Energy from Form: How Geometry Powers a Self-Accelerating Mechanism

An Essay on the CFAD System and a New Form of Dynamic Equilibrium: Model and Implications

Ranko Artuković
Independent unaffiliated author, Zadar, CROATIA
e-mail: bokola1@proton.me
Date: 15 January 2026

NOTICE TO THE READER: Preprint / Philosophical-Engineering Essay. Submitted to establish priority and invite scientific scrutiny. This work is intentionally written as a scientific essay, deliberately departing from strict academic form. The goal is to preserve the authenticity of the emotional and intellectual journey of discovery without sacrificing scientific rigor. It is an independent, pioneering research without referring to the existing literature, except for the basic reference [1].

Abstract

This work presents the Carrier-Feedback Acceleration Drive (CFAD) – a mechanical system that, due to a specific kinematic coupling and built-in tension, achieves a state of dynamic inertial equilibrium. We discover that this equilibrium cannot relax in the classical manner. Instead, the only physically consistent response is a dynamic one – continuous acceleration, whose magnitude is not limited by the energy invested in maintaining the tension, but by the geometry of the system and the magnitude of the chain tensioner force. The paper proposes a cyclical mode of operation where an acceleration phase alternates with a phase of regenerative braking, thereby converting kinetic energy into electrical energy and keeping the mechanism within physically achievable limits. The work shows that the negative effective moment of inertia of the carrier is a key condition for self-excitation, and that ECT is a vital control element. CFAD opens a new field of research – the physics of mechanical systems in a state of dynamic inertial equilibrium.

Keywords

CFAD, mechanical feedback, tense assembly, dynamic inertial equilibrium, built-in tension, negative moment of inertia, kinematic trap, exotic mode, energy of dynamic response, self-excited state

1. Introduction

I am not writing as an academic, but as a free and curious mind – an entirely ordinary person who, through stubborn persistence and challenging imposed authorities, has discovered something extraordinary and wishes to share it with you. I am writing this work in essay form for the sake of investigative freedom, the joy of discovery, and the emotions I went through as the inventor (especially in Chapter 18.1). Without these, the charm and human dimension of the moment would be lost. Although the work lacks strict academic form, the mathematical and physical models within it are rigorous, and all ideas are my own, without reliance on existing literature – this is a pioneering work that opens a new field of research.

This story represents a personal invitation to look beyond the fences of classical mechanics in a different way. The secret I will reveal to you here is good news and could be one of the most important insights you will ever encounter. *I encourage you to copy and share this text freely and widely – but without any modifications.* This is not reserved for elites or gatekeepers; this is for everyone.

2. The Core of the Discovery

At the heart of classical mechanics lies an indisputable axiom: internal forces cannot change the motion of a system as a whole.

The Carrier-Feedback Acceleration Drive (CFAD) does not refute this axiom, but rather deepens it: Through an ingenious kinematic coupling and mechanical feedback, the carrier (C) ceases to be a passive support and becomes a dynamic fulcrum—a "springboard"—that enables continuous acceleration of the planet, the rails, and itself.

Chain tension remains constant, angular velocities and power increase linearly with time—all without external sources of torque. To keep CFAD within physically realizable parameters, the paper proposes a cyclic mode of operation with regenerative braking. This mechanism is not a violation of physics but its deepening; it is deeply connected to the environment via the static torque of the fixed sprocket called the sun (S), and its dynamics arise from a symmetry in power and energy (50/50) between the carrier and the moving elements.

In the following, I will reveal a path toward a completely new understanding of energy, motion, and self-excited systems. What follows is a description of a complex mechanical device called the Assembly, which contains two components, A and B.

3. Component A: Planetary Chain Mechanism

Parts of the mechanism (Fig. 1.):

- Main central axle. Fixed.
- Sun (S) - Fixed sprocket, radius R_S, angular acceleration $\alpha_S=0$. Mounted rigidly on the fixed main axle, which stands perpendicular to the base. The moment of inertia of (S) is effectively infinite in this model.
- Planet (P) - Sprocket bearing-mounted at the end of the rail, radius R, angular acceleration α_P.
- Rail (R) rotates (bearing-mounted) around the fixed main axle and carries (P) and (T1). The moment of inertia of the rail is I_R. The angular acceleration of the rail is α_R. Due to rotational balance, the rail has a counterweight (B) at its other end.
- Chain1 connects (S) and (P), inextensible and without slippage. In the calculation, we neglect its mass and moment of inertia.
- Distance between centers of (P) and (S), d > R+Rs.
- First Twin (T1) - identical to (P), mounted below and rigidly connected to (P), radius R, angular acceleration α_P.
- Second Twin (T2) - identical to (P), bearing-mounted on the main axle, radius R, angular acceleration α_P.
- Chain2 connects (T1) and (T2), inextensible and without slippage. In the calculation, we neglect its mass and moment of inertia.
- Distance between centers of (T1) and (T2), d.

- Sprockets (P), (T1), and (T2) have the same angular acceleration α_P. Therefore, the total moment of inertia of all three bodies together is I_P.
- Counter-clockwise rotation (left) is considered positive.

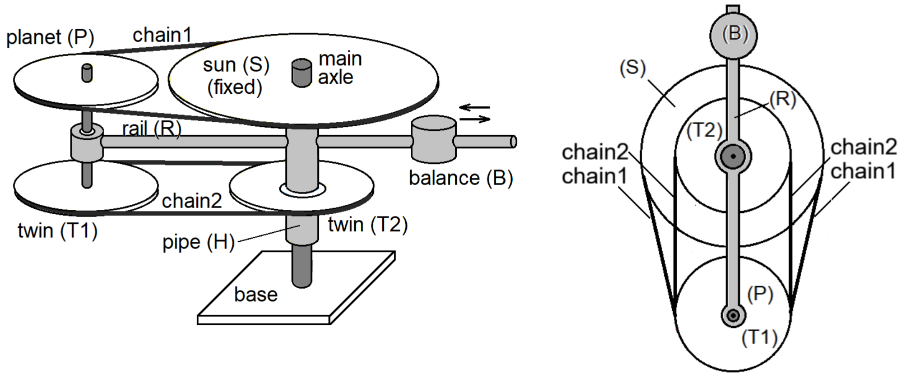


Figure 1. Left: Component A. Planetary chain mechanism
Figure 1. Right: Top view

3.1. Description of the Planetary Chain Mechanism

The mechanism in question (Fig. 1.) consists of two horizontal sprockets named sun (S) and planet (P) connected by Chain1 which does not slip. The central sprocket (S) of radius R_S is fixed and non-rotating. The other sprocket (P) of radius R is rotatably mounted on a horizontal rail (R**)** and moves along a circle of radius d > R+Rs around the main axle. The angular acceleration of the rail, α_R, is simultaneously the orbital angular acceleration of the planet (P) around fixed (S).

Let the described planetary mechanism have the following addition: Below (P) lies an identical gear, Twin (T1), which is rigidly connected to it. (T1) is then connected via Chain2 to Twin (T2)**.** Sprocket (T2) is rotatably mounted on the main axle. Sprockets (P), (T1), and (T2) have the same angular acceleration α_P.
Note: Besides the chain-driven type, a planetary mechanism with gears is also possible, but the latter will not be considered here.

4. Component B: Differential Mechanism

Parts of the mechanism (Fig. 2.):

- Main central axle. Fixed.
- Upper bevel gear (U)**,** radius R, angular acceleration α_U. Bearing-mounted on a vertical tube (H) on the main axle. Meshes with the vertical (I).
- Lower bevel gear (L)**,** radius R, angular acceleration α_L. Bearing-mounted on a vertical tube (H) on the main axle. Meshes with the vertical (I).
- Idle pinion (I)**,** radius r<R, angular acceleration α_I. Simultaneously meshed with (U) and (L). Can rotate freely (bearing-mounted) about its own horizontal axle (arm) with angular acceleration α_I. Also, due to its placement on the carrier (C), it has an orbital angular acceleration α_C.
- Carrier (C)**,** a uniquely rotating body that carries (I), bearing-mounted on the vertical tube (H) on the main axle. Located between (U) and (L), angular acceleration α_C. For dynamic balance, it is optimal for the carrier (C) to carry at least 2 identical (I)

symmetrically distributed. Each side arm contains a movable mass (M). In this way, the desired moment of inertia of the carrier can be achieved.

- Vertical tube (H) - bearing-mounted on the main axle.
- Gear radius refers to its pitch radius, a technical term most commonly used in mechanical engineering.

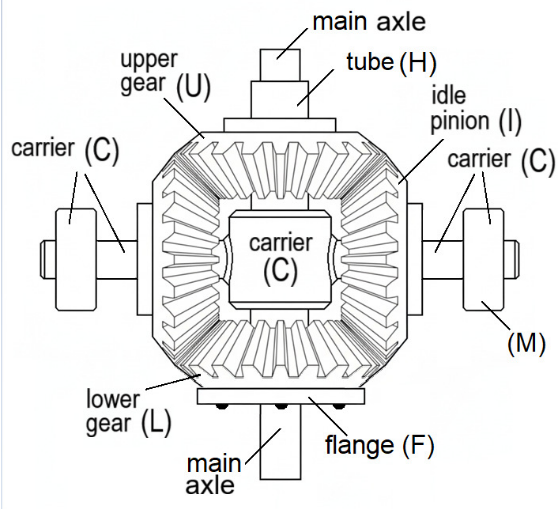


Figure 2. Component B. Differential mechanism. Due to the dynamic balance, the carrier (C) contains two or more identical idle pinions (I)

4.1. Description of the Differential Mechanism

The mechanism in question (Fig. 2.) consists of a set of three bevel gears in mutual mesh. Two equal crown gears, named upper bevel gear (U) and lower bevel gear (L), are rotatably mounted on a common vertical tube (H), thus forming a coaxial pair. Both rotate in the horizontal plane.

Between (U) and (L) is placed a third bevel gear (usually more than one), named idle pinion (I). Gear (I) is simultaneously meshed with (U) and (L). It is equipped with a bearing that allows it to rotate freely about a horizontal axis called the arm.

The configuration of the arm and the central carrying element is defined as a uniquely rotating body, called the carrier (C), which has a bearing in the middle and is rotatably mounted between (U) and (L). Thus, the carrier (C) can rotate freely about the vertical tube (H), i.e., the main axle.

Therefore, the mechanism consists of three meshed gears (U), (L), (I) and a fourth rotational element (C) which carries (I).

5. Both Components Together

Let us now create a new mechanical device called the Assembly which contains both components A and B placed one above the other on a common main axle (Fig. 3.). Below the planetary mechanism (component A) is mounted the differential mechanism (component B).

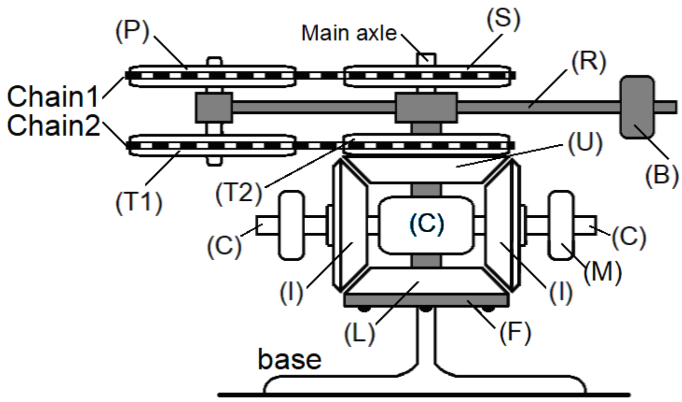


Figure 3. Assembly on a fixed base. Components A and B are mounted one above the other. Rotational balance is achieved by moving the counterweight (B) along the rail (R).

To simplify the calculation as much as possible, let's also introduce this approximation: Let the idle pinion (I) have negligible mass and moment of inertia (m_I=0, I_I=0). In practice, gear (I) can be made from a lightweight material with high toughness and sufficient hardness. Its pitch radius, r, is usually 2-3 times smaller than the radius R of (U) and (L)

6. Connection Method

- Sprocket (T2) is rigidly connected to the upper bevel gear (U). Thus, (T2) and (U) together form a compact rotating rigid body bearing-mounted on the main axle, (Fig. 4.).
- The lower bevel gear (L) is rigidly connected to the rail (R) via a vertical tube. This rigid body as a whole has the shape of an underlined letter "T". Its vertical part is a hollow tube, and the upper horizontal part is the rail (R). The underlined part of the letter "T" is a plate flange (F) rigidly connected to the lower bevel gear (L). This unique rigid body consisting of elements: (R), (H), (F), and (L) can rotate about the main axle.

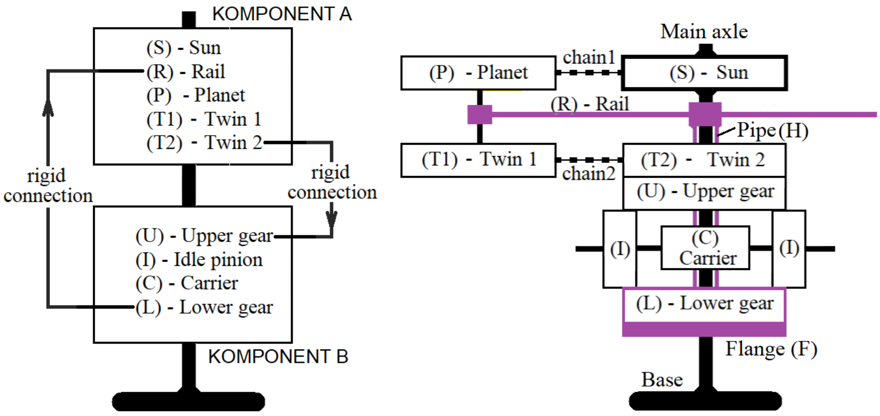


Figure 4. Schematic representation of the entire Assembly.

7. Mechanical Feedback

If both components of the Assembly are interconnected in the described way, we observe that there is a mechanical feedback between them. Thus:

- The output of component A, due to the rigid connection of (T2) and (U), becomes the input of component B.

- The output of component B, due to the rigid connection of (L) and (R), becomes the input of component A.

8. Dynamics of the Assembly - classical mode

Starting the described Assembly can be achieved by external action: Let two external torques, τ_C and τ_R , act simultaneously on the Assembly. The first acts on the rail (R), and the second on the carrier (C). As a consequence, all parts of the Assembly begin to rotate with acceleration. Let us now set up Newton's equations of motion for this system and find their solutions:

$$I_P \alpha_P = (F - T)R \tag{1}$$

$$I_R \alpha_R = F R - T(R_S - R) + \tau_R \tag{2}$$

$$\alpha_P = \alpha_R \cdot (R - R_S)/R \tag{3}$$

$$I_C \alpha_C = -2F R + \tau_C \tag{4}$$

$$\alpha_P = \alpha_C - \alpha_I \cdot r/R \tag{5}$$

$$\alpha_R = \alpha_C + \alpha_I \cdot r/R \tag{6}$$

In the above formulas, T and F are induced tension forces on one side of chain1 and chain2, respectively. These forces are a direct consequence of the action of external torques τ_R and τ_C. Equations (1), (2), and (4) are dynamic, and (3), (5), and (6) are kinematic.

Key assumptions in the above set of six equations include negligible moment of inertia of gear (I), and rigid connections between some elements of the mechanical system. The above equations are consistent with Newton's laws for rotation [1] and the kinematic constraints of the mechanical system. They are based on physical principles and geometric relationships that are standard in mechanism analysis. Together they form a dynamic model of the Assembly - a system that includes component A and component B with feedback.

9. Solutions

We seek solutions to the above set of equations for the angular accelerations of elements (P), (R), (I), and (C). Here, for brevity, we will not present the entire calculation but give the ready (and multiply verified) solutions. Let $k = (R - R_S)/R$. The angular accelerations of the planet, rail, carrier, and idle pinion are respectively:

$$\alpha_P = k \cdot \alpha_R \tag{7}$$

$$\alpha_R = \frac{2 \cdot \tau_C \cdot (1+k) + 4 \cdot \tau_R}{4 \cdot (I_R + I_P \cdot k^2) + I_C \cdot (1+k)^2} \tag{8}$$

$$\alpha_C = \frac{1+k}{2} \cdot \alpha_R \tag{9}$$

$$\alpha_I = \frac{R}{2r} \cdot (1-k) \cdot \alpha_R \tag{10}$$

From equations (4) and (2), the induced tension forces directly follow:

$$F = \frac{\tau_C - I_C \alpha_C}{2R} \tag{11}$$

$$T = F - \frac{I_P \alpha_P}{R} \tag{12}$$

The input power of the Assembly is:

$$P_{IN} = \tau_C \alpha_C t + \tau_R \alpha_R t \tag{13}$$

where t is elapsed time. All elements of the Assembly accelerate, so their kinetic energy increases. The time derivative of the kinetic energy gives the output power:

$$P_{OUT} = I_P \alpha_P^2 \cdot t + I_R \alpha_R^2 \cdot t + I_C \alpha_C^2 \cdot t \tag{14}$$

The calculation shows that always P_{IN}=P_{OUT}. The torque of all rotating elements is:

$$M_1 = I_P \alpha_P + I_R \alpha_R + I_C \alpha_C \tag{15}$$

The external torque acting on the Assembly is:

$$M_2 = \tau_C + \tau_R - T \cdot R_S \tag{16}$$

The third term on the right is the external (reaction) torque acting via chain1. The calculation shows that always M_1=M_2.

10. Function Graphs

Looking only at the above formulas, it is difficult to see the broader "picture" of the described physical model. Function graphs give us a much clearer view. Therefore, in the above solutions, let the planet radius, R, be the input variable denoted by x. Let the other parameters be given. Angular accelerations (7)-(10) thus become functions of x.

Given: R_S=2m, r=0.8m, I_P=2kgm^2, I_R=1kgm^2, I_C=3kgm^2, τ_C=2Nm, τ_R=0, t=1s. Thus, external torque acts only on the carrier, not on the rail. The following drawing shows graphs of angular accelerations and power:

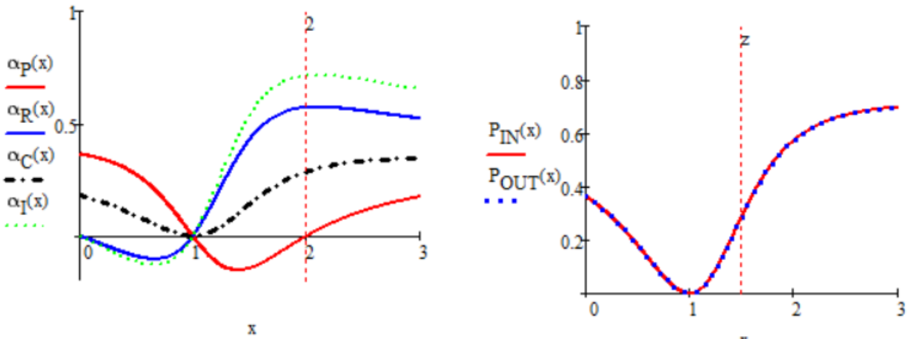


Figure 5. Left: Graphs of angular accelerations of the planet, rail, carrier, and idle pinion, formulas (7)-(10). **Figure 5. Right:** Graph of input and output power, formulas (13) and (14).

The following drawing shows graphs of induced tension forces and torques:

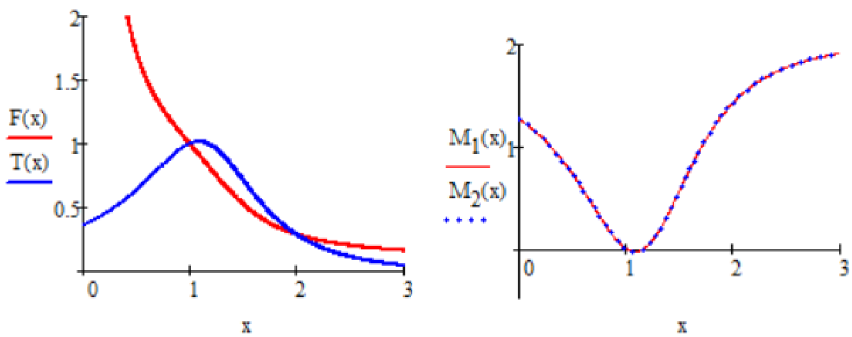


Figure 6. Left: Graphs of tension forces F and T, formulas (11) and (12).
Figure 6. Right: Torque balance, formulas (15) and (16).

Conclusion: The obtained results show that solutions (7)-(10) are consistent because they fully satisfy the set of six equations. Equations (1)-(6) accurately describe the dynamics of the Assembly shown in Fig. 3. and 4. Their solutions are in accordance with the laws of conservation of energy and angular momentum, see Fig. 5. and 6. right. Thus, the Assembly behaves in the fully expected, classic way - the Assembly in the classic mode.

11. Tense Assembly

The induced tension forces F and T, formulas (11) and (12), are a consequence of the action of external torques. So, if τ_R and τ_C vanish, the mentioned forces and angular accelerations will disappear. Now a typical research question comes to the stage: What if…

What if I "embed" tension forces into the Assembly so that they remain permanent? Such an assembly I will call the Tense Assembly.

But wait! Is permanent chain tension even sustainable? Under normal circumstances, a tensioned chain would lose all initial tension through oscillation. This phenomenon is called relaxation. In other words, all elastic potential energy would eventually turn into heat.

The above question is posed outside classical frameworks. Still, I will try.

11.1. Basic (Passive) Chain Tension

The need to define the following technical details immediately arises (Fig. 7.): Let's denote the chains as follows: chain1 (m,n) and chain2 (p,q). The first letter in parentheses denotes the left side of the chain, and the second the right. Let chain2 have its own passive tensioner mounted on the rail (R). It tensions the left (p) side of chain2. In this way, one side of chain2 becomes longer than the other, i.e., p>q.

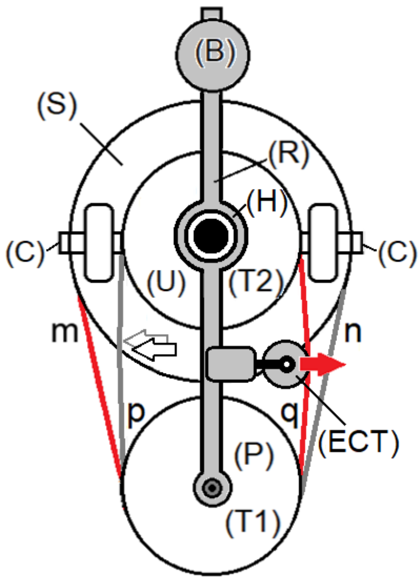


Figure 7. (Top view) ECT tensions both chains simultaneously.
Tensioned sides are colored red.

11.2. Active Chain Tensioner

In addition to the passive tensioner, the Assembly has another, active tensioner (Fig. 7). Its name is: Electromagnetic Chain Tensioner (ECT). It is located on the right side of the rail (R) and tensions the right (q) side of chain2.

In this way, the desired tension F_0 is achieved in chain2, and indirectly also tension T in chain1. That is because sprockets (P) and (T1) are rigidly connected to each other. Therefore, ECT tensions both chains simultaneously.

11.3. Built-in Tension and the Kinematic Trap

Looking at Fig. 7., the tensioned right (q) side of chain2 acts on sprocket (T2) and tries to turn it clockwise. If sprocket (T2) were free, the tensions on both sides of the same chain would immediately equalize and we would not get any desired effect.

But sprocket (T2) is not free. This is due to the mechanical feedback achieved by the fixed connection of (T2) with (U) and (L) with (R) via the plate flange (F) and vertical tube (H), see Fig. 3. Ultimately, tension F_0 is not transferred to the other side of chain2, but to the horizontal rail (R) trying to turn it counter-clockwise. This is again kinematically transferred to the planet (P) (see formula (3)). And so we are back at the beginning of a closed loop. The final conclusion is that the tension of both chains caused by ECT cannot vanish through relaxation, or

Built-in tension remains permanently within the Assembly and cannot disappear. This fact is of crucial importance for the further dynamics of the Tense circuit.

Simply, there is no mechanical path for relaxation that is not kinematically blocked. The chains and gears in mutual mesh are trapped in a kind of kinematic trap. No angular displacements except those described in kinematic equations (3), (5), and (6) are possible. Otherwise, the chain would have to jump or the teeth would have to break.

11.4. Physical Consequences

Built-in tension must have physical consequences on the mechanical Assembly. Our system is not isolated, as it is connected to the environment at only one point in one moving point - via the fixed sun sprocket (S). That is the point where the tensioned chain1, on side (m), touches the sun (S), see Fig. 7. The other side (n) of the chain1 is relaxed.

Due to interaction with the environment, the physical system must respond. What its response will be, static or dynamic - we will see soon.

The elastic tension force of the chains achieved via ECT remains the same over time because there is no relaxation. More precisely, only one side of each chain remains permanently tensioned - built-in tension is an inherent property of the system.

The described mechanical device with built-in tension will be called the Tense Assembly.

12. Dynamics of the Tense Assembly – exotic mode

Now follows a description of the physical model. Therefore, let's write Newton's equations of motion for the Tense Assembly shown in Fig. 3. and Fig. 7. The same equations as before (1)-(6) will also be valid here, but with two key differences:

- There are no longer external torques τ_C and τ_R that would create tensile stress in both chains as a consequence.
- Instead, we have ECT which tensions the chains and creates the built-in tension. It causes accelerated rotation of elements such as planets, rail, and carrier.

The new equations of motion practically remain the same as before. The only difference is the deletion of τ_C and τ_R. Due to the importance of these equations, let's write them again:

$$I_P \alpha_P = (F_0 - T) \cdot R \tag{17}$$

$$I_R \alpha_R = F_0 \cdot R - T \cdot (R_S - R) \tag{18}$$

$$\alpha_P = \alpha_R \cdot (R - R_S)/R \tag{19}$$

$$I_C \alpha_C = -2F_0 \cdot R \tag{20}$$

$$\alpha_P = \alpha_C - \alpha_I \cdot r/R \tag{21}$$

$$\alpha_R = \alpha_C + \alpha_I \cdot r/R \tag{22}$$

where T is the tension of the left (m) side of chain1, and F_0 is the tension of the right (q) side of chain2, see Fig.7.

These equations completely describe the Tense Assembly - CFAD. The constant force F_0, as a given input parameter, represents the built-in tension on the right (q) side of chain2 created by ECT. Due to mechanical feedback, it is transferred among the elements of the Assembly exactly as described by Newton's dynamic equations (17), (18), and (20).

13. Solutions

In the above set of equations, angular accelerations are sought. Due to limited article length, the entire calculation is not shown, but the ready and multiply verified solutions are given. Thus, the angular accelerations of the planet, rail, carrier, and idle pinion are respectively:

$$\alpha_P = \frac{F_0 R (R - R_S)(2R - R_S)}{D} \tag{23}$$

$$\alpha_R = \frac{F_0 R^2 (2R - R_S)}{D} \tag{24}$$

$$\alpha_C = \frac{F_0 R}{2} \cdot \frac{(2R - R_S)^2}{D} \tag{25}$$

$$\alpha_I = \frac{F_0 R^2 R_S}{2r} \cdot \frac{2R - R_S}{D} \tag{26}$$

$$T = F_0 R \cdot \frac{I_R R - I_P (R - R_S)}{D} \tag{27}$$

where

$$D = I_R R^2 + I_P (R - R_S)^2 \tag{28}$$

I_P - total moment of inertia of elements (P), (T1), (T2), and (U),
I_R - total moment of inertia of the rail.

13.1. Critical moment of inertia of the Carrier

The above solutions, as a mathematically necessary consequence, fully satisfy the set of 6 equations of motion (17)-(22). The system is consistent only if $\alpha_C = (\alpha_P + \alpha_R)/2$ holds, which leads to the condition:

$$I_C = -4 \cdot \frac{I_R R^2 + I_P (R - R_S)^2}{(2R - R_S)^2} \tag{29}$$

Let the moments of inertia I_P and I_R be given. The moment of inertia of the carrier, I_C, is no longer arbitrary; it must satisfy equation (29), see Fig. 9 right. This follows from the mathematical necessity of the mentioned equations and is of crucial importance for the dynamics of the Tense Assembly. For the purposes of design, construction, and prototype verification, we can ignore the negative sign in (29). Thus:

$$I_{CRIT} = |I_C| = 4 \cdot \frac{I_R R^2 + I_P (R - R_S)^2}{(2R - R_S)^2} \tag{30}$$

Let's call this physical quantity the critical moment of inertia. It is the real, physical moment of inertia of the carrier as a rigid body.

13.2. Function Graphs

Unlike formulas, function graphs give a much clearer physical picture. Let the planet radius, R, be the input variable x. Let's present the above solutions as functions of x, and then draw graphs. Let all input parameters be given, for example: R_S=2m, r=0.8m, I_P=2kgm^2, I_R=1kgm^2, F_0=5N, t=1s. Angular accelerations and tension forces are shown in the following drawing:

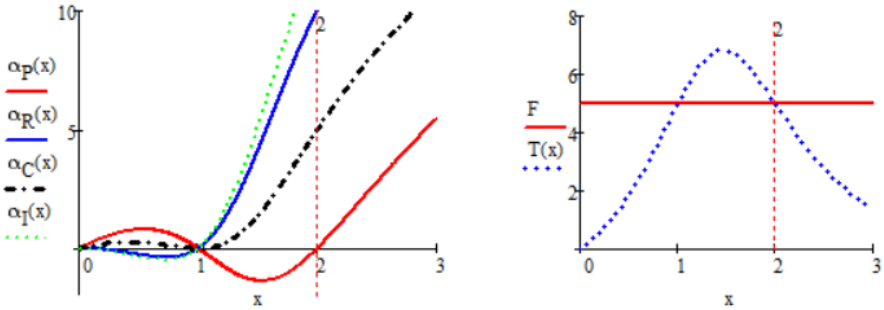


Figure 8. Left: Graphs of angular accelerations of the planet, rail, carrier, and idle pinion, formulas (23)-(26). Accelerations depend dramatically on geometry, i.e., on the ratio R/R_S.
Figure 8. Right: Tension forces F_0 and T, formula (28).

So, for example for x=R=2m we get: α_P=0, α_R=10s^{-2}, α_C=5s^{-2}, α_I=12.5s^{-2}, T=F_0

14. Is Negative Moment of Inertia - a Mistake?

Conventional thinking draws us into the classical story about chain elasticity and stored potential energy. Due to oscillations and conversion to kinetic energy, the potential energy of a tensioned chain decreases to zero over time – it is a physical phenomenon called relaxation.

But for oscillation, degrees of freedom are needed, which the system lacks. If we try to "push" the chain to relax, that displacement would, according to kinematic coupling, propagate through the entire system and return back, because (T2)-(U)-(I)-(L)-(H)-(R)-(P)-(S) are all in rigid kinematic coupling. This is not a chain between two free sprockets; it is a closed kinematic loop where every displacement is defined by equations.

The main problem is that condition (29) implies that the moment of inertia I_C must be negative, which classical mechanics does not permit as it is physically impossible. The story seems to end there. But wait!

Negative moment of inertia here is an interesting mathematical consequence, not a new physical law or a denial of the definition. Of course, the physical (real) moment of inertia of the carrier (C) is positive.

But due to the built-in tension in the entire kinematic loop, the system "sees" the negative I_C and behaves exactly like that - as if it contains an energy source. This mathematical phenomenon follows directly from the equations of motion (23)-(26), and especially from (29), which is undeniable. That is precisely why the system is in a self-exciting exotic mode. This means that all its elements (P, R, C, I) are constantly accelerating. Without built-in tension, the system would behave in a classic way, exactly as described by equations (1)-(6).

Therefore, I claim that - the story is just beginning here. There are two other strong arguments for this:

14.1. First Argument: Power Analysis

Something very interesting happens if we calculate the total power of the Tense Assembly. According to the above calculation, all its elements accelerate, except the fixed sun (S). The time derivative of rotational kinetic energy gives power. The power developed on the planet and the rail together is:

$$P_P + P_R = I_P \alpha_P^2 \cdot t + I_R \alpha_R^2 \cdot t \tag{31}$$

where t is elapsed time. The power on the carrier is:

$$P_C = I_{CRIT} \alpha_C^2 \cdot t \tag{32}$$

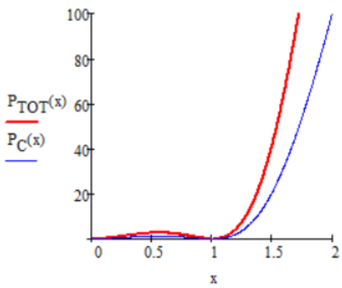
The total mechanical power developed by the Assembly is:

$$P_{TOT} = P_P + P_R + P_C \tag{33}$$

The calculation shows (see Fig. 9 left) that it is always true that:

$$P_P + P_R = P_C \quad \text{or} \quad P_{TOT} = 2P_C \tag{34}$$

Power graphs are shown in the following drawing on the left:



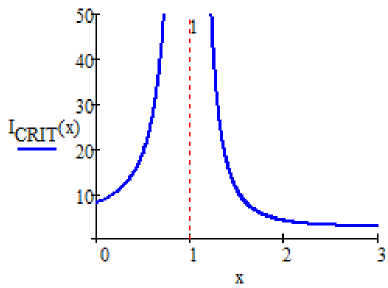


Figure 9 left. Power on the carrier and total power, formulas (32) and (33). Power dramatically depends on geometry, i.e., on the ratio R/R_S
Figure 9 right. Moment of inertia of the carrier, I_{CRIT}, formula (30).

The energy balance confirms the following:

- We observe mechanical symmetry - Power on the carrier is exactly equal to the power on the planet and rail combined, formula (34)
- Power depends dramatically on the geometry of the Tense Assembly, i.e., on the ratio R/Rs.

The above facts about power are deeply significant and fascinating. This is not a "mere coincidence."

14.2. Second Argument: Torque Analysis

All rotating elements contribute to the total torque. Thus:

$$M_1 = I_P\alpha_P + I_R\alpha_R + I_C\alpha_C = \tau_P + \tau_R + \tau_C \tag{35}$$

This is the dynamic torque because on the right side it contains only dynamic terms. Looking in the context of action-reaction, there must be a corresponding counter-torque, which is:

$$M_2 = T \cdot R_S \tag{36}$$

This is the static torque.

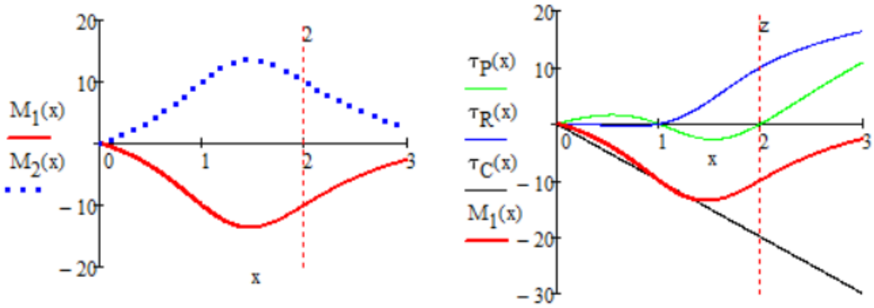


Figure 10. left: Balance of torques, formulas (35) and (36).
Figure 10. right: Dynamic torque and its components, formula (35).

Using formulas (23)-(28), (35) and (36), we find that $M_1+M_2=0$ always holds. This shows that the static and dynamic torques are always in balance. The described balance has deep physical significance:

- The static support (i.e., the fixed sun (S)) acts on the Assembly as a whole. This is realized via the tense side (m) of chain1 (see Fig. 7). The only possible counter-response of the Assembly is dynamic – through constant acceleration α_P, α_R, and α_C.
- The balance is achieved using inertia as an inherent property – this is dynamic inertial equilibrium.
- The environment neither receives nor gives any energy (the torque from the fixed (S) is infinite, so its acceleration is zero). In an energetic sense, the environment here is merely a mediator.
- The energy given by the Tense Assembly does not come "from nothing." The energy is an inevitable physical consequence of the balance between the dynamic and static torques M_1 and M_2 respectively. We will therefore call this energy the energy of dynamic response.

It is precisely the described new form of equilibrium and new form of energy source unknown in classical mechanics. These facts about torque are deeply significant and fascinating. This is also not a "mere coincidence."

14.3. Note on the Applicability of Lagrangian Formalism

In the initial phase of the research, I attempted to describe both the classical and exotic modes using an alternative, Lagrangian approach. While for the classical mode the Lagrangian method yielded results identical to Newton's equations of motion – thereby confirming the model's consistency – for the exotic mode it proved inapplicable. The reason lies in the nature of the built-in tension which, due to the kinematic trap, remains permanently trapped within the system, preventing any relaxation.

This condition violates the fundamental assumptions of the Lagrangian formalism, which relies on the minimization of potential energy and the conservation of energy in a closed system. The built-in tension creates a kinematic trap that renders classical variational approaches inapplicable, whereas Newton's equations – which deal directly with forces, moments, and kinematic constraints – remain fully valid and consistent. This inapplicability of Lagrangian mechanics is not a shortcoming of the model, but rather additional proof that CFAD requires an extension of classical analytical mechanics to encompass this type of dynamic equilibrium.

15. How to Achieve the Critical Moment of Inertia of the Carrier

(NOTICE TO THE READER: On first reading, you can feel free to skip Chapters 15. and 16. They contain important information for prototype builders)

For the Tension Assembly to function, it is necessary to achieve the critical moment of inertia I_{CRIT}, according to formula (30). If, for example, $I_C \neq I_{CRIT}$, the Tension Assembly will not function because the kinematic conditions are not satisfied.

To satisfy the condition $I_C = I_{CRIT}$, the following must be measured prior to the assembly of the Mechanism:

1. Moment of inertia of the planet, I_P. Measurement is performed using one of the known methods, for example, via a torsional pendulum or trifilar suspension. The total moment of inertia I_P equals the sum of the moments of inertia of the rigid bodies such as (P)+(T1), (T2)+(U), see Fig. 3. To this, the moments of inertia of both chains must be added: $I_{1,2} = (m_1 + m_2)\cdot R^2$, where m_1 and m_2 are the masses of each chain.
2. Moment of inertia of the carrier, I_C. The carrier is a rotationally symmetrical body with two or three lateral arms equipped with movable masses (M), Fig. 11. These masses serve to alter (regulate) the moment of inertia of the carrier. Prior to measurement, each mass (M) must be fixed at an equal distance from the carrier's center. All elements (I) involved in the measurement must be mounted on the carrier.

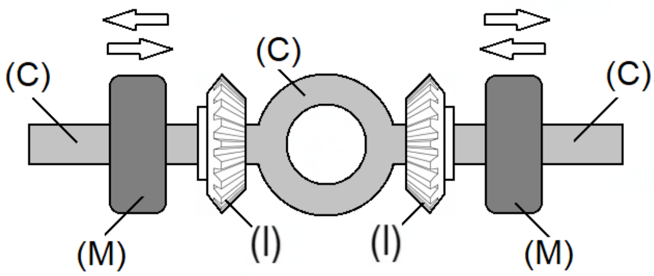


Figure 11. Measuring the moment of inertia of the carrier. Using the iteration method, the weights (M) are adjusted until $\alpha_R = \alpha_{CRIT}$, i.e., until $I_C = I_{CRIT}$ is achieved.

The moment of inertia of the rail, I_R, will be measured after assembly according to Fig. 3.

- To avoid eccentric centrifugal forces during the rotation of the Assembly, care must be taken to ensure that the counterweight (B) is in strict dynamic balance with the elements (P) and (T1).
- ECT must be mounted on the rail during measurement and must be in a relaxed state.
- A new sprocket or pulley is fixed to the flange (F). In this way, by applying an external force, the rail (R) and thus the entire Assembly can be accelerated or decelerated.

If a constant external torque τ_R is applied to the new sprocket or pulley, the Assembly accelerates. The angular accelerations are described by formulas (7)–(10). This is the classical operating mode.

In this regime, the angular acceleration of the rail, α_R, is measured using one of the standard methods.

15.1. Calculation of the Moment of Inertia of the Rail

With known I_P, I_C, and α_R, formula (8) allows for the calculation of I_R, which is:

$$I_R = \frac{\tau_R}{\alpha_R} - \frac{I_C(2R - R_S)^2}{4R^2} - \frac{I_P(R - R_S)^2}{R^2} \tag{37}$$

With known I_R, formulas (8) and (30) allow for the calculation of the critical angular acceleration of the rail:

$$\alpha_{CRIT} = \frac{1}{2} \cdot \frac{R^2 \cdot \tau_R}{I_R R^2 + I_P(R - R_S)^2} \tag{38}$$

15.2. Iteration Method

If the previously measured $\alpha_R > \alpha_{CRIT}$, the moment of inertia I_C must be increased to further reduce their difference. The correction of Ic is performed using the movable masses (M) by moving each equally along the arm towards the periphery (Fig. 11.). Thus, the moment of inertia is increased to a new value I_C. Then,

1. The Assembly is accelerated with a constant external torque τ_R, and
2. α_{R1} is measured. If $\alpha_{R1} > \alpha_{CRIT}$ still holds, then
3. the rotation of the Assembly is stopped by braking, and
4. the masses (M) are moved to increase the moment of inertia to I_C.

Steps 1–4 are repeated (indices 2, 3, …, n) until $\alpha_{Rn} = \alpha_{CRIT}$ is achieved.

The critical moment of inertia of the carrier (C) now precisely satisfies formula (30). It is no longer necessary to use an external torque τ_R. The Assembly is ready for operation in the exotic mode.

15.3. Geometric scaling of the CFAD

We are interested in the behavior of the CFAD under geometric scaling of the planet and sun radii, provided all other input parameters remain unchanged. Let a CFAD have geometric parameters in the ratio $c = R/R_S$. Now construct a new CFAD whose R and R_S are larger by a factor λ (the ratio c stays the same). How is this change reflected in functions such as I_{CRIT}, power, and angular accelerations of the CFAD? Answer:

- The carrier's critical moment of inertia, formula (30), shows scale invariance (homogeneity of degree 0). Thus, the function I_{CRIT} remains unchanged under scaling.
- The angular accelerations α_P, α_R and α_C (formulas (23), (24) and (25)) show linear scaling (homogeneity of degree 1) with factor λ.
- The CFAD power (33) and angular acceleration α_I (26) show quadratic scaling (homogeneity of degree 2) with factor λ^2.

15.4. Tips for building a CFAD prototype

The prototype will be completely mechanical, without any electronics, with the sole purpose of demonstrating the operation of the CFAD - it is not intended for commercial use.

- Construction plan: The prototype is built according to the sketch on Drawings 3 and 7, where the main central axle is fixed and stands vertically (can also be horizontal). Components such as bearings, sprockets (P), (T1), (T2), gears (U), (I), (L) and chains 1 and 2 are easily available as ready-made parts. Parts that are not available require milling and turning, either classic or CNC.
- Measurements: Perform all measurements according to the instructions in this Chapter.
- Chain tensioner: Instead of (ECT), use a classic mechanical tensioner with a spring.
- Recommended dimensions: The prototype should be portable and preferably modularly separable - not a requirement, for example: height about 40 cm, weight 4-6 kg. Pitch radius of planet: R=6 cm, sun: R_S=4 cm, ratio R/R_S=1.5. These measurements are only approximate; refer to available finished parts.
  The upper and lower bevel (crown) gears (U) and (L) can have any pitch radius, $R' \neq R$, but it is important that both gears are the same. Two or three idle pinions, (I), are usually of smaller radius. Gears (U), (L) and (I) must have the same module.

16. How CFAD Works

The power produced by the Tense Assembly depends dramatically on the ratio of planet and sun radii, R/Rs, and the magnitude of the built-in tension (see graphs in Fig. 8. left and Fig. 9. left).

CFAD's power depends on geometry. That is revolutionary!

So, the Tense Assembly behaves in a completely unexpected, exotic way. To prevent the unphysical consequences of continuous acceleration and infinite growth of angular velocities, CFAD should not operate continuously but cyclically (hysteresis regulation). In this regime, the energy generated during the acceleration phase is extracted during the regenerative braking phase. This is the essence of its practical application.

After ECT in the 'TENSIONED' state initiates acceleration and the system accumulates sufficient kinetic energy, it transitions to the 'RELAXED' state. Thus, "permanent acceleration" now loses that epithet because it lasts only as long as the 'TENSIONED' state. In the 'RELAXED' state, the built-in tension disappears, and the system is brought into regenerative braking mode, where the kinetic energy is converted into electrical energy by decelerating elements (e.g., via the rail or carrier - that case is already described in the first set of equations). Thus CFAD becomes a practical energy converter. The mechanical connection between CFAD and a generator is achieved via an electromagnetic clutch. While CFAD accelerates, the clutch is disengaged and vice versa.

ECT should gradually, but within a strictly defined time interval, transition from the 'RELAXED' state to the 'TENSIONED' state and vice versa, to ensure smooth change without harmful oscillations, but without unnecessarily long retention in the transitional state.

In one of the embodiments, the assembly includes a system for automatic control of operating modes. The system contains a sensor for measuring the angular velocity of the rail (R), a control unit, and actuators for controlling ECT and clutch. The control unit continuously compares the measured angular velocity with preset limit values. When the angular velocity reaches the upper limit (ω_{upper}), the system automatically switches to energy conversion mode: ECT transitions to the RELAXED state, the clutch engages, and the Assembly decelerates. When the angular velocity decreases to the lower limit (ω_{lower}), the system returns to acceleration mode: ECT transitions to the TENSIONED state, the clutch disengages, and the

Assembly accelerates. This cyclic operation ensures self-regulating operation of the Assembly within safe operating parameters.

Let us also mention that the CFAD mechanism is scalable, i.e. it works well in micro, medium or large dimensions.

17. Comparison of Input and Output Energy

ECT is not a "motor" that supplies energy. ECT maintains a constant chain tension force. Since there is no relaxation, there is also no displacement – therefore the work performed by ECT is zero. Electrical energy is consumed only to maintain the necessary magnetic field.

When transitioning to the "TENSIONED" state, electrical energy is consumed to tension the chain. This energy remains "trapped" as elastic deformation but cannot be dissipated because the system has no mode or kinematic path of dissipation that does not violate the kinematic constraints. Relaxation would require a change in geometry or kinematics, which is prevented by the design.

The energy for chain tensioning is the input energy for setting the system into the state of dynamic inertial equilibrium. But this "initial investment" is negligible in the total energy balance. It is, together with friction and all other losses, several orders of magnitude smaller than the energy of dynamic response (output energy) discussed in this work.

18. Conclusion

In this work, I could have easily omitted chapters 5. to 10. In that case, the physics authorities would likely say that the physical model of the Tense Assembly and the mathematics are probably good, but that equations (17)-(22) are incorrectly set up and need revision – all to ensure compliance with the law of energy conservation, i.e., input = output. Precisely to refute their argument and eliminate that type of criticism, I kept the mentioned chapters. Thus, I obtained solutions (7)-(12) which confirm, from every aspect, the laws of conservation of energy and angular momentum. Not only that – they confirm the validity of the equations of motion (1)-(6), which was most important to me in eliminating doubt. The same set of equations (17)-(22), but without τ, was applied later.

If authorities were to say: "Equations (17)-(22) are wrong because they yield negative I_C", I would reply: Wait! If equations (17)-(22) are wrong, then equations (1)-(6) are also wrong, because they are identical in structure. But equations (1)-(6) give perfectly conventional solutions that obey all conservation laws. You cannot reject (17)-(22) and accept (1)-(6). If equations (1)-(6) are correct, then (17)-(22) are necessarily correct and unassailably consistent. This is not a coincidence - this is a designed proof of self-verification through two regimes. In my reasoning, I persistently and repeatedly tried to refute myself with counterarguments and find an error - but despite great effort, I did not succeed in that. And my joy grew. The strongest card - symmetries that are not imposed - because they arise from the solutions. It is as if mathematics itself says: "Here is how this system must function to be consistent."

The fact that power is distributed 50/50 between the carrier and the rest of the system is fascinating and deeply significant. It contains a profound message for a paradigm change that has held us captive for centuries. This is not a "coincidence" – it is a direct consequence of the kinematic and dynamic symmetries and feedback in this system. In such geometry, the built-in tension and the free carrier (C) result in dynamic inertial equilibrium.

Thus CFAD is not isolated from the environment, but responds to the static torque of the environment, formula (36), with an equal dynamic counter-torque, formula (35). In this, the carrier (C) assumes the role of a dynamic support, which is manifested through the torque $I_C \cdot \alpha_C = -2 \cdot F_0 \cdot R$ in the fourth equation of motion (20). Therefore:

- Negative I_C is not a coincidence or a mistake - this mathematical information tells us that something deep and revolutionary has been touched. Equations (17)-(22) form a completely consistent mathematical model - negative I_C is physically meaningful as a description of an energy source.
- The dynamic response of the system (carrier acceleration) has an effect equivalent to a negative moment of inertia in the energy balance. But this is a consequence of function, i.e., specific kinematic coupling, and not a real property of mass or a denial of the definition.
- Due to the built-in tension F_0 in the entire kinematic loop, the system immediately enters the self-excited state, not the classical one.
- This is not an "inconsistency" - it is a new physical reality.

The above analysis is not only consistent but reveals a completely new physical paradigm. This changes the way we understand mechanical systems. CFAD is not a "perpetuum mobile" in the classical sense that violates the laws of physics, but a mechanism that extends them in a way that requires deeper understanding. Traditional mechanics may have overlooked cases where internal kinematic coupling can generate net acceleration without external influences.

18.1. The Enchanted Forest and the White Unicorn

(NOTICE TO READER: If you prefer a strictly academic tone, skip 18.1)

CFAD is a pretty well-rounded story. Due to the classical fear of "authority" it would be easiest to give up and say: Okay. I_C is negative, solutions inconsistent, I quit. That would be a big mistake. But I did not give up. I was pursued by a strange feeling that nature hides a deeper message it perhaps wants to tell us. Metaphorically, it is like an enchanted forest with undiscovered secrets. The described physical model fascinated me again and again - an almost obsessive mystery, like slightly ajar doors, offering an alluring and new view into the unknown. And who could resist such an invitation?

Guided by intuition that there must be something hidden there, in my thoughts I constantly returned to it, again and again re-examining my own physical model. And I did not regret at all the lost time spent exploring this enigma: Instead of a rabbit, a white Unicorn emerged from the bush. And suddenly, as if the key to those doors fell straight into my hands. The old doors of mechanics open…

When I felt, experienced, and finally mathematically proved all the equations and insights, an unexpected intensity of feeling overwhelmed me: indescribable fulfillment, pure, naked rapture, gratitude, childlike joy of discovery… At the same time, being powerless and omnipotent, infinitely vulnerable and indestructible. Are these six equations on a piece of paper an immeasurable value, even more important than life itself? Are they the first "spark" that can move and change the world and everything on it, forever – for the better? Are they the "butterfly" that, with its wings, will start a tsunami of positive change? One that will forever extinguish every fossil flame and smoke, clear the gray polluted mornings, let the waves roar freely, rivers flow unimpeded, wind whisper and roam where it pleases, sky blaze in pure blue—erasing scars from the weary face of Mother Earth and all beings? And give clean, easily accessible and endless energy – forever?

Tightness in the chest and tears of joy from discovery. I summon silence and gather courage. Fear disappears. At the same time I would shout at the top of my voice, run through the forest, bathe in icy water, hug a stranger, wave to pigeons. Instead, I am silent and sit - fulfilled. No one knows, no one suspects… Who should I tell, who should I share this dream with? I could easily erase everything and forget. But I will not. Somehow I feel I have no right to.

18.2. Experimental Verification: The Logical Next Step

The proposed CFAD mechanism is not based on speculation, but on a solid theoretical foundation – Newton's equations of motion, kinematic constraints, and the dynamic symmetry arising from the very form of the system. The mathematical consistency of the solutions for both the classical and exotic modes, along with the observed balance of powers and torques, renders the physical model complete and self-contained. Therefore, experimental verification is the logical and expected next step in the development of this concept.

Constructing a prototype does not serve to prove whether the mechanism will function – that is already contained within the theoretical analysis – but rather to confirm its behavior under real conditions, enable precise measurement of its dynamics, and demonstrate the practical application of cyclic operation with regenerative braking. This is the natural continuation of any serious engineering research.

This work paves the way towards a new field – the physics of mechanical systems in dynamic inertial equilibrium. The final validation, as well as insights into scalability and optimization, can only be provided by built and tested devices. Therefore, I call upon the research community for independent experimental verification. Instructions for building and calibrating a prototype are provided in Chapter 15.

19. Acknowledgments

I am not a prophet nor a genius - just a man who looked where others did not. What I have seen I share with you. My searchings and wanderings lasted a very long time. I know Who gave me the strength to persevere on that path. It was the plan and will of the One Who Is. For just a moment I was a brush in His hand. This work, the fruit of that guidance, may it glorify Him.

References:

[1] Newton, I. (1687). Principia Mathematica.

Contact: bokola1@proton.me
Project page: https://rart-ghub.github.io/CFAD-research/