PIPE BENDING.

Before taking up the construction of bends from flat sheet-metal, it will not be out of place to devote some little space to a consideration of the methods to employ, and tools to use, in bending ordinary metal tubing, as this is a knowledge oftentimes wanted in the sheet-metal workshop, and is by no means common knowledge there. The workman who is unacquainted with these methods and tools finds great difficulty in giving to a straight piece of tubing a desired curvature, that is, so shaping it, that the completed bend shall be free from ridges, dents, or kinks, and not flattened in the throat, the perfection of a bend, of course, being when the internal diameter or bore of the tube is the same throughout.

What has to be done in the way of pipe bending in the ordinary workshop must be done with the appliances that are usually found there, or can easily be made there. The tools necessary for the production of bends, especially smooth and circular in section, such as those of wind musical instruments, cannot be made in the ordinary sheet-metal workshop, it will be well, however, to also give a brief description of the working of these bends.

The method of bending a pipe or tube varies with the metal, its diameter, and the curvature required. Ordinary gas pipe, of the smaller sizes, may readily be

bent without any special preparation to curves, even of small radius. A piece of iron, preferably round iron, being gripped in a vice, horizontally or vertically as most convenient, and used as a fulcrum or bending post, the barrel may be shaped round it to the curve required. A slight curvature should first be given, then, changing the place of contact of pipe and fulcrum, a further curvature, and so on. A piece of wood, if of sufficiently large diameter to bear the strain it will be put to, may be similarly used. If the pipe is of so large diameter that its bending against a piece of iron in the manner described is beyond the workman's strength, it should be made red-hot where the bend is to come. Thus softened, the workman will find the bending comparatively easy. In bending iron pipe in this way there is always a slight flattening in the throat of the bend. In such work, however, as iron pipe is generally used for, this flattening is not of consequence, the thickness of the pipe and the toughness of the metal prevent any great amount of flattening.

The procedure necessary to bend tubes made of metals softer than iron, of copper, brass, zinc, tin or lead, is less simple, and to prevent buckling, puckering or flattening, in the throat of a bend, such pipe must be loaded. The materials used for loading are various, and the choice between them depends upon the metal of which the pipe to be bent is made, and greatly upon the finish and symmetry required in the particular work to be done. Lead, resin, pitch, and rosin and pitch in equal parts, are the substances most in favor. When set after being melted and run into tube, they are found to bend without breaking as the bending of a tube progresses, and to offer the needful resistance

to change of section of it. A spiral spring not closely coiled, or a piece of cane or solid rubber, may often be advantageously used to load soft metal pipe with. Either of these loadings can be pulled through the made bend, and will serve again and again as loading. A tightly-rolled piece of paper will often serve, even for brass tubing, if used for brass tubing, it can be burnt out if need be. On an emergency, and if the ends of the piece of tube to be bent are tightly corked or otherwise sealed up, and the look of the finished work is not of particular importance, a pipe may be loaded with sand, or even with water. The reason why sand and water, as loading, are suitable only for an emergency, is that the plugging at one of the pipe ends often gives way in the course of the bending.

The melting-point of lead is 323° Centigrade, and as a loading substance for brazed brass tube, lead has this disadvantage, that when melting it out of a bent tube, there is danger lest any weak spot in the brazed seam should crack or open up, and special care needs to be taken to warm up the tube slowly and equally in melting out the lead because of this. When the lead has been run out of a bent tube, little particles of lead often remain in the tube adhering to the surface. To dislodge these, the tube should be again warmed up, to a temperature a little higher than that of the melting point of lead, and the open end struck smartly on the bench, or with a piece of wood, the tube being held with a pair of pliers, or otherwise as may be convenient. Rosin or pitch, as loading substances, leave behind a thin adherent film after being melted out of a pipe. This must not be forgotten when choice of a loading substance has to be made. If it is imperative that

the inner surface of a bent pipe should be clean, then neither of these substances can be used with a tube of soft metal, as the film has to be burnt off, which would mean spoiling the tube. They may be used with copper or brass tubing, when, for the reason that the throat of the bend need not be perfectly circular in section, it is desired that the loading substance shall not offer any great resistance to bending.

Brass or copper drawn tubing should be annealed before being bent. In loading a piece of pipe with either lead, pitch, or rosin, two or three layers of brown paper should be wrapped round one end of it and securely tied. If lead is the loading material, the tube should be rigidly fixed vertically, with its closed end embedded in sand, so that molten lead may not run out to do mischief. The lead may be poured from an ordinary plumbers' ladle. And in loading with pitch and rosin the tube should rest and be secured with its closed end on some solid substance, to prevent leaking out of the hot pitch or rosin.

Small copper pipes, tubes, and spouts, are readily bent into curves without wrinkling, if they are first filled with lead. One end of the pipe is closed with thick brown paper, and the pipe laid in a box of damp sand, while the lead is being poured in. The lead must be soft. An iron rod is cast in with the lead, its end standing out at a distance of a few inches to afford the necessary leverage for bending the pipe. This, of course, is melted out after the bending is done. The bending is variously effected with a mallet, or with leverage, or with both in combination. Before running the lead out the outside of the work should be covered with a solution of whiting in water. Copper pipe may

also be filled with rosin before bending. Lead is better for quick bends, rosin for long ones. Only the part to be bent and that immediately beyond need be filled, or wad of paper, or cotton waste being inserted at the locality beyond which the filling material is not required. The part which has to be bent must be annealed first to a cherry red, in daylight. Portions which have to be left straight must be left unannealed, or hard.

There are many methods and rigs adopted for bending copper pipes. Much depends on the size of the pipe. Up to about five inches diameter manual labor is sufficient, but above that hydraulic power is generally employed. The bending is always done by leverage or pressure, never by hammering. In all coppersmiths' shops there is a strong bending-block sunk in the floor for the purpose of pipe-bending. It is of cast-iron about twelve inches square, and standing up to about the ordinary height of a workbench. It is made to receive the various attachments required for pipe-bending. The top of the block is shouldered down to receive a strap which confines a bending-block. The latter is a stout plate of lead with a hole or holes in it for the insertion of pipes. The lead being soft does not bruise the pipe which is being bent. It is secured with the strap. On one side of the block a back plate is inserted with pins fitting into the holes cast in the block, which affords an essential point of leverage in the bending of pipes. Holes are cast in the top of the block to receive pins which also form suitable points of leverage.

Most work in sheet copper is planished at some stage or other. The object of planishing is to close and

harden the grain of the metal, taking the limpness out of it, and to make it more elastic and rigid so that it will retain its shape. Often this operation is performed before any work is done upon the sheets, in order to make them stiff enough to work upon. Often it is done at a later stage. It consists in hammering over the whole surface in detail until every portion has been subjected to the hardening effect of the hammer blows. The hammering is done in straight lines, or in concentric curves, depending on the nature of the work. The planishing is done on a bottom stake, fixed in the floor-block, or on a level block of metal. Various hammers are used for different work. Copper goods are polished with a file first, followed by emery cloth applied on a stick, then by fine emery, rubbed on with hempen rope, wrapped round with a single hitch, and drawn to and fro, and finally with a metal burnisher and sweet oil.