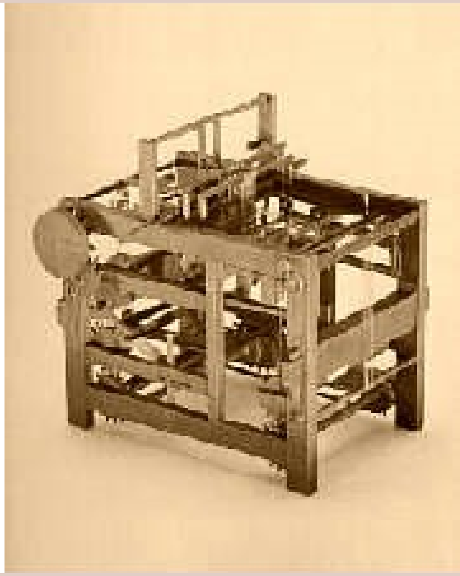
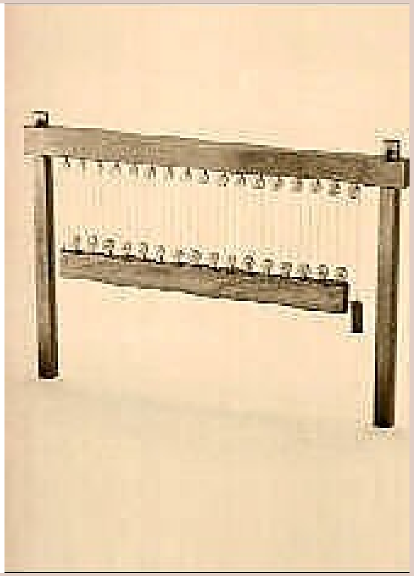


Magnetic Bearings: Application to High Speed Textile Processing

ISMB14 Linz 2014

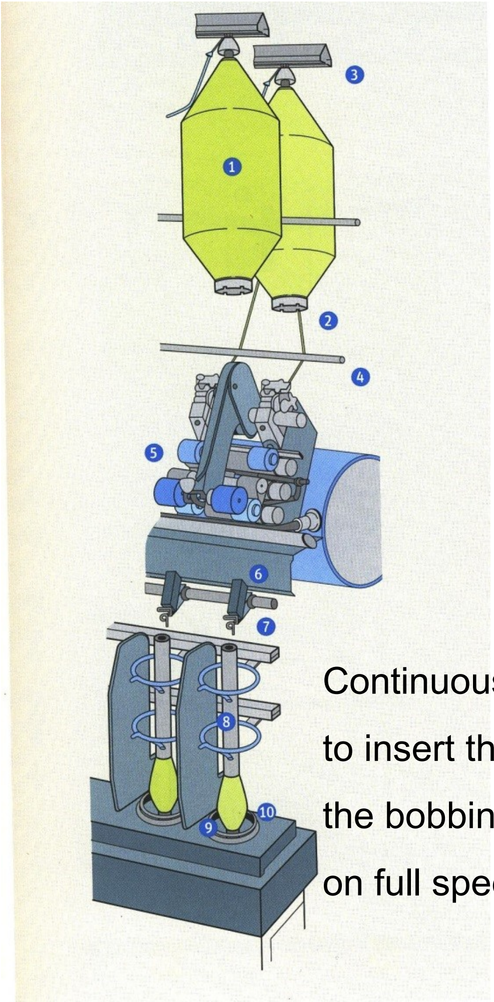
Jiří Sloupenský, Vicepresident Product Research Rieter

Spinning = yarn production

From hand made yarn …

Today industrial solutions

Clasical (Ring)



Continuous fiber stream –

to insert the twist

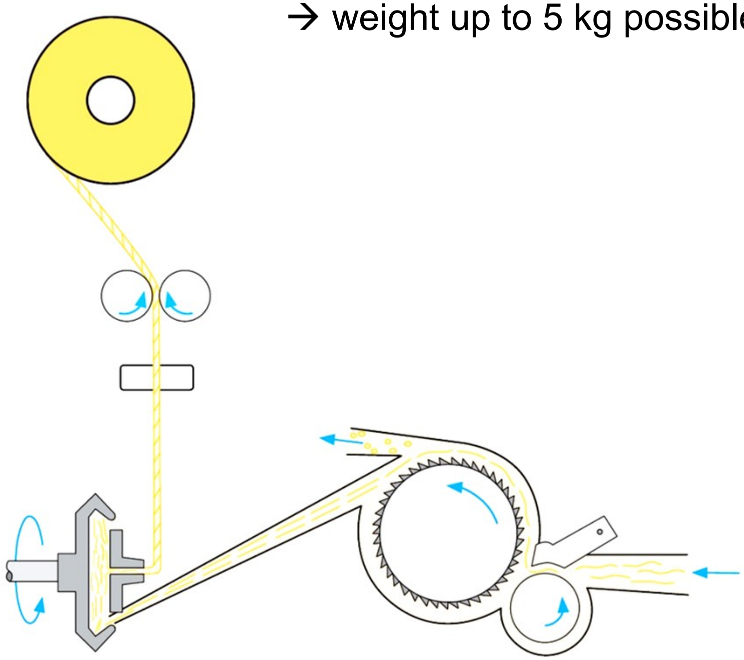
the bobbin has to rotate

on full speed → only 150 g possible

" Open End" (Rotor)

Bobbin rotates just on winding speed

→ weight up to 5 kg possible



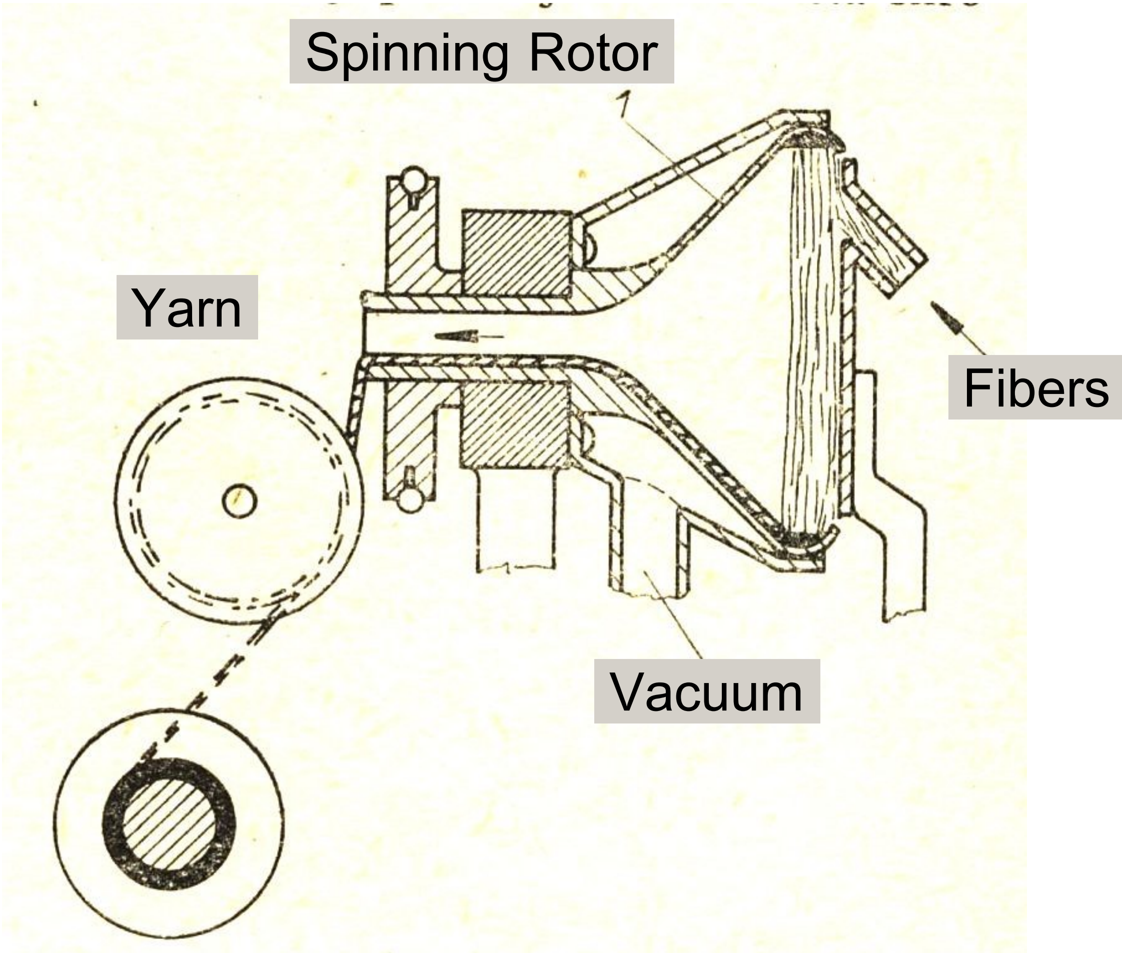
single fibers in the channel

→ Open End of the yarn

Open End (Rotor) spinning history - milestones

1937	Berthelsen developed first open end
1950 ….	Meinberg in Germany makes trial with different Open End spinning systems
1965	Czechoslovak KS200 rotor spinning machine was introduced to public runnig at 30 000 rotor rpm.
1967	Improved BD200 was presented with first spinning mill of OE coming under production
1971-1975	Many machine manufacturers started with OE , improved versions of machines were launched with speed up to 100 000 rpm .
1975	Schlafhorst (DE) introduced fully automated Autocoro machine
1999	Rieter introduced "Semi automated machine " for low cost countries

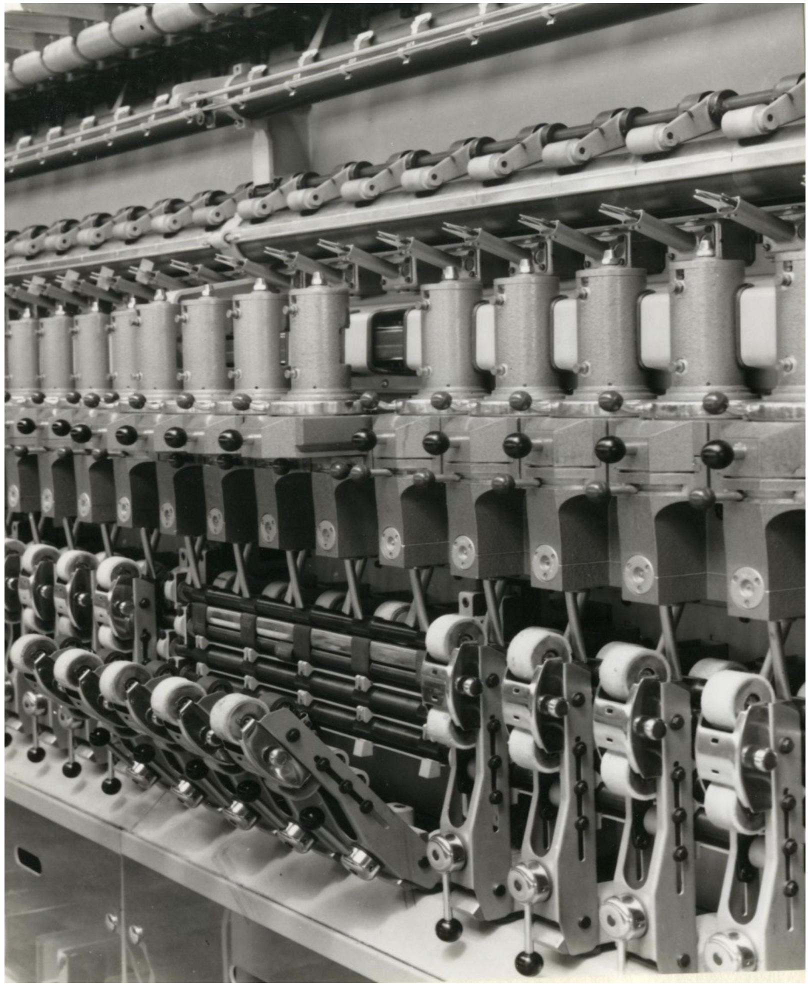
1937 Berthelsen developed first open end



Important : Yarn is taken out opposite to the fiber input

Industrialisation of OE spinning in Czechoslovakia

1965 – first industrial OE machine introduced to public: KS 200



Still yarn is taken out
opposite to the fibber input !!

State of the art - fully automated Rotor machine

Rotor speed – way to productivity

Productivity of Rotor spinning machine is given by the rotor speed

→ high requirements for drive and bearing , but high cost pressure

All historical units had a yarn take up to the opposite direction

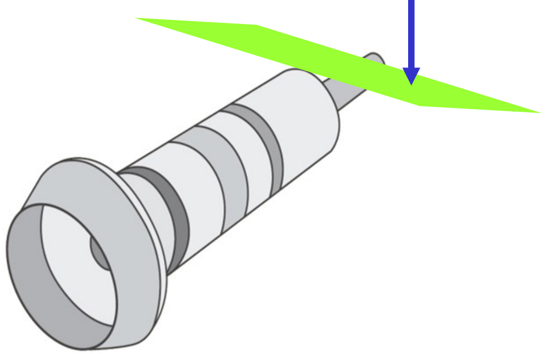
than fiber input, but it was too complicated for drive and bearing

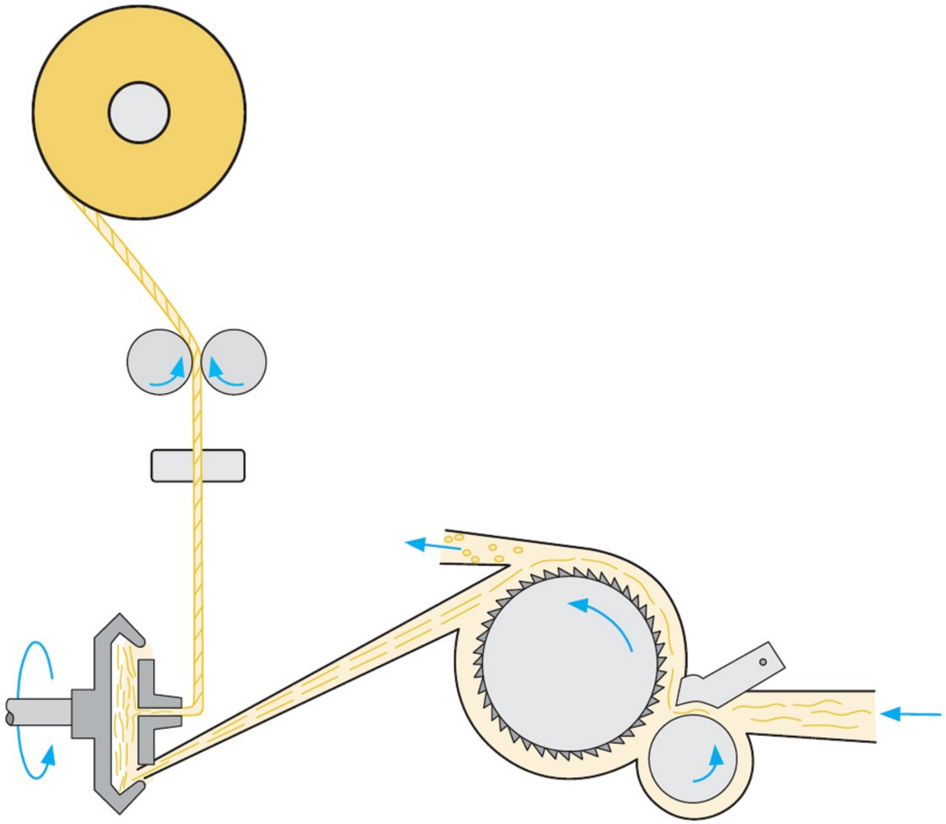
→ The new concept of Rotor spinning was developed in 60th

yarn take up to the same side as fiber input

Direct rotor drive – the most simple solution

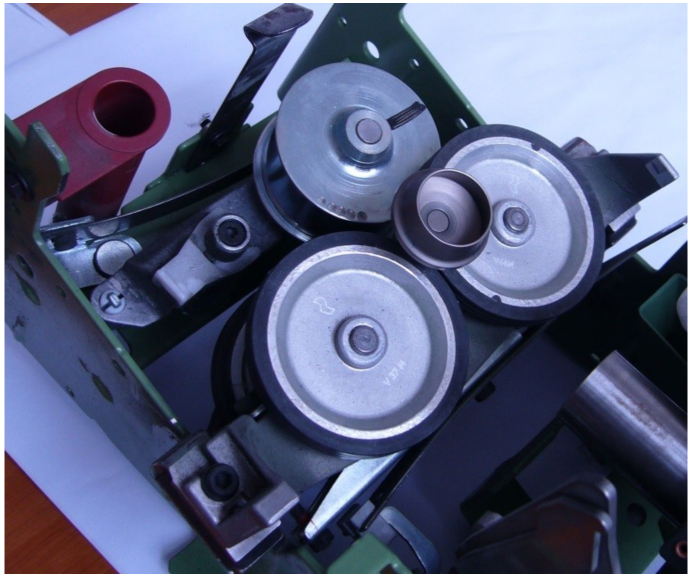
Belt driven shaft





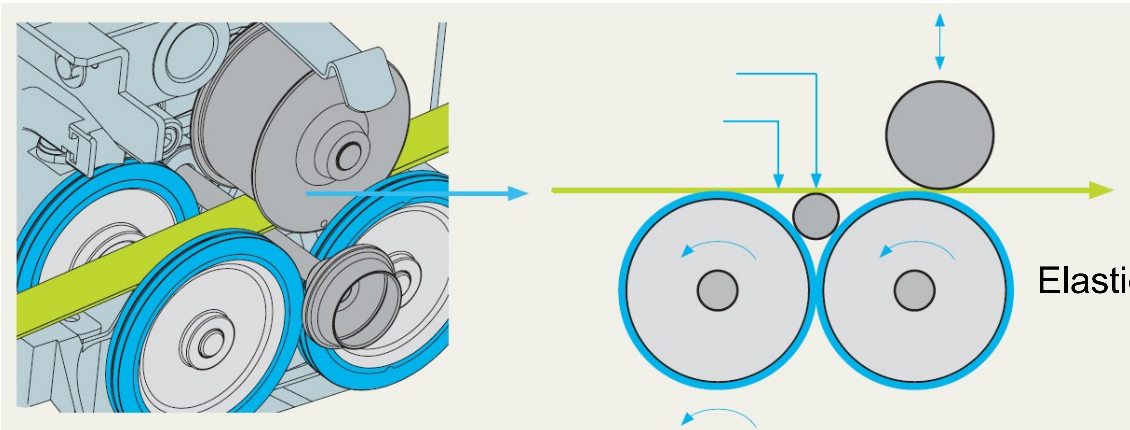
Speed limit about 100 000 r.p.m.

Indirect drive – speed multiplier



Speed up to 160 000 r.p.m possible,
but high friction , high abrasion

→ part wearing
and high energy consumption



Why Magnetic Bearing ? - Expectations

- Reducing energy consumption
- Reducing mechanical abrasion → higher life time
- Possible higher rotor speed ??
- Recovering of the idea of opposite yarn take up
  → different yarn properties ?
  → less dust deposit ?
- Utilization of newly available technologies and components

Project History

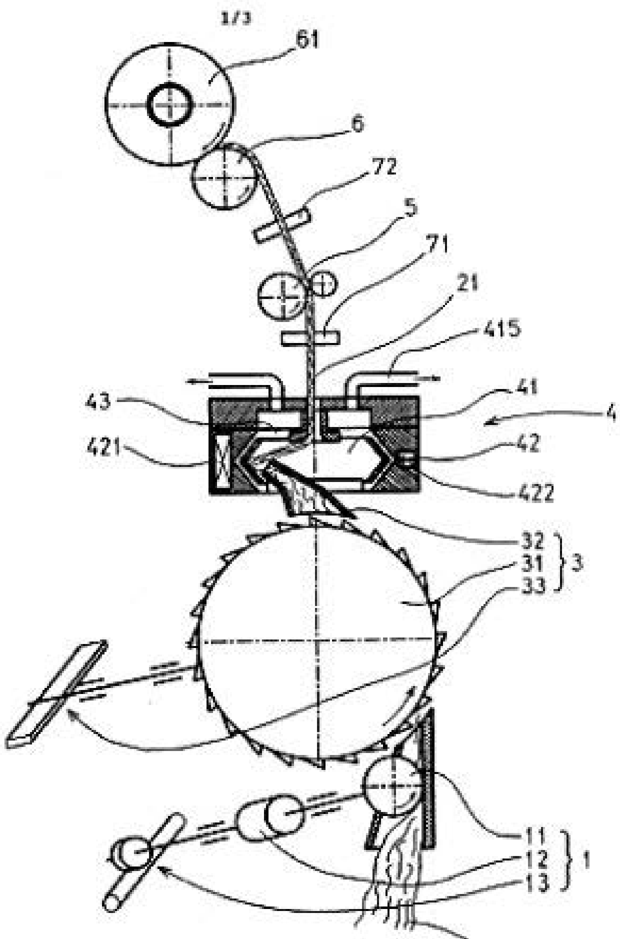


Fig. 1

1999 – first patent applied

2000 .. 2004 – our own (home) experiments

(not successful- only 30 000 r.p.m. reached)

2005 - collaboration with JKU/LCM starts

2006 - first running unit – 85 000 r.p.m.

2007 .. 2013 – many details solved,
step by step development

2012 - 150 000 r.p.m. reached

High-speed motor

Requirements

High efficiency

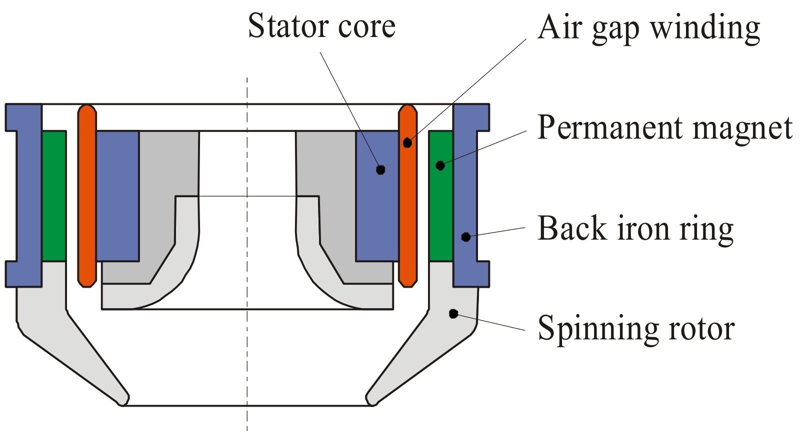
Low destabilizing stiffness in radial direction.

Short axial length to minimize air drag.

Mechanical protection of the permanent magnet to withstand high centrifugal forces (tensile strength of permanent magnet materials is limited to approx. 100MPa).

Back iron ring is part of the bearing too.

→ Mutual influence should be avoided!



Reality

Rotor

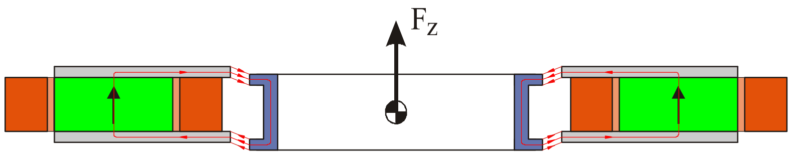
Stator

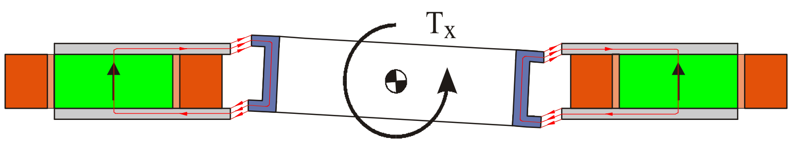
Magnetic bearing

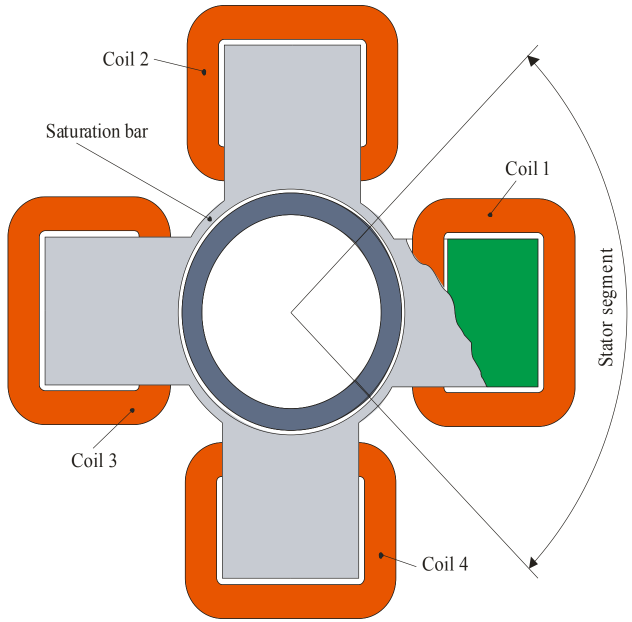
Combination of active and passive magnetic bearing

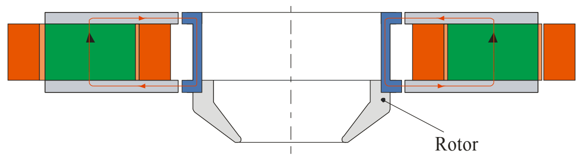
Radial DOFs are stabilized actively.

Axial and tilting DOFs are stabilized passively.





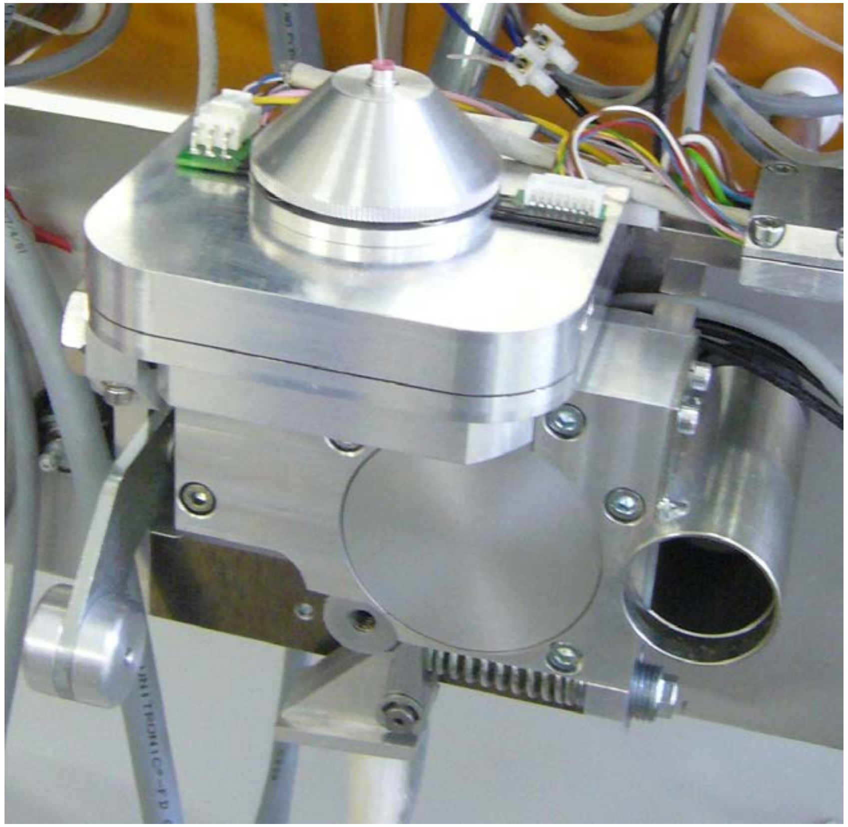




First experimental units

September 2006 : first runnig unit with magnetic bearing (85 000 r.p.m.)

One of the following prototypes (up to 130 000 r.p.m.)

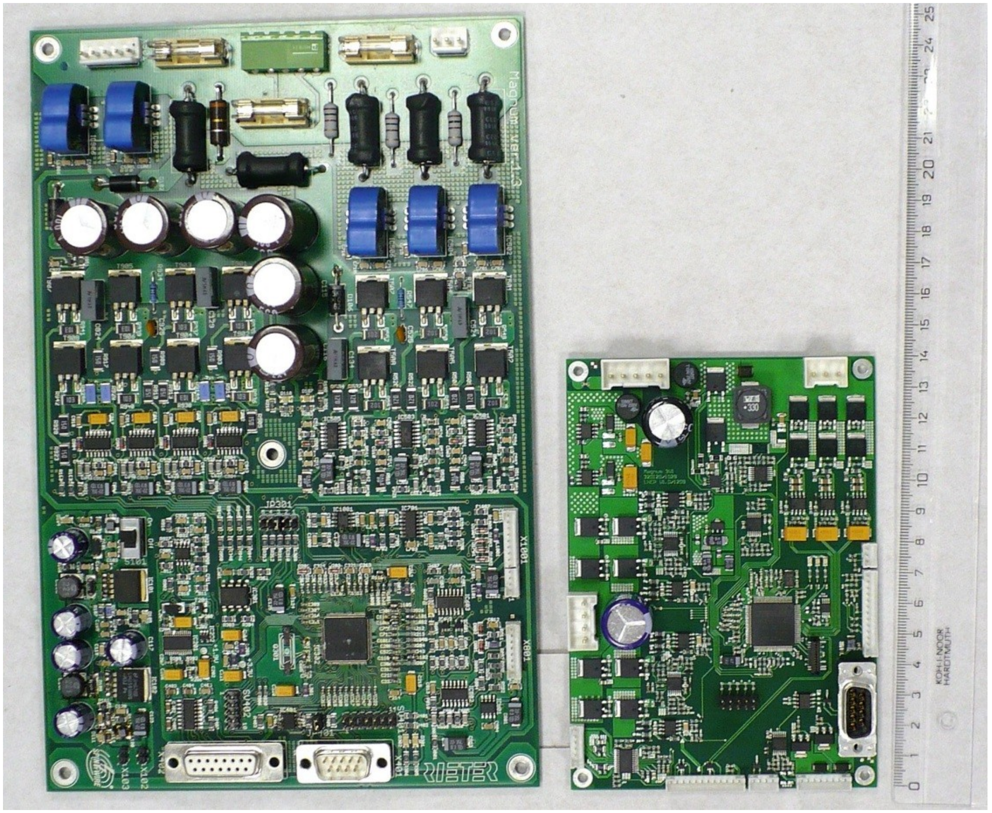


MAGNUM – electronics development

First experiments with LCM modular electronics

Step by step down sizing

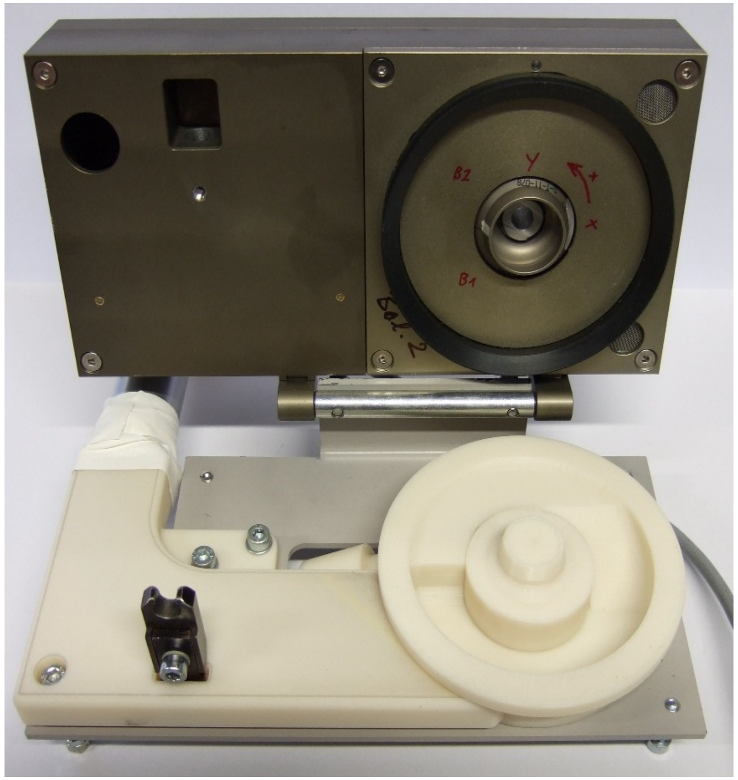
and cost reduction



Rieter own development
with JKU/LCM support

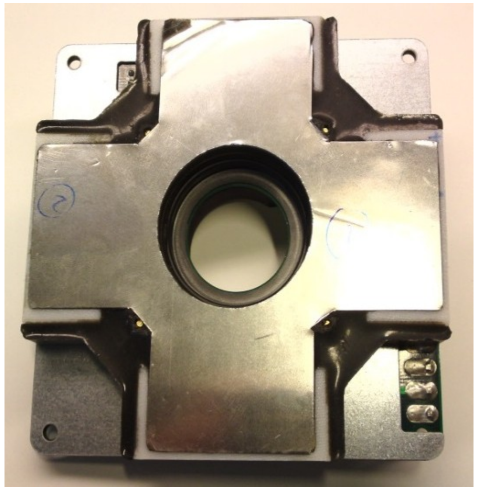
Experimental results - design

Prototype



Integrated spinning unit

High speed motor



Magnetic bearing

Experimental results – textile technology, energy

Yarn propertiess – fully comparable with comercial machines

Dust deposit in the rotor groove - at least 10 x less

After 8 hours of spinning

Conventional unit

unit with magnetic bearing

Energy consumption : reduced at least 30 % on 100 000 r.p.m.
(110 W → 75 W)

(The energy for spinning and air friction remain the same)

Success because of close collaboration between university and industry

JKU/LCM people working in Rieter laboratory

End

Thanks for your attention