CHAPTER XVIII.

Transitional Elbow in Rectangular Pipe.

There is a demand for the transitional elbow in rectangular pipe in some branches of sheet metal work. To satisfy this demand, passable results may be secured by applying triangulation to the development of its patterns, although the author has never seen an example wherein ideal results were obtained when the throat and heel were cylindrical.

This can be attributed to the fact that a portion of such forms is in close relation to the form known as the Right Helicoid. The Right Helicoid is a warped surface, and cannot be obtained without a drawing or stretching of the material when made from sheet metal.

In the following demonstration it has been presumed that one side of the elbow, or that which is commonly known as one cheek, is to be flat. This has been the case in nine out of ten examples which have come to the author's notice.

Plan and Elevation of the Elbow.

Fig. 69 shows the plan and elevation of an elbow of this class. Here it will be noted that the throat and heel have been cut obliquely, as shown by lines *A B* and *A C* in elevation. The elevation of a short collar at one end is shown by *D A E F,* and *B C G H* is the collar when looking into the other end. The plan clearly shows the throat and heel.

To secure the true lengths of lines presumed to be upon those parts, we divide the curved portion of said

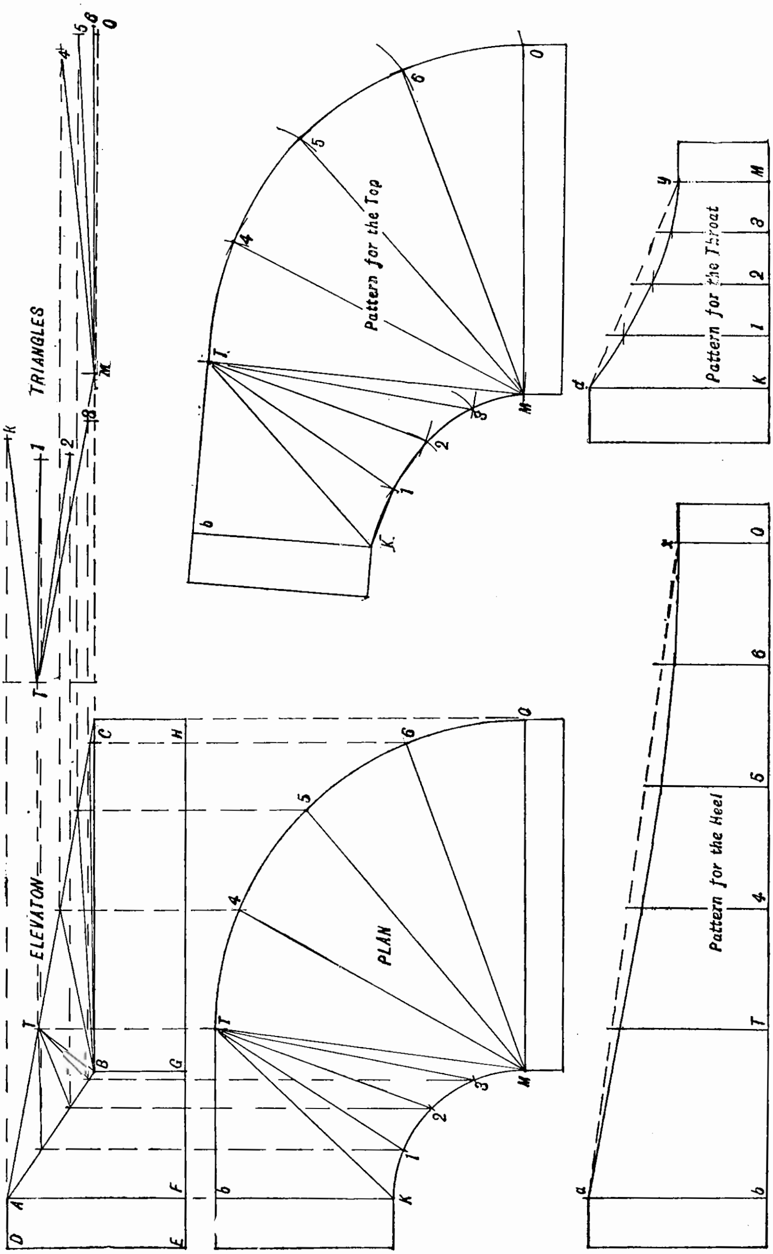

Fig. 69. Plan, Elevation, Triangles and Patterns for a Transitional Elbow in Rectangular Pipe.

lines into convenient parts as shown at *T 4 5 6 0,* and *K 1 2 3 M.* From these points of division lines are projected to intersect the oblique lines *A B* and *A C* of the elevation, as also shown. The patterns for the throat and heel are now secured as for any cylindrical form which has been cut obliquely, i.e., in the same manner that the patterns are secured for an elbow in round pipe. In other words, the above spoken of points of division may be looked upon as plans of elements of the cylindrical surface, and since the plan supplies the distance between these elements, we have only to determine their lengths to develop the patterns for the throat and heel as shown.

The points of division previously located upon the arcs in plan are also utilized as points between which lines are drawn, and presumed to divide the surface of the upper cheek, or top, into triangles. The elevation clearly shows these lines, although in a problem of this class, they are by no means necessary, since measurements may be secured from the patterns for the throat and heel. These lines in elevation may at times be an element in avoiding confusion, and may also be utilized as here shown, to determine the difference in hight of the extremities of lines upon the surface of the elbow of which they are the elevation.

True Lengths of Lines Upon the Top.

Presuming the patterns for the throat and heel to have been secured as shown at Fig. 69, our next work is to determine the true lengths of those lines which cross the upper cheek, and shown in plan at *T K, T 1, T 2, T 3, T M,* also *M 4, M 5, M 6,* and *M 0.* This is accomplished by the use of the right angled triangle as shown in the diagram of triangles Fig. 69, since from the plan we secure the length of base for each triangle, and from the elevation the perpendicular is secured.

It may be here explained that in case the work is large, and it is desirable to avoid making a plan and elevation, we may look upon the lower cheek as a plan, and draw lines upon that surface which shall represent the triangles presumed to be upon the opposite cheek. From the patterns for the throat and heel we can determine the difference in hight of the extremities of those lines, thereby securing the perpendiculars for all triangles.

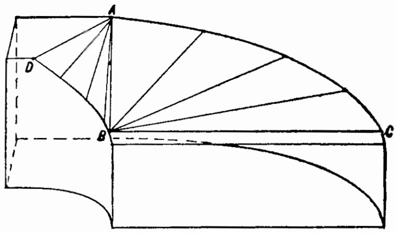

Fig. 70. Scenographic Representation of Elbow in Rectangular Pipe.

These triangles may of course be drawn upon the surface which constitutes the lower cheek, although in this we have constructed separate diagrams. To secure a better understanding of this, the reader may construct his elbow as the patterns are secured, thereby placing a model before him.

Pattern for Upper Cheek or Top.

The pattern for the upper cheek is secured by placing lines in their true lengths and positions upon the plane of development, as shown in the pattern for the top, Fig. 69. As for example, the surface shown in plan at *b K T* is triangular; *b K* is the true length of one side of the triangle, and the true length of *b T* is secured either from the elevation, or from the pattern for the heel. The true length of line *T K* is secured from the diagram of triangles. The true lengths of the four remaining lines radiating from point T are also found in the diagram of triangles. The distance these lines are from each other at the throat is secured from the pattern for that portion. By applying the same reasoning to those lines

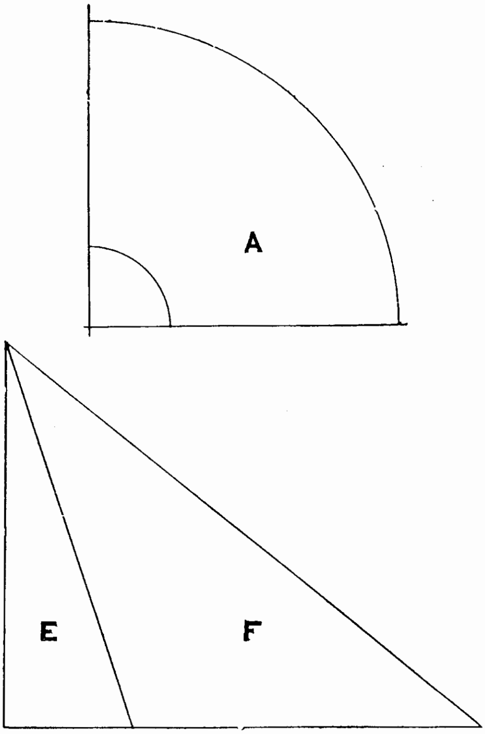

Fig. 71. Parts of Object to Be Constructed as An Experiment.

radiating from point M, it is but a simple operation to develop the pattern for the upper cheek as shown.

Variation in Methods.

The work of securing the patterns for an elbow of this class may be somewhat simplified by cutting the upper edge of the throat and heel upon straight lines, as shown by broken lines *a x* and *d y* of the patterns for the throat and heel, thereby dispensing with an elevation. When this course is pursued, the method of developing the pattern for the upper cheek differs in no material respect, since lines may be located upon those portions which are to form the throat and heel, whose plans will be points *K 1 2 3 M* and *T 4 5 6 0* of the plan as shown.

Breaks or Bends in the Upper Cheek or Top.

Either mode of procedure demands that there be breaks or bends in the material upon lines *A D*, *A B*, and *B C* shown in the scenographic representation of an elbow in

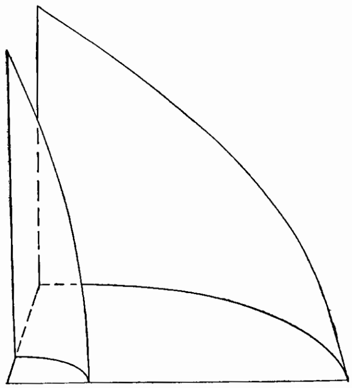

Fig. 72. Object Constructed from Parts Shown in Fig. 71.

Fig. 70. These breaks or bends are the objectionable feature, although difficult to eliminate, especially if the rise is considerable, from the fact that the surface resembles the above spoken of surface, the Right Helicoid.

A Simple Experiment.

If the reader is of an experimental turn of mind, and wishes to prove beyond question the truth of the above statement, he may draw two concentric arcs as shown at *A* Fig. 71, and cut from sheet metal two triangular pieces whose base lengths are equal to the length of the arcs, and whose perpendiculars are equal as shown at *E* and *F*, Fig. 71. Form these triangular pieces so that their bases will conform to the arcs shown at *A*, and construct an object as illustrated at Fig. 72. He may then use any flexible but non-elastic material to cover the space between the two cylindrical forms, and endeavor to fit it to the upper edge of each at the same time, thereby supplying a surface known as the Right Helicoid.

The author has found it a difficult matter to convince the average man that this surface is warped and cannot be developed without a stretching or drawing of the material. He therefore suggests the above experiment as a proof that this surface cannot be developed absolutely, even though triangulation be applied.