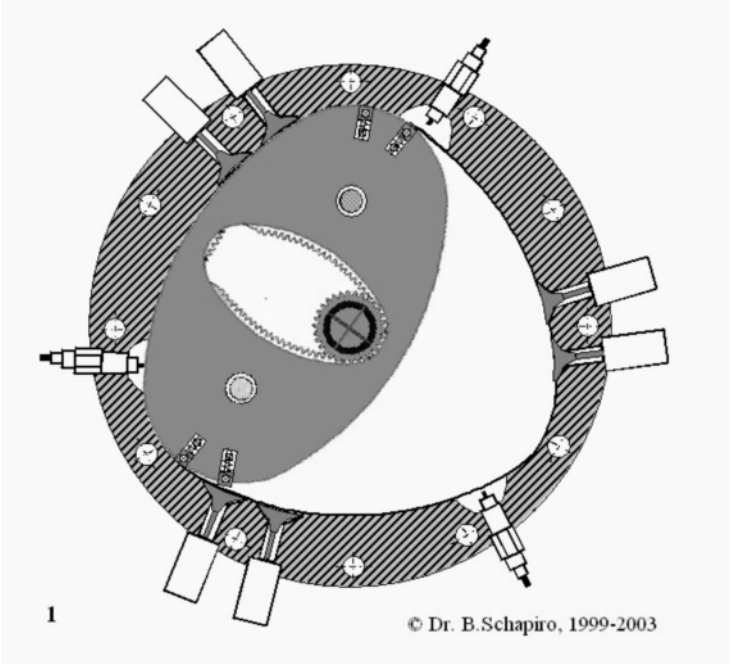
RKMs:
New Class of Machines



B. Schapiro and L. Terlitsky

- **An old dream** of engine builders is to create a rotational machine with **the same good features** as machines with reciprocating, back-and-forth piston motion.

- We are attempting to fulfill that dream.

Good features of machines with back-and-forth piston motion are:

- **Surface-to-surface sealing** between piston and work chamber
  ➔ Excellent in maintaining the pressure difference;
- **The geometries** of piston and work chamber **conform** to each other
  ➔ **Compression can be determined** by the machine's construction.

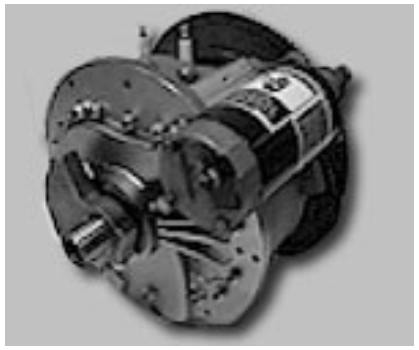
Numerous attempts have been made to solve this problem.

- The most famous examples are the so-called Wankel machines with several **excellent features**, including:
  - **Compactness and high power density** achieved through high rotational speed of the piston
  - **Smooth running**
- However, the Wankel machine also has:
  - **Line-to-surface sealing** between piston and work chamber
  - **Limited compression** (in one-stage machines)

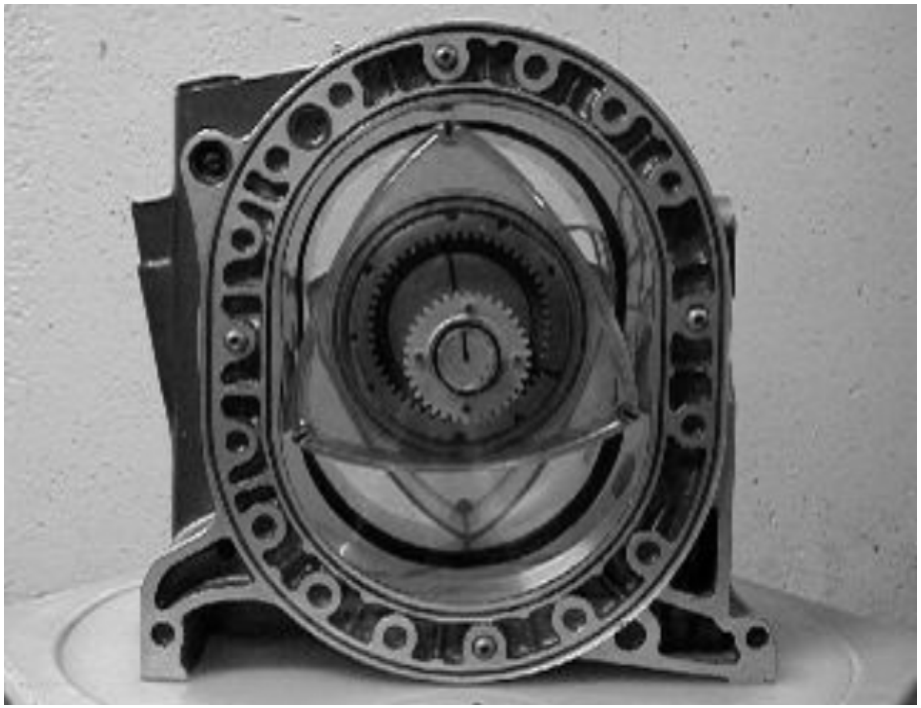
- The common topological feature of all previous solutions, including Wankel machines, is the **continuous and smooth trajectory of the instantaneous axis** of piston rotation.

Examples:

Arnold Wagner's spherical engine



Moller International's Rotapower®



Sedunov's double Wankel

Smooth trajectory of the instantaneous axis.

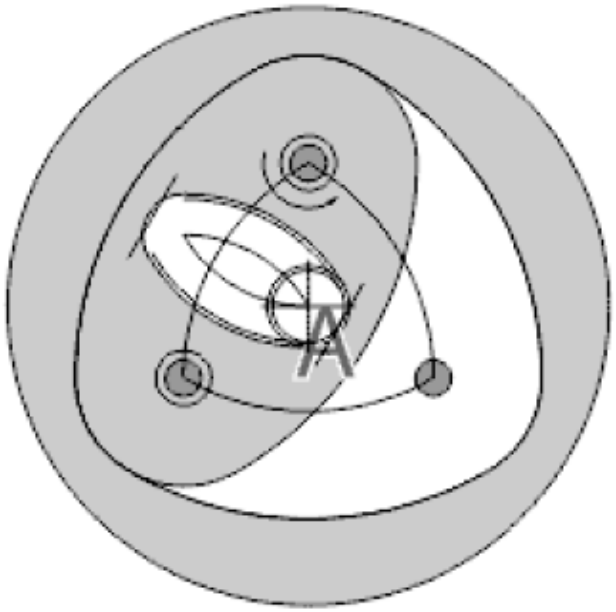
We **decouple** the features of the **power shaft** from the features of the **axis of rotation**.

- **The power shaft is a physical object.**
- **The axis of rotation is a mathematical concept. It is a virtual object.**
- **In general, it is misleading to equate the two.**

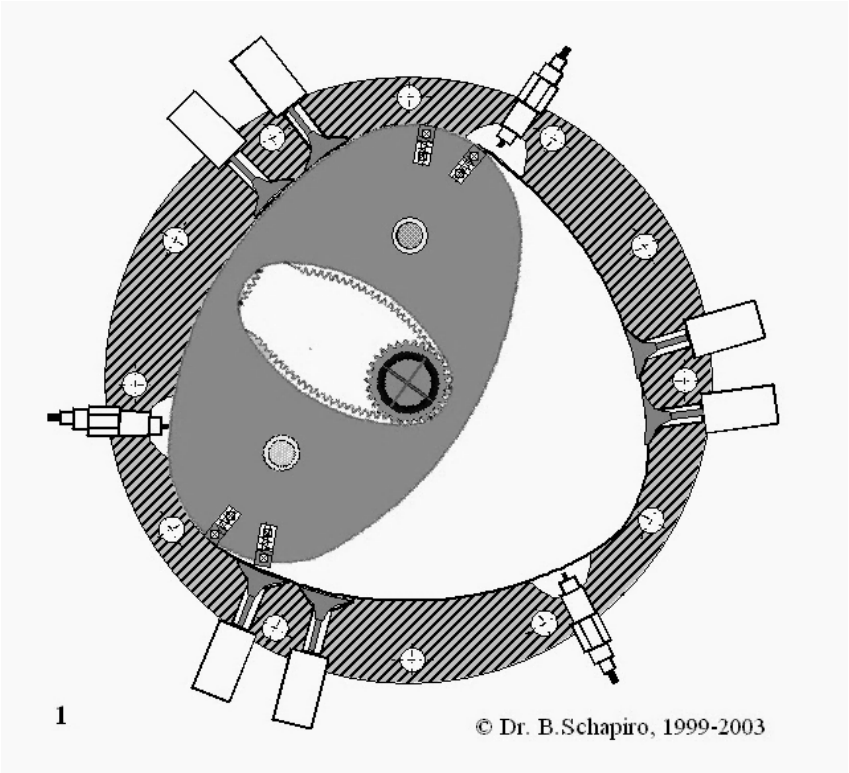
- The general **topological feature of RKMs** is the **discontinuous trajectory of the instantaneous axis** of the piston's rotation.

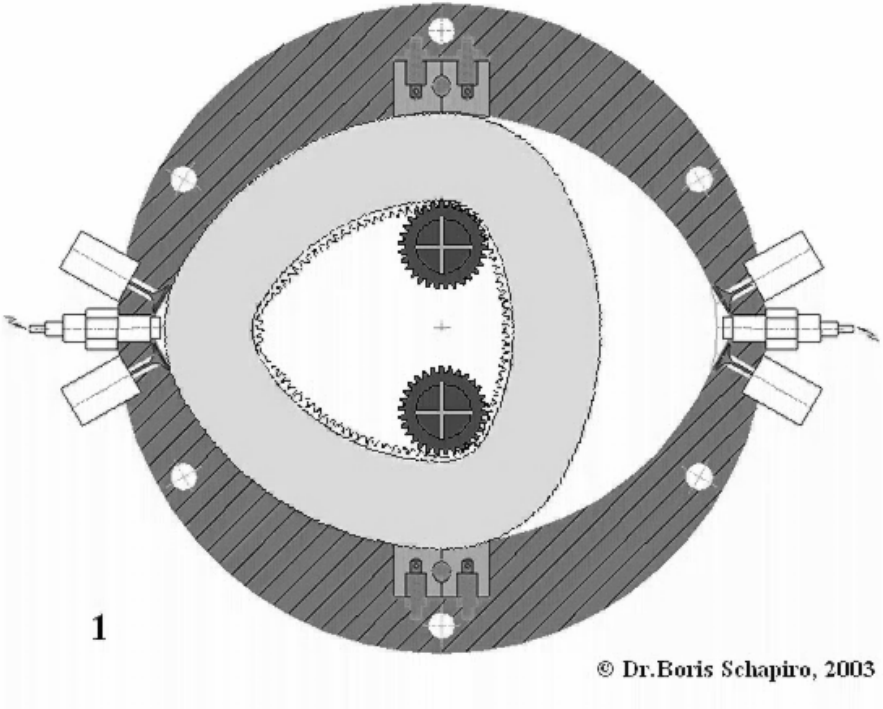
- In other words, **the instantaneous axis** of piston rotation **jumps** in all types of RKMs.

The geometry of a single-shaft RKM with bi-oval piston in tri-oval work chamber

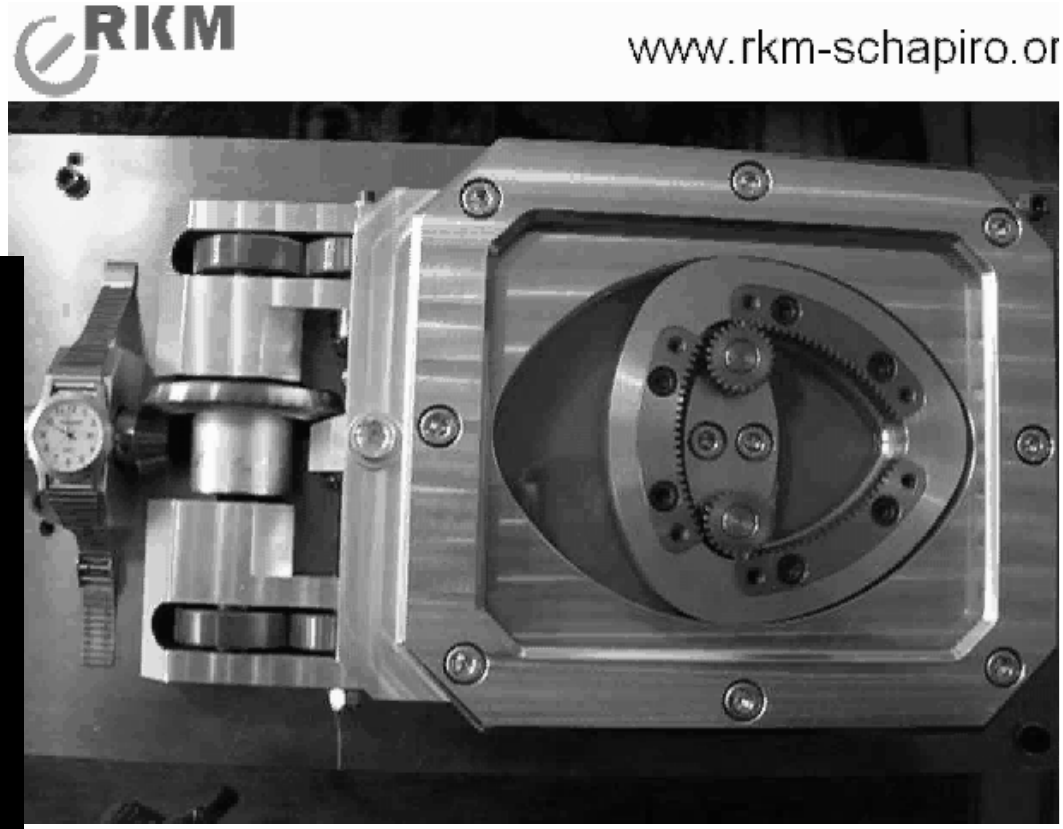


- **A** = power transfer shaft.
- The **small circles** inside the chamber are the **locations of the 'jumping' instantaneous axis** of piston rotation.
- The contours of the work chamber and the piston are formed by smoothly conjugated circular arcs.

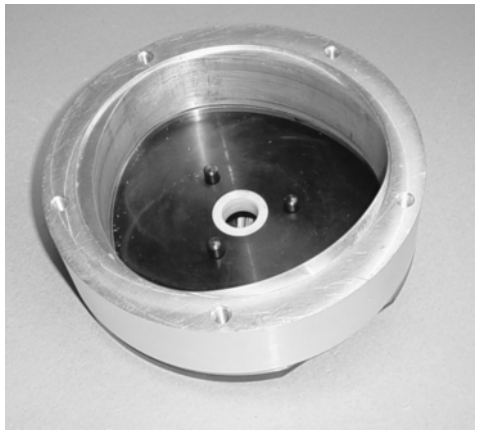


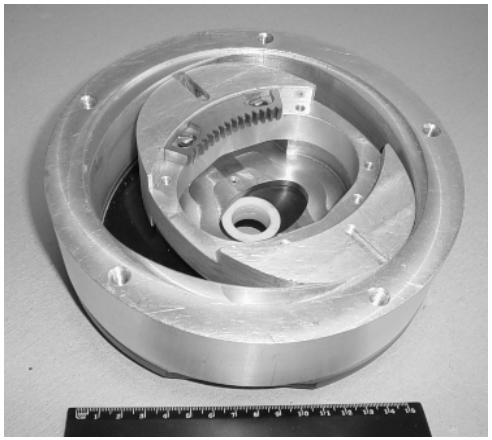
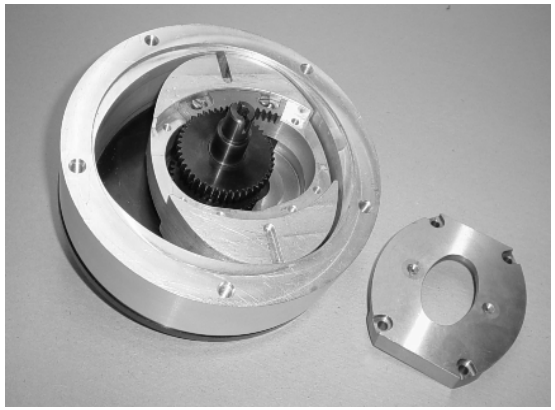
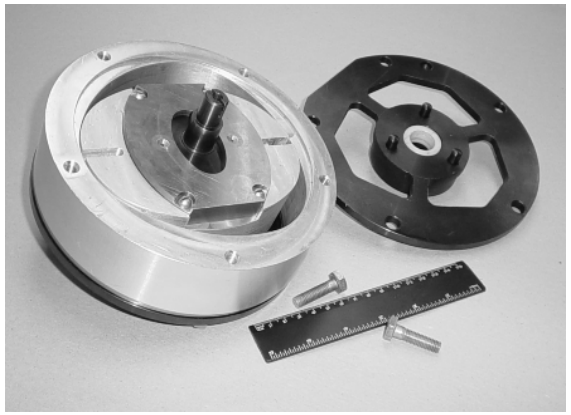
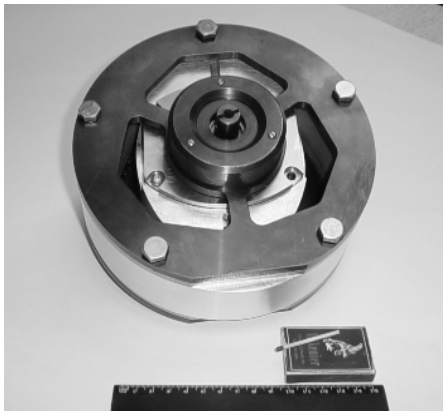


Functional Schematics of RKMs with one and two axes of rotation

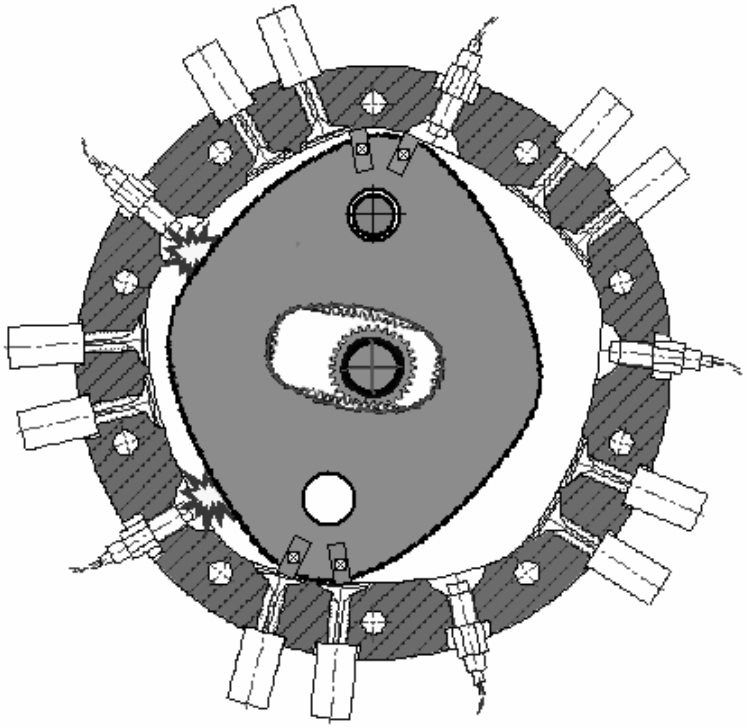


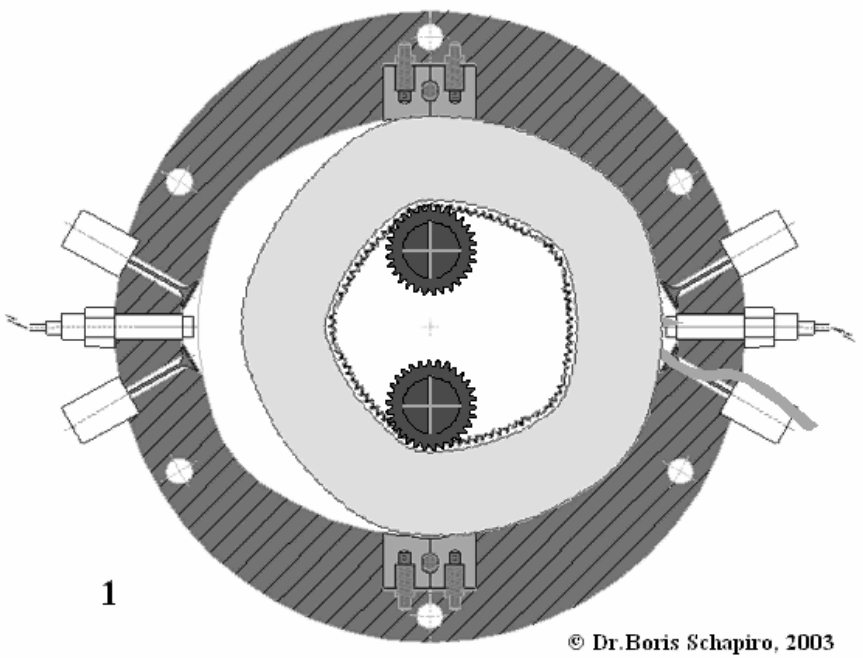
RKM functional models #4 and #6



RKM functional model #2





RKMs also allow for higher symmetries

The case of infinite order of symmetry: Degeneration of rotational degrees of freedom

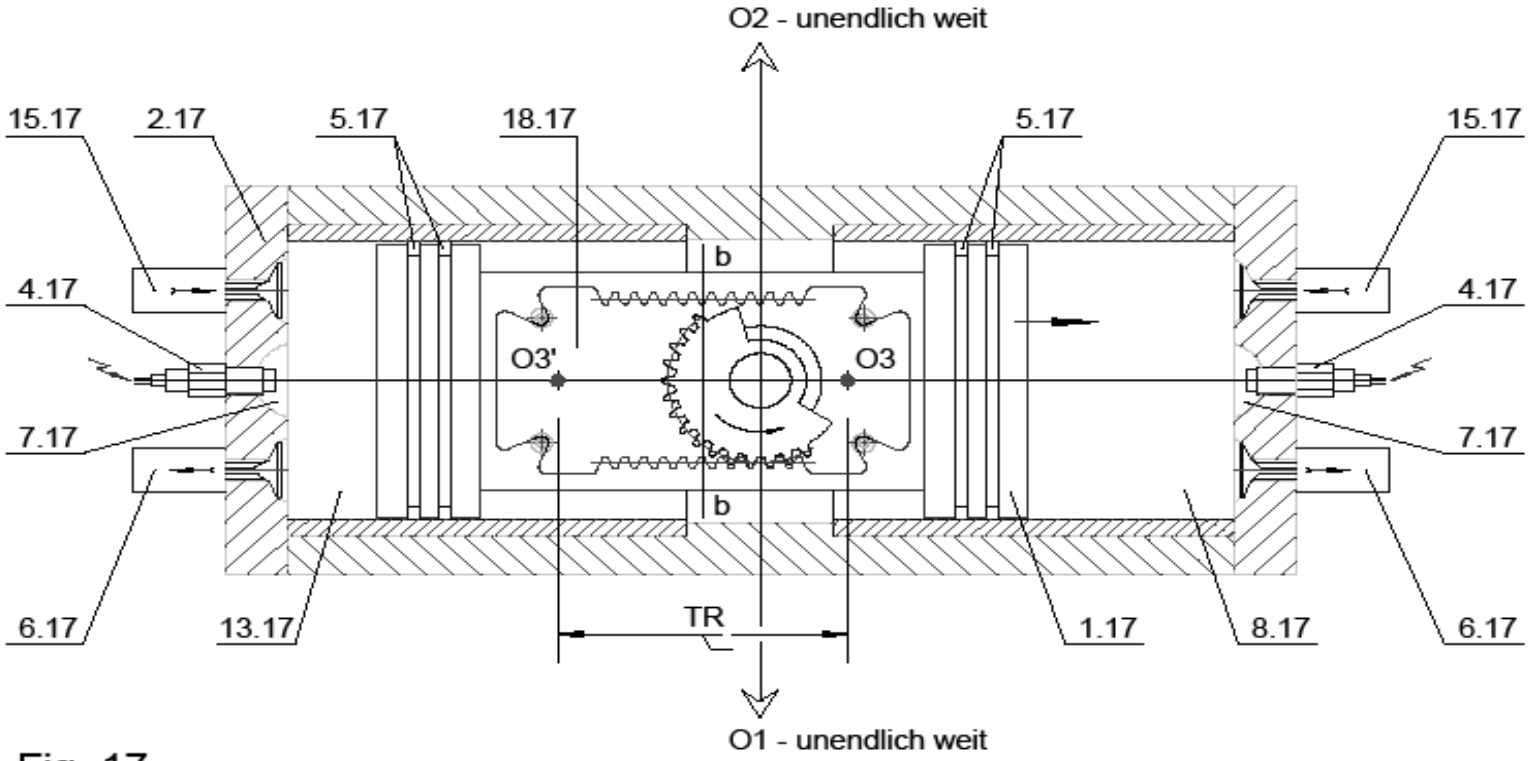


Fig. 17

- ➔ The well-known back-and-forth piston maschine is a **special limit-case** of the RKM-technology.

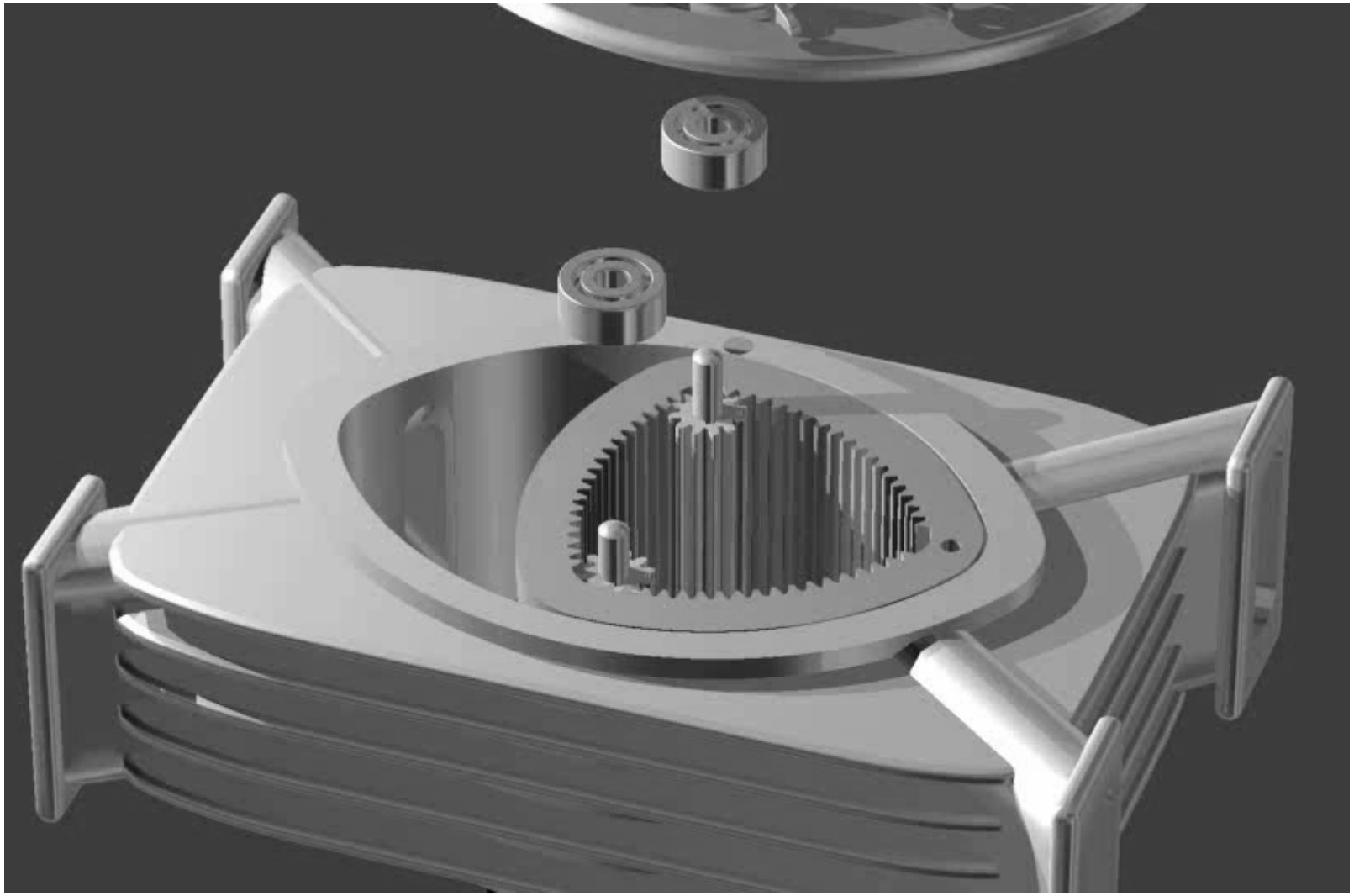
- ➔ The essential **topological features** of the back-and-forth-technology such as **surface-on-surface sealing** and **defineable compression** are common **for all RKMs**.

- Estimates indicate that **some RKMs** have **characteristics superior** to existing technologies in certain applications
- Comparison between **RKMs as pumps** and conventional technological pump principles is shown in the table developed by **Nhi Lai, D., Ch. 2005**, in: ***Comparison of Pump Principles***, Undergraduate's thesis at the Polytechnische Hochschule – University of Applied Sciences, Ingolstadt, Germany

Table: Comparison of Pump Principles

##	Technical characteristics	Pump type							Factor (multiplier)
		Ideal pump	Centrifuge (1 level)	Screw spindle	Tooth wheel	Piston pump	**RKM**		
							with seals	**w/o seals**	
1	Max. pressure p	**5**	3	3	4	5	**5**	**4**	4
2	Max. flow Q	**5**	5	4	3	2	**3**	**3**	4
3	Max. delivery height H	**5**	3	4	3	5	**5**	**4**	4
4	Production costs	**5**	4	1	4	1	**2**	**3**	4
5	Overall efficiency	**5**	3	2	4	5	**5**	**4**	4
6	Volumetric efficiency rate	**5**	2	3	4	5	**5**	**4**	3
7	Hydraulic-mech. efficiency rate	**5**	4	2	3	4	**4**	**4**	3
8	Wear & maintenance	**5**	5	2	4	3	**4**	**4**	2
9	Compactness / size	**5**	4	3	5	1	**3**	**3**	2
10	Pulsation	**5**	4	5	4	1	**3**	**3**	2
11	Min. viscosity	**5**	5	3	5	5	**5**	**5**	1
12	Max. viscosity	**5**	3	5	5	5	**5**	**5**	1
	TOTAL	**140**	106	84	104	92	**110**	**102**	

A Designed Product



Conclusions

- **The RKMs** form an entirely **new class of rotary machines** and a basic technology for a very broad range of possible applications.

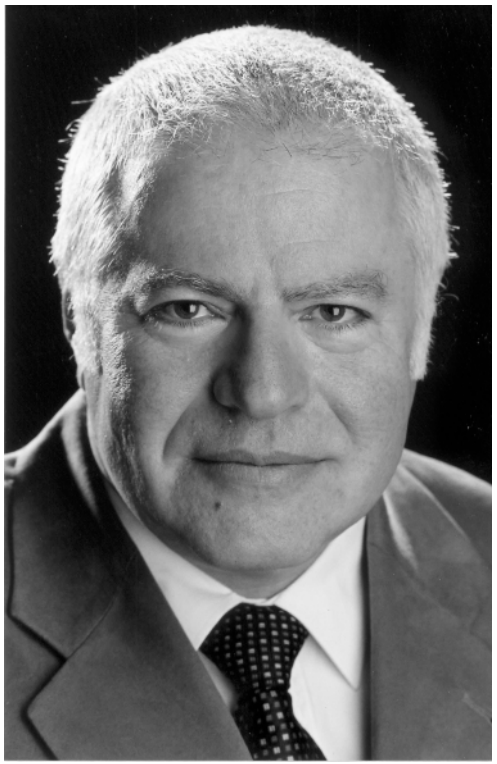
- **The RKMs** are based on completely **new principles of**

  (a) piston motion,

  (b) power transfer from piston to driven shaft or, conversely, from shaft to piston.

- **RKMs are capable of converting into rotation both physical energy (through pressure) or vice versa, and stored chemical energy (through combustion).**

Contact



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Thank you
for your attention !