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AN EXPLANATION OF THE J. HUBER EFFECT, WHICH DOES NOT CONTRADICT THE LAWS OF PHYSICS AND EXPERIMENTAL RESEARCH

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Abstract.. An explanation of any physical phenomenon is essential, both theoretically and practically. The phenomenon discovered by the Austrian engineer J. Huber, the so-called "Huber effect," posits that if an electric current passes through an already moving wheelset of wheels of a railroad train from one rail of a railway to another, an additional accelerating mechanical force arises in the direction of travel. From 1951 to the present, scientists have tried to explain and utilize this effect. A brief overview of these explanations and their contradictions in theory and experiment is given. However, they have become important for finding an explanation that does not contradict the laws of classical electrodynamics and experimental data.

Keywords: Huber effect, Kosyrev–Milroy engine, Biot–Savart–Laplace law, systemic approach, electricity flow, super-capacitor, ferromagnetism

INTRODUCTION

In 1951, the Austrian engineer J. Huber discovered the following physical phenomenon: if during the existing movement at speed V of a railroad train or a separate pair of wheels (Fig. 1) one connects a source 4 of voltage U_s to the rails, then, under the action of current I passing from one rail to another 3 through the wheels 2 and the axle, an additional force F is created, which increases the speed of rectilinear motion V or that of rotational motion Ω of the wheels. This effect was used at the railway sorting station. The same phenomenon was observed in a bearing pair (Fig. 2) by Kosyrev–Milroy [1]. Here, instead of wheels and rails, there were balls and bearing clips.

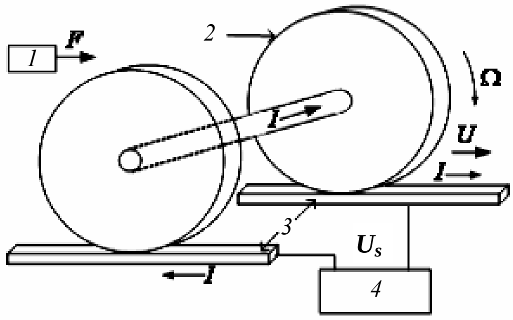

Fig. 1. Wheelset

The ambiguity of the effect and the low efficiency of the Kosyrev–Milroy engine required scientists to further study to explain the Huber effect and identify areas for its effective use.

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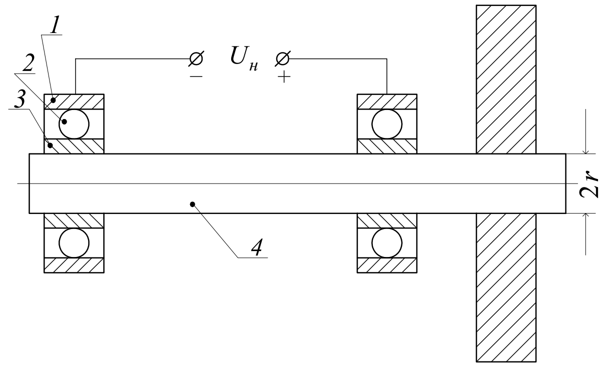

Fig. 2. Kosyrev–Milroy electric motor: *1*, *3* — clips; *2* — ball; *4* — shaft; $U_н$ — source voltage

BRIEF OVERVIEW OF THE EFFORTS TO EXPLAIN THE HUBER'S EFFECT

It was considered [2, 3] that the interaction of electric currents in accordance to Ampere's law in the wheel and rail, which are positioned at an acute angle due to motion, creates a torque (Fig. 3). However, in the second wheel of the wheel set or on the opposite side of the bearing ball, it will be of the opposite direction.

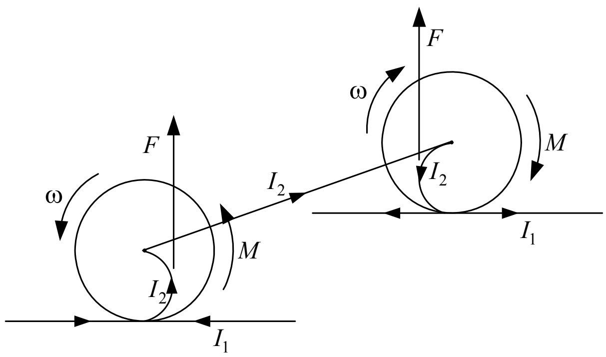

Fig. 3. Kuzmin–Shpatenko's oversight

Nonetheless, the curvature of current I_2 trajectories was further developed in our studies.

It was also believed [3] that the torque arises from sparking on the falling side of the contact.

Indeed, when the bearing was placed in a vacuum chamber [4], after a while the movement stopped. But, as we found out (and confirmed by experiment), this was due to the significant heating of the balls without heat dissipation in vacuum, and, as a result, the mechanical jamming of the almost non-existent clearance between the ball and the clip. In 1973, the author of [4] claimed that the spark is the cause, and in 1982, already points [5] to the negative impact of the spark.

Thermodynamic explanation [6] of motion caused by thermal deformation contradicts the thermal inertia of bearing bodies. Some studies [7] suggest propositions that generally contradict the laws of physics. Additional ambiguities were introduced by [8, 9], where the J. Huber effect is conflated with an unexplained effect of J. Searle ("flying saucers") and "non-physical" laws [7] of G. Nikolaev, in which the directions of current I and magnetic flux Φ coincide. This is possible only for the longitudinal along the shaft axis current component I through the cross-section of the shaft rotating with frequency Ω (Fig. 4).

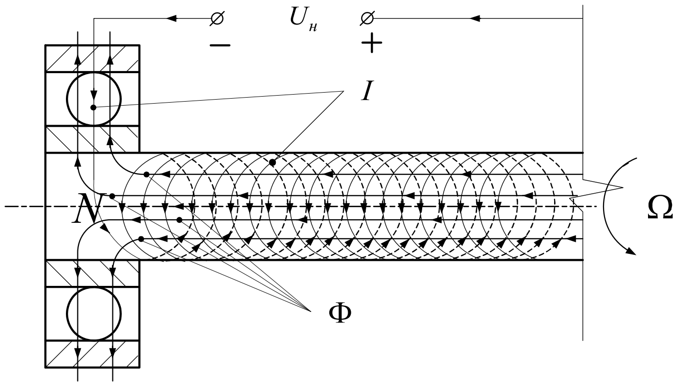

Fig. 4. The trajectory of “streams” of electrons in a rotating shaft

MULTI-STEP PROCESS FOR SOLVING THE PROBLEM EXPLAINING THE J. HUBER’S EFFECT

Thus, on the basis of the analysis of efforts to explain the effect rather simplistically (in one step), one should find an explanation for it through a multi-step truth-oriented algorithm, preserving the results that do not contradict the laws of physics, as well as finding new course of search.

In mathematics, this resembles the search for the extremum of a function in a multidimensional space of constrained variables [10].

Step 1. Analysis within the statics of the contact zone of the wheel and rail, or balls and clips.

As a rule, in any electric contact, one, first and foremost, points out its active resistance $R_к$. However, the contact is not a point or a line: it has a finite area $S_к$, an extremely small clearance δ with dielectric conductivity ε. And, as a result, it is determined by the final electrical resistance $R_к$ and capacitance $C_к$. The power supply circuit additionally has a resistance R and an inductance L (Fig. 5).

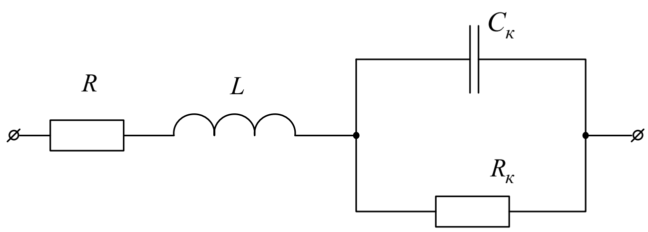

Fig. 5. Current circuit replacement scheme in the contact zone

Resistance R is much lower than $R_к$. Therefore, in a pair of wheels, almost half $U_к$ of the voltage of the source U_S falls on the contact, creating a current I in the resistance $R_к$, and a charge $q_к$ on the capacitance $C_к$. For example [10], for the contact of the wheel and the rail of the railroad car capacity of $C_{\kappa} = (0{,}02 \div 0{,}03)\mu F$, the charge of q_{κ} at voltage of $U_{\kappa} = 10V$ is $(0{,}2 \div 0{,}3) \cdot 10^{-6} C$. This is posited for a clearance of one micron. But in the central zone of contact of the polished surfaces of a wheel and a rail under a force of pressure under car's weight the clearance δ can be even smaller (effect of the super-capacitor).

Therefore, at the first step, an important result of the study is the opening of the contact capacitance C_{κ}.

Step 2. Analysis of electricity flow through a moving contact.

Let us present the flow of electricity I as a sum of the currents $j_{\kappa} \Delta S_{\kappa}$ of each k[th] tube:

$$I = \sum j_{\kappa} \Delta S_{\kappa} ,$$

where j_{κ} is the density, and ΔS_{κ} is the cross-sectional area of the k[th] tube Ω.

If a wheel (or a ball) rotates with frequency and speed V_0, then to the left of the contact will be the area whose clearance δ decreases, and to the right — increases (Fig. 6).

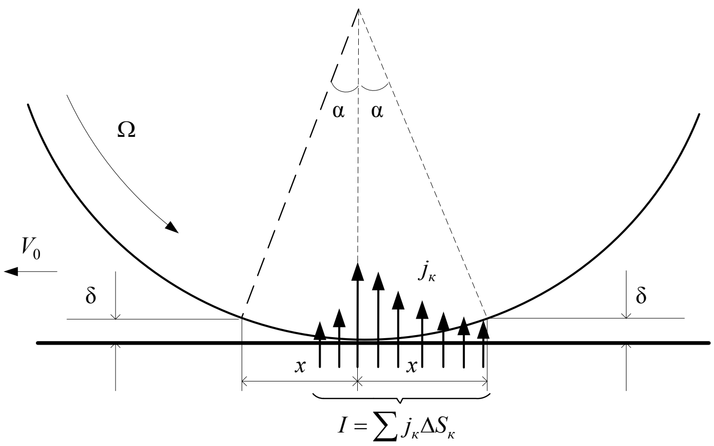

Fig. 6. Asymmetric distribution of density j_{κ} of current *I*

Then, taking into account the active inductive nature of the power supply circuit (Fig. 5), the current through the clearance on the left will increase exponentially [11].

$$I_{\kappa}(t) = I_{\kappa y}[1 - e^{-\int_0^t \frac{d\theta}{\tau_{\kappa}(\theta)}}],$$

where $I_{\kappa y}$ is the default value, $\tau_{\kappa} = \dfrac{L_{\kappa}}{R_{\kappa}(0)}$ is the time constant; to the right — decreasing exponentially

$$I_{\kappa}(t) = I_{\kappa y} \cdot e^{-\int_0^t \frac{d\theta}{\tau_{\kappa}(\theta)}} .$$

The greater the V_0 or Ω, the fewer current tubes there is to the left (lesser time t the current does not reach $I_{\kappa y}$). Next, in the area of mechanical contact a current $I_{\kappa y}$ is set, which will decrease exponentially to the right of the contact, creating sparks due to EMF of self-induction of $\varepsilon_к = -\frac{dI_к}{dt}$. As a result, the flow q of electricity I shifts, as V increases to the right.

Step 3. Bilateral action of the Biot–Savart–Laplace law.

The product of the voltage $U_к$ and the capacitor $C_к$ is the charge $q_к$. During movement, the charge $q_к$ moves in the body of the wheel and rail at a speed V equal to the angular velocity Ω times the radius $r_к$ of the wheel.

Then, according to Biot–Savart–Laplace law, (if we apply the product of $q_к$ and V as the product of the conditional current $I_к$ and the path component Δx, where Δx equals to the product of V and the time component Δt of time t) we obtain the magnetic field of induction ΔB at the point M (Fig.7):

$$\Delta B = \frac{\mu_0}{4\pi}\frac{I_y \Delta x \sin\beta}{r}.$$

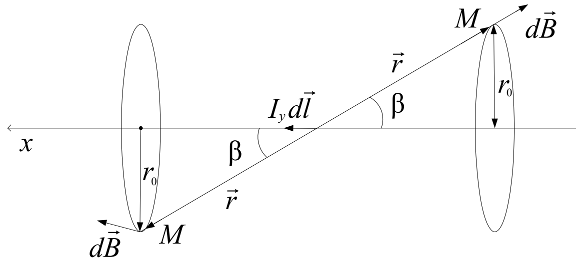

Fig. 7. Biot–Savart–Laplace law

Due to the ferromagnetism of the wheel and rail bodies (ball and clip), the magnetic field is amplified and, according to the property of minimizing the loss of magnetic energy W_M [11] in the air clearance, creates a force P_M derived from W_M along δ, which reduces the clearance δ.

The Biot–Savart–Laplace law has a bilateral effect (Fig. 1), and, with the movement of the wheel (the ball) and the presence of at least inductance of L in the supply circuit, the flow of electricity I will shift towards the falling part of the contact zone, forming sparks. This leads to the arm of force P_M and the torque on the falling side increase as the speed goes up, and slowing down of the movement.

Therefore, as the current I passes through the moving contact, the initial movement speed V_0 should not increase, but instead decrease until complete cessation of movement.

This was observed in the bearing pair at low currents I, or at a minor moment of inertia of the flywheel on the shaft of the Kosyrev–Milroy engine.

Step 4. Transition from instantaneous values of moments to pulses of mechanical energy.

Given the specifics of the electrodynamics of moving bodies [12] with time-varying parameters (clearance δ to the left over time Δt decreases, to the right — increases), it is not difficult to show that the momentum of the energy of motion over time Δt, taking into account the influence of the dynamic moment from the mass or moment of inertia of the moving bodies of the system will be greater than the braking to the time at which the displacement of electricity flows in the direction of the falling part of the contact, is set at the appropriate speed V balance. In this case, the greater the dynamic moment of inertia, the greater the speed.

CONCLUSION

This explanation is fully consistent with the laws of electrodynamics and the results of experimental studies of the Huber effect.

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ПОЯСНЕННЯ ЕФЕКТУ ГУБЕРА, ЯКЕ НЕ СУПЕРЕЧИТЬ ЗАКОНАМ ФІЗИКИ Й ЕКСПЕРИМЕНТАЛЬНИМ ДОСЛІДЖЕННЯМ / А.М. Сильвестров, Д.К. Зіменков, Л.Ю. Спінул, В.А. Святненко

Анотація. Пояснення того чи іншого фізичного явища конче важливе як у теоретичному, так і в практичному аспекті. Виявлене австрійським інженером Ж. Губером явище, так званий «ефект Губера», полягало в тому, що якщо від рейки до рейки залізничної колії через уже рухому колісну пару коліс залізничного потяга пропускати електричний струм, то виникає додаткова механічна сила в напрямку руху, яка збільшує швидкість. Із 1951 р. і дотепер учені багато разів намагались пояснити і використати цей ефект. Наведено короткий огляд цих пояснень та їх суперечностей теорії та експерименту, однак вони стали важливими для відшукання пояснення, яке не суперечить законам класичної електродинаміки й експериментальним даним.

Ключові слова: ефект Губера, двигун Косирєва–Мілроя, закон Біо–Савара–Лапласа, системний підхід, потік електрики, надконденсатор, феромагнетизм.