CONSTRUCTIVE SOLUTIONS TO OPTIMIZE THE MOVEMENT COLLECTOR FORM IN CASE OF THE ELECTROSTATIC MOTOR

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Abstract: In the construction of the electrostatic motor, that we developed, the rolling spherical bodies caused the rotation at the level of the rotor. In time of the experimental resources we found an interesting movement for the metal ball which causes the rotation movement of the rotor. This movement shows at the first time the interaction between the rolling body and the rotor collector arm, this interaction we try to optimize with an insulator material for the collector arm/arms.

1. THEORETICAL AND EXPERIMENTAL ELEMENTS

In the function of electrostatic motor, that we proposed and developed, the rolling bodies are caused the rotation of the rotor in directly physical contacts. For this reason we tray to optimize the complex movement of one rolling body versus the movement of the rolling body which is strait-laced by the arms of collector, movement collector. The rolling of the metal ball is caused by the concurrence of many forces and interactions, among which there are the effect of the Coulomb force between the sphere and the metallic ring of the spatial condenser's fitting, the effect of the centrifugal force of the rolling body, the instantaneous distribution of duties on the surface of the rolling body reported to the condenser's fittings, and not in the last, the rolling of this body on the surface of the superior dielectric. [1]

The rolling movement of the body involves the precession of the instantaneous axis of the body's rotation – implying a continuous variation of the sphere rolling circle, a variation of both this circle's plane on the rolling area, and of the length of this circle.

In consequences generate at their turn a "sinusoidal", winding movement of the mass center trajectory to the inner perimeter of the superior fitting's ring of the spatial condenser,[2]. Experimentally, the rolling movement of the body involves the precession of the instantaneous axis of the body's rotation – implying a continuous variation of the sphere's rolling circle, a variation of both this circle's plane on the rolling area, and of the length of this circle. In theoretical studies we are modeling this movement with the parametrical equation, [4**].**

About this complex movement doesn't exist currently an explication, only the Coulomb force is evidently but who is responsible to the rotation of the metal ball, maybe Lorenz force or Maxwell-Faraday's law can cause the rotation of the spherical body, (metal ball, in our case).

Summary the experimental stand contains: the spatial condenser formed of: the square stand and the inferior dielectric on which the fitting of the condenser is laid, superior dielectric 4, which represents the rolling area of the spherical body 5, in the end of the same time of the stator at the electrostatic engine. Placed on the superior dielectric inside the metallic ring 6, it can found the rolling body that, when this condenser is fed from a source of constant high tension, starts the rolling movement, inside the superior fitting. In this type of construction the collectors 16, are makes from steel the constructions elements, 1 to 4 and 6 form the spatial condenser in witch is replaces the whole rotor 13, with horizontally two arms 9 and another vertically two arms 10, like as see in top figure.

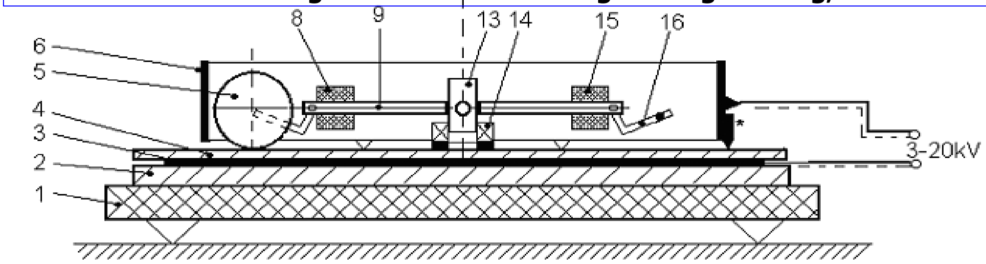

Fig.1 The collector design with the for arms and one rolling body

To center dynamically the rotor it's use the masses 8, and 15, for each arm in construction. In this way it's increase kinetically moment of the whole rotor.

The precession of the instantaneous axis of the body's rotation – implying a continuous variation in this time the rotation ax determine the conical surface 2 in figure 2.

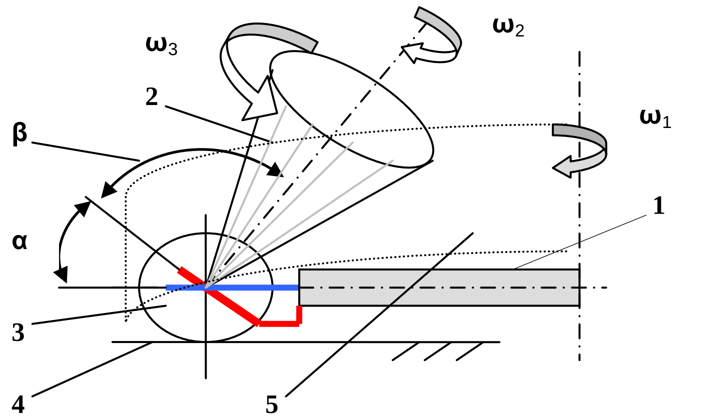

Fig. 2. The precession of the instantaneous axis of the body's rotation

The rotation ω_3 represents the precession (conical surface) of the instantaneous rotation axis and ω_2 the rotation of the metal ball, in our case. These movements of the metal ball are caused a "winding" (sinuous) trajectory of the rolling body on the inner perimeter of the superior fitting's ring 5, fig. 2, of the spatial condenser. The rolling movement of the body 3, implying a continuous variation of the sphere's rolling circle, a variation of both this circle's plane on the rolling area 4, and of the length of this circle.

For this reason the collector of mechanical movement of the metal ball must has an angular correlation with the conical surface (virtual) 2 in figure 2, this is the α angle. The propulsion of the arm 1 is optimal if the symmetry ax of surface 2 (conical surface) is perpendicular to the collector plane, traces with red line in figure 2. It will be so important to determine the angle at peak of the conical surface, certain to establish the angle α for the collector. Currently this value we tray to determine experimentally with measurement of the best time of period of rotation.

Another important problem in construction represents the material of the collector, it's clear that the metal collector that we use in one variant of experimental searches is a conductor material that causes a perturbation at the surface of the metal ball of her electrical charges. If this electrical charge is responsible in the movement of the rolling body it's necessary to replace this solution and use an insulator for the collector of the rotor arm, 1 in figure 2.

Is also equally important the geometrical form of the collector to decrease the mechanical friction between the rolling body and the collector. Comparing the period of the rotation of a single body with one of the rotor with one rolling body we can say that the movement of the metal ball if is interrupted (jerky motion), the period of the rotation it's increase by reduction of the propulsion.

2. MATHEMATICAL AND EXPERIMENTAL ELEMENTS

As a conclusion, the rotation movement of the rolling body recorded at the center of the fitting's ring by a position vector that follows the mass center, will take place in a variation of the instantaneous module of the vector, variation that takes place in limits approximately experimentally determined. The fixed reference system (x_2,y_2,z_2) placed in the geometric center of the metallic ring figure 2, records the movement of the components vector (r_{x2},r_{y2}). If the inner radius of the fitting is noted R_e, respectively the radius of the rolling body r_{cr}, it results the maximum and the minimum radius on which the mass center is moved on the inner perimeter of the metallic ring,

$$\mathbf{r}_{max} = \mathbf{R_e} - \mathbf{r_{cr}} \quad ; \quad \mathbf{r}_{min} = \mathbf{R_e} - \mathbf{r_{cr}} - \delta \tag{1}$$

Geometrical also can be determine approximately δ, that mean the angle at peak of the conical surface is know now.

The parametric equation to approximate the movement of the mass center corresponds to the suggested form, where n represents the number of loops made on the trajectory of the mass center;

$$\begin{aligned} \mathbf{r}_{x2} &= \mathbf{r_m} + \delta/2 \sin(\mathbf{n}\alpha)\cos\alpha \\ \mathbf{r}_{y_2} &= \mathbf{r_m} + \delta/2 \sin(\mathbf{n}\alpha)\cos\alpha \end{aligned} \tag{2}$$

As sea in [5], we consider that the energy of one single rotation body at the same hay voltage value is equal with the energy of the rotor in different constructions.
Base on this consideration we can determine another relation of the rotation period for the motor in each case of the construction solutions.

$$\mathbf{T}_{\mathbf{Mnt}} = \mathbf{T_b}\sqrt{\mathbf{n} + \frac{5\mathbf{m}_1^{(i)}}{7\mathbf{m}}} \tag{3}$$

Rotation period of the rotor it is symbolize by – $\mathbf{T}_{\mathbf{Mnt}}$, where “i” represent the type of the construction for the rotor and “n” represent the number and the relative position of the rolling bodies. In figure 3 we have two experimental sets of dates mark with blue and yellow line, the first is the rotor with form arms in witch we put alternatively one, two, rolling bodies, to four and measure the periods in each mode for the rotor where the collector of mechanical movement is made by an conductor material (like metal for example), in the yellow graphic the strategy is the same but the movement collector is made by an insulator material (composite epoxy and glass fiber in mixture). The upper graphic in figure 3 with red line represents the mathematical approach in base of relation 3, and last the indigo line (straight one) mark the movement of the single rolling body the period of the rotation of course, and shoe the difference between the motor rotations periods compare with the single rolling body. All these dates represent arithmetic average for minimum five different determinations for the experimental results.

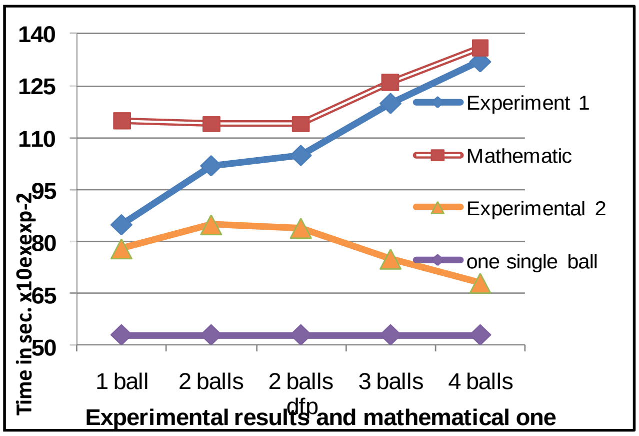

Fig. 3 Theoretical and experimental values compare

The geometrical form of the collector is the same in the both cases and respect the angular position by angle α, figure 2., in future it's interesting to study the optimal geometrical form for the movement collector.

3. CONCLUSIONS OF THE SUGGESTED MODELS

We have two models of rotors one with metal movement collector and another with composite insulator material, the difference between these referring to the mass tray to equalize by use masses 8 in figure 1, this way can say that the rotors are identically by there mass. Of course we expected to decrease the rotation period or at least for different numbers of propulsion rolling bodies.

What we obtain is remarkable all the values are decrease and more for tree and four propulsion rolling bodies. Interesting is the difference between tree and four rolling bodies on the composite solution (yellow line tree and four balls), referring at the rotation period that we determined.

In this case of the composite collector we obtain apparently curious result at the tree respectively four rolling bodies to the composite rotor. The mechanical friction is increase with the number of balls and different by the metal rotor (blue line), figure 3 in the last composite collector is showing the decrease between the tree and four rolling bodies propulsion. See the difference between the two graphics in figure 3,(blue and yellow line mostly for the tree and four balls propulsion). In the previous work [6], we show the conclusions for the metal collector and the mathematical results, (blue and red line graphics) figure 3 also).The fourth graphic we represent for showing the difference which exist between the motor rotations periods and the single free rolling body period to estimate the mechanical friction growing, (indigo line, below).

The final conclusion can be that the metal movement collector generated a perturbation at the surface of the rolling body at the electrical charge level, perturbation that cause the diminutions of the propulsion effect generated by the rolling body. The composite solution for the collector degrease the period of the rotation at the rotor level. At last mention that the geometrical form of the movement collector in these cases are identically.

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