CHAPTER XV.

A Three Pieced Tapering Elbow.

The solution of the problem here presented should interest the pattern cutter, although the demand for a fitting of this class is limited. An endeavor is made in this example to satisfy a popular demand for something out of the ordinary. Therefore the fitting, as shown in Fig 59, has been presumed to be what is commonly known

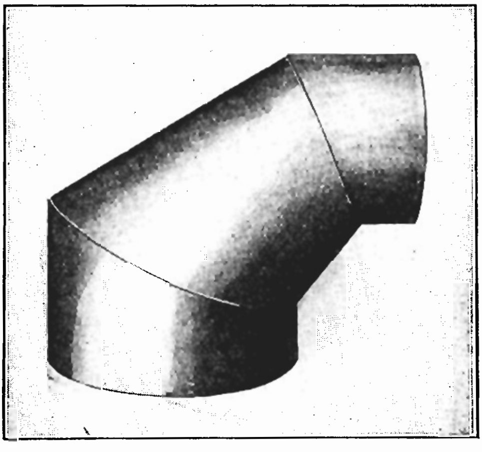

Fig. 59. Photographic View of Three-pieced Tapering Elbow.

as flat on one side. This necessitates the developing of the pattern for the whole irregular portion, as one half cannot be duplicated for the other.

In examples of this nature there are no additional principles to be applied, but it adds to the complication of lines shown in the diagrams. Unless they are given careful attention, no doubt these diagrams will appear complicated. On the other hand, some attention to this will pave the way for one to successfully develop patterns for those objects which have more or less of a distorted form, since some principles as here explained, may be applied to practically all such examples.

The scenographic representation of the object, and the planes within which it is presumed to be situated, as shown at Fig. 60, has been introduced in an endeavor to show to some extent, in a pictorial way, the value and

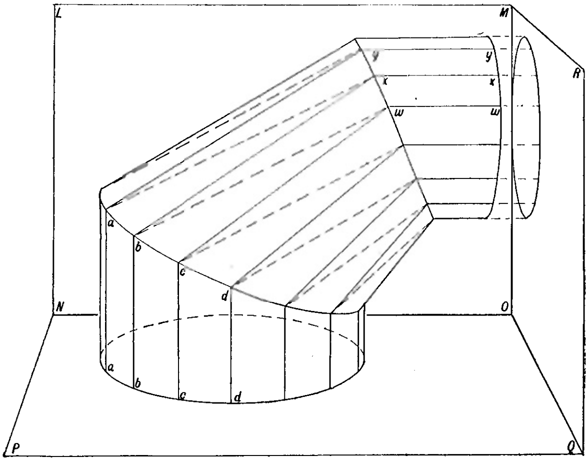

Fig. 60. Scenographic Reproduction of Elbow and Lines Presumed to Be Upon Its Surface, Also the Planes Within Which It Is Presumed to Be Situated.

positions of lines whose plans and elevations are shown in Fig. 61.

It will be noted that the fitting consists of three parts, i.e., there are two round collars placed in positions which are in this instance, at right angles to each other, and one piece forming a center portion. This demonstration deals chiefly with the center portion, since the round collars are but parts of elbows in round pipe of different diameters. The center portion is in reality a transition, or a change of form to make the necessary connection as shown. The ends of this piece are elliptical, since said ends connect cylinders which have been cut obliquely. Therefore we could determine the size and form of the oblique ends of the round pipes or collars, and consider the center portion as a transition whose ends are elliptical and not in parallel planes, although perhaps the more simple course to pursue is as will be here explained.

The Elevation.

The most simple diagram to be drawn which will represent a fitting as illustrated at Fig. 59, is an elevation somewhat as shown at Fig. 61. The author has used the word "somewhat" for the reason that considerable change may be introduced into the fitting and yet employ the same methods of securing its patterns. The positions of the miter lines are by no means arbitrary, although in this instance they have been given the same inclination that would prevail in a three pieced elbow in round pipe.*

The Plan.

Having drawn the diagram to represent the object, which is to some extent a section as shown by the boundary line of the elevation, Fig. 61, the plan may be proceeded with. The large circle in plan is drawn to the diameter of the large collar, and in a position as shown. To secure a plan of the small collar involves somewhat more detail. The small collar in this example is parallel to the horizontal plane, with one end cut obliquely. A plan of the oblique end becomes an ellipse. To secure this ellipse, we presume lines to be upon the surface of the

* If the reader desires information on the development of patterns for elbows in round pipe, he will find that the book "Elbow Patterns for all forms of Pipe" explains this in every detail.

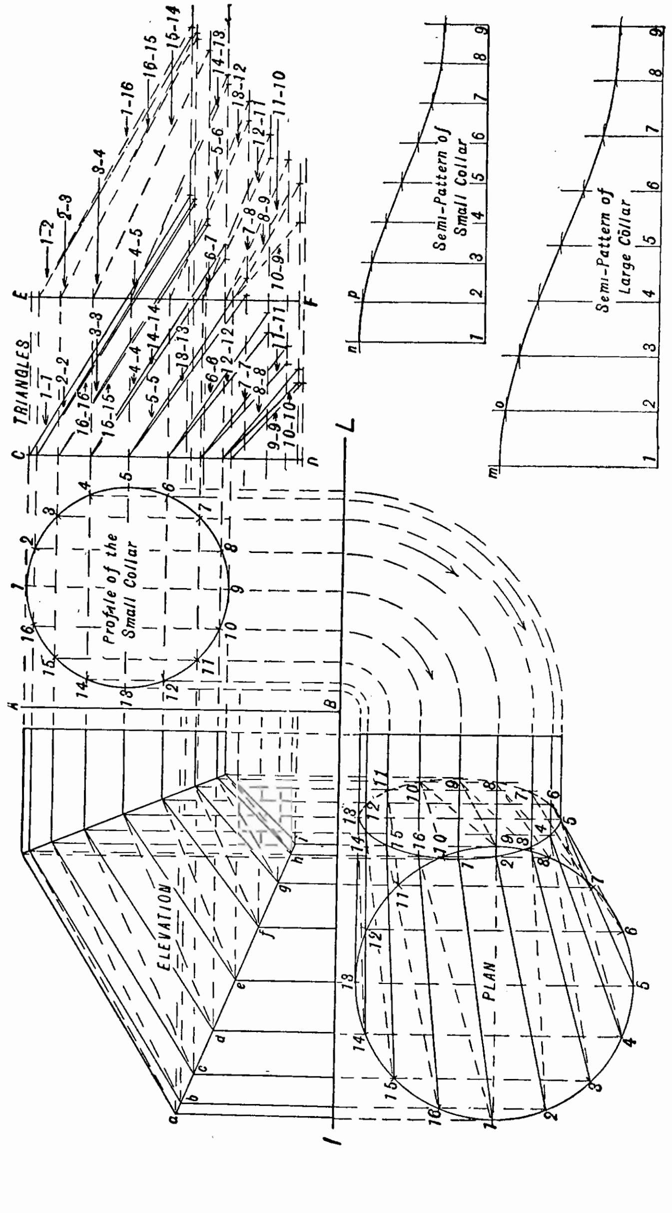

Fig. 61. Plan, Elevation, Diagram of Triangles and Semi-patterns of Round Collars.

collar, and to locate those lines we introduce the profile plane. As for example, a circle is drawn to the right of the elevation whose diameter is equal to the diameter of the small collar, and in a position as shown. For convenience, this circle is divided into an equal number of equal parts, and from said points of division, lines are drawn parallel to line *I L* to intersect the miter line of the small collar. Such lines are known as elements of the cylindrical surface, and their left hand extremities are now points in the ellipse. In other words, those lines terminate at the miter line, since said miter line is looked upon as the edge view of a plane which has cut said cylinder, and since this plane is represented in elevation by a right line, it must be perpendicular to the primitive plane of projection.

From points secured by the intersections of the elements of the cylinder with the miter line, perpendicular lines are drawn of indefinite lengths below the line *I L,* then points in the ellipse must lie in some points along these lines. From what has been explained in previous demonstrations, it should be understood that when the profile of the small collar was drawn, an additional plane was presumed which is known as a profile plane, and the line *A B,* presuming it lies in the plane of the paper, may be looked upon as a vertical axis upon which said profile plane may be presumed to revolve.

This is shown in a pictorial way at Fig. 60, where *L M O N* represents the vertical plane, *N P Q O* the horizontal plane, and *M R Q O* the profile plane. The line *N O* is the intersecting line between the vertical and horizontal planes, while *M O* corresponds to the line *A B* of the elevation, Fig. 61. Since the line *A B* of the elevation lies in the vertical plane, its plan must be a point in line *I L,* as at *B,* Fig. 61. If perpendicular lines be drawn from the points of division of the circle in elevation to intersect line *I L,* said lines must be distant from line *A B* equal to the distance points are from which these lines have been drawn from the primitive vertical plane.

If these distances are revolved about the point *B* upon the horizontal plane, then said distances are located upon that plane. Lines now drawn through these points so revolved, and parallel to the line *I L,* will intersect vertical lines drawn from the miter line in points which are located in the ellipse as at numbered points of that diagram.

Relative Position of the Large Circle in Plan.

It may be explained that the large circle in plan which represents the large collar must be placed in its correct relative position. For example, if the fitting is to be made in two equal halves, then the axis of each collar will be represented in plan at the same distance from line *I L,* but if in an instance as here shown, where one side of the fitting is flat and composed of two unequal parts, then the circle in plan which represents the large collar must be so placed as to allow one side of the fitting to be represented in plan by a line parallel to *I L.*

Presuming lines to have been drawn whose intersections upon the horizontal plane are points in the ellipse, as shown in plan, Fig. 61, we are now in a position to locate lines which are looked upon as being upon the surface of the object, somewhat as follows: Divide the large circle in plan into the same number of equal parts as the small circle of the profile has been divided into. Draw lines from each point of the large circle to a similarly numbered point of the ellipse, as *1 1*, *2 2*, *3 3*, etc. This secures plans of the above spoken of lines. To secure the elevations of said lines, project vertical lines from the points of division of the large circle to intersect the miter line of the large collar in elevation. Lines drawn, as shown by full lines upon the irregular portion in elevation, supplies elevations of those lines whose plans are *1 1, 2 2, 3 3,* etc.

A Practical Demonstration.

If the reader has any difficulty in comprehending this, he is advised to lay out two collars something like those whose semi-patterns are shown in Fig. 61, with a number of equi-distant parallel lines, as shown at *1, 2, 3, 4,* etc., of those patterns. Form them, and secure them in positions as suggested by the diagrams. He may then presume to draw strings between the extremities of the equi-distant lines, using care that the first one is from the longest line of each collar. He will then find that the strings so drawn will include the form for which the pattern is required, and the strings may be looked upon as elements of that surface.

The reader may draw upon his imagination to see this in Fig. 60, where lines as *a a, b b, c c* and *d d* are the equi-distant parallel lines, or elements of the large collar. Lines as *y y, x x,* and *w w* are the equi-distant parallel lines or elements of the small collar, and lines as *a y, b x,* and *c w* represent the strings. As these strings include the surface of the required form, it is evident that we have only to determine the length of each string and the distance they are from each other to develop the pattern.

However, since the strings represented by the full lines will not divide the surface into triangles, we are obliged to introduce additional lengths of string, as shown by the broken lines. These must be represented in plan to secure the pattern from the diagrams. This is accomplished, as will be noted, when the broken lines are drawn as *1 2, 2 3, 3 4,* etc., in Fig. 61.

The True Lengths of Lines.

With the plan and elevation complete as shown at Fig. 61, we now proceed to secure the true lengths of lines presumed to be upon the surface of the object, i.e., we may construct our triangles. This is but a simple operation if it is remembered that the plan of the line supplies the base, and from the elevation the perpendicular is secured. For example, we may draw indefinite horizontal lines through the points of division of the profile as shown. From the intersections of lines presumed to be upon the large collar with its miter line as at *a, b, c, d,* additional horizontal lines are also drawn.

In any convenient position we may draw a perpendicular line as *C D* of the diagram of triangles, and presume the perpendicular of a number of triangles to lie in this line. For example, we select the line *1 1* of the plan and set off its length from *C D* upon the horizontal line drawn from *a* as shown. The point *C* represents the vertical hight of the upper extremity of that line, therefore upon drawing a line as *1 1* of the diagram of triangles, the true length of that line is before us.

This operation must be repeated for each line represented, since there is no guarantee that any two will be of the same length. It should also be remembered that the true lengths of those lines, as *1 2, 2 3, 3 4,* etc., shown as broken lines, must also be secured. This is accomplished in the same general manner as has been explained for the full lines, and shown in the diagram of triangles where the upper extremities terminate at line *E F*.

The Pattern.

To locate lines upon the plane of development which we have presumed to be upon the surface of the object, in their correct lengths and positions, now becomes a simple, although a somewhat prolonged operation. In practice it may be well to develop the pattern as the true lengths are secured. This course will very likely render one less liable to error, inasmuch as each length may be utilized when determined, thereby avoiding to some extent, that complication of lines shown in the diagram of triangles.

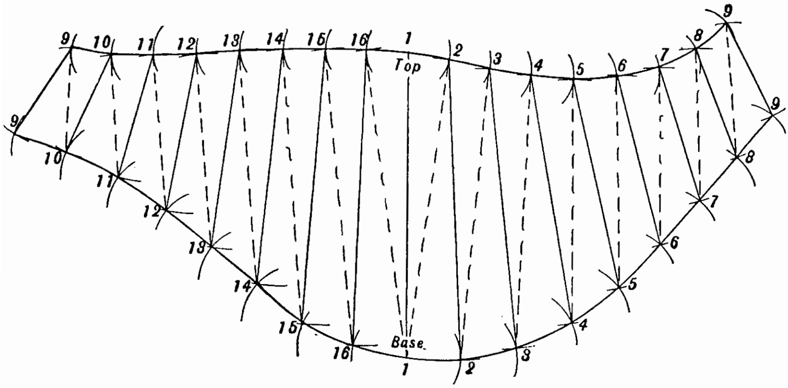

Fig. 62. Pattern for Center Piece of Elbow.

The distance lines are from each other at their extremities is clearly shown upon the mitered ends of the collar patterns, which we shall presume to have been first developed. Since these patterns are but portions of elbows in round pipe, we will pass directly to the pattern for the center piece. In examples of this nature it may be well to first place the longest full line as *1 1* upon the plane of development in its true length, as found in the diagram of triangles. By working each way from this line so located, we may avoid some additional opportunity for error.

No attempt will be made here to describe in detail the method of locating each and every line shown, since that simply involves duplicate operations, as has been frequently explained in foregoing demonstrations. However, we will select a few lines as an example, and if the reader comprehends the methods of locating these, he will have little difficulty in completing the pattern as shown. For example, first draw line *1 1* in its true length upon the plane of development. The lower extremities of line *2 2* and *16 16* are distant from the lower extremity of line *1 1* equal to the distance between elements *1* and *2* at the miter cut of the semi-pattern for the large collar as *m o*, Fig. 61. Therefore we set our compasses to a span equal to the distance between points *m* and *o*, place one point at the lower extremity of line *1 1* of the pattern Fig. 62, and describe small arcs as shown at *16* and *2* at the base. It may be explained that for convenience in this example, that end of the center piece which joins the small collar has been designated as the top, and that portion which joins the large collar as the base.

The upper extremities of line *2 2* and *16 16* are distant from the upper extremity of line *1 1* equal to the distance between points *n* and *p* of the semi-pattern for the small collar, Fig. 61. Therefore we set our compasses to the distance *n p* of the pattern for the small collar, place one point at the upper extremity of line *1 1* of the pattern, Fig. 62, and describe small arcs as shown *2* and *16* at the top. The extremities of lines *2 2* and *16 16* must now lie in some points of these arcs.

To determine the exact location of the above spoken of points the broken lines are employed. In other words, if we can determine the true lengths of lines *1 2* and *1 16* we can definitely locate points *2* and *16* at the top of the pattern. Therefore we set our compasses to a span equal to the length of line *1 2* found in the diagram of triangles, and placing one point at *1* of the base, describe the second small arc as at *2* of the top. With compasses set to a span equal to the true length of line *2 2* found in the diagram of triangles, place one point at *2* of the top of the pattern, and describe the second small arc as shown at *2* of the base. With compasses set to a span equal to the true length of line *16 16,* also found in the diagram of triangles, place one point at *16* of the top and describe the second small arc shown at *16* of the base. Lines may now be drawn as shown at Fig. 62 to complete what may be looked upon as two sections of the pattern for the center piece. To complete the pattern, these operations just described are continued, using each true length found in the diagram of triangles, as is clearly shown by the construction lines.

It will be noted that the broken lines shown in plan upon that portion of the object which lies furthest from the eye, connect points in a reverse order from those shown nearest the eye. This not only allows one line in elevation to represent two lines in reality, but allows us to work both ways from line *1 1* of the pattern.

When the pattern is completed it must be formed in the proper direction to allow it to be placed in position as shown in plan. Care should also be used in connecting the collars, i.e., lines as *1 1, 2 2,* etc., should be continuous, or the fitting will be distorted.