CHAPTER 8

TUBE BENDING MACHINES

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LIST OF ILLUSTRATIONS

General

1. Tube bending machines are provided for use when bending metal tubing whenever there is a risk of the tube walls collapsing or rippling, a possibility which is greater for tubes of a light gauge when compared with the diameter, than with heavy gauge tubes of similar diameters. To prevent collapse of the walls of the tubing, the bending force and supporting pressure for a thin-walled tubing must be applied at a different position in relation to the bending point than for a thick-walled tube of the same outside diameter. As a result of this principle the pressure applied to the walls of thin tubing by means of a correctly designed tube bending machine is greater than that applied to the walls of thick tubing of the same outside diameter.

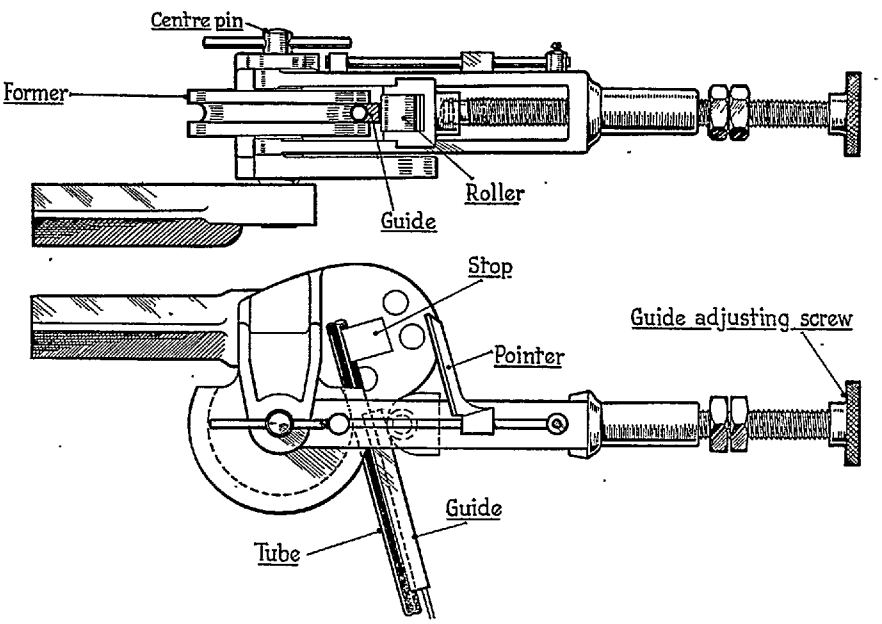

Fig. 1.—Tube bending machine, Type A2

Description

2. There are two types of bending machine in use in the Service, namely the A2 type (see fig. 1, Stores Ref. 3A/626) for bending tubes up to $\frac{7}{8}$ in. dia., and the larger C type (Stores Ref. 3A/642) for tube sizes from 1 in. to 2 in. dia. The two types are the same in principle, the major difference being that the operating lever of the C type is moved by a ratchet arm and pinion working on a circular rack which is mounted on a heavy cast-iron base. The A2 type is described in the following paragraphs.

3. The machine can be secured by bolts to the bench, or the underside of its base-plate may be gripped in a vice. Alternatively the hollow square-shaped lug provided may be held in a pipe vice.

Formers and guides

4. The machine is provided with a set of interchangeable circular formers, grooved to receive different diameters of tubing. The tube is forced round the former by means of a grooved guide which exactly fits the tube and former. A range of guides is provided to correspond with the range of formers. The following are the sizes of guides and formers provided with each type of tube bending machine:—

Machine type	O/d of tube	Outer radius of bend
Type A2 Stores Ref. 3A/626	$\frac{1}{4}$ in.	$1\frac{1}{4}$ in.
	$\frac{5}{16}$ in.	$1\frac{5}{8}$ in.
	$\frac{3}{8}$ in.	$1\frac{13}{16}$ in.
	$\frac{7}{16}$ in.	$2\frac{1}{8}$ in.
	$\frac{1}{2}$ in.	$2\frac{7}{16}$ in.
	$\frac{5}{8}$ in.	$2\frac{3}{4}$ in.
	$\frac{3}{4}$ in.	$3\frac{3}{8}$ in.
	$\frac{7}{8}$ in.	$3\frac{3}{4}$ in.
Type C Stores Ref. 3A/642	1 in.	$4\frac{1}{2}$ in.
	$1\frac{1}{8}$ in.	$4\frac{7}{8}$ in.
	$1\frac{1}{4}$ in.	$5\frac{1}{4}$ in.
	$1\frac{3}{8}$ in.	$5\frac{7}{8}$ in.
	$1\frac{1}{2}$ in.	7 in.
	$1\frac{3}{4}$ in.	$7\frac{3}{4}$ in.
	2 in.	$8\frac{1}{2}$ in.

5. From the above table it will be seen that each former provides for a mean radius of bend equal approximately to four times the diameter of the corresponding tube. The radius given may be regarded in each instance as the safe minimum for the diameter of tube concerned.

6. To remove and exchange the formers, the centre pin (see fig. 1) should be withdrawn and the former slid from between the forks of the bending lever arm. When replacing a former, care should be exercised to ensure that the centre pin is pushed right home before commencing bending operations.

7. Each guide is provided with a handle with which it can be conveniently inserted between the circular former and the roller (see fig. 1) after the tube to be bent has been laid in the groove of the former.

8. An adjustable stop (see fig. 1) is provided to withstand the thrust transmitted to the tube by the operation of bending. The position of the stop should be selected to suit the class of bend to be made.

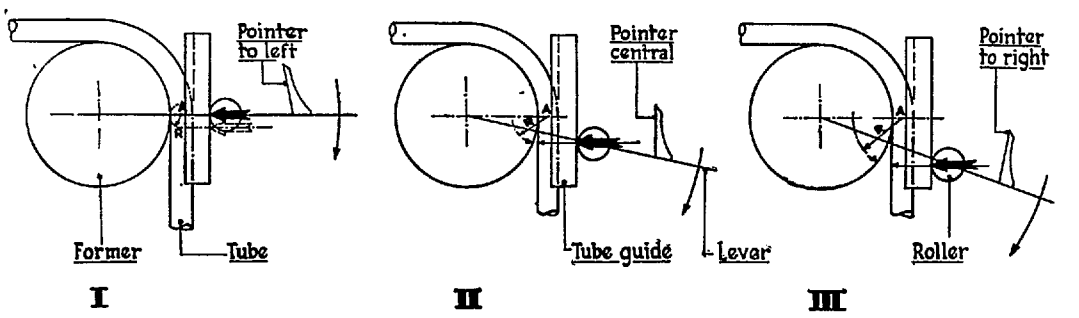

Fig. 2.—Roller settings for tubes of varying thickness

Operation

9. A roller is mounted in a slidable crosshead on the bending lever arm. Rotation of a knurled headed adjusting screw at the end of the lever causes the crosshead and roller to approach, or recede from, the guide and the former. The position taken up by the roller determines the point at which pressure will be applied to the tube (see fig. 2, Sketches I, II and III). A slidable pointer mounted on the bending lever arm, indicates the position of the roller in relation to the guide, tube and former in use on the machine. To use the pointer as an indicator of the roller setting it should be moved until its straight edge lies approximately over the centre of the tube to be bent. With the bending-lever arm pulled lightly towards the operator to take up any slack between the roller, guide, and tube to be bent, the angle of the pointer is noted in relation to the walls of the unbent tube. When the pointer is inclined to the left (see fig. 2, Sketch I) it indicates that the pressure applied to the tube through the roller and guide has approached the limiting position shown in fig. 2, Sketch I. In this position the radius R about which the tube will try to bend from the point A is a minimum and the force required to effect the bending is proportionately great. This is an extreme setting and is used for bending thin walled tubes without forming ripples on the inside radius of the bend. Fig. 2, Sketch III shows the roller withdrawn to allow the bending lever arm to swing forward sufficiently to tilt the pointer to the right. At this setting the radius R is large and the force required to bend the tube will be proportionately small, a condition suited to the bending of thick walled tubes which have less tendency to ripple or form flats. An intermediate setting, with the pointer lying parallel with the walls of the tube to be bent, is shown in fig. 2, Sketch II. This position will be correct for bending tubes with walls of average thickness. It should be noted that a setting similar to that shown in Sketch I should be used to prevent rippling of the inner radius, and the formation of flats on the outer radius of a tube; and that a setting similar to that shown in Sketches II or III should be used if undue squeezing of the tube occurs. The operation of bending must be effected by pulling evenly on the bending lever arm. The tube itself must not be assisted.

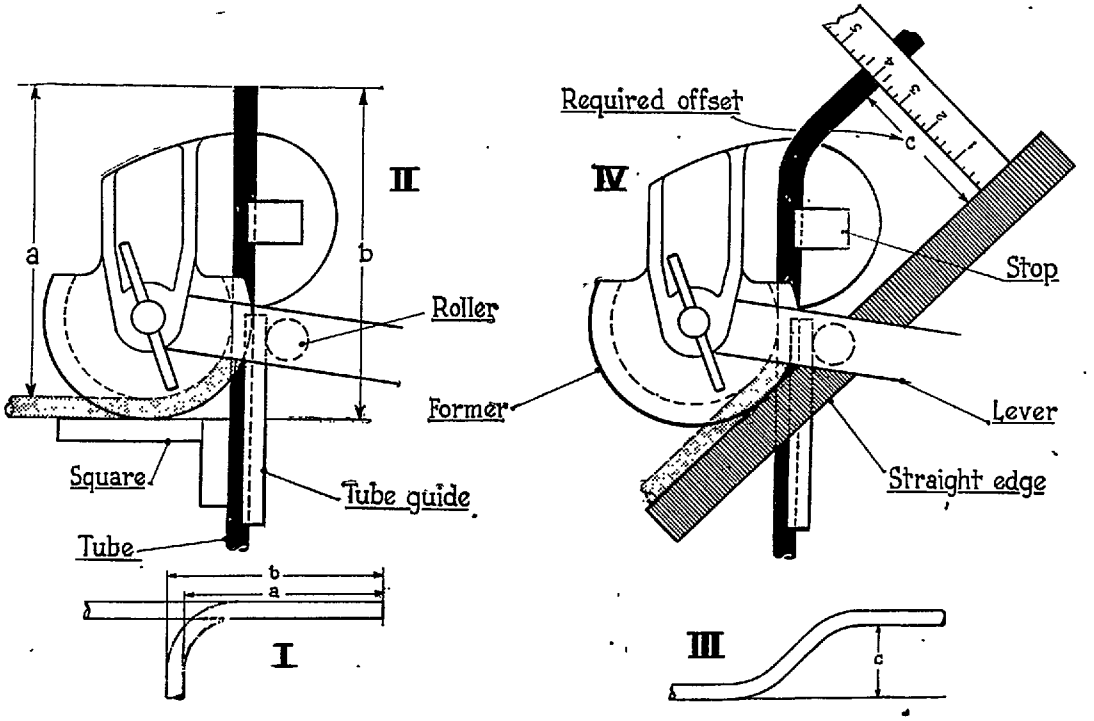

Fig. 3.—Bending tubes to measurements

Bending tubes to measurements

10. The U-section recess machined in the former is equal in depth to the diameter of the tube to be bent. This allows accurate bends to be made to specified dimensions (see fig. 3).

11. To bend a tube at a right angle so that the *outside* edge of the bent portion is a given distance from the tube end, this distance should be marked, with a pencil, on the straight tube at (b) (see fig. 3, Sketch I). With the stock of a set-square held against this mark, the tube should be inserted into the machine in a position such that the blade of the set-square touches the *outer* radius of the former (see fig. 3, Sketch II). In this position the tube will be bent to the required dimension.

12. To bend a tube at a right angle so that the *inside* edge of the bent portion is a given distance from the tube end, this distance should be pencil-marked, on the straight tube at (a) (see fig. 3, Sketch I). With the stock of a set-square held against this mark the tube should be inserted into the machine in a position such that the blade of the set-square touches the *inner* radius of the former.

13. To offset a tube to a specified distance by making adjacent left and right-hand bends (see fig. 3, Sketch III) the first bend (usually of 45°) is made on the bending machine in the normal way. Replace the tube in the machine in the position shown in fig. 3, Sketch IV, and lay a straightedge tangentially to the outer radius of the former and parallel with the part of the tube furthest from the operator. Adjust the tube until the distance between the straightedge and the parallel part of the tube is equal to the required offset (c). At this setting the second bend should be made.

14. When several tubes are to be offset to the same dimensions, the first tube should be marked where it touches the stop when set in position for the completion of the bend (see fig. 3, Sketch IV). Using this tube as a template, all the remaining tubes should be similarly marked after the first bending operation. No further measurement will be required.

Servicing

15. The machine should be kept clean and free from rust or corrosion. The roller should be lubricated and kept free to revolve in its mounting; the crosshead should be lubricated where it slides along the forked bending lever; oil should be applied to the threads of the roller adjusting screw. Guides and formers should be kept clean and readily available for use when required.

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