METHOD OF DETERMINING THE CURVE OF INTERSECTION BETWEEN A CYLINDRICAL SURFACE AND A TORUS

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Abstract
The intersections of the cylindrical surfaces with a torus are often met in practice, for instance in the pneumatic transport installations for the intermediate products resulted from grist. The descriptive geometry is the foundation of the engineering sciences, giving force looking into space, much necessary to the specialists in this domain. She is the way to solve the problems in design and is one interdisciplinary link in the training of specialists in engineering science.
The general method of construction of the curve of intersection of two surfaces is to find as many of its points, that it can be drawn as accurately. Such points can be found using auxiliary surfaces (plan or spherical), which intersects the firsts. The paper solves graphical one of these applications, using the classical method of the descriptive geometry.

Keywords: cylinder, torus, intersection, surface, curve

1. INTRODUCTION

The descriptive geometry is the foundation of the engineering sciences, giving force looking into space, much necessary to the specialists in this domain.
The general method of construction of the curve of intersection of two surfaces is to find as many of its points, that it can be drawn as accurately. Such points can be found using auxiliary surfaces (plan or spherical), which intersects the firsts. The objective of the paper is the finding the intersection curve between a torus and a cylinder. Such surfaces intersections are met in the industrial practice, an example being the pneumatic transport installation for the intermediate products, resulted from the milling (fig. 1). As noted in the figure 1, the problem is reduced at the intersection between a right circular cylinder (with horizontal axis) and a quarter of a torus.
The proposed method for determining the curve of intersection, between cylinder and torus is the spherical surfaces method, less used method in practice.
This method requires the inclusion of a sphere having the centre in the point of intersection of the axes; it can be considered coaxial with either of the two coaxial surfaces.

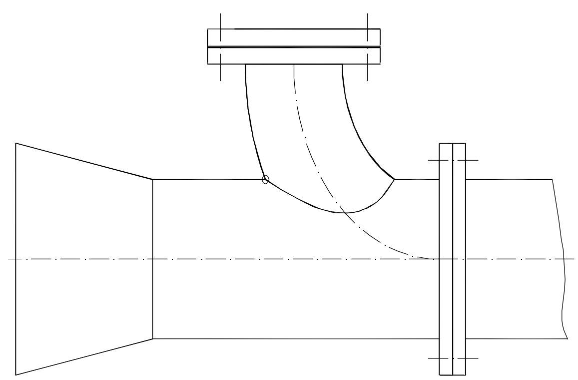

Fig.1. Standardized horizontal receiver of an installation of pneumatic transport

2. MATERIAL AND METHODS

The spherical surfaces method consists in inscribe a sphere, having the centre in the point of intersection of the axes; it can be considered coaxial with either of the two surfaces.
In practice we can distinguish three cases, as the cylinder diameter is smaller, equal or larger than the diameter of the circle, which generates torus.

2.1. The case of the torus having larger diameter than the cylinder

In the figure 2, the two apparent contour generators of the cylinder intersect the larger circle of the torus in the points a 'and b', belonging to the curve.

The spheres method applies only when the axes of the two corps are intersected. It is therefore an element of torus is taken, for instance, the element whose long arc is $a^{'} - 1_1$.

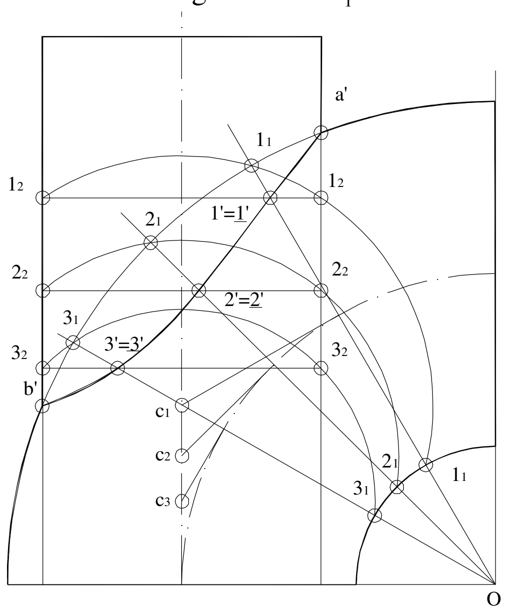

Figure 2. Torus having larger diameter than the cylinder

This element can be considered as a right cylinder and therefore its axis must be perpendicular on base, which is in this projection the segment $1_1 - 1_1$. This perpendicular intersects the cylinder axis at the point c_1. The distance from c_1 to 1_1 is the radius of the sphere which can be traced.

This sphere intersects the torus after the circle $1_1 - 1_1$ and the cylinder after the circle $1_2 - 1_2$. The intersection of the two circles determines the projections $1' \equiv \underline{1}'$. With the second element of torus, considered a cylinder, we trace its axis perpendicular on its base, which is the segment $2_1 - 2_1$. This perpendicular will intersect the cylinder axis in c_2. The distance $c_2 - 2_1$ will be the radius of the second sphere. This sphere intersects the torus after the circle $2_2 - 2_2$. The intersection of the two circles determines the projections $2' \equiv \underline{2}'$.

We take the third element of torus, too, that we consider a cylinder, and we trace, similarly, the axis perpendicular on its base, namely on the segment $3_1 - 3_1$. Its point of intersection with the cylinder axis is c_3. The distance $c_3 - 3_1$ will be the radius of the last sphere, which we trace. It intersects the torus after the circle $3_1 - 3_1$ and the cylinder after the circle $3_2 - 3_2$, obtaining the points $3' \equiv \underline{3}'$.

2.2. The case of torus having diameter equal with the cylinder

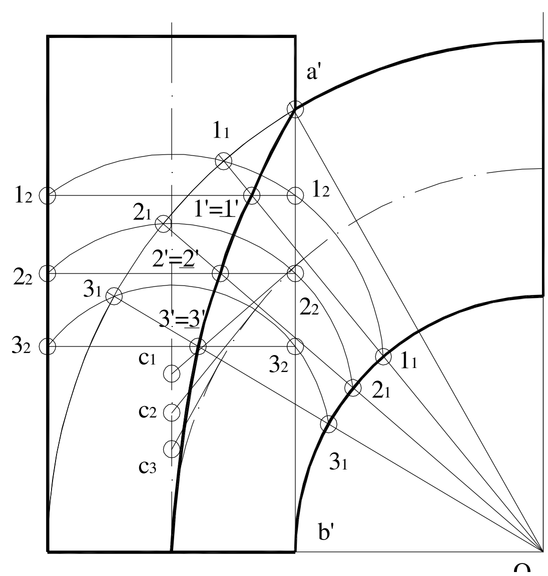

Figure 3. Torus having diameter equal with the cylinder

In the figure 3, where the diameter of the generator circle is equal with the diameter of the cylinder, we proceed in a similar manner described above, resulting the centers of the spheres and the projections $1' \equiv \underline{1}'$, $2' \equiv \underline{2}'$ and $3' \equiv \underline{3}'$, which, together with the return point a' and the point $e' \equiv \underline{e}'$, determines the projection of the curve.

2.3. The case of the torus having smaller diameter than the cylinder

In the figure 4, where the diameter of the generator circle is smaller than the diameter of the cylinder, we proceed in a similar manner described above, resulting the centers of the spheres and the projections $1'\equiv \underline{1}'$, $2'\equiv \underline{2}'$ and $3'\equiv \underline{3}'$, which, together with the return point a' and b', determines the projection of the curve.

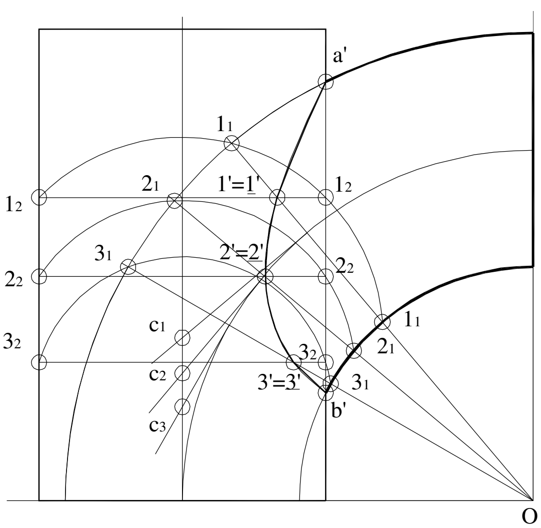

Figure 4. Torus having smaller diameter than the cylinder

3. CONCLUSION

The spheres method has a great practical importance in solving of some technical problems, as such connecting pipes of different diameters.

The descriptive geometry is the way to solve the problems in design and is one interdisciplinary link in the training of specialists in engineering science.

4. REFERENCES

[1] Husein, Gh., Mănescu, M., - Geometrie descriptivă, Universitatea Ploieşti, 1993;

[2] Botnărăscu, H., - Geometrie descriptivă, Universitatea Ploieşti, 1979;

[3] Ivănceanu, T., Şofronescu, E., Geometrie descriptivă, Ed. Didactică şi Pedagogică, Bucureşti,

[4] Matei, Al., Geometrie descriptivă, Ed.Tehnică, Bucureşti, 1982.