible, and is capable of standing much wear and tear, lasting indefinitely.

Rivets

Black, tinned, copper or brass rivets can be obtained in weights from 8 ounces to 12 pounds to the 1,000. Flat head tinned iron rivets are chiefly in use, these being made from soft Norway iron. The 2-ounce rivet is most generally used in riveting metal ducts, etc. The various rivets in use have heads which are known as flat, round, countersunk and coneheaded.

Burrs

The burr shown in Fig. 22 is used in riveting, and keeps the sheet metal from spreading and tearing



Fig. 22—Burr Used in Riveting

during that process, and is used as shown at A. Burrs come in different sizes for the rivets in use.

Stove Bolts

Flat and round-headed stove bolts and nuts are used for bolting together angles, braces, etc., which are not riveted.

The Washer

The washer shown by A in Fig. 23 is used in connection with the bolts, as shown at B, and gives the head of the bolt a flat bearing against the sheet metal,

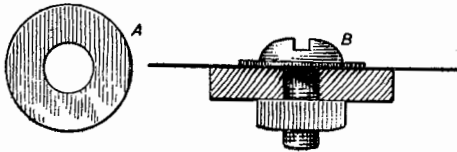


Fig. 23—Washer Used with Bolts

thus preventing the tearing of the bolt head through the sheet, the latter being subject to a strain when the braces or other iron work are put in position.

The Expansion Screw

The expansion screw A shown in Fig. 24 is used to fasten registers to marble walls. The screw is usually a brass or nickel plated round headed wood screw. The anchor *a* is made of a lead composition metal in

one piece and is so constructed that the screw cuts its own thread, thereby allowing the use of any kind of screw. This anchor **a** is placed into the hole previously drilled into the marble, stone or iron, after which the



Fig. 24—Expansion Screw

object to be fastened is screwed in place. The screw expands the lead anchor **a** and holds it firmly. On heavier work, such as the fastening of heavy iron braces and hangers, bolts having an eye or a square head can be used.

Wood and Machine Screws

Wood screws employed for fastening registers, braces, flanges, etc., may be obtained in any size made of steel, coppered, brass, nickel plated, tinned, galvanized, etc., according to requirement.

Machine screws are used to fasten the brass trimmings to planished sheet iron work, which in turn is fastened to angle iron frame work, into which holes have been tapped to receive the proper size of screws. These screws, unlike common wood screws, are not gimlet pointed, and come with three styles of heads, known as flat, round and fillister.

Steel Wire Nails

The sizes of steel wire nails are usually 1, 1¼, 1½ and 2 inches long. They are made from Nos. 9, 10, 11 and 12 wire respectively.

Wall Hooks

When wire is used for fastening round or small

size square pipe, a wall hook may be obtained which can be used in both wood and brick joints.

Pulleys

Encased and tackle pulleys, brass or galvanized, are used in connection with brass safety chains for operating dampers, blast gates, etc. Where the ceiling is of wood they are screwed in. If the ceiling or side wall is of marble, stone or brick, holes are drilled and a lead anchor, previously described in connection with expansion bolts, is used into which the screw of the pulley can be firmly secured.

Dampers

Among the various styles of dampers used for heater pipes, smoke pipes and brick flues are those made of malleable iron and of sheet metal. Fig. 25 shows

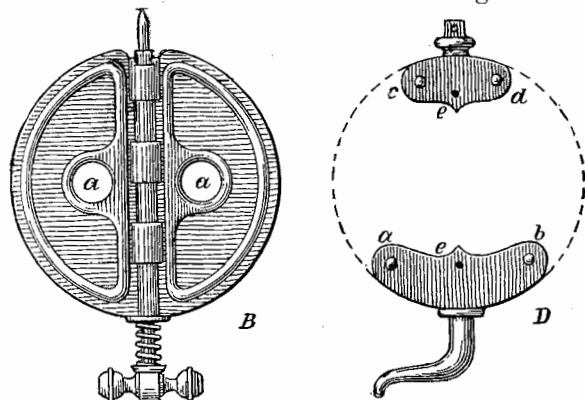


Fig. 25—Malleable Iron Damper for Smoke Pipe

malleable iron dampers for smoke pipes, the small holes *a a* allowing the coal gas to escape when the damper is closed. The rods being pointed, allow them to be driven with the hammer into the sides of the

pipe. When round dampers are made of heavy sheet iron, as shown at D, damper clips made of malleable iron are riveted to the metal disc. These have solid rivets at a b and c d and extra holes for riveting at e and e.

Wind or Blast Gates

Wind or blast gates, one of which is shown in Fig. 26, are used for closing pipes supplying blast to furnaces, forges, etc. They are also for use in exhaust

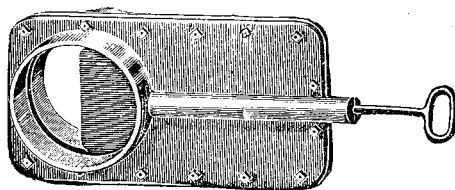


Fig. 26—A Blast Gate

or blast pipe systems, where materials of any kind, such as sawdust, shaving, cuttings or gases of any nature are to be removed, or for controlling the heated air in connection with fan systems of heating. Large ventilating dampers, usually made by hand, are also used in square ducts to control the amount of cold air entering the building.

Turnbuckles

Turnbuckles are used in hanging large, heavy sheet metal ducts. The rods are threaded right and left, so that by turning the buckle one way or the other the duct can be raised or lowered as desired.

Asbestos Paper

Asbestos paper, which usually comes in 50-lb. rolls, is used for covering hot air pipes to avoid the loss

of heat, caused by the cold air coming in contact with the surface of the pipe. It is secured to the pipes by using a paste prepared for that purpose, which can be purchased in cans.

Corrugated asbestos sheathing is also used. It covers the heating pipes, thus protecting the surface of the metal pipe from any outside air whatever. The rolls usually come in 24 and 36-inch widths. It is secured around the metal ducts by means of hoop brass, which comes in coils. This is drawn tightly over the sheathing, the ends of the hoops being locked together. It can be obtained from $\frac{3}{8}$ to 2 inches wide, and from No. 16 to No. 26 B. and S. gauge.