AESTHETIC SURFACES BASED ON EPICYCLOIDS AND ORTHOCYCLOIDS, GENERATED BY VIBRO-ROLLING

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Abstract. In this paper are presented the procedures at vibro-rolling by which can be obtained surfaces that have flaws with regular forms with particularly aesthetic appearance. These surfaces may be exterior surfaces of some products, such as should be aesthetic, too.

For surfaces in contact with relative motions certain relief's benefit lubricant penetration. Processing by vibro-rolling allows obtaining surfaces with particularly shapes but with some flutes that permit easy penetration of lubricant. For achieving this study, the epicycloids and orthocycloids generation principles and the turning process possibilities are used.

Kinematics generation of some elongated epicycloids and orthocycloids allow the approximation of some sections for pieces turned processed. Using the method of generation by epicycloids is advantageously because decreases the processing time for some gross production pieces. The established relations permit the designing of such devices. The experimental model permitted the testing of theoretical views.

This paper presents the adequate relations for designing and they are provided examples. In addition, it is verified the solutions by means experimental model.

Keywords: vibro-rolling, orthocycloid, epicycloids, aesthetic surfaces

1. Introduction

The pieces processed by cutting have more surfaces which are equipped with different roughness.

By fitting, some surfaces remain external surfaces of subassemblies or products and other form fits with matting members.

These surfaces which remain at exterior must be protected against corrosion but, must have special aesthetic forms.

These surfaces are galvanic coatings or dyed.

Because of aesthetic reasons, some of external surfaces by vibro-rolling are obtained since traces of tool rolls are symmetrical and aesthetic.

The surfaces that come in contact with matting surfaces so that between them have held relative motions to allow penetration of lubricants and for resist at corrosion must have high durability.

Because of these reasons and depending on required accuracy for assembly, the adequate roughness is established.

Many researchers have studied vibro-rolling so, in [1] processing by vibro-rolling of outer cylindrical surface and in [2] plant for superfinishing by vibro-rolling is presented.

In [3] the superfinish flat surfaces by vibro-rolling are investigated.

In [4] studies the phenomena of the rolling wheels on railway wagons. In [5] shows how to finish a surface vibro-rolled with the help of rotating brushes.

In figure 1 aesthetic surfaces obtained by vibro-rolling on outer cylindrical surfaces are shown and in figure 2 on flat surfaces are presented [6].

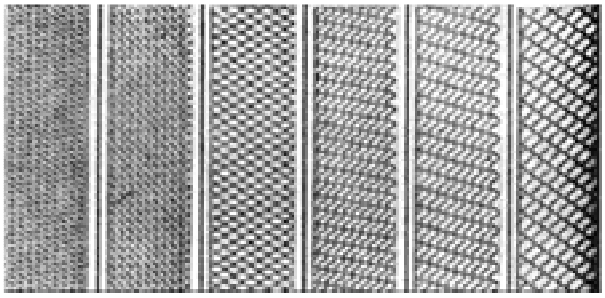
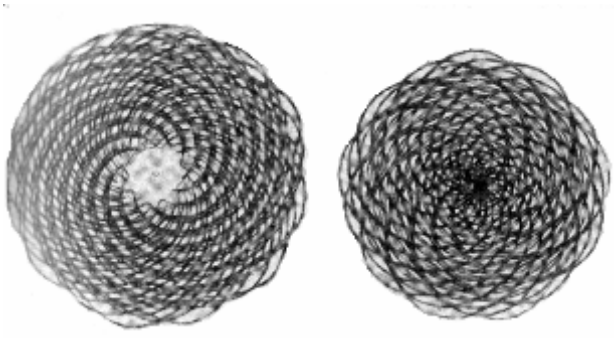


Figure 1. Aesthetic surfaces obtained by vibro-rolling on outer cylindrical surfaces



a b.

Figure 2. Aesthetic surfaces obtained by vibro-rolling on flat surfaces

2. Kinematics generation of some surfaces obtained by vibro-rolling

Shapes of analogous surfaces like those from figure 1 and 2 achieved by kinematics generation with programmes based on curves equations can be obtained.

Practical performing can be made with special devices generally based on gearings.

2.1. Surfaces based on epicycloids

If one the base circle with r_1 radius (figure 3) rolls without slipping the pitch line with r_2 radius, then the points will describe a normal epicycloids, the point E – elongated one, and point C-shortened one.

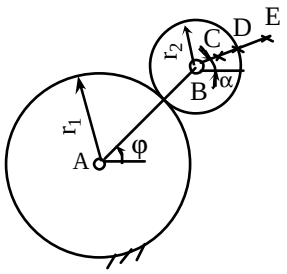


Figure 3. Scheme for generating of a epicycloids

Noting: $a = r_1 + r_2$ and $r_1 = r_2 \cdot n$, having b distance from B to tracer point (C, D or E) following epicycloids equations can be established:

$$x = a \cdot \cos\varphi + b \cdot \cos\alpha \quad (1)$$

$$y = a \cdot \sin\varphi + b \cdot \sin\alpha \quad (2)$$

Surfaces with certain uniformity of micro-irregularities and with special aesthetic can be generated by using epicycloids.

Based on these relationships and with using a program following surfaces have been drawn (figures 4-9). The values of parameters are presented on figures. Only normal epicycloids have been plotted.

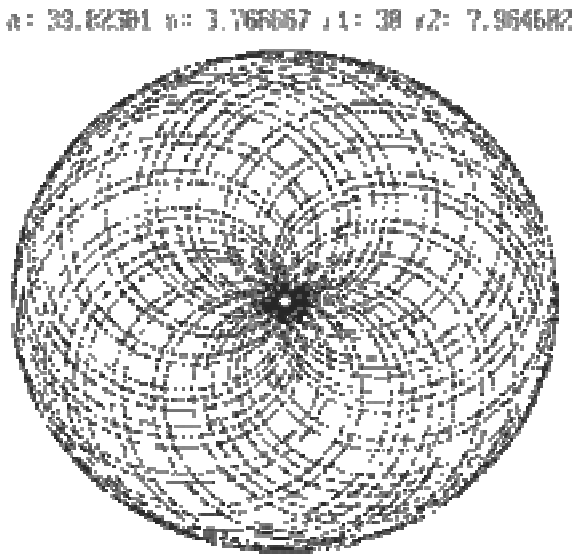


Figure 4. A surface obtained by epicycloids

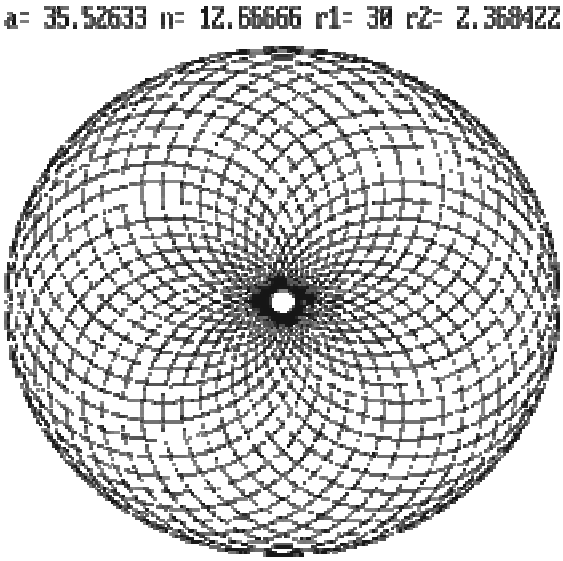


Figure 5. A surface obtained by epicycloids

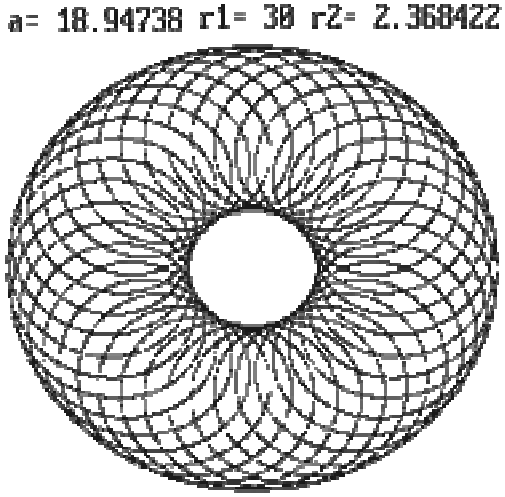


Figure 6. Surface achieved through epicycloids

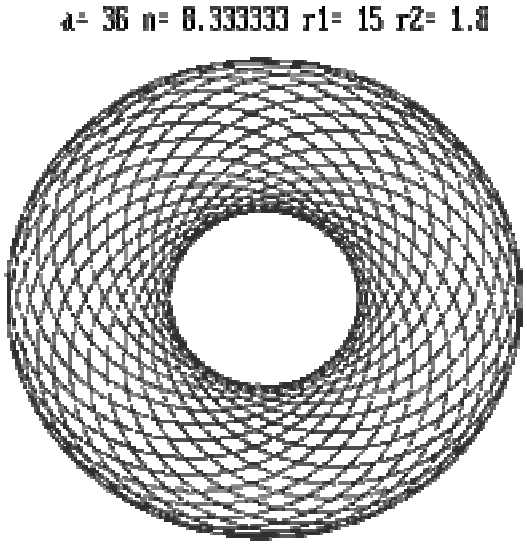


Figure 7. A surface achieved by epicycloids

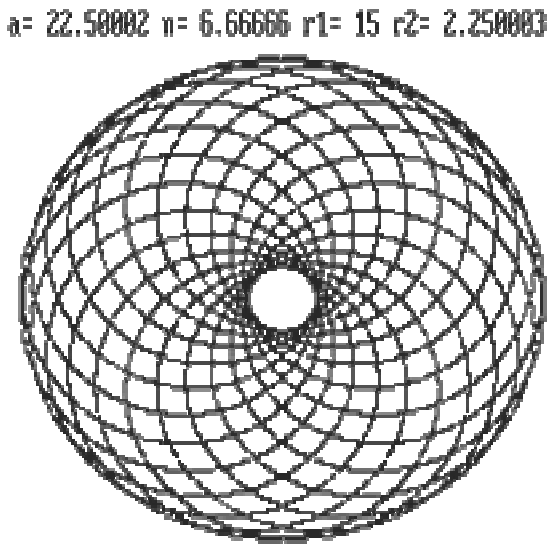


Figure 8. A surface obtained by epicycloids

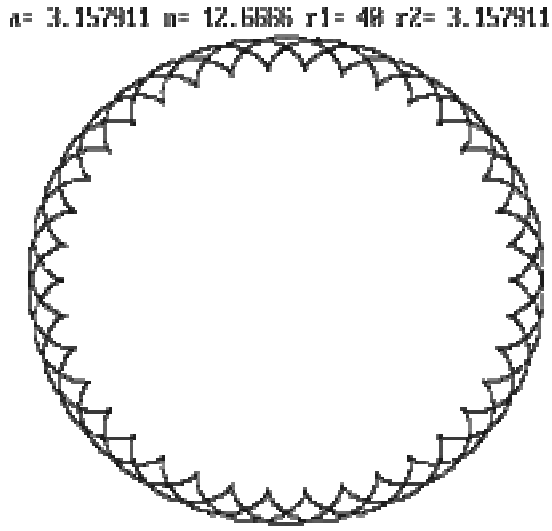


Figure 9. A surface obtained by epicycloids

At these surfaces, the empty areas from the middle can be bores.

It can be observed that generated surfaces perform requisites of easy lubrication and great aesthetics.

2.2. Surfaces based on orthocycloids

Circle with centre in A, figure 10, rolls up without slipping on the EG right.

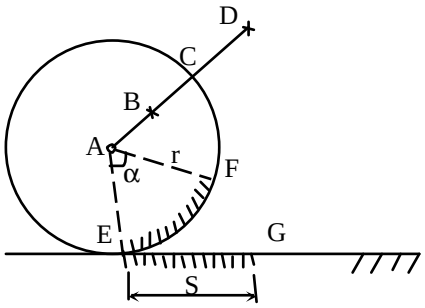


Figure 10. Scheme for generating of an orthocycloid

Followings relationships are used:

$$S = r \cdot \alpha \quad (3)$$

$$x = S + r \cdot \cos\alpha \quad (4)$$

$$y = r + r \cdot \sin\alpha \quad (5)$$

While running the point C will describe a normal orthocycloid (figure 11), D point-one elongated (figure 12), and B point-a shortened one (figure 13).

Figure 11. Normal orthocycloid described by C point

Figure 12. Elongated orthocycloid desribed by point D

Figure 13. Shortened orthocycloid desribed by point B

In figure 14 a surface formed by successive positions of the cranes (orthocycloid points are superimposed on some points of the diagram).

This surface is available as shape and has a great aesthetic.

A normal orthocycloid with r = 30 mm has been plotted.

It can be noticed that these surfaces perform the requested conditions about aesthetics and controlled lubrication.

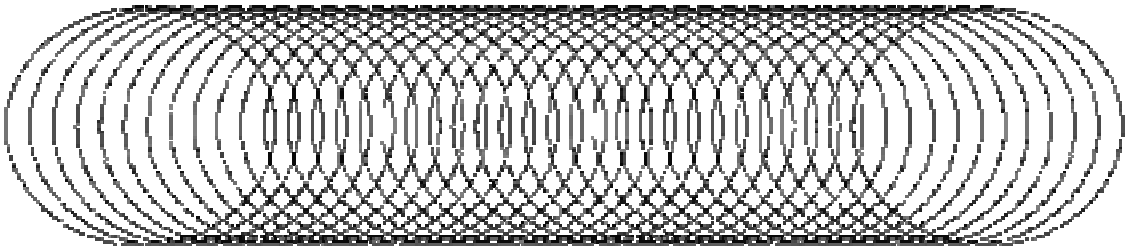


Figure 14.Orthocycloid formed by successive positions of the cranes

3. Conclusions

- ✓ Some surfaces of pieces must have aesthetics forms, too.
- ✓ Other surfaces of pieces must have certain flutes which benefit lubricant penetration.
- ✓ Such surfaces can be obtained by vibro-rolling.
- ✓ Kinematics, such surfaces can be obtained based on generation methods of some cyclic curves exemplified in this study by epicycloids and orthocycloids.

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