SYN ISON Laboratory

Advanced Engineering Solutions

GREEN ENGINE PROJECT

TWO MULTI APPLICABLE MECHANISMS
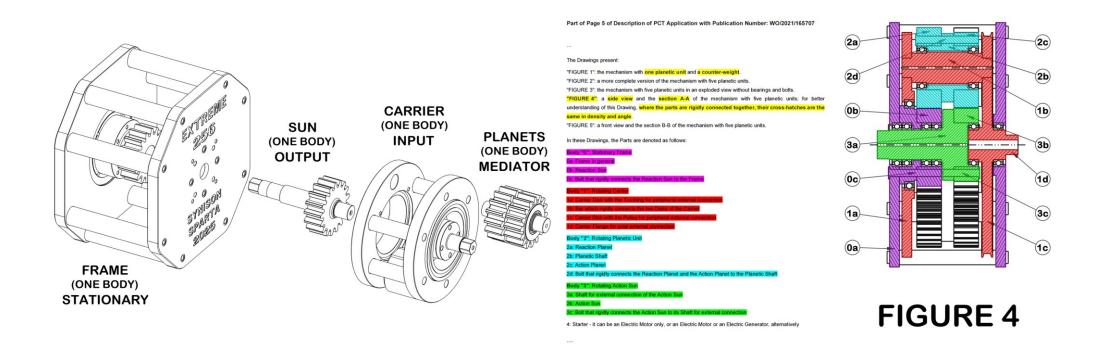**EX.T.R.E.ME. & ELEUTHERO-STROPHE**

1) EX.T.R.E.ME.: *EXtreme Transmission Ratio Efficient MEchanism*

the **simplest** ever such a mechanism, a **non-friction based** reducer or increaser, using the least number of moving parts (just **ONE** - "MEDIATOR" below- between its input and its output, only **THREE** in total), being the **most compact** one and, moreover, having coaxial input & output, having, also, low cost construction, easy maintenance and the **highest efficiency**, while as an increaser is the **world's first** one to exceed the ratio 1:200 for a considerable amount of power

Patent Application: Drawings

SUN (ONE BODY) OUTPUT

CARRIER (ONE BODY) INPUT

PLANETS (ONE BODY) MEDIATOR

FRAME (ONE BODY) STATIONARY

Part of Page 5 of Description of PCT Application with Publication Number: WO/2021/165707

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The Drawings present:

"FIGURE 1": the mechanism with one planetic unit and a counter-weight.

"FIGURE 2": a more complete version of the mechanism with five planetic units.

"FIGURE 3": the mechanism with five planetic units in an exploded view without bearings and bolts.

"FIGURE 4": a side view and the section A-A of the mechanism with five planetic units; for better understanding of this Drawing, where the parts are rigidly connected together, their cross-hatches are the same in density and angle.

"FIGURE 5": a front view and the section B-B of the mechanism with five planetic units.

In these Drawings, the Parts are denoted as follows:

Body "0": Stationary Frame
0a: Frame in general
0b: Reaction Sun
0c: Bolt that rigidly connects the Reaction Sun to the Frame

Body "1": Rotating Carrier
1a: Carrier Disk with the Toothing for peripheral external connection
1b: Bar which rigidly connects the two Disks of the Carrier
1c: Carrier Disk with the Pulley for peripheral external connection
1d: Carrier Flange for axial external connection

Body "2": Rotating Planetic Unit
2a: Reaction Planet
2b: Planetic Shaft
2c: Action Planet
2d: Bolt that rigidly connects the Reaction Planet and the Action Planet to the Planetic Shaft

Body "3": Rotating Action Sun
3a: Shaft for external connection of the Action Sun
3b: Action Sun
3c: Bolt that rigidly connects the Action Sun to its Shaft for external connection

4: Starter - it can be an Electric Motor only, or an Electric Motor or an Electric Generator, alternatively

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FIGURE 4

Patent Application: Abstract

A planetary mechanism has a stationary frame on which are supported a first gear with a central axis of rotation, a second gear and carrier. The second gear and the carrier are configured to rotate freely and endlessly about the central axis of rotation. Planetic shafts are supported on the carrier coaxially with respective planetic axes equally angularly distributed around the central axis of rotation. The planetic shafts are configured to undergo rotation freely and endlessly about the respective planetic axes. Third gears cooperate with the first gear and are connected to respective first ends of the planetic shafts. Fourth gears cooperate with the second gear and are connected to respective second ends of the planetic shafts. The first gear, the second gear, each of the third gears, and each of the fourth gears have a teeth number $Z1$, $Z4$, $Z2$ and $Z3$, respectively, satisfying the relation: $(Z1-Z2)*(Z4-Z3) > 0$, while when the teeth numbers satisfy the relations: $(Z1-Z2)*(Z4-Z3)*(Z4-Z1) = 1$ or: $(Z1-Z2)*(Z4-Z3)*(Z1-Z4) = 1$ the resulted transmission ratio is the maximum possible for this area of teeth numbers.

Patent Application: Bibliographic Data

- Title: ***EXTREME TRANSMISSION RATIO EFFICIENT MECHANISM***

- PCT Publication Number: WO/2021/165707
- PCT Filing Date: 22.02.2021
- Priority Date (Greece): 20.02.2020
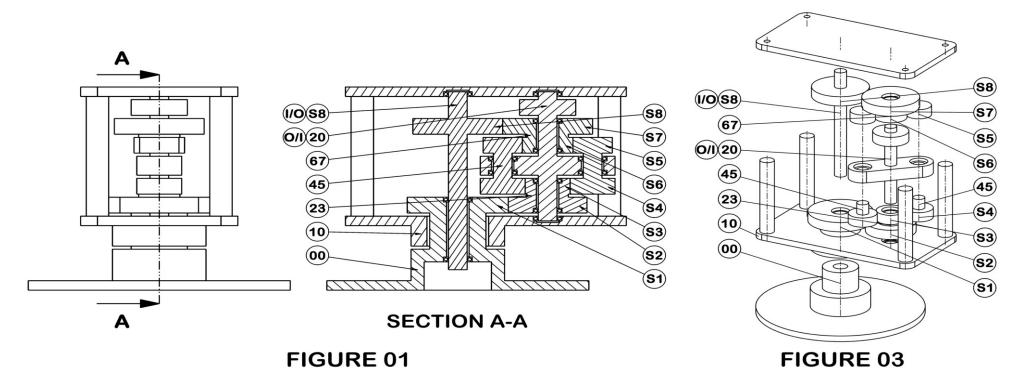
- **US** granted patent **US11940034B2** and **EP** & **IN** pending applications

2) *ELEUTHERO-STROPHE*:

a mechanism that transmits power on an endlessly rotating shaft (***STROPHE***) supported on an endlessly rotating carrier,
in such a way that the rotation of the shaft is independent (***ELEUTHERO***) of the rotation of the carrier,
meaning that this mechanism **kinematically and dynamically decouples two inherently strongly coupled rotations**,
while **it returns the produced reaction torque to the frame**

Patent Application: Drawings

FIGURE 01

SECTION A-A

FIGURE 03

Patent Application: Abstract

For the transmission of endless rotation from stationary frame to endlessly rotating carrier, or vice versa, independently of the rotation of the carrier, an efficient mechanical mechanism is missing.

A Compound Planetary Mechanism, named "*Eleuthero-Strophe*", is proposed, with the already existing central carrier, two suns with teeth numbers Z_{S1} or Z_{I1} and Z_{S8} or Z_{I8}, an eccentric planetary carrier on which an eccentric satellite shaft rests, bearing two satellites with teeth numbers Z_{S4} or Z_{B4} and Z_{S5} or Z_{B5}, and four planets with teeth numbers Z_{S2}, Z_{S3} or Z_{B3}, Z_{S6} or Z_{B6} and Z_{S7} which cooperate with the suns and the satellites, where the teeth numbers of all gears meet this Independence Condition:

$K_*L = 1$ or: $(1-K)_*L = 1$,   where:

$K = Z_{S1}/Z_{S2}*Z_{S7}/Z_{S8}$ or: $K = -Z_{I1}/Z_{S2}*Z_{S7}/Z_{S8}$ or:
$K = -Z_{S1}/Z_{S2}*Z_{S7}/Z_{I8}$ or: $K = Z_{I1}/Z_{S2}*Z_{S7}/Z_{I8}$ and:
$L = Z_{S3}/Z_{S4}*Z_{S5}/Z_{S6}$ or: $L = -Z_{B3}/Z_{B4}*Z_{B5}/Z_{B6}$.

Patent Application: Bibliographic Data

What we are looking for

Both of these mechanisms have plenty of very promising applications, almost ready for a profitable exploitation.

We are seeking collaboration with

- at least one **Business Partner** from the military, automotive or the unmanned vehicles industry and

- at least one **Academic Institution**, preferably a university.

We plan to carry out a more mature design process, improve prototypes, test them exhaustively and, as an outcome, to create almost ready to sell products.

This cycle will have at least two complete iterations and the need of sufficient funding is obvious.

A more detailed presentation of the land applications of the mechanisms

1) We propose the use of an **electric motor of very high speed** (over 100.000 RPM) in combination with our **reducer (*EXTREME*)** with high transmission ratio, for any electric vehicle for land, sea or aerial use, **manned** or **unmanned**.

In this way the motor is very compact, yet very powerful, and since our reducer is compact as well, their total volume is smaller and their weight is lighter than the currently in use proposals, while the **efficiency is much higher**.

Other applications of the *EXTREME* are where extreme precision is required, such as in **robotics** as well as in **dynamic positioning** and **targeting** systems, for example for azimuth and inclination setting of a **telescope** or a **rocket launcher**.

2) We propose, also, the use of our second mechanism (*ELEUTHERO-STROPHE*) in order to **supersede** the currently in use **delicate constant velocity joint** as the final power transmission to the wheels of a vehicle, fossil fuel powered or electric, **in many applications**, like these:

a) a **military** vehicle, like Hummer H1, where the 2 or even the 4 wheels are simultaneously driving and steering, with a steering angle of even 360 degrees (practically endless), **which will be globally the first holonomic vehicle with a single ICE or a single electric motor***,

b) a firefighting vehicle with a very high clearance from the ground,

c) an agricultural tractor with a very high clearance, also, from the ground (like Massey Ferguson 9310 model, for example: **https://www.farmmachinerysales.com.au/editorial/massey-ferguson/mf-9310-plus/**).

d) a family car where the 2 front wheels are simultaneously driving and steering, via our mechanism, while the angle of steering can be 90 degrees or even more, for an **easy parking process**, and

e) a FWD supercar, since our mechanism can transmit a huge amount of torque to the -drive and steering at the same time- wheels via robust gears instead of **the delicate balls of the constant velocity joint**; in this way **this supercar will be the first one in the world***,

Other applications of the *ELEUTHERO-STROPHE* are in an **excavator** or a **battle tank**, where a power transmission can be achieved between the chassis and the rotating turret **in a purely mechanical way**, meaning that there is **the need of one only engine**, preferably ICE, and these vehicles can be protected from special weapons like an **electromagnetic pulse**.

*except the huge scientific interest for such an effort, **here is a great opportunity to make history**; literally.

A more detailed presentation of the sea applications of the mechanisms

1) We propose that our first mechanism (*EXTREME*) will replace every winch on a vessel of any type and size.

These winches are many in number and they are used for many different purposes.

2) We propose, also, the use of our second mechanism (*ELEUTHERO-STROPHE*) to drastically improve the efficiency and maneuverability of the azimuth thruster of a vessel or a submarine of any type and size, manned or unmanned, as well.

Our mechanism solves the **fundamental problem** of the operation of an azimuth thruster **achieving kinematically and dynamically the independence** between the rotation of the pod and the rotation of the propeller and **absolutely eliminates the reaction torque**, and thus renders the maneuverability of the azimuth thruster even more efficient and much faster, **using a rather small electric servomotor which can execute any command of the captain in seconds**.

So, improving its efficiency, maneuverability and environmentally friendly behavior, we render the **azimuth thruster** as **the most ecological solution for today sea transportation of people and goods***.

The fundamental problem of the azimuth thruster which our second mechanism (*ELEUTHERO-STROPHE*) solves:

The azimuth thruster is the best way to control the direction of a vessel, of any type and size, and offers the most flexible and smart maneuvering of this vessel especially in narrow places and small ports.

In fact, the azimuth thruster is the combination of the propeller with the rudder.

However, the relocation of the support of the propeller shaft from the frame of the vessel onto a case/pod, which in fact is a carrier, rotatable with respect to the frame about an axis almost perpendicular to the one of the propeller, automatically generates a problem:

Now there is a redundant degree of freedom for the whole mechanical drivetrain from the engine shaft up to the propeller shaft: the rotation of this carrier with respect to the frame.

The drive torque (Q in figure, above) that rotates the propeller shaft about its own axis produces also a torque which has the direction of the axis of rotation of the carrier, applied on the carrier and forcing it to rotate with respect to the frame.

This second torque (M_z in figure, above) is an undesired **reaction torque**, and **the next bad news is that the magnitude of this torque is directly comparable** and **even greater** -depending on the overall transmission ratio of the drivetrain of the azimuth thruster- **than the one of the useful drive torque of the propeller shaft**.

*except the huge scientific interest for such an effort, **here is a great opportunity to make history**; literally.

The Company

SYNISON Laboratory Ltd

Contact: director@synison.com

The Profile

• Founded in: Sparta - Greece / Annex in Chicago - Illinois - USA

• Business Activity: Invention Generation, Invention Engineering, PoC Prototyping, Patent Rights Exploitation

• Current R&D projects: Advanced Holonomic Vehicle (recovery of all DoFs and optimization of Scrub Radius)

Innovative Rotary ICE (with very High Compression Ratio and thus High Power Density)

• The Inventor:

Panos Zaraphonitis: Mechanical Engineer MSc NTUA / PhD NTUA (not completed), Number Theory, Group Theory, Topology, Differential Calculus, Physics, Mechanics, Engineering, C++ Programming, G-Code Direct Programming, CAD/CAM/CAE, History of Science, Physiology of Invention, Idea Conception & Synthesis & Analysis Methodologies

• The Core Team:

Yannis Andriotis: Bio Mechanics R&D, International Power Waste to Energy / WtE, NASA Research Labs, Sandia Labs, USA Naval Institute, AECOM, Seajets

Giorgios Haniotis: Mechanical Engineer NTUA, MSc Aeronautics, MSc Solid Mechanics FEA, Expert in PTC/Creo CAD/CAE & ANSYS Mechanical Topology Optimization/Light Weighting, Rapid Prototyping, Group Leader at Philips Health/Medical

Nikos Alexandropoulos: Lawyer, Legal Services

Vicky Katsichti: PR, Marketing, Scientific Support, Analytical Instrumentation, Laboratory Testing / Materials, Applied Archaeological Sciences / Archaeometry

• Key partners: INTELLEX, NTUA, CERTH, ELLENIC VEHICLE RESEARCH, AIR ACTION

LINKS:

https://engine.green

https://increasest.com

https://thrusteer.com

https://azimuthruster.com