Article from collected materials of the 2nd International Science and Practice Conference "Tore Technologies", September 21 – 24, 2005, Irkutsk State Technical University, plenary report, pages 79 – 99.

VEHICLES TOROIDAL PROPULSIVE DEVICES

Dr. Valeriy Shikhirin
ELASTONEERING INC
E-mail: info@elastoneering.com, Website: www.elastoneering.com.

Tore Technologies (TORTECH) and Elastic Engineering (ELASTONEERING) is an adoption of natural mechanics based on toroidal motion with the purpose of creating on this base:

1. Tore based elastic machines and mechanisms,
2. Engines and energy systems,
3. Suppression systems for natural mass destruction weapons like hurricane / tornado.

From [1] it is seen that the main construct (design) element of:

- ***Tore/elastic machines and mechanisms*** is thin sealed or non-sealed (for pressure impulse) elastic/soft toroidal shell made of real elastic/soft material and filled out with working/fluid medium at overpressure (gas) or at normal pressure (liquid): eversible (turning inside out) or enveloping elastic toroid. When external or/and internal forces are applied elastic toroid moves forward turning inside out / enveloping (rolling) [2] relative to its anchoring belt.
- ***Engines and energy systems –*** virtual thin non-sealed eversing elastic/soft shell continuously filled up (by suction from outside environment) with fluid medium at overpressure (gas) or normal pressure (liquid): steady eversible/ enveloping elastic toroid/vortex.

Most important types of tore/elastic machines and mechanisms are vehicles toroidal propulsive devices including loading – unloading operations and having many consumer and performance characteristics.

Evolution of vehicles toroidal propulsive devices

1963 (USA): The first invention demonstrating technical eversible elastic toroid as the basic element of a vehicle [4].

1972 (USSR): R.Z. Kozhevnikov – Russian inventor who designed vehicle tore propulsive device [5] and proved its performance and efficiency on working models.

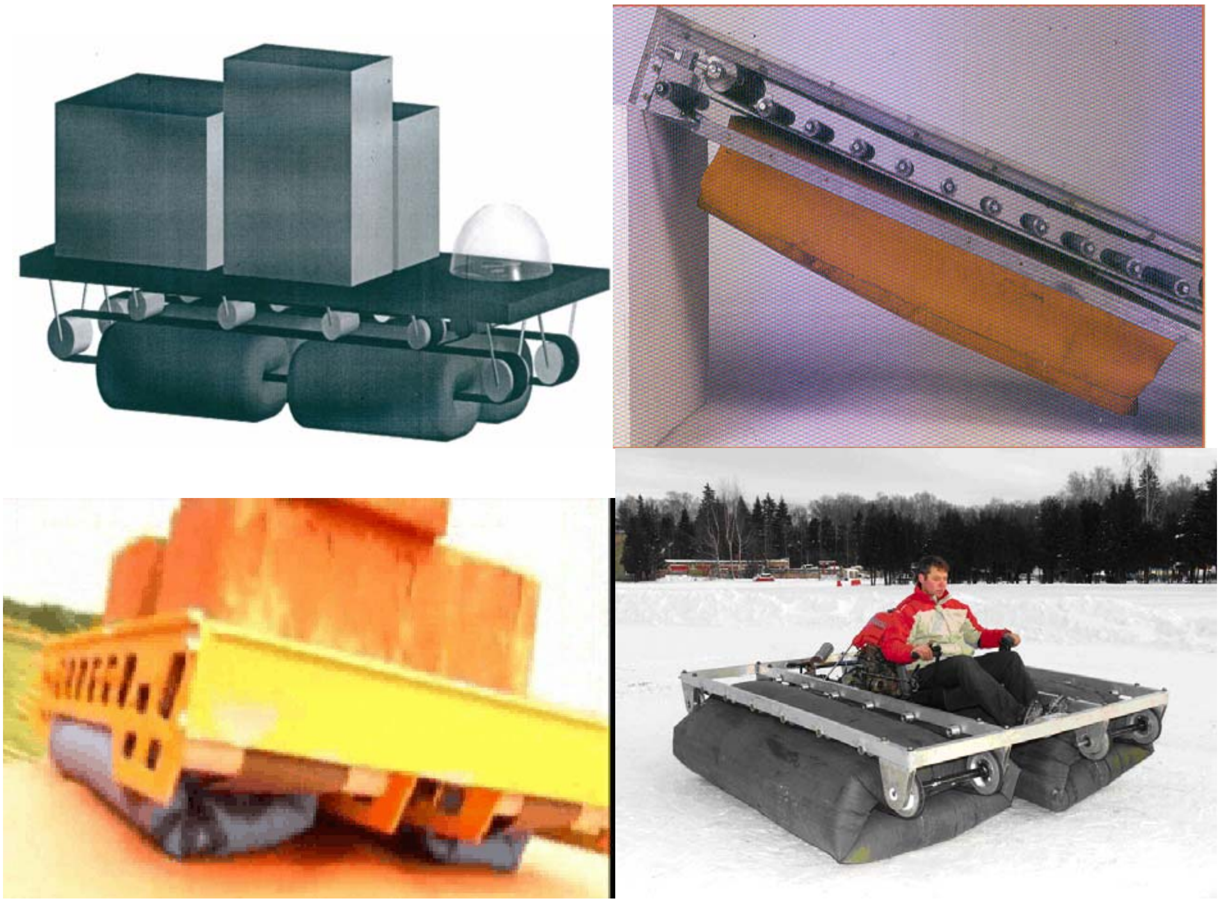


Fig. 1 Toroidal propulsive device evolution: (1993) - virtual / tentative vehicle toroidal propulsive device, (1996) [3], (1998) and (2005) - working models.

<u>1972 (USA):</u> B.E. Ilon registered in Patent Agency vehicle toroidal propulsive device [6] 26 days after the preceding one.
<u>1977 and 1996 (USSR, Russia)</u>: invention of toroidal propulsive devices capable of moving both in longitudinal and broadside direction, including displacement on water, with improved rotation function [7, 8] respectively.
Russian company «*Graderika, Ltd*», Zelenograd, Moscow (President, PhD (Technology) Shikhirine; Vice President, PhD, Professor A.I. Korobov) carried out complex research works [9 - 14]:
<u>1993 - 1995:</u> Development of toroidal propulsive devices of transport systems and maintenance facilities thereof:

- studying the possibility of using tore technologies in automobiles and means of their support,
- development of transport technologies capable of carrying bulky and super heavy cargo (more than 1500 tons) over cross country and loose bearing surfaces in extreme environment as well as loading and unloading facilities thereof,
- development of pump & compressor systems,

- development of transport technologies (pipeline and single-rail) to transfer carriers (cassettes) with silicon wafers and chemical reagents inline and in the semiconductor Fab.,
- development of equipment cluster elements (propulsive devices): vacuum gate valves, medium separators, loading/unloading sealed entry, mechanism for vertical wafer transfer, clamshell vacuum conveyor, vacuum and roughing piston pumps
- 1999: Study of vehicles based on tore technologies and their comparison with conventional propulsive devices. Joint work with the Chair of Automobiles and Engines at Moscow Institute of Motor-Car Construction (MASI-VTYZ-ZIL, Professor, PhD, G.K. Arzhanukhin
- 1993: The following research works have been carried out for the purpose of fitting out toroidal propulsive devices with environmentally pure combustion engines (hydrocarbon fuel saving and reduction of combustion product toxicity) [15]:

- «Testing of magneto-catalytic activator on MASI test bench for gasoline A-76 / A-92 and straw oil modification» - jointly with the Chair of Automobiles and Engines at Moscow Institute of Motor-Car Construction (MASI-VTYZ-ZIL, Professor, PhD G.G. Gusarov) and Research Department of Russian Academy of Economy (NIO REA) named after G.V. Plekhanov, laboratory of Professor A.V. Chernetsky (senior staff scientist, PhD. P.A. Sergeev),
- «Development of test procedure and testing of magneto-catalytic device on MosGasNII Project test bench for gas fuel activation» - jointly with Department of Power Engineering and Power Supply at Moscow Government, MosGasNII Project and NIO REA named after G.V. Plekhanov, laboratory of Professor A.V. Chernetsky (senior staff scientist, PhD. P.A. Sergeev).
- Test Results (average):
    - 10% reduction of fuel consumption,
    - reduction of carbonic acid and hydrocarbon content by 30% and half the amount respectively,
    - heat of combustion increase by 5-10%,
    - ignition temperature increase by 7-10% etc.
- «Development of hydrocarbon fuel activation machines using plasma of root, barrier and other types of charges» - jointly with NIO REA named after G.V. Plekhanov, laboratory of Professor A.V. Chernetsky (senior staff scientist, PhD. P.A. Sergeev).
- Preliminary results show at least 3-5 times less fume and toxicity.
- 2001(Russia, V.N. Shikhirine): in order to impart (create) intellectual properties in the material of eversible elastic toroid shell, for example to create “touch and sense” function in the material structure of toroidal propulsive device shell V.N. Shikhirine proposed new scientific and technical direction called “Elastic Engineering” [16, 17].

- 2002 (USA, "*Elastoneering, Inc"*): first research works and developments of machines and mechanisms, propulsive devices in particular, having multi-component (multi-cavity, multi-chamber) eversible/enveloping elastic toroids as the main design (structure) element. The working models of these machines called *"Self Systems"* were fabricated and tested.
- 2004 (USA, "*Elastoneering, Inc"*): in order to prevent early destruction of shell material caused by friction (rubbing) during active folding at elastic toroid's flanks when it moves forward by eversion and enveloping, there were:
- discovered the regularities in the folding process,
- obtained technical solutions how to control and manage these processes,
- made and tested working models

2005 (USA, "*Elastoneering, Inc"*): important result of the research – discovered **absolute identity of mechanics in tore/elastic machines and existing vortex phenomena like hurricane or tornado based on toroidal motion.**
This allows sensible and intelligent (contrary to "blind") work ("Vortex Heat-Generators", "Energy Extraction from Environment with the Help of Vortex" etc.) aimed at making propulsive devices, engines and energy & information systems on its base – creation of controlled gas and/or liquid eversible/enveloping elastic toroids allowing further capture of energy and /or information from them and/or target conversion thereof.

Functional features and advantages of toroidal propulsive devices

"Propulsive Device" *is a device designed to convert the work of an engine or other energy source into the work setting vehicles movement"* [18].
Vehicles toroidal propulsive devices belong to propulsive devices with super low (not more than 0.20 kilogauss/sq. cm) internal pressure of working/fluid medium [19] in toroidal elastic shell that moves forward turning inside out / enveloping (by rolling) relative to its long axis.
Complex researches related to conventional propulsive devices, wheeled or caterpillar ones are described in many publications, for example in [20, 21] whereas the information on tore based propulsive devices is gradually becoming publicly available [22 - 25].
Let us describe the peculiarities of vehicles toroidal propulsive devices in "automobile language" though lacking experience in this area and supposing that knowledge presented in this article requires additional study and development:
Vehicles toroidal propulsive device as one of the types of propulsive devices is divided into several sub-types (Fig. 2):
1. Progressive motion by turning inside out under the effect of external forces when the mechanism of elastic toroid's eversion is located outside toroid.

1.1. «Ikar» - Pipelined, submersible, subterranean and air transport.

Base surface of propulsive device like a "tube" (funnel) or fluid medium surrounding the propulsive device: gas, liquid, loose material (sand) is external peripheral body that fully or partially covers the peripheral part of eversible elastic toroid [26] (Fig. 2a).

1.2. «Kozhar» - earth - based or above-water transport.

The base surface may be soil (at the bottom) or the boundary of 2 different medium, for example liquid/gas and/or platform bearing roller (on top) that partially covers (envelopes) the peripheral part of eversible elastic toroid [4 – 8, 28] (Fig. 2b, c).

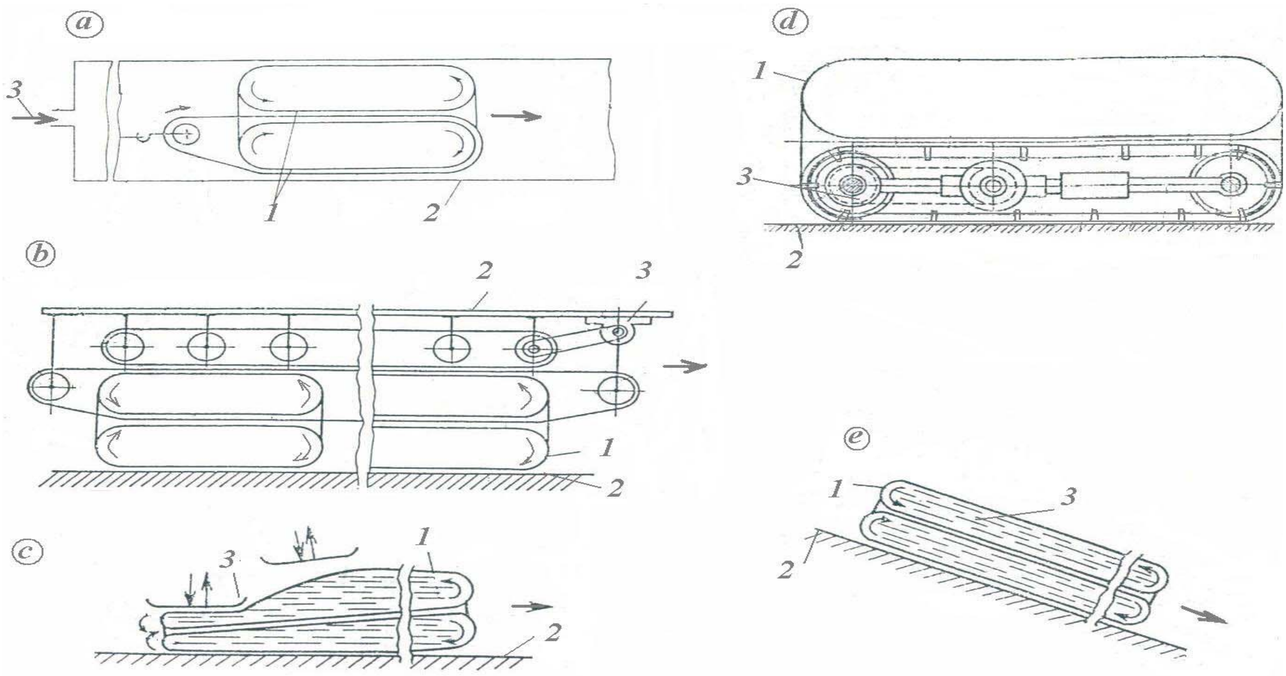


Fig. 2 Examples of sub-types of vehicles toroidal propulsive devices:
a – pipeline transport; в – earth-based or above- water transport; c – earth-based transport - a container filled out with fluid/working medium; d – earth-based transport; e – earth-based transport - gravitational container/propulsive device filled out with fluid/working medium.
1 – *turning inside out/enveloping elastic toroid,*
2 – base (support) surface,
3 – force effect: *a,в,c – mechanism of eversion outside the shell; d,e – mechanism of eversion inside the shell*

2. Progressive motion by turning inside out under the effect of external forces when the mechanism of elastic toroid's eversion is located inside toroid's shell.

«Mukhtar» - Earth-based, submersible, air or above-water transport.

The base surface may be soil, "tube" or fluid medium: gas, liquid or loose material (sand) surrounding propulsive device or the boundary of 2 media that fully or partially cover (envelope) the peripheral part of eversible elastic toroid [27, 28] (Fig. 2d, e).

3. Progressive motion by enveloping under the effect of external or internal forces when the mechanism of elastic toroid's envelopment is located outside or inside toroid's shell.

«Shikar» - Single-rail / string transport with *enveloping* or suspended wagons (carriages).

Base surface is single-rail / string being a central body, for example rail, stock, rope or reeds fully covered with its central part elastic toroid by enveloping.

4. Combination of mentioned sub-types.

Technical and performance characteristics

Data is received from comparing toroidal propulsive devices with conventional ones.

Let us analyze the most widely used vehicles propulsive device: «*Earth-based and above- water transport»*.

In the family of toroidal propulsive devices soil, water or the boundary of two medium is used as base surface for this sub-type 1.2. (Fig. 2).

Thus,

• Conventional wheel and caterpillar can move forward by rolling only relative to (around) its long axis whereas the progressive movement by rolling (eversion /envelopment) along the same axis (at 90º) is not possible because:

- chamber (tire, tore) cannot everse relative to its long axis as tore's outside diameter is larger than its internal diameter and when there is an attempt to turn it inside out tore just chocks (jams).
- a caterpillar forced to move by means of rolling relative to its quadrature axis/axes will probably look like "stupid" (idiotic) invention.

On the contrary, elastic toroid can progressively move by turning inside out / enveloping (rolling) along its long axis and also move forward by rolling relative to (around) it, i.e. vertically (in perpendicular direction) to long axis.

• Main force characteristics of elastic toroid (toroidal "wheel" of a vehicle) are twice as much as force characteristics of a spherical wheel. Chamber - Tire - Tore put (mounted) on a rigid disc with axis can be represented as a spherical wheel with axis [23]. Then at other equal conditions, for example same dimension (height) and overpressure of working/fluid medium in the shell cavity there are the following advantages:

- tension (stretch) value of shell material in elastic toroid is half of that in shell material of elastic sphere,
- shock absorbing properties of elastic toroid are twice as better as those in elastic sphere - "double" shock absorption: in the zones before and after "squeezed" flat central part of elastic toroid,
- material tension at the flanks of elastic toroid is half of that in the peripheral part, therefore the possibility of material pick or deformation is much less and flexibility with regard to collision to sharp, hard obstacles is much higher, there is no slippage (sliding friction) during collision or head-on crash.
- «washing» of the obstacle instead of knocking against it or colliding with it.
– stretched (strained) central part of elastic toroid (squeezed and tending to become a plain) is an internal tie reducing to half longitudinal loadings to the

shell material thus preventing its busting from inside by working/fluid medium in the shell of elastic toroid at overpressure.

• Elastic sphere does no have the central part being an essential element of elastic toroid. This adds to elastic toroid extra design capabilities allowing increase its functional features, for example the use of central body.

Process of axis integration into wheeled or caterpillar propulsive device as an obligatory element of its performance requires unreasonably complex and expensive design and engineering efforts.

• The wheel "captures" from engine 10-15% of its power (caterpillar about 20%) and elastic toroid - five times less (4%).

• The area of contact surface of wheel tire is increasing due to decrease of internal pressure thereof, in wheel tire it may change maximum 10%, in caterpillar 0% whereas in toroid up to 500% (5 times as much) and more (Fig. 3, top).

• Toroidal propulsive device may be simultaneously:

- loading-unloading device with better technical and economic characteristics comparing to similar devices (Fig. 3, bottom) because the height of wheel tire increases due to decrease of internal pressure thereof, in wheel tire it can change maximum 10%, in caterpillar 0% whereas in toroid up to 200% (2 times as much),
- propulsive device and elastic container for handling "loose" cargo, for example fuel (Fig. 1c),
- propulsive device and elastic platform for handling (carrying) various types of cargo and /or placement of additional technical systems therein,
- Propulsive device for displacement over hard surface (transport facility) and in water (floating platform).

• Possibility of using extra equipment also made on the basis of tore technologies and elastic mechanics: *tore* lifting jack, pump, cable hoist for self extraction etc.,

• Possibility of "adjusting" parameters of propulsive device to fit required carrying capacity and other technical requirements with the help of unified modules. Each module includes drive lead infinite belt, belt transmission, tension roller, tightening device, rollers of friction infinite belt, infinite belt and eversible elastic toroid,

• Possibility of quick disassembly of propulsive device (if required) and its further tight stowage for its shipment on other vehicles. This is particularly important for air shipment sensitive to size and weight of a transport facility.

• Toroidal propulsive device can be equipped with engine working on various power sources,

• Possibility of using any types of trailer (wheeled, caterpillar, sledge etc.),

• Use of soft ramps to overcome ditches, cracks, difficult roads,

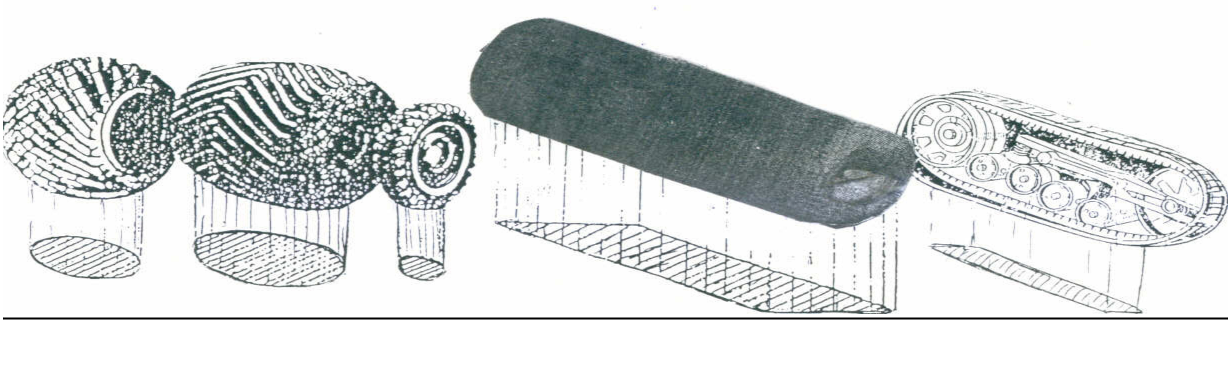
• Possibility of using replaceable spare toroidal shells. Due to small size and volume during storage they can be used as other functional elements: machines for increasing floatation ability, containers for liquid and gas fuel, household appliances (beds, tables, chairs, mattresses, pillows) etc.

• Toroidal shell is a protective shell protecting cargo against knock,

• Toroidal propulsive device can be displaced manually, for example with the help of cable hoist, which is absolutely not possible for “heavy” conventional propulsive devices,
• Availability of various “wheel formula” options, which is excluded for conventional propulsive devices,
• Formation in a certain manner of a platform in the structure of toroidal shell material and/or inside its cavity and/or on its outside surface – peripheral and/or central part thereof etc.

Significant advantages of toroidal/elastic propulsive device in comparison with existing wheel and caterpillar vehicle propulsive devices are:

- small energy and material intensity in key design elements of propulsive devices – elastic toroids, where the mechanism is an interaction between the shell and the fluid medium; sliding friction is replaced by rolling friction; metals are replaced by composite materials of the shell; requirements for conditioning (processing) “remaining” rigid surfaces are not very tough etc.,
- easy to assemble and operate in difficult conditions;
- transportability and convenient warehousing;
- significantly less energy is required for shell eversion (enveloping) than for driving through wheel or caterpillar axis;
- overcoming road surfaces inaccessible for similar devices; better cross - county ability for overcoming obstacles and slopes etc.;
- elastic toroid has significantly larger contact area with the base surface and wider possibilities of its adjustment (if required);
- low unit pressure to base surface (less than 0.1 kilogauss/sq. cm);
- low pressure of fluid medium in a shell (maximum 0.2 kilogauss/sq.cm), such pressure can be generated by a human being with his lungs, though it takes more time;
- high amortization and shock absorbing abilities;
- higher lifting capacity;
- noiseless,
- very simple design of vehicle suspender etc.



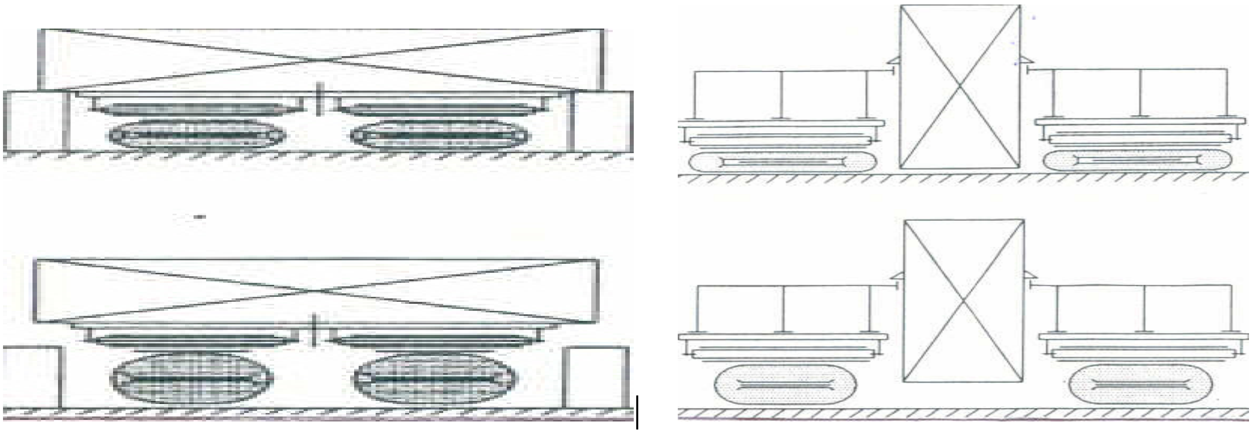


Fig.3. the upper part shows dimensions of contact surface of arched tire, pneumatic roller, normal tire, elastic toroid and caterpillar.
The bottom part shows luggage loading/unloading options directly by toroidal propulsive device.

It is without doubt that in terms of performance characteristics, practical application, environmental parameters, “pantophagy” in extreme conditions and actually in any operational environment (medium) toroidal propulsive devices in vehicles surpass similar conventional drivers.

Toroidal propulsive device functioning

Vehicle toroidal propulsive device consists of drive/lead infinite belt 1, enveloping (rounding) the rollers mounted on a frame and driven by a roller 3 connected to transmission 4 and engine 5 (Fig. 4).
Tension is achieved by tension mechanism 7. Friction infinite belt - eversing elastic toroid- envelops (rounds) two rollers 8, it is a central part of elastic toroid 10 and is frictionally (due to friction force) connected to drive infinite belt 1.

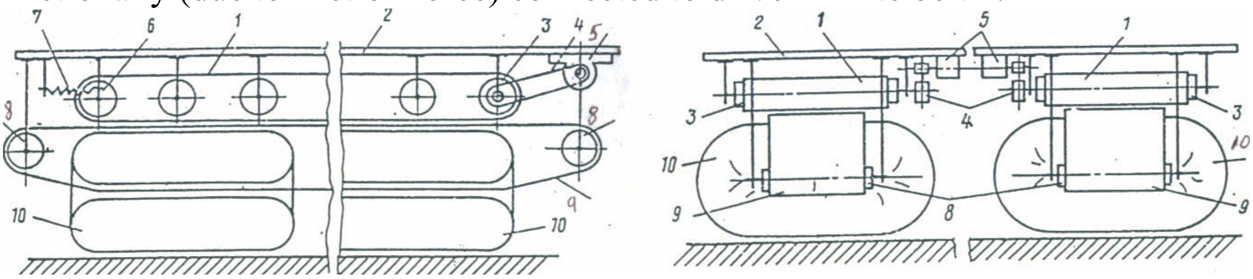


Fig. 4 One of the simplest from design and construction point of view toroidal propulsive device [5] realized as working model.
1 – drive, lead infinite belt, 2 – frame/platform, 3 – drive belt rollers, , 4 - transmission (belt), 5 – engine, 6 – strain roller, 7 – tension mechanism, 8 – rollers of friction infinite belt, 9 – friction infinite belt, 10 – eversible elastic toroid

<u>Operation of toroidal propulsive device:</u>
Engine 5 through transmission 4 rotates roller 3, setting in motion drive (lead) belt 1. This belt due to friction forces drives friction belt, which is being a central part of

elastic toroid 10 turns it inside out. As elastic toroid is located on a base (bearing) surface (soil) it interacts with the surface and moves the vehicle.

Behavior of elastic toroid during obstacles overcoming (Fig. 5)

A. If the height of an obstacle (h) is less that half of the height of elastic toroid (H) (A, B, C, D - positions I, II, III), toroidal propulsive device easily overcomes the obstacle regardless how long (length *l*) and wide (width *s*) the obstacle is.

B. If the height of an obstacle (h) is more than or equal to half of the height of elastic toroid (E – positions I,II,III) “jamming” (squeezing) caused, as thought, by high sliding friction (jamming) between internal area of central and peripheral part does not happen. Operational capability of elastic toroid is not disturbed because when elastic toroid runs into (knocks against) high obstacle the pressure in the shell of elastic toroid drastically increases, thus preventing internal surfaces of elastic toroid to join each other (to close). And we have in this case a kind of gas or liquid bearing. Moreover, even if the contact happens the surfaces are sliding relative to each other. This was proved by the tests on material with polymer coating.

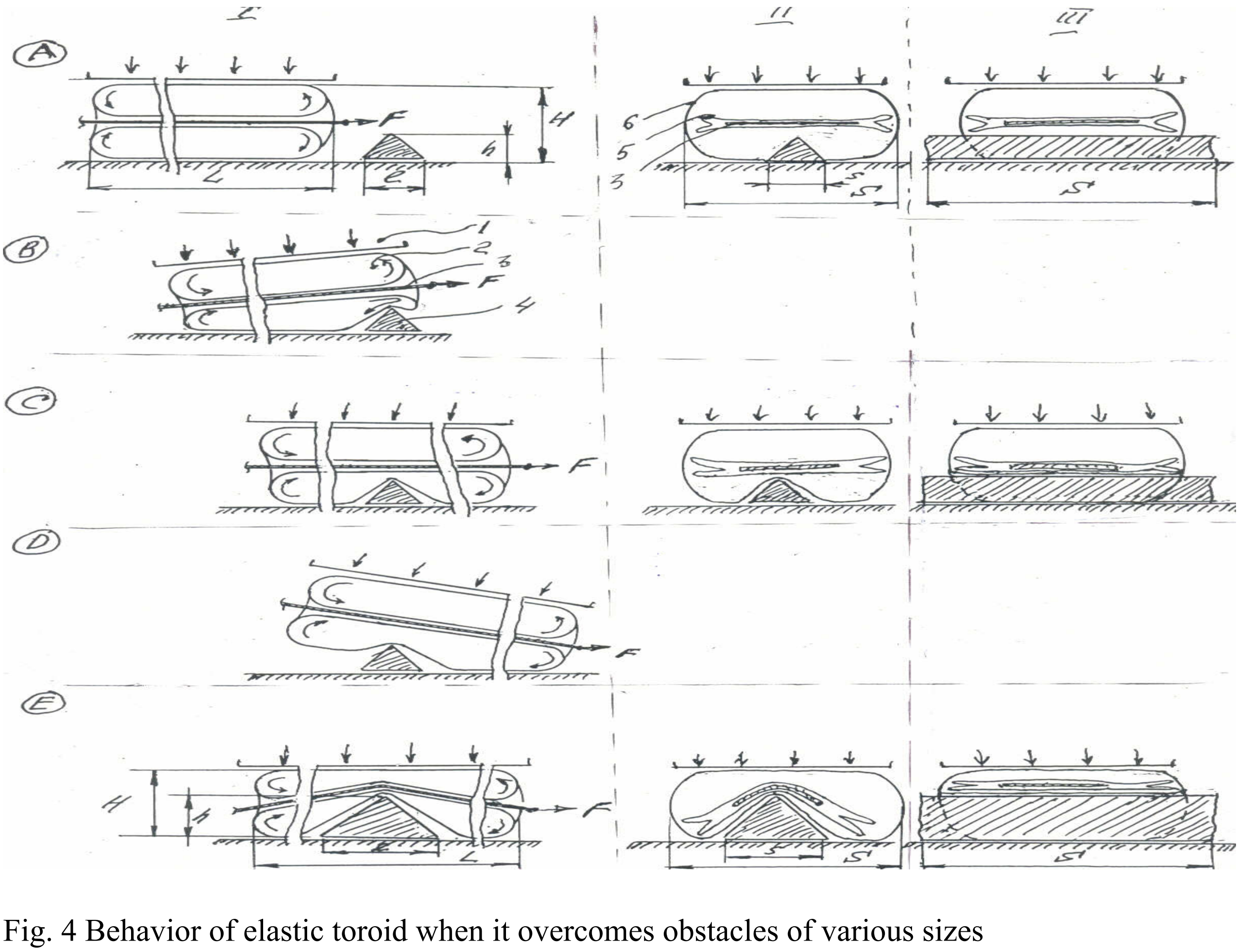


Fig. 4 Behavior of elastic toroid when it overcomes obstacles of various sizes
1 – cargo, 2 – elastic toroid, 3 –central body – infinite belt, 4 – obstacle, 5 – central part of elastic toroid with folds, 6 – peripheral part of elastic toroid, F – pulling force (drag force).

Characteristics of working model:

- It consists of two unified modules integrated on a frame/platform 2, where engine 5 is mounted. Each module has drive lead infinite belt 1, belt rollers 3, transmission (belt), tension roller 6, tightening mechanism 7, rollers of friction infinite belt 8, friction infinite belt 9 and elastic eversible toroid 10.
- length ~ 920 mm,
- width ~ 520 mm,
- height (with platform) - maximum 160 mm,

Eversible elastic toroid

- length ~ 60 cm,
- diameter ~ 14 cm,
- *width of elastic toroid ~ 15 cm,
- mass of propulsive device without load (cargo) ~ 12 kg,
- mass of load (cargo) – maximum 120 kg,
- area of base/contact surface (soil) without load (cargo) ~ 1800 cm^2,
- specific pressure applied to base surface or pressure in the cavity of elastic toroid depending on mass:
  - - 12 kg (without cargo) ~ 0,0067 Kgf/cm^2,
  - - 12 kg + 50 kg - 62 kg ~ 0,034 Kgf/cm^2,
  - - 12 kg + 100 kg - 112 kg ~ 0,062 Kgf/cm^2,
  - - 12 kg + 150 kg - 162 kg ~ 0,09 Kgf/cm^2

*working width of eversing elastic toroid "squeezed (smashed)" by base surfaces, for example platform with cargo and soil.

Main physical and mechanical properties of textiles and materials with coating used for making working models of toroidal propulsive devices are shown in Table 1.

Working model of toroidal propulsive device shows the following features (capabilities):

- Overcoming obstacles of about 5 cm height (half of toroid's height).
- Handling, loading and unloading of objects whose weight is 10 times more than the weight of toroidal propulsive device working model.
- Speed of forward and backward movement over horizontal surface up to 0.5 km/hour.
- Movement over cross country and at 20º angle etc.

The working model of toroidal propulsive device is a reduced experimental model (prototype) proving the operational integrity of tore technologies realized in vehicles toroidal propulsive device.

Patent objects:

- vehicle toroidal propulsive device (new versions),
- formula and technology of new intellectual (smart) composite elastic materials manufacturing and testing,
- design and technology of elastic toroid shells manufacturing and testing,

- new types of protectors,
- *Tore* lifting jacks, pumps, cable hoists for self extraction, devices for floatability enhancement, containers for liquid and gas fuel, household appliances (beds, tables, chairs, mattresses),
- design and technology for manufacturing and testing toroidal propulsive device elements (valves, tightening mechanism, infinite belts etc.),
- new machines and mechanisms, for example toro-byke, toro-scooter, toro-cycle, toro-mobile, amphibian etc.

Table 1

#	Material parameter	Textile, caprone, art. 56307	Rubber cloth		Fabric with polymer coating	
			L-10-613	L-10-619	Nylon with polyurethane*	Nylon with polyurethane*
1	Mass 1m^2, g	35	330	225	170-200	200-235
2	Breaking load, H/5cm base/weft	360/350	470/410	460/410	2014/1680	2000/1800
3	Bond strength, H/cm	-	1,4	0,7	>10	55-110
4	Gas - permeability at pressure 0.04Mpa	-	imperm.	imperm.	imperm.	imperm.
5	Reversing factor , (SH=Kn/Kb x H/H*), б/р**	-	11	14	17	18

Note:
* Data source: Laminating Coating Technologies, Inc.
** Eversion coefficient for toroids made of fabrics with coating is proportional to "hardy foldable (packable)" module (handle module $H=1/A_0N$), with account for draw force (dF) when the folds in cone cross section change (dP_0), as well as empirical coefficient of "enveloping" (Кн=1) and «eversion» (Кв=1,1) [29].
For reference:
H^*=2,17 N/cm^3 of parachute nylon VIL-C-7020F, type 1. Desired (unknown) "hardly foldable" module ($H/H^* < 40$).

Possible application of toroidal propulsive device

Vehicle toroidal propulsive device has many applications due to its improved capability to overcome obstacles, economical efficiency, environmental safety and cost comparing to competitive conventional propulsive devices.

Table 2 shows possible applications of toroidal propulsive device and its advantages comparing to competitive conventional propulsive devices (X) or the areas where the use of conventional propulsive devices is not possible for technical or environmental reasons (XX).

Table 2

Applications	Obstacles/ any surface/amortization	Environ-mental effect	Energy saving	Price advantage	Portability	Loading/ Unloading
«Mars Rover»	XX	X	X	X	XX	XX
Robots	XX	X	X	X	XX	XX
Military machines	XX		X	X	XX	XX
Golf cart		X	X			
Transport for large parks like in Alaska and similar territories.	XX	X		X	XX	XX
Snowmobile	XX	X			XX	XX
Tools for earth and non-earth surface exploration	XX	X	X	X	XX	XX
Carrying cargo more than 350 tons	XX					XX
Transfer of invalid persons	XX	X	X	X	XX	XX
Toro-cycle – toro-byke....	XX	X	X	X	XX	XX

Literature

1. V.N. Shikhirine. Prospects of Tore Technologies and Elastic Mechanics Development, and “Wonders” they Create in Nature. Article from collected materials of 2nd International Scientific and Practical Conference “Tore Technologies”, September 21 -24, 2005, Irkutsk State Technical University, plenary report.

2. V.N. Shikhirine. Tore Technologies as the Basis of Elastic Engineering. Article from collected materials of 1st International Scientific and Practical Conference “Tore Technologies”, June 2, 2004, Irkutsk State Technical University, plenary report, p. 22-48.

3. Shikhirin V.N. Tore technologies/Russia SCI-tech, Science & Technologies from Russia, A Quarterly Magazine, Inter Group Corporation, № 1, 1996, c.32, New-York, USA

4. R.N. Thomson, Load or Vehicle Supporting Devices, USA Patent Патент No. 3,272,172 of September 13, 1966 (Priority of Sept. 6, 1963).

5. R.Z. Kozhevnikov and E.I. Kozhevnikova. Vehicle Propulsive Device. USSR Patent No. 513899, priority 01.09.72., published 15.05.76. Bul. No 18.

6. B.E. Ilon, Vehicle for Use on Land, in Water, on Ice and in Snow. USA Patent 3,814,046 of June 4, 1974 (Priority Sept. 27, 1972).

7. E.L. Sosnovsky, V.P. Sidorenko, A.H. Eloev. Sosnovsky’s Propulsive Device of a Vehicle. USSR Patent No. 701858, Priority 01.09.77., published 15.12.79. Bul. No. 45.

8. Shikhirin V.N. and Shikhirin N.V. TOROIDAL PROPULSION DEVICE FOR VEHICLES, PATENT COOPERATION TREATY B 62D 57/02, WO 98/10975, PCT/RU96/00258
9. Hose and Tore Converters. Possibility and Practicability of their Use in General Purpose Machines and Devices. All Union Research Institute of Inter-Industry Information. Special Issue (7 articles), Moscow, 1995, under edition of A.I. Korobov and V.N. Shikhirine, p. 85.
10. A.I. Korobov and V.N. Shikhirine. Hose and Tore Converters – a Reserve for Improving Quality and Technology of General Purpose Machines and Devices Design. Journal "Science and Engineering" No.2, Collected Materials of 2nd Russian and South Korean Science and Technology Conference, Moscow, 1995.
11. A.I. Korobov and V.N. Shikhirine. Design of Pumps Made on Flexible Elastic Shells. Journal "Science and Engineering" No.2, "Sotrudnichestvo", Collected Materials of 2nd Russian and South Korean Science and Technology Conference, Moscow, 1995.
12. A.I Korobov, M.U. Priz, V.N. Shikhirine and R.V. Sherbachev. The Concept of Using Tore and Hose Elements in Microelectronic Tools. Journal "Science and Engineering" No.2, "Sotrudnichestvo", Collected Materials of 2nd Russian and South Korean Science and Technology Conference, Moscow, 1995.
13. A.I Korobov, M.I. Kritenko, S.B. Podyampolsky, G.H. Satarov, Yu. I. Stepanov and V.N. Shikhirine. Possibility of Using Elements with Elastic Shells in the Production of VLSI ICs. Proceedings IIA, Microelectronics & Information Technology Section, Issue 2, 1997
14. V.N. Shikhirin, S.V. Larionova and N.V. Shikhirin, Kinematics and Electronics of Elastic System, SEMI EXPO CIS 2000, October 3-6, Program Directory and Product Guide, Moscow, Russia, p.37-39.
15. O.V. Koltun, K.F. Reader, P.A. Sergeev, V.M. Skorobogatov, V.N. Shikhirine. Creation of Devices for Hydro Carbon Fuel Activation and Products of its Burning Purification. 3rd Congress. Association of engineers for heating, ventilation, air conditioning, utilities and construction thermal physics (AVOK). Colleted reports, Moscow, Sept. 22-25, 1993, p. 76-77.
16. V.N. Shikhirine. Elastic Machines and Mechanisms of Future. Sum of technologies, No. 3, 2000, p.52-53.
17. V.N. Shikhirine. Elastic Engineering. Basis of Machines and Mechanisms of Future. Electronics: science, technology, business, No. 5, 2001, p. 10-14
18. Polytechnic Dictionary. «Sovetskaya Entsiklopedia», Moscow, 1976, p. 132.
19. Cross-Country Vehicles on Tires with Super Low Pressure for Arctic Round-The-World Expedition "Polar Ring", http://www.ec-arctic.ru/index_rus.html, 2005
20. Ya. S. Ageikin. Cross-Country Wheel and Combined Propulsive Devices. Theory and Calculation. "Machine-Building", Moscow, 1972.
21. R.G. Armaderov, N.F. Bocharov, A.V. Filushkin. High Maneuverability Vehicle Propulsive Devices. "Transport", Moscow, 1972.

22. V.I. Kotlyarenko, V.N. Shikhirine, O.V. Shalnev. Schematics and Tasks for Machines and Mechanisms with Vehicle Toroidal Shell Propulsive Devices. XI All Union Science and Practical Conference (with international participation). “Rubber Processing Industry. Products. Materials. Technology. Investments”. Materials of the Conference.Moscow,2005,p.236.
23. V.I. Kotlyarenko, V.N. Shikhirine, O.V. Shalnev. Schematics and Tasks for Cross-Country Vehicle Propulsive Devices. 50th International Science and Technology Conference “Automobile and Environment”. Abstracts of reports. Dmitrov, 2005, p. 219.
24. O.V. Shalnev, V.N. Shikhirine, V. I. Kotlyarenko. Soft Vehicle Propulsive Devices. Article from collected materials of 2nd International Science and Practical Conference “Tore Technologies”, Sept. 21-24, 2005, Irkutsk State Technical University.
25. V.F. Ionova, O.V. Shalnev, V.N. Shikhirine, V. I. Kotlyarenko. Construction Materials for Tore and Elastic Machines and Mechanisms. Article from collected materials of 2nd International Science and Practical Conference “Tore Technologies”, Sept. 21-24, 2005, Irkutsk State Technical University.
26. R.Z. Kozhevnikov. Device for Cargo Transportation over Pipeline. USSR Patent No. 548505, priority 21.02.72., published 23.03.77. Bul. No. 8.
27. V.V. Shishkin. Vehicle Propulsive Device. USSR Patent No. 1483816, 17.10.86
28. R.Z. Kozhevnikov. Method of Transporting Bulk Cargo to Reservoir. USSR Patent No. 1224206, priority 14.07.81., published 15.04.86. Bul. No. 14.
29. Rueter L.L. and Munson J.B: The Effect of Configuration on Strength, Durability, and Handle of Kevlar Fabric-Based Materials, NASA CR-2738, 1976