

SECTION 2, CHAPTER 5

PIPE BENDING AND FLARING

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PIPE BENDING

Introduction

1. Damaged pipelines are normally replaced by the fitting of standard spares, but if such parts are not available it is sometimes permissible to make up a new member from straight tubing of similar specification. To lessen the possibility of the tube wall "kinking" when the tube is being bent, it may be filled with a filler. This is advisable when the tube exceeds $\frac{1}{2}$ in. dia. and/or when the bend is acute. Bending jigs, blocks or machines are available to facilitate the bending operation.

Fillers

2. The filling should be fusible alloy. In an emergency, sand or liquid filling can be used, but care must be taken not to apply heat to a tube that has been plugged after being filled with liquid. The choice of filler is extremely important. A pipe which forms part of an oil system, for instance, must be scrupulously clean internally; it is therefore essential that the filler used when bending such pipes can afterwards be removed with ease and certainty.

3. **Fusible Alloy.** This alloy has a melting point below 100° C., and can, therefore, be melted for filling purposes with the aid of boiling water in a suitable container. The alloy must not be subjected to a temperature exceeding 100° C., either during pre-heating or unloading operations. Before filling, the tube should be oiled to ensure that the fusible alloy will not stick to the walls of the tube when the alloy is subsequently removed.

4. After the tube has been oiled internally, it should be plugged at one end and pre-heated in boiling water. The molten alloy should then be poured into the tube. When the tube is completely filled, the whole should be cooled by immersion in cold water or by directing a stream of cold water against it. To prevent the formation of cavities in the fusible alloy, cool progressively from the plugged end. The filler must be allowed to cool to room temperature before the tube is bent.

5. After bending, the tube should be unloaded by immersing it in boiling water until all the alloy has run out. The tube must then be cleaned internally to ensure that any alloy sticking to the walls is removed. Quench the

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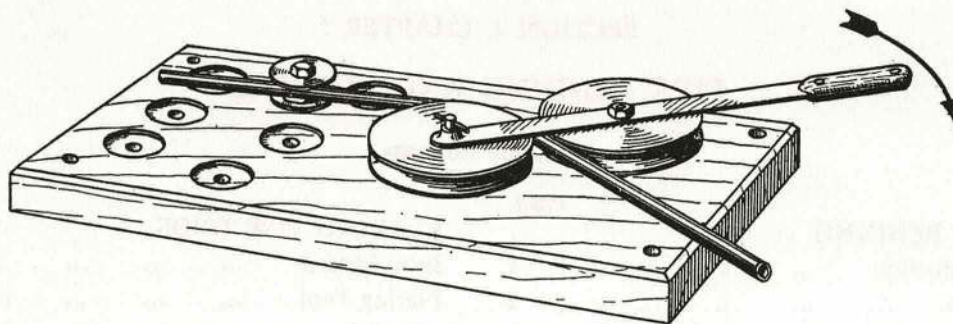


Fig. 1. BENDING JIG

tube in cold water and use a suitable wire brush. The fusible alloy which has run out of the tube into the water can be recovered and used again.

Note. The complete removal of the fusible alloy is of extreme importance, as its presence may lead to blockages or corrosion and, in steel tubes which may be subsequently heat-treated, the presence of any alloy would cause inter-crystalline cracking.

Bending Jig

6. The simple bending jig illustrated is supplied with several different sizes of rollers. The desired curvature is set out on a bench or other flat surface, against which the tube is checked at intervals during the bending operation. The appropriate rollers and stop are fitted to the jig, and the tube to be bent is so placed that one end is resting against the stop, with the tube situated between the rollers. The handle is then pulled until the tube takes a slight set. The tube should then be slid along about 1 in. and bent again, the

process being repeated along the tube until the required curvature is obtained.

Bending Machine

7. Two sizes of tube bending machines are available. Type A.2 is suitable for tubes up to $\frac{7}{8}$ in. dia., and type C for tubes 1 in. to 2 in. dia. They can be secured by bolts to a bench, or the underside of the base plate may be gripped in a vice. Alternatively, the square tube lug provided may be held in a pipe vice. Each machine is provided with a set of interchangeable circular formers which are grooved to receive different diameters of tubing, and a range of guides is provided to correspond with the range of formers.

8. The tube is forced round the former, each former being designed to give a mean radius of bend equal to four times the diameter of the tube for which it is intended. This radius should be regarded in each instance as the safe minimum for the diameter of the tube concerned. The former can be removed and exchanged by withdrawing the centre pin and sliding the former out. After replacing a

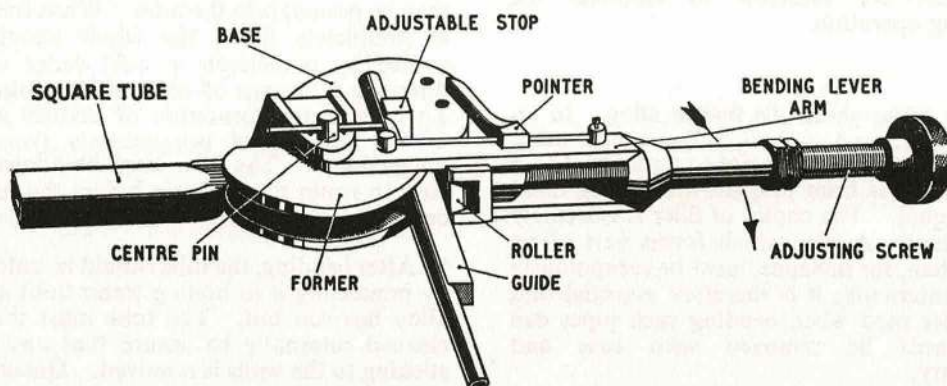


Fig. 2. TUBE BENDING MACHINE

former, ensure that the centre pin is pushed right home before commencing bending operations.

9. The guide is inserted between the former and the roller after the tube to be bent has been laid in the groove of the former. The roller is mounted on the slideable crosshead attached to the bending lever arm, and the position of the roller can be adjusted by rotating the knurled screw at the end of the lever. This adjustment determines the point at which the pressure will be applied to the tube. A sliding pointer, mounted on the bending lever arm, indicates the position of the roller in relation to the guide, tube, and former in use. An adjustable stop is provided to withstand the thrust transmitted to the tube by the operation of bending. The position of the stop is varied to suit the class of bend required.

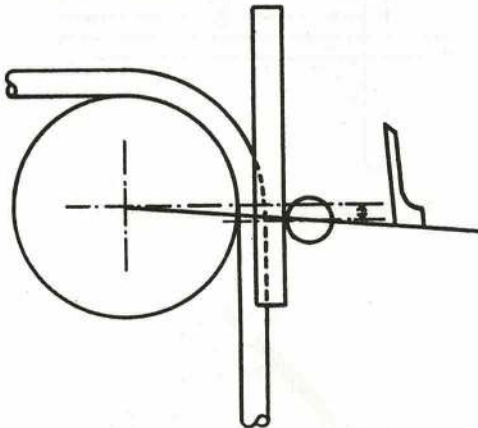


Fig. 3. POINTER TOWARDS TUBE—SMALL LEVERAGE

10. **Operation.** Set the pointer until its straight edge lies approximately over the centre of the tube to be bent. Pull the bending lever arm to take up any play between the roller, guide, and tube. Note the angle of the straight edge of the pointer in relation to the unbent tube. Fig. 3 shows an extreme setting which is used for bending thin gauge tubes without forming ripples on the inside of the bend or flats on the outer radius of the tube. In this position the pointer is inclined towards the tube, the leverage from roller to point of contact with former is at its minimum and the force required proportionately great.

11. Fig. 4 shows the roller withdrawn so that the bending lever arm may swing far

enough forward to tilt the pointer away from the tube. This setting is used for thick gauge tubes which have less tendency to ripple or form flats when bent. The leverage is large and the force required proportionately small, though still fairly great because the tube is much stiffer.

12. An intermediate setting with the straight edge of the pointer parallel to the tube is shown in Fig. 5. This is the correct position for bending tubes of average gauge.

Note. The bending operation must be effected by pulling evenly on the bending lever arm; the tube itself must not be assisted.

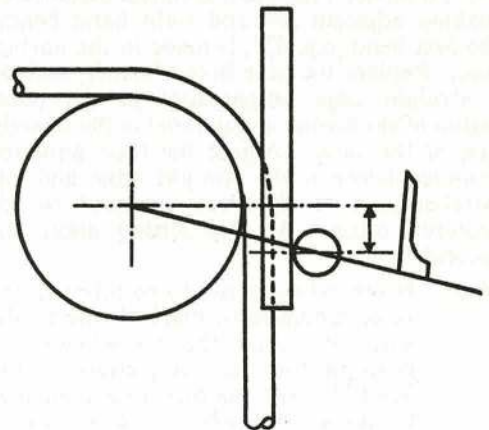


Fig. 4. POINTER AWAY FROM TUBE—LARGE LEVERAGE

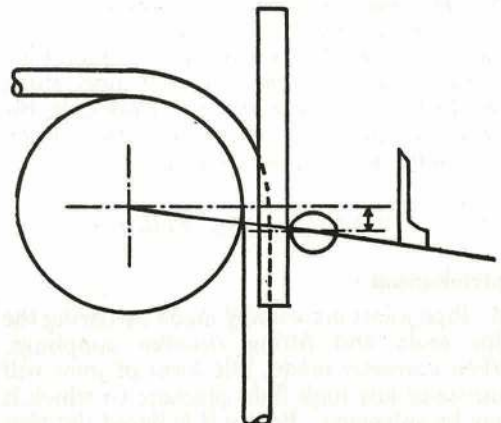


Fig. 5. POINTER PARALLEL TO TUBE—AVERAGE LEVERAGE

13. Bending to Measurements. The U-section recess in the former is equal in depth to the diameter of the tube to be bent, thus allowing accurate bends to be made to specified dimensions. To bend a tube at a right angle so that the outside edge of the bent portion is a given distance from the end of the tube (dimension A), mark the distance with a pencil on the straight tube, insert the tube into the machine, and line up the pencil mark with the outer radius of the former by using a square. The tube is now ready for bending. To bend a tube at right angles so that the inside edge is a given distance from the end of the tube (dimension B), proceed as for an outside edge bend, but line up the pencil mark with the inner radius of the former.

14. To off-set a tube to a specified distance by making adjacent left and right hand bends, the first bend, e.g. 45°, is made in the normal way. Replace the tube in the former, and lay a straight edge tangentially to the outer radius of the former and parallel to the straight end of the tube. Adjust the tube until the distance between the straight edge and the parallel part of the tube is equal to the required offset. At this setting make the second bend.

Note. If several tubes are to be offset to the same dimensions, mark the first tube where it touches the stop when set in position for the completion of the bend. Using the tube as a template, the remaining tubes should be similarly marked after the first bending operation. No further measurement will be required.

15. Servicing. Keep the machine clean and free from corrosion. Lubricate the roller so that it is free to revolve in its mounting. Lubricate the cross head where it slides along the forked bending lever. Lubricate the threads of the roller adjusting screw. Keep the guides and formers clean.

FLARING PIPE ENDS

Introduction

16. Pipe joints are usually made by flaring the pipe ends and fitting suitable couplings. When correctly made, this form of joint will withstand any high fluid pressure to which it may be subjected. Before it is flared the pipe end must be accurately squared. A jig may be used, and can be made up locally. The jig

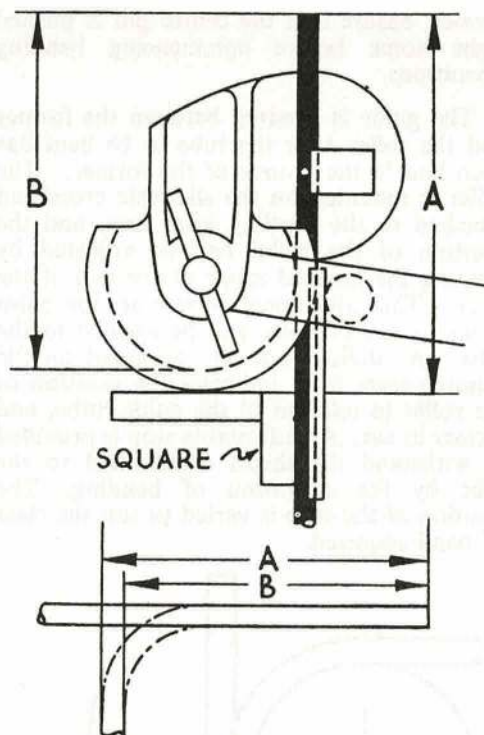


Fig. 6. BENDING TO MEASUREMENTS

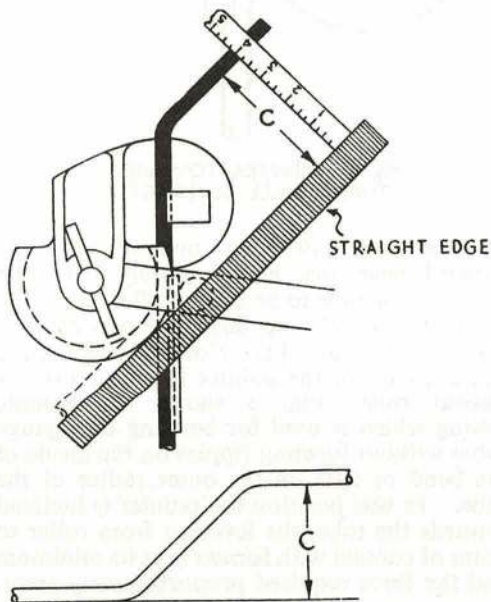


Fig. 7. DOUBLE BEND

illustrated (Fig. 8) accommodates the pipe which is lightly clamped by tightening the thumb screw. The jig edges are case-hardened, and the end of the pipe is squared-off by filing it down level to these edges. After the pipe has been filed square, remove any burrs and use a pull-through to clean the interior of the pipe.

Flaring Tool

17. The tool (Fig. 9) is available in two sizes; small for flaring pipes from $\frac{3}{8}$ in. to $\frac{1}{2}$ in. dia., and large for pipes up to $1\frac{1}{2}$ in. dia. Sets of half bushes are provided to cover the range of pipe sizes. Having squared-off the end of the pipe and removed all burrs, select the pair of half bushes of the correct size for the outside diameter of the pipe. Remove any oil or grease from the half bushes and the pipe end. Mount the flaring tool in a vice, and fit the half bushes in the troughs of the latch fitting and body, so that their shouldered ends are adjacent to the expander cone. Pass the union nut and collar over the end of the pipe, and clamp the pipe in the flaring tool, ensuring that the squared-off end is level with the widest diameter of the countersunk end of the bushes.

18. Fit the tommy-bar in an appropriate hole in the knurled boss of the threaded sleeve, and

screw in the sleeve until the expander cone end of the captive pin begins to force the end of the pipe towards the sides of the counter-sunk ends of the half bushes. At this stage, commence to rotate the expander cone by turning the tommy-bar at the outer end of the captive pin, and, at the same time, advance the threaded sleeve gradually until the pipe end is flared to the limit imposed by the sides of the counter sunk ends of the half bushes. It is important not to apply unnecessary force, otherwise, cracks will appear in the flare. A correctly flared end should be concentric and free from cracks, and not have more than $\frac{7}{8}$ in. clearance in the threaded part of the union nut. When the collar is slid along the pipe to the flared end, the distance from the collar to the flared end should be as follows:—

Pipe, outside dia.	Distance of collar from flared end
Up to $\frac{1}{4}$ in.	0 to $\frac{1}{16}$ in.
$\frac{5}{16}$ in. to $\frac{3}{8}$ in.	$\frac{1}{16}$ in. to $\frac{1}{8}$ in.
$\frac{7}{8}$ in. to $1\frac{1}{2}$ in.	$\frac{1}{8}$ in. to $\frac{1}{4}$ in.

Check that the collar or sleeve fits squarely on the expanded portion of the pipe, and that the union nut when pushed against the collar, rotates freely.

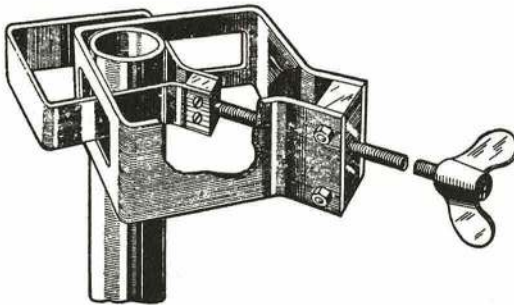


Fig. 8. PIPE SQUARING JIG

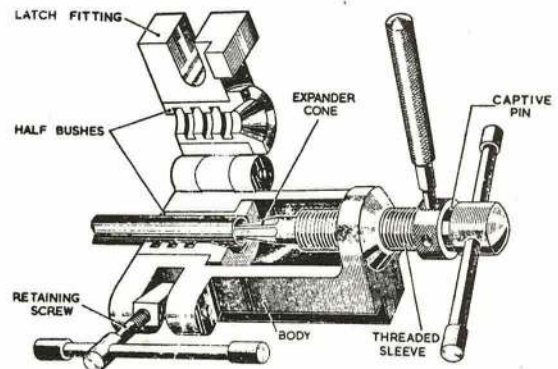


Fig. 9. FLARING TOOL



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