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Method to Develop a Bend Consisting of Conical Elements

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Abstract: The paper presents a graphical method to develop the cones the conical bends consist of, using the methods provided by Descriptive Geometry.
Keywords: bend, cone, development, projection, planes, graphic.

1. INTRODUCTION

The bends consisting of conical elements are usually made of iron plates cones having the same conicalness. The following example satisfies this condition.

The graphical method presented in the paper work is easy to be applied in practice if the positions of cones' axes and the intersection points of these axes are known.

As for all graphical methods, the following one may be replaced by an analytical method. The analytical method has the disadvantage of laborious reckonings which are not improving the accuracy of development.

2. EXAMPLE OF BEND'S DEVELOPMENT

Fig. 1 presents an example of conical bend having radius *(R)* and angle *a*. Bend's development can be obtained if it is divided into a basic conical number of elements [1]. The advised number of elements is three for the present example. The number of elements is settled on construction criteria, according to the requested conjugation continuity of the bend.

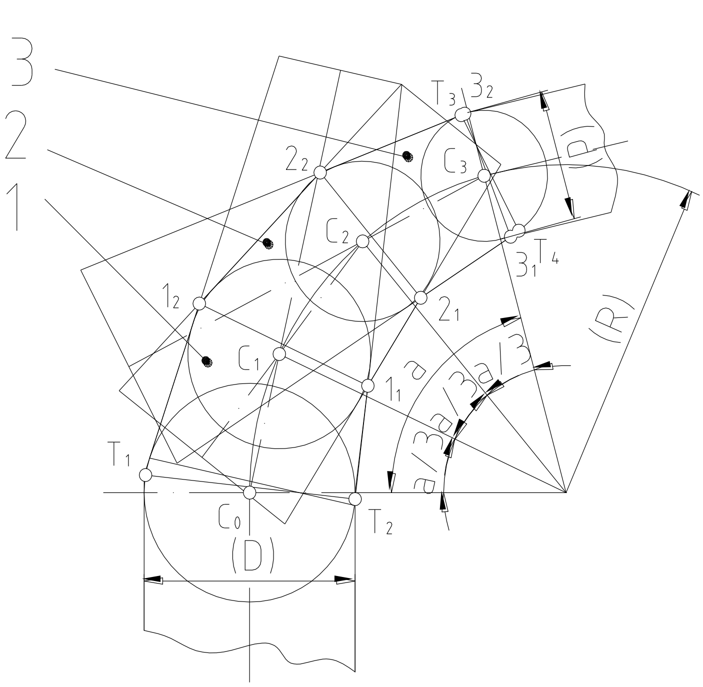

Fig. 1

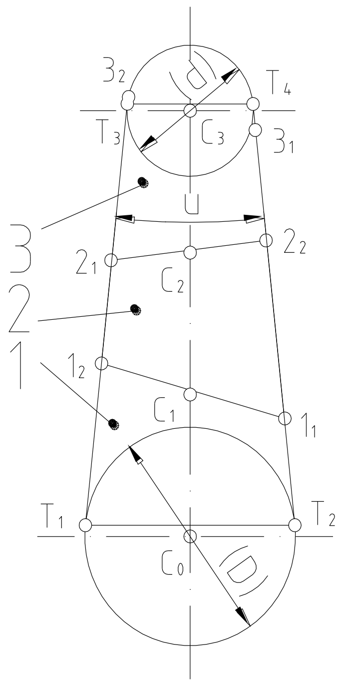

Fig. 2

The lengths of chords *(C_0C_1), (C_1C_2), (C_2C_3)* are measured on a conveniently selected direction, for example the vertical direction.

With the centers in points C_0 and C_3 two circles of diameters *(D)* and respectively *(d)* are plotted.

Draw the tangent lines common to the two circles, which specify the outline of the cone having the vertex angle *u*, the conical bend comes from (fig. 2). Thus obtained cone is plotted in the three selected positions such that chords *(C_0C_1), (C_1C_2), (C_2C_3)* coincide on both Fig. [1].

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In order to control the accuracy of the geometrical construction the spheres plotted with centers in points C_0, C_1, C_2, C_3 must be simultaneously tangent to the generating lines of two adjoining cones, respectively to the cylinders situated in extreme positions.

The different elements the bend consists of (fig. 1) are right circular truncated cones obtained cutting the same cone (fig. 2) with ending planes bent under different angles. The developments of such elements are further explained. In order to plot the developments the true sizes of the geometric elements of the truncated cones obtained when cutting are requested.

Element *1* is similar to a right circular cone cut by an ending plane *[P]* bent under an angle *t* in report to horizontal projection plane [2]. In order to develop its lateral surface, proceed as follows (fig. 3):

- plot the projections on horizontal and vertical projection planes of the cone cut by the ending plane (the cutting is an ellipse);
- select a number (6) of points and draw level planes through these points;
- the true length of generating lines of the cone comes out in the projection on vertical plane *(1'v')* or *(2'v')*;
- the true lengths of generating lines of the truncated cone are found with the help of true length of generating line of the cone *(2'v')*;
- from vertical projections *a'*, *e'*, *f'*, …, *b'* draw horizontal lines intersecting line segment *(2'v')* in points a_0, e_0, f_0, …, b_0;
- the lengths of segments *(*a_0*2')*, *(*e_0*2')*, …, *(*b_0*2')* are the true lengths of generating lines of truncated cone
- in order to develop the truncated cone firstly develop the cone it came from;
- the central angle *c* of the cone is obtained with the help of diameter *(D)* and length of generating line *(G)* of the cone;

$$c = 180^0 D/G \qquad (1)$$

- the length of arc of circle drawn on the development between the two generating lines is equal to the circumference of base circle;

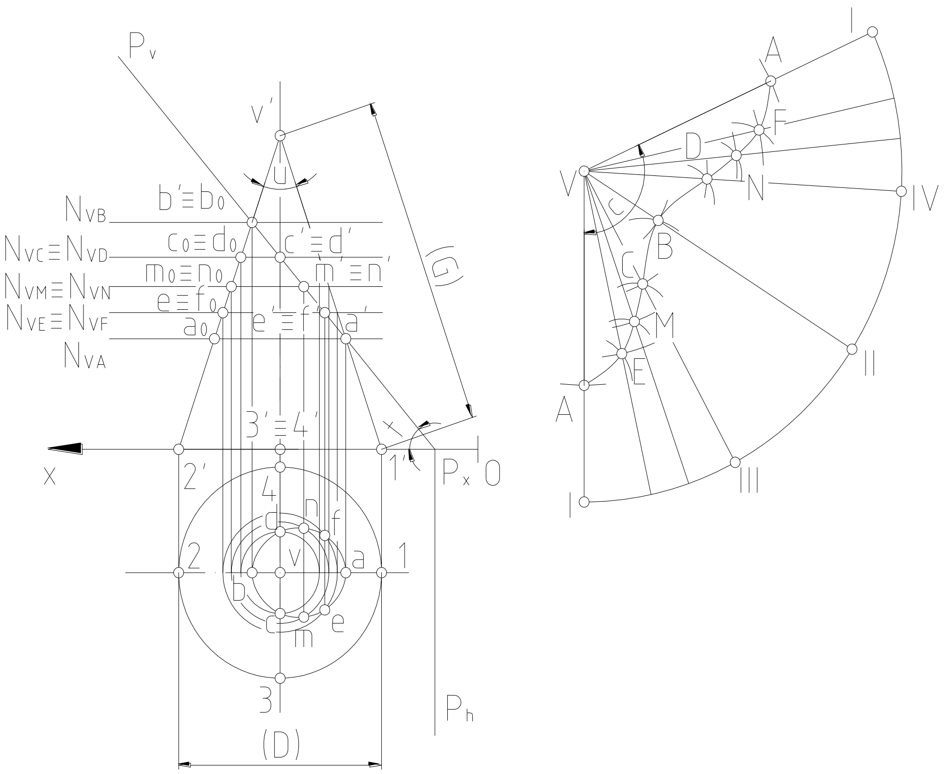

Fig. 3

- on generating line *(VI)* the true length of generating line *(VA)* is measured;
- with center in point *A* and with radius equal to the length of arc of ellipse *(AE)* an arc of circle is drawn;
- with center in point *V* and with radius equal to the length of generating line *(VE)* a second arc of circle is drawn, intersecting the previous one in point *E* on the development;

- the generating line *(VE)* is plotted on the development;
- applying the method previously explained the points describing the ellipse *A*, *E*, *M*, …, *F*, *A* are plotted on the development;
- the lengths of arcs of ellipse may be accurately replaced by the lengths of the adequate subtending chords.

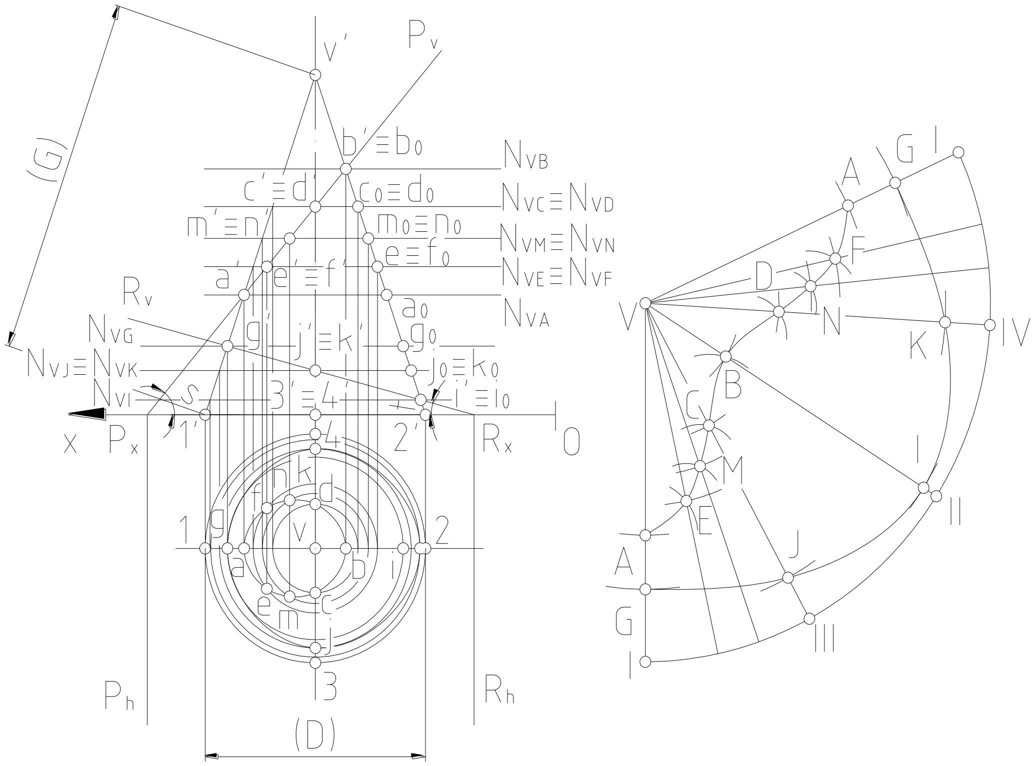

Fig. 4

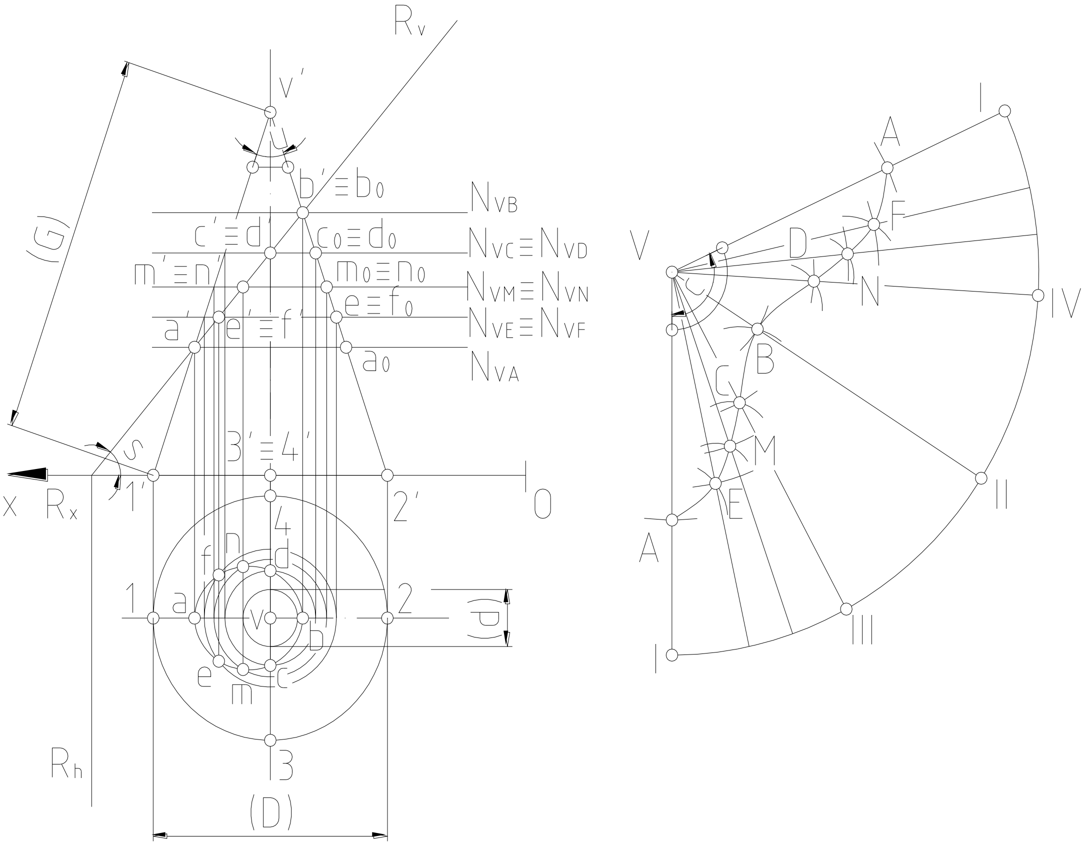

Fig. 5

Element *2* is similar to a right circular cone cut by two ending planes *[P]* and *[R]* bent under angles *t* and *s* in report to horizontal projection plane [4]. In order to develop its lateral surface, proceed analogously as explained for element *1*. In this case the initial cone is cut twice and two ellipses come out this cutting (fig. 4).

Element *3* is similar to a right circular truncated cone cut by an ending plane *[R]* bent under an angle *s* in report to horizontal projection plane [4]. The development of this element is obtained using a method alike the one described for element *1* (fig. 5).

3. CONCLUSIONS

The paper presents an example of a simple bend consisting of three conical elements, but the method may be extended to other bends, consisting of several elements. For each bend dividing it into the appropriate number of simple elements is very important. The number of elements is requested by the conjugation continuity.

Development of bends consisting of conical elements comes to the cases previously described. This thing is possible because conical bends may be divided into a number of elements similar to the mentioned cases.

REFERENCES

[1] *V. L., Dănăilă,* Practical Geometry, 2013, LAP Lambert Academic Publishing, ISBN 978-3-659-19362-0, Saarbrücken, Germany

[2] *V. L., Dănăilă, A. A. Anghel,* Considerations on Some Characteristic Cases of Surfaces Able to be Developed, Proceedings of the 3rd International Conference on Engineering Graphics and Design, Technical University of Cluj-Napoca, 2009, Acta Tchnica Napocensis Publishing, ISSN 1221-5872, Cluj-Napoca, Romania, pp. 51-55

[3] *V. L., Dănăilă,* Dimensioning of the Development Drawings, Proceedings of the 2nd International Conference on Engineering Graphics and Design, Dunărea de Jos University, Galaţi, 2007, Cermi Publishing, ISBN 978-973-7-252-1, Iaşi, Romania, pp. 41-45

[4] *V. L., Dănăilă, A. A. Anghel,* Descriptive Geometry, 2006, Tehnopress Publishing, ISBN 973-702-345-5, Iaşi, Romania

[5] *V. L., Dănăilă, M. Baran, I. Antonescu* Technological Observations about the Display of the Iron Plate Machine Parts, Proceedings of the 1st International Conference on Engineering Graphics and Design, "Politehnica" University, Bucureşti, 2005, Politehnica University Publishing, ISBN 973-685-217-5, Bucureşti, pp. 56-57