EXPERIMENTAL RESOURCES ELEMENTS IN ELECTROSTATIC PROPULSION IN CASE OF ELECTROSTATIC MOTOR FOR METAL BALLS PROPULSION

Titus Deliman
University of Oradea, tdeliman@uoradea.ro

Key words: propulsion, motor, electrostatic, electrical field, electrostatic effects.

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 a group of metal rolling bodies, at will show. This movement shows at the first time the interaction between the rolling bodies. Perhaps electrostatic effects between the rolling bodies cause the rotor arms number modification, for the optimal geometry.

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. This movement is experimentally point it, [1]. In fig. 1 it s show the geometrical principle for the propulsion at the single rolling body inside the inner of the spatial condenser. About for this complex movement we found an analytics equation for the position vector [2]. Relation 1, that it s can approximate the movement of the rolling body, single metal ball.

Shortly about figure 1, who s represents the experimental stand: the spatial condenser, formed of: the square stand and the inferior dielectric on which the inferior fitting of the condenser is laid, the 4 superior dielectric, fig.1, which represents the rolling area of the spherical body 5, and in the end the metallic ring 6 placed on the superior dielectric which has the role of the superior fitting and in the same time of the stator of the electrostatic engine.

Placed on the superior dielectric inside the metallic ring, it can found the rolling body that, when this condenser is fed from a source of constant high tension, starts the rolling movement, carried out inside the superior fitting, the movement taking place in the electric field generated by the spatial condenser on the superior dielectric.

This movement of the spherical body determines the drawing of the engine's rotor – reason for which it is necessary to study the movement of the rolling body in order to establish the geometry, the material of which the collector of the electrostatic engine is made and the movement collector that takes over the mechanic energy from the rolling body transferring it to the engine's rotor. The rolling body executes a rolling movement inside the superior fitting 6, of the condenser, a process where the sphere takes over an energetic quantum from the superior fitting 6, of the condenser by contact, after which the fitting's potential, is electrified. There follows a removal by rolling from the inside part of the fitting's ring, the main cause of this phenomenon being the Coulomb electric repulsing force. The movement implies an energetic loss by electric leakage through the dielectric which will generate attraction forces between the rolling body 2 and the fitting's ring 1, not before the apparition of the centrifugal force which will redirect the rolling body towards the metallic ring. In this phase, the body is attracted to the fitting's ring due to a new electrization force,
together with the effect of the centrifugal force, the rolling body will hit (touch) the superior fitting's.
In time between the ring and the rolling ball are taking place a reloading with charge of the sphere, phenomenon that generates the repetition of the process described above. In finally it s clear that exist an exchange of charge between the fitting 6 and the ball 5,

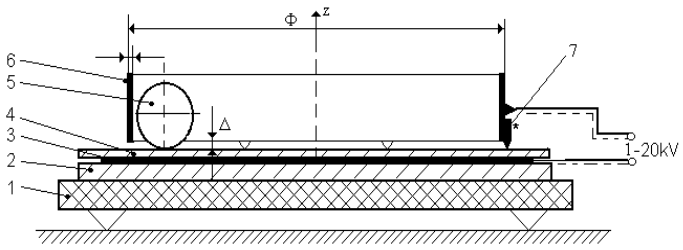

Fig. 1 The experimental stand

(rolling body-as we named). The complex movements of the rolling body in the inner of the ring 6 it was described detailed in [2, 3], with the interaction of electrical and mechanical phenomena witch describe the movement at the metal ball level, it most interesting that this strange movement we can obtains for a glass ball, that is a insulator and for this the electrical properties are different.

2. Mathematical and experimental elements

Experimental studies and resources proves that the metal ball, (rolling body), have a "winding" (sinuous) trajectory of the rolling body on the inner perimeter of the superior fitting's ring of the spatial condenser. [2] 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. [6]

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; and $\alpha = \omega \mathbf{t}$, where ω represents the angular velocity of the ball rotation.

$$\begin{aligned} \mathbf{r}_{x2} &= \mathbf{r}_m + \tfrac{\delta}{2}\sin(\mathbf{n}\alpha)\cos\alpha \\ \mathbf{r}_{y_2} &= \mathbf{r}_m + \tfrac{\delta}{2}\sin(\mathbf{n}\alpha)\cos\alpha \end{aligned} \qquad (1)$$

Where δ represents the oscillation of the mass center to the theoretical circular trajectory, respectively the double value of the movement's amplitude in the direction of the vector radius, it s delimitate at the amplitude of the "winding" (sinuous) trajectory, as it show in figure 2, with red sinuous line.

The cinematic elements corresponding to the speed of the sphere's center can be calculated according to the model where ά=ω, representing the angular speed recorded in the relative fixed system.

$$\begin{aligned} \mathbf{r}_x' &= -\alpha' \mathbf{r}_y + \tfrac{\delta}{2}\alpha' \mathbf{n}\cos(\mathbf{n}\alpha)\cos\alpha \\ \mathbf{r}_y' &= \alpha' \mathbf{r}_x + \tfrac{\delta}{2}\alpha' \mathbf{n}\cos(\mathbf{n}\alpha)\sin\alpha \end{aligned} \qquad (2)$$

For this reason the rolling body, performs a complex rolling where the instantaneous rotation axis makes a precession to the theoretical perpendicular which passes through the mass center, a perpendicular to the superior dielectric 3. The experimentally determined model involves the existence of a rolling circle of the spherical body that changes the perimeter and inclination of the rolling plane of the circle defined inside it. The precession, the proper rotation and the movement of the instantaneous axis become evident for the model defined and experimentally determined. The instantaneous rotation axis performs a precession movement, the geometrical locus being identified in a cone with the top in the mass center of the spherical rolling body 5. In this way it can be explained the continuous variation of the inclination of the rolling center plane reported to the dielectric plane.

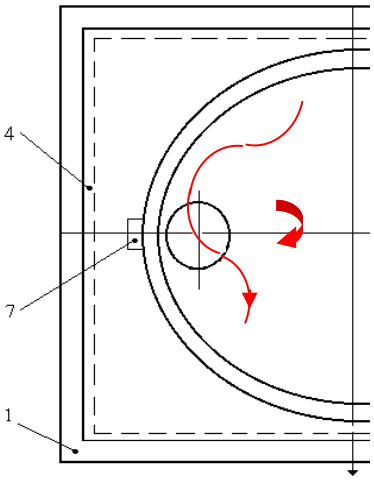

Fig. 2 Sinusoidal winding movement of the rolling body, (metal ball)

These 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.

In the general case where the angular speed is not considered constant, for simplifying the model, the hypothesis of the areolar speed can be accepted as being constant, in this situation suggests the mathematical model of the spherical body movement at the mass center level, a parallel plane movement, plane 1 in figure 2. [2, 3]

$$r_{x2}\, r_{y2}'' + r_{y2}\, r_{x2}'' = 0 \qquad (3)$$

All this experimental facts for a single rolling body are important to developing the rotor arms geometry, [3 and 4]. Connections between the movement and the physical value of high voltage to supply the condenser, or the geometrical dimensions for the spatial condenser are giving by the relations;

$$T_b = \sqrt[3]{(2\pi)^2 \frac{7mR^2}{10\, i\, U}} \qquad (4)$$

Where, T_b – represent the rotation period for a single spherical steel body, m – mass of the rolling body, R – interior radius of the metal ring, part of the spatial condenser,
i – polarization current, U – high voltage to supply the condenser. [3]

The relation 4 giving real values witch are experimentally tested in many cases, we can say that is functionally. The difference between theoretical and experimental values shows the influence of the friction force between the rolling spherical steel body and the glass plain by the spatial condenser.

To concept the geometry for the rotor, and establish the numbers of arms is necessary to study the influence between the rolling bodies, of course, the electrostatics influences if are exists, and if exist how are takes effects.

We tray to make experiments with rotors with two, four and three arms in each constructions, after it, put in each of them one, two or many it s possible balls for action the rotor. Evidently the frictions are caused the diminution of the rotation but in many cases the velocity it s increase.

In this stage of experimental status decide to tray, making be shore if are exists influences between the rolling bodies, so that, take into the inner of the spatial condenser as like ring 6 figure 1 four identically rolling balls, made by metal.

At first time we grouping them one by another. Input the supply at 6~7 Kv, the group of four balls are beginning to executes a rolling movement inside the superior fitting 4, figure 1, nothing new, but suddenly after a short time, the first rolling body, (the red one, figure 3) it s rolling faster at the inner of ring 6, in the same direction to the another three balls, which continue the rolling movement but a little slowly, (the yellow three balls, in figure 3). This one way movement it s continuing until the red ball, (figure 3), catch behind the last tree yellow balls. In this faze the new group are formed and continuing to rolling at the inner of ring 6 figure 1. In short time (a few seconds not more) what does happen before will be repeating by the first yellow ball in the way of movement.

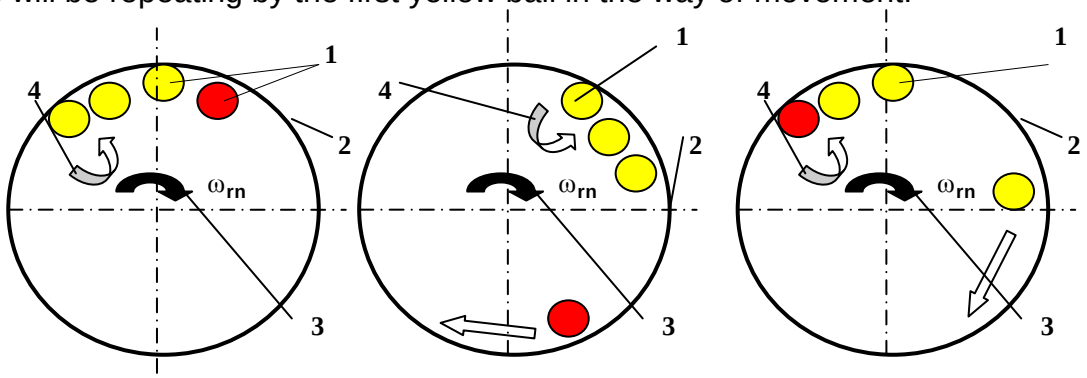

Fig. 3 The complex winding movement at the four rolling bodies level

This movement is continuing in time while we have high voltage on the spatial condenser or by the case, electrical energy cumulating in the coupling condenser use for filtration in the electrical system.

3. Conclusions

The rotation period its grow by the number of rolling bodies motivate by the frictions forces between rolling body, glass plain and metal ring. Relation 1 it s functional for a single rolling body and for the metal ball, existing a few experimental resources for the electrostatic motor with more that one collector arm. [4 and 5]

It must make an important observation at the level of propulsion, also just one rolling body push instantly the rotor. Maybe this is a second reason because the rotation period grows with the numbers of rolling bodies.

This last mention is so close that we found and presents in figure 3. The movement of the four balls shows that exist an influence between the electrostatic charges between the rolling bodies. Interesting is the fact that also the first ball is the fates and the other three continuing in group the movement and a little slowly.

The question is way the last tree (yellow balls in figure 3) balls are not repeat the identical movement like dose the red one, before. Anyhow this experiment is so important to establish the number of the arms for the electrostatic motor, because if the successive two arms are so close, constructively, maybe appear the effect describe before, in conclusion the period of rotation possible to increase.

Bibliography references

1. T. Deliman — Theoretical and experimental resources elements in electrostatic motors construction. Fascicle of Management and Technological Engineering. 2007.
2. T. Deliman. — Theoretical and experimental resources elements in electrostatic propulsion of the spherical rolling bodies in case ofelectrostatic motor. Fascicle of Management and Technological Engineering. 2008
3. T. Deliman — Theoretical and experimental resources elements in rotation period of the electrostatic motor, constructions for different rotors solutions. Fascicle of

Management and Technological Engineering. 2009

4. T. Deliman — Theoretical and experimental resources elements in electrostatic propulsion of the output in case of electrostatic motor. Fascicle of Management and Technological Engineering. 2010.

5.T. Maghiar, T. Deliman, K. Bondor — Electrostatic motor. International Application under the patent cooperation (PCT) 2003. WO 03/041259. A1.

6. T. Maghiar, T. Deliman, K. Bondor — Motor electrostatic. Brevet de invenţie OSIM RO 119848 B1, 2005.