

A METHOD FOR PROCESSING CHAMBER PROFILE EPITROCHOIDAL FOR WANKEL ENGINE, USING THE ELLIPTIC TOOL BY A MACHINE COMPUTER

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Abstract— This work presents a new personal method of precise machining for processing chamber volumetric Wankel engine with cutting tools or final polishing, the roughness required by the manufacturer, using Program MATLAB words.

Keywords—machining, volumetric chamber

I. INTRODUCTION

A METHOD for processing chamber profile epitrochoidal Wankel engine, the elliptic tool using a computer MATLAB program, we have designed a method of processing very accurate profile cylindrical section epitrochoidal chamber at Wankel engine.

In Fig. 1 below, one can see the following mathematical relationships that underlie the process or method of processing Epitrochoid room, Wankel engine.

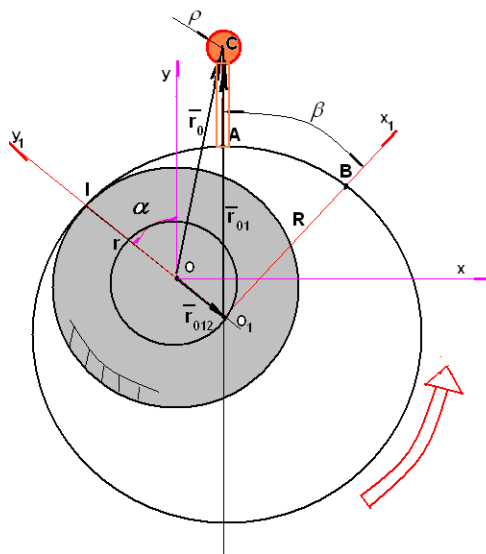


Fig. 1. Determination of kinematic equations that underlie the piston rotation

$$e = R/3 = \text{const.}$$

$$\overline{O_1C} = R + 20 = \text{const.}$$

$$\vec{r}_0 = \vec{r}_{01} + \vec{r}_{012}; \quad (1)$$

$$\begin{cases} \vec{r}_{012} = e \cdot \sin \alpha \cdot \vec{i} + e \cdot \cos \alpha \cdot \vec{j} \\ \vec{r}_{01} = a \cdot \cos \beta \cdot \cos \alpha \cdot \vec{i} + a \cdot \sin \beta \cdot \sin \alpha \cdot \vec{j}; \end{cases} \quad (2)$$

$$\vec{r}_0 = (e \cdot \sin \alpha + a \cdot \cos \beta \cdot \cos \alpha) \cdot \vec{i} + (e \cdot \cos \alpha + a \cdot \sin \beta \cdot \sin \alpha) \cdot \vec{j}; \quad (3)$$

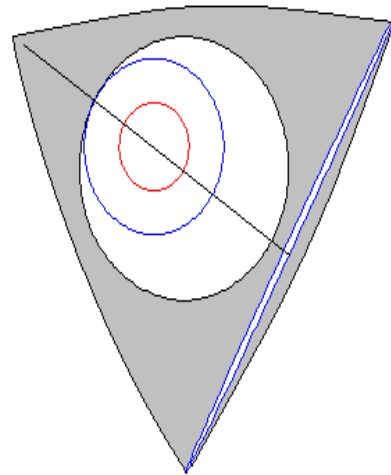


Fig. 2. Position the ellipse manufacturing on the triangular piston

The cutting tool to be machined, is placed on top of an ellipse, as shown in Figure 1, starting position elliptical processing tool since working here.

Machined tool may be turning knife or rectifier stone or a diamond tip that accurately corrected, right profile section of the working chamber.

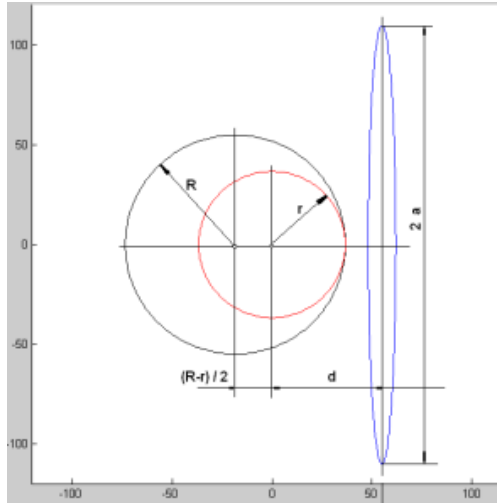


Fig. 3. The design that makes MATLAB

Sealing rings transversely seal should gasses, without moving in the radial direction in their slots. At high speed, it would compromise the seal. Until now, processing epitrochoidal profile was machined with a tool that materializes triangular plunger tip according to Figure 2.

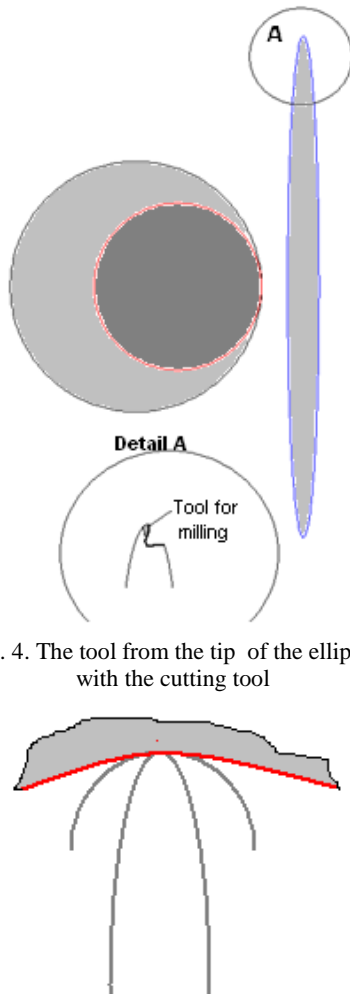


Fig. 4. The tool from the tip of the ellipse, with the cutting tool

Fig. 5. Elliptical profile is better than the circle

If we analyze the kinematics equations, written in mathematical language (1) (2) and (3), and then reprinted in the MATLAB Program, we not see that major difficulties in adapting the specific language of a numerical control machine tool.

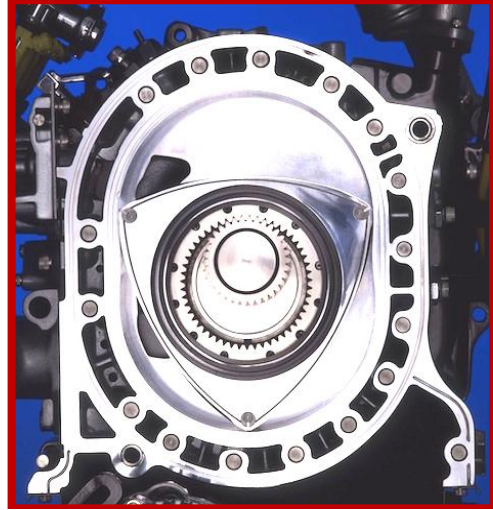


Fig. 6. The principle of the Wankel engine operation

I, by presenting the original works to be understood Wankel engine manufacturers, and if you want more technical explanations, I will be most happy to discussions on this method of processing, Wankel engine room.

Wankel rotary piston engine, is best known rotary piston engine worldwide. Triangular Wankel piston is circulated inside the explosion chamber, Epitrochoid shape, the rotation of the piston triangular by means of a shaft coaxial to the motor, the motor shaft is even. Triangular Wankel piston, is coaxial with the piston, a cylinder in which is mounted a toothed crown inside. This toothed crown inside than rolls more than one tooth gear, with the ratio 3/2, small sprocket is fixed to side wall of the Wankel engine.

Through a MATLAB program, we determined the inner gear ratio 3:2 gear meshing according Wankel, interior gear Otherwise is fix and inner tread crown rotates together with the piston, Fig. 4.

By adapting this process for new Wankel engine room on a work program of a machine tool with automatic work program, can process accurate, micron, because the cutting tool tip radius is not well-rounded defined, but is elliptical, it is always enter into the rounded profile above, Fig. 5.

A. Great circle mobile equation in MATLAB

$$x(j) = R \cdot \cos(\theta(j)) \cdot \sin(\phi(i) - R \sin(\theta(j) \cos(\phi(i)) + \frac{R}{3} \sin(-3 \frac{\pi}{2} + \phi(i)); \quad (4)$$

$$y(j) = R \cdot \cos(\theta(j)) \cdot \cos(\phi(i) + R \sin(\theta(j) \sin(\phi(i)) - \frac{R}{3} \cos(-3 \frac{\pi}{6} + \phi(i)) \quad (5)$$

B. Small circle fixed equation in MATLAB

$$\begin{aligned} u(j) &= 2\frac{R}{3}\cos(\theta(j)) \\ v(j) &= 2\frac{R}{3}\sin(\theta(j)) \end{aligned} \quad (6)$$

C. Rotating with ellipse's parametric equations in MATLAB Program

$$\begin{aligned} e(j) &= 2R\cos(\theta(j))\sin(\varphi(i)) - \frac{R}{8}\sin(\theta(j))\cos(\varphi(i)) + \\ &(-R\sin(-3\frac{\pi}{2} + \varphi(i))) \end{aligned} \quad (7)$$

$$\begin{aligned} f(j) &= 2R\cos(\theta(j))\cos(\varphi(i)) + \frac{R}{8}\sin(\theta(j))\cos(\varphi(i)) - \\ &(-R\cos(-3\frac{\pi}{6} + \varphi(i))) \end{aligned} \quad (8)$$

The method we propose is a completely new method, personal, using MATLAB, which is a graphical processing very precise blade movement inside the camera profile Wankel engine. This profile is called the profile Epitrochoid.

The engine invented by German engineer Felix Wankel in 1966 can be used with specific weight, fast naval craft operation and use of aviation engines for light sport aviation or sanitation.

The method that we propose is a new process that can be continually improved through the use of very hard materials for the knife on top of the ellipse tool holder. Also conducted a gear inside 3/2, is needed working without too much movement, the movement is limited to 0.002 [mm].

Rotary piston engine, the German inventor Felix Wankel, was first used by the Japanese company Mazda. On a sports car Mazda Wankel engine capacity of 1000 cc equivalent, Wankel engine has been fitted with two pistons 180 degrees out of phase.

II. CONCLUSION

A Wankel rotary piston engine, usually from nodular cast iron, which need to be 30..50 [m / min]. Thus, it will, cutting speeds normalized national Standards.

In the programming operation, taking into account the geometrical sizes, interveners may correlate port ellipse tool length, standard length Wankel engine running.

Cutting regime is adopted depending on the material from which is made the inside surface of the working chamber, of the Wankel rotary piston engine. Thus, it will, cutting speed is adopted depending on the material from which is made the inside surface of the working chamber of the engine.

Processing method for the explosion chamber, with rotary piston engine, invented by German engineer Felix

Wankel, is new and absolute worldwide. Patenting this method is very expensive in Romania, so I cannot patentable, but to give immediate release to the benefits they bring in processing accuracy inner chamber epitrochoid Wankel rotary piston engine.

Wankel rotary piston engine, usually from nodular cast iron. Thus, regime manufacturing, normalized national Norm Standards.

In the programming operation, taking into account the geometrical sizes, interveners may correlate port ellipse tool length, standard length Wankel engine running.

Cutting regime depending on the each material from is made the inside material of the chamber. Thus, it will, cutting speed is adopted depending on the material from which is made the inside surface of the working chamber of the Wankel rotary piston engine, usually from nodular cast iron, which need. Thus, it will, cutting speeds normalized national Standards.

Mazda company, ensure your engine running at 300,000 [km] and used engine change was made to firms Mazda factory in a charge .

By running MATLAB in Annex 1, it can be seen, half processing Winkle engine room, then the room Epitrochoid Chamber process.

Processing method explosion chamber, with rotary piston engine invented by German engineer Felix Wankel is new and absolute worldwide. Patenting this method in my country is quite expensive, but a present pleasure, to be used safely at room manufacturing Wankel engine explosion.

I look with confidence manifest, suggestions and comments on the method of processing inner chamber work, Wankel rotary piston engine,

processing method for the explosion chamber epitrochoidal, with rotary piston engine invented by German engineer Felix Wankel, it is a processing method with high productivity, at the same time as a program is taken to convert Matlab program, with the actual machine tool.

In Fig. 7, is presented by inventor Felix Wankel, its engine that bears his name, with the lid opened, thus visualize piston, chamber work and eccentric axes.

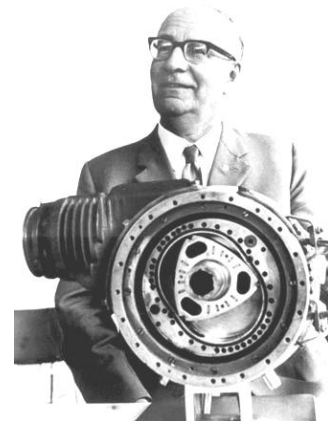


Fig7. Eng. Felix Wankel with his principle of the Wankel engine operation - 1967

In Figure 8, is presented Wankel half - chamber, and in Figure 9, is presented Wankel chamber in total contour, very good accuracy. This precision is extremely for the seal segments to work in the slots.

I look with confidence manifest, suggestions and comments on the method of processing inner chamber work, Wankel rotary piston engine.

A machine tool for machining profile Epitrochoid working inside the room, the Wankel rotary piston engine, is not difficult to build. This processing program is taken to convert Matlab program, with the actual machine tool.

In Fig. 7, is presented by inventor Felix Wankel, its engine that bears his name, with the lid opened, thus visualize piston, chamber work and eccentric axes.

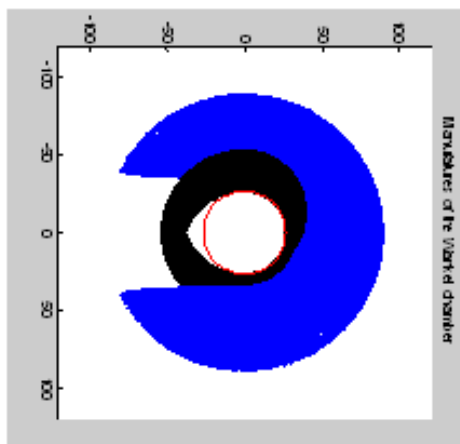


Fig.8. Principle of the Wankel chamber manufacturing (half chamber)

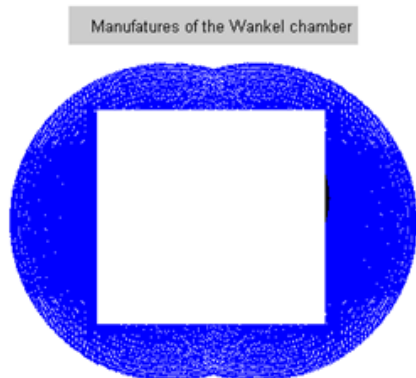


Figure 9. Principle of Wankel total chamber manufacturing

III. COMPLETE MATLAB PROGRAM TO SEE OPERATING PRINCIPLE ADOPTED OF THE CHAMBER WANKEL ENGINE

```
R = input('R = ');
b = input('b = ');
```

```
hold on;
axis([-120 120 -120 120]);
axis square
title('Manufactures of the Wankel
chamber')
n      = 200;
m      = 200;
p_teta = 2*pi/m;
p_fi   = pi/n;
teta   = [0:p_teta:4*pi];
fi     = [0:p_fi: 4*pi];
x      = zeros(m,1);
y      = zeros(m,1);
    for i = 1:n+1
        for j = 1:m+1
            x(j) = R*cos(teta(j))*sin(fi(i))-
                R*sin(teta(j))*cos(fi(i))+(R/3)*sin(-
                3*pi/2+fi(i));
            y(j) =
                R*cos(teta(j))*cos(fi(i))+R*sin(teta(j)
                )*sin(fi(i))-(R/3)*cos(-
                3*pi/6+fi(i));
            u(j) = 2*R/3*cos(teta(j));
            v(j) = 2*R/3*sin(teta(j));
            e(j) = 2*R*cos(teta(j))*sin(fi(i))-
                R/8*sin(teta(j))*cos(fi(i))+(R)*sin(3*
                pi/2+fi(i));
            f(j) =
                2*R*cos(teta(j))*cos(fi(i))+R/8*sin(te
                ta(j))*sin(fi(i))-(-R)*cos(-
                3*pi/6+fi(i));
        end
        plot(x,y,'k',u,v,'r',
            e,f,'b','EraseMode','none','Markersize
            ',5);
        set(gca,'nextplot','replacechildren');
        F(j) = getframe(gca);
        drawnow;
    end
```

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