CHAPTER XVII.

On the Tapering Elbow to be Made in Any Number of Pieces.

The tapering elbow is a fitting occasionally demanded. No doubt in some instances it is best developed by presuming it to be the frustum of a right cone which has been cut obliquely to its axis. This makes every piece of an equal flare throughout, therefore somewhat difficult to connect.

Where the difference in the diameter of the end is not great, the tapering elbow is best developed as so many pieces of an elbow in round pipe, by gradually reducing the diameter of each piece, and compensating for this in the miter seams. There are occasionally instances where a departure from the above is desirable, when we may perhaps secure our patterns by triangulation.

An attempt to show the relation between the ship's ventilator with a round mouth, and the tapering elbow, is somewhat a departure from fixed customs of the past, nevertheless there is close relation if we are allowed to modify the elbow slightly. It has been generally conceded that the right section of each piece in a tapering elbow should be round. However, a slight variation from this would hardly be apparent in some of the larger work if it is made in a considerable number of pieces, i.e., five or more.

The modification spoken of is to make each piece round at each end, and with some method of drawing a side elevation, a problem in close relation to the ship's ventilator is before us. The purpose of the writer is not to prolong this work beyond a reasonable discussion of principles and methods which may be employed to secure the patterns for all forms where triangulation is to be applied. Therefore he will simply attempt to show the relation the tapering elbow may be made to bear to the ship's ventilator with a round mouth.

Since the development of one piece of the ship's ventilator has been explained, the reader should have little difficulty in securing patterns for the tapering elbow, beyond drawing the first diagrams to represent a side elevation. In the specifications for a tapering elbow, we may find a fixed radius of throat, or a fixed radius of back, or it may be required to have an equal flare at back and throat, thus making a fixed radius for the center.

Some Suggestions.

The writer suggests methods as illustrated at Fig. 67 for drawing elevations of tapering elbows. Here it has been presumed that the elbow is to be made in six pieces, and at an angle of 90 degrees. However, it will be readily understood that the number of pieces, or the required angle, will make no material difference in the methods to be pursued, although the inclination of the miter lines will, of course, be dependent upon the angle and number of pieces.

In No. 1 a given radius of throat has been assumed at *A B,* and the arc *B C* drawn with that radius. The miter lines are drawn of indefinite lengths at the same angle that would prevail for an elbow of a constant diameter. Using the same methods that would be employed for an elbow of a constant diameter, the elevations of the pieces at the extremities of the tapering elbow are drawn in positions as shown, thus establishing the lengths of two miter lines, i.e., *m o* and *n p*.

To secure a symmetrical form it is fair to presume that the remaining miter lines, i.e., *d e, f g,* and *h k,* should be of proportionate lengths. These proportionate lengths may be secured in many ways, one of which is shown at No. 4, Fig. 67. In No. 4 the line *D E* is drawn to a length equal to the length of miter line *n p,* and a distance set off from *E* equal to the length of miter line *m o,* as at *F.* The line *F D* is divided into as many parts as there are remaining pieces in the elbow, thus securing points as *1, 2,* and *3.* The upper extremities of the miter lines in No. 1 are now located by setting off from *k* along the miter line *k h,* a distance equal to *E 1* in No. 4; from *g* along the miter line *g f* a distance equal to *E 2,* and from *e* along the line *e d,* a distance equal to *E 3.* With points connected as shown at No. 1, an elevation is completed, when a given radius of throat is demanded.

In No. 2, Fig. 67, a given radius of back is assumed as *G H,* and an arc drawn as shown. The elevations for the pieces at the extremities of the elbow, and the miter lines, are drawn in the same manner as was explained for No. 1. Here it will be apparent that the lower extremities of the miter lines as at *s, t,* and *u,* may be located in positions which suit our fancy, or, in other words, in positions which will give the fitting the best form when finished.

In No. 3, a given radius of center is assumed as *X Y,* and the arc *Y W* drawn as shown. The elevations for the pieces at the extremities of the elbow, and the miter lines are again drawn in positions as shown, and in the same manner as has been suggested for Nos. 1 and 2. Here we use the same lengths of miter lines as was used in No. 1, although points on the arc *Y W* are looked upon as the centers of those lines, i.e., we set off one-half the length of each on either side of the arc *Y W.* By drawing lines to connect points which have been located in this manner upon the miter lines as shown, an elevation is completed.

It will be noted that this gives the fitting a symmetrical

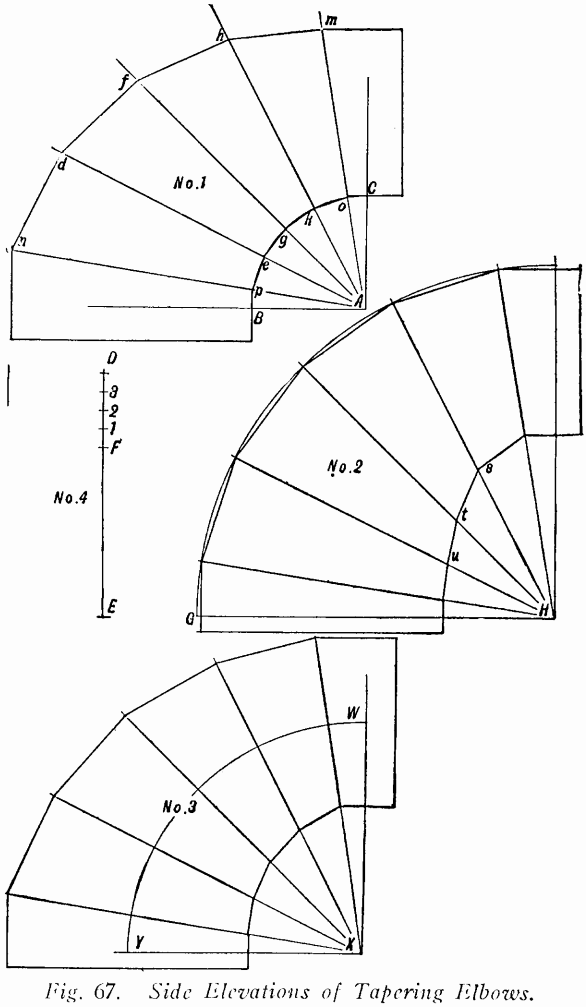

Fig. 67. Side Elevations of Tapering Elbows.

form when viewed from the side, and allows the ends to be comparatively straight for connecting. There is, of course, some slight distortion in these pieces, which is the outcome of making both ends round when not parallel.

Assuming that each piece in the elbows whose elevations are shown in Fig. 67 is to be round at each end, and of diameters equal to the lengths of lines which represent those ends in elevation, we have an exact counterpart of the ship's ventilator when a formula is supplied for a side elevation of that object. To secure the pattern we may proceed in precisely the same manner as has been explained for the ship's ventilator.

In discussing this matter with a man familiar with this class of work, the question was raised: "What shall we do if it is required to make the elbow straight on one side?" The reply was: "If you wish to secure the pattern for an elbow of this class when the ends are what you call 'off center' construct your plans accordingly. This will demand a full plan for each piece, as one-half is not a duplicate of the other. Therefore the complete pattern for each piece must be developed."

To Draw the Plan When the Elbow is to be Straight on One Side.

Fig. 68 is shown in an endeavor to illustrate methods which may be employed to draw the plan when a fitting of this class is required, which is commonly known as "straight on one side." It is, in fact, presumed to represent the piece marked *A* in the elevation for the ship's ventilator, if it was required to make that piece straight on the side furthest from the eye, and with the form and diameter of the ends remaining the same. As will be noted, the elevation is substantially the same as shown in Fig. 65, Chapter XVI.

For the plan a circle is drawn equal in diameter to the length of the base line and in a position as indicated by the vertical projectors. We may now presume the oblique line X Y of the elevation Fig. 68 to be the intersecting line between the vertical plane and a supplementary oblique plane.

Draw in position as shown a circle whose diameter is

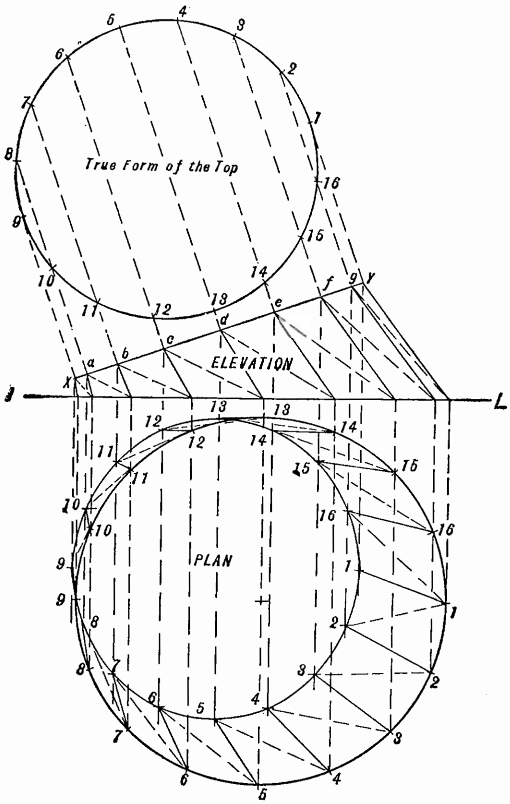

Fig. 68. Methods That May Be Employed to Draw the Plans When a Tapering Elbow Is Required to Be "Straight on One Side."

equal to the length of the oblique line X Y, using care to place it at the same distance above the line X Y as the large circle in plan has been placed below the line I L. This represents the true form of the top. Divide each circle into the same number of equal parts as shown. From the points of division of the circle which represents the true form of the top, project lines to intersect the oblique line *X Y* as shown at points *a, b, c, d,* etc. From these points of intersection, i.e., *a, b, c, d,* etc., draw indefinite lines below and perpendicular to the line *I L*. Points as *a, b, c, d,* etc., may be looked upon as the end elevations of lines which cross the top.

The plans of these lines are some portions of the perpendicular lines drawn below the line *I L* from said points. Since the lengths of these lines are shown in the lines which cross the circle representing the true form of the top, it only remains to locate their extremities in their correct relative positions.

It will be noted that point *d* is in reality an elevation of the line designated as *5 13* upon the true form of the top. The extremities of this line are distant from the vertical plane equal to the lengths of lines *d 5* and *d 13* of the true form of the top. Therefore if we set off below the line *I L* upon line shown at *5 13* of the plan, distances as found from *d* to *5* and *d* to *13* of the true form of the top, those points are located in plan as shown. Continue this operation until each point has been located in plan.

A line traced through these points forms an ellipse, which is a plan of the top and may be numbered as shown. Draw lines between points of the same number located upon the circle and ellipse in plan, and plans of full lines presumed to be upon the surface of the object are secured. When broken lines are drawn as *1 2, 2 3, 16 15, 15 14,* etc., plans of those lines are also secured.

It may be explained that to avoid confusion in the elevation, lines have been drawn in such a manner as to allow one line in elevation to represent two in plan. Having now before us the plan and elevation for each line presumed to be upon the surface of the object, we construct triangles to secure their true lengths in the same manner as was explained for the ship's ventilator. Lines placed upon the plane of development in lengths as found in the diagram of triangles so constructed, and in their correct relative positions, supply points through which lines are traced to secure the pattern.