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Profiling disk tool for generating female rotor screw compressor component by meaning of graphical method

Popa Camelia Lăcrămioara[a,]*, Popa Viorel[a]

[a] *"Dunărea de Jos" University of Galati, 800008, Romania*

Abstract

The paper proposes a method of profiling the disk tool generating the helical groove of the female rotor of the compressor, on the basis of a complementary theorem of enveloping surfaces, e.g. theorem "Substitution Circles Family", whose principles are developed in analytical way. On the basis of this theorem is proposed a method developed in the graphical environment Auto-CAD, in purpose to design the disk tool for profiling the female rotor and also to determinate the front view profile of this rotor, screw compressor component. Has been also detailed a numerical example for a known built compressor.

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Keywords: screw compressor; enveloping complementary theorems; enveloping condition; helical surfaces.

1. Introduction

Helical female rotor, screw compressors component, with elliptical front profile represents an embodiment of compressors circular profile.

Front profiles of helical rotors are profiles associated with circular centrodes in rolling motion and each other enveloping in this process.

By analytical setting one of the two profiles, usually the male rotor, is determined the front profile of female rotor, under guidance of the theorem I Olivier, or theorem Gohman [1],[2]. The theorem Willis [1] can also be used

* Corresponding author. Tel.: +40-724-125-999.
E-mail address: lpopa@ugal.ro

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in solving this problem. Knowing the analytical or numerical form of the male rotor front profile, will lead to generation the helical surface, cylindrical and constant pitch, of this rotor; the disk tool will be profiled on the basis of the theorem I Olivier [1], starting from this surface.

The both complementary theorems of enveloping surfaces, as "The Minimum Distance Method" [3], [4] and "Substitution Circles Family Method" [4], can also be used.

Applications based on these methods can be developed, using the graphical environments such as AutoCAD [4], or Catia [5],[6].

The front view profile of male rotor is designed according to Fig.1.

The reference systems will be as follows:

$X_1Y_1Z_1$i- mobile system jointed with the centrode C_1, which belongs to the front view of the male rotor;

$X_2Y_2Z_2$ -mobile system jointed with the centrode C_2, which belongs to the front view of the female rotor;

$x_1y_1z_1$ - the global system, z_1 axis is overlapped with the male rotor axis;

$x_2y_2z_2$ – global system, z_2 axis is overlapped with the female rotor axis.

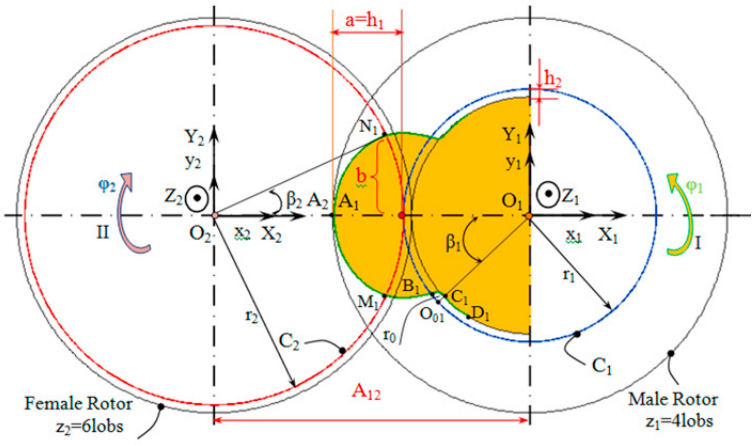

Fig. 1. Front view of profiles of rotors, compressor components, of elliptic shape.

C_1 and C_2, are the two centrodes associated with the front profiles of the two rotors.

The relative movement of the system $X_1Y_1\ Z_1$, related to system $X_2Y_2\ Z_2$ is described by coordinates transformation:

$$X_2 = \omega_3(-\phi_2)\left[\omega_3^T(\phi_1)X_1 + \begin{Vmatrix} A_{12} \\ 0 \end{Vmatrix}\right], \tag{1}$$

where A_{12} is the distance between the rotation axis of the two centrodes,

$$A_{12} = r_1 + r_2 \tag{2}$$

Front view profile of male rotor is made up of assemblies of arcs, as follows:

The arc $\overset{\frown}{N_1A_1M_1}$ is an arc of elliptical shape, with semi-axis **a** and **b** (**a** small semi-axis) defined by the equation as follows:

$$\begin{vmatrix} X_1 = -a\cos\theta - r; \\ Y_1 = +b\sin\theta. \end{vmatrix} \tag{3}$$