

# ELECTRIC DRIVES



# Electric drives

- Electric drives are the most modern and efficient kind of driving mechanism
- Last model of BMW car has 700 electric drivers
- **Basic properties:**
  - Speed 0-5000 rpm
  - Shaft torque  $M_n = 0,05 - 25 \text{ Nm}$
  - Overloading of torque  $M_n = 5 - 7 \text{ DC motors}$   
 $M_n = 2 - 2,5 \text{ AC motors}$
  - Range of power  $P_n = 0,01 - 7,5 \text{ kW}$
  - Electric brake time  $T_R < 0,1 \text{ s}$
  - Max of reversion  $2500 \text{ h}^{-1}$
  - Max of acceleration  $\varepsilon - \text{till } 10^4 \text{ s}^{-2}$

# Electric drives

- DC motors,
  - AC motors,
  - Step motors
- 
- For sewing machines are used
    - AC motors drivers
    - AC brushless drivers
    - DC motors drives

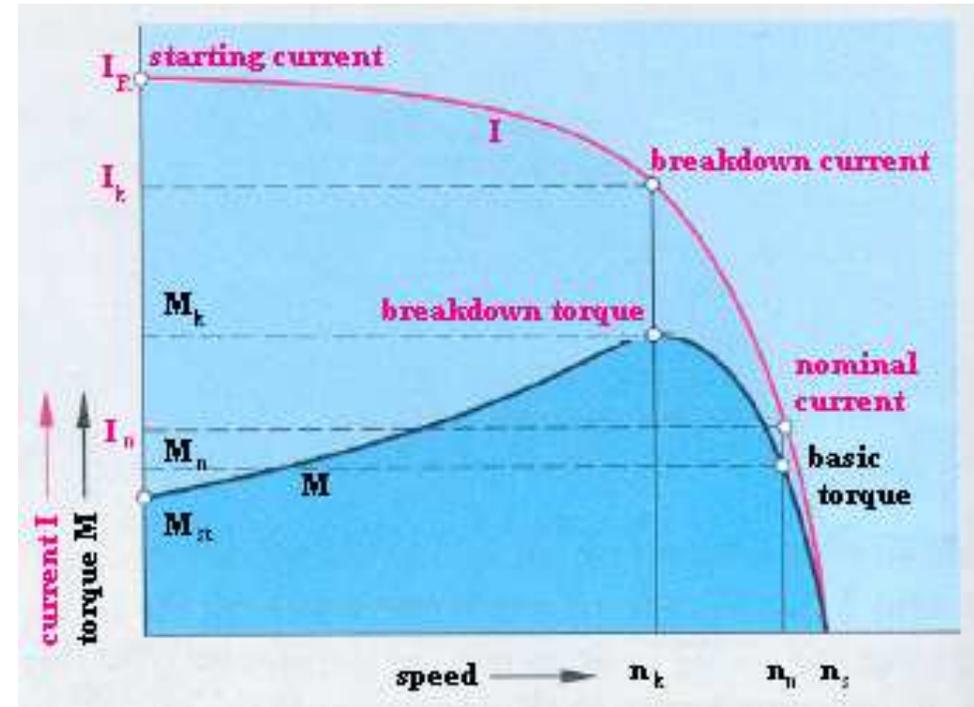
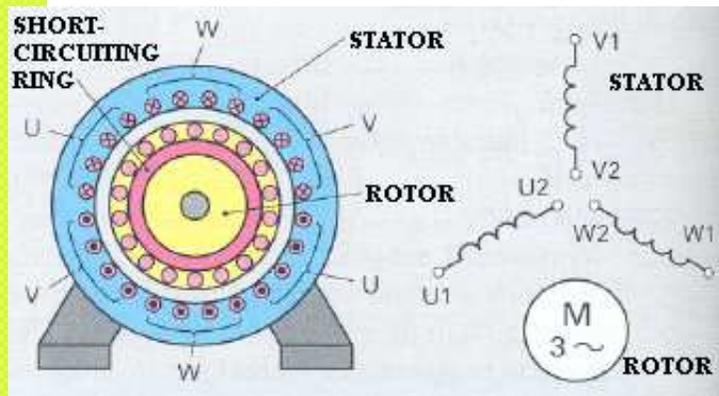
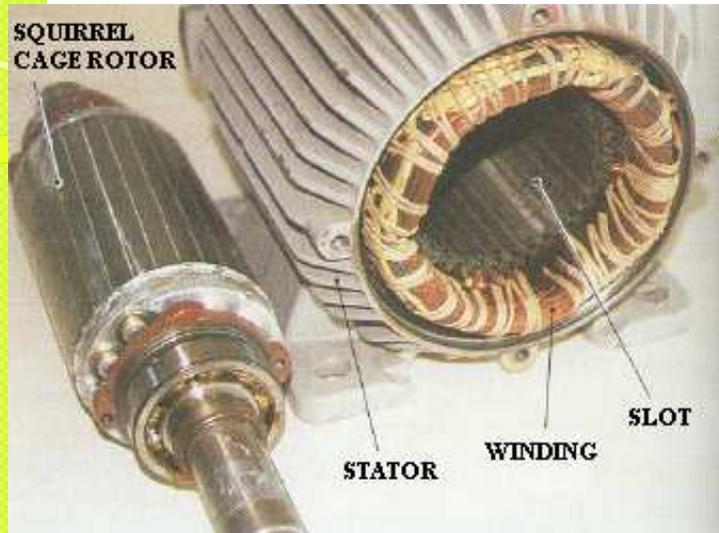


# Classic AC three-phase motor

- This type of motor **has been used** as drive for all sewing machines.
- This motor is used for each simple sewing machine.
- Speed is controlled through an interaction between a slip clutch and a full speed driving wheel, but the clutch runs with relatively slow controls responses and its performance depends on its quality.

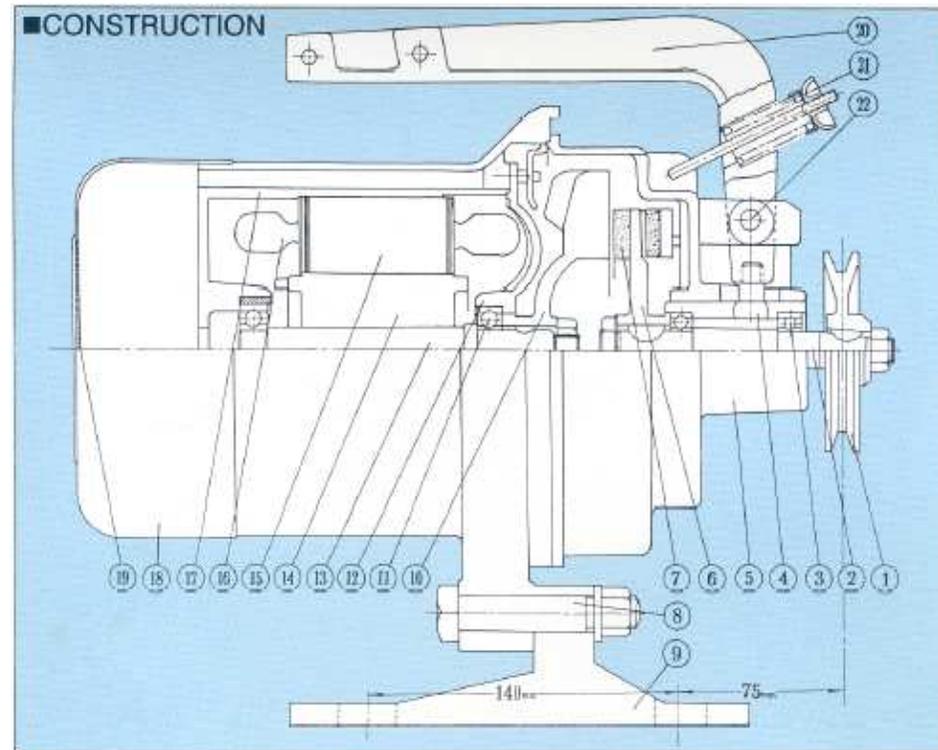


# Classic AC three-phase motor



# Classic AC three-phase motor

- This motor is very simple but, speed regulation is problematic and is still provided with coupling. It is not possible to stop exactly at a desired position



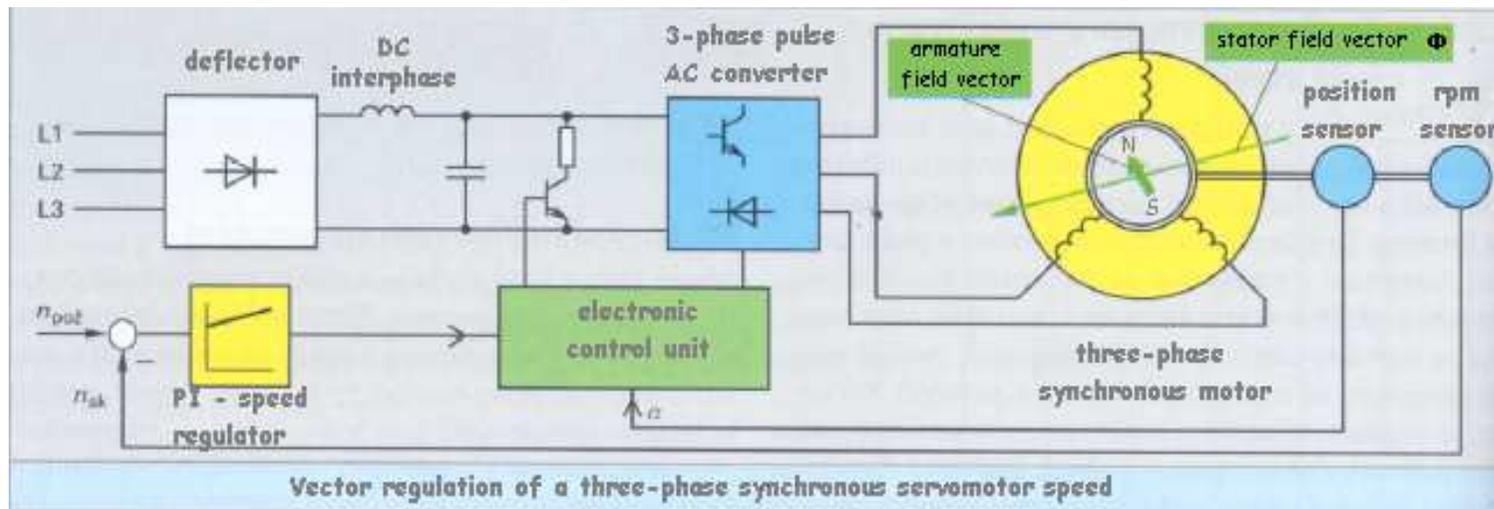
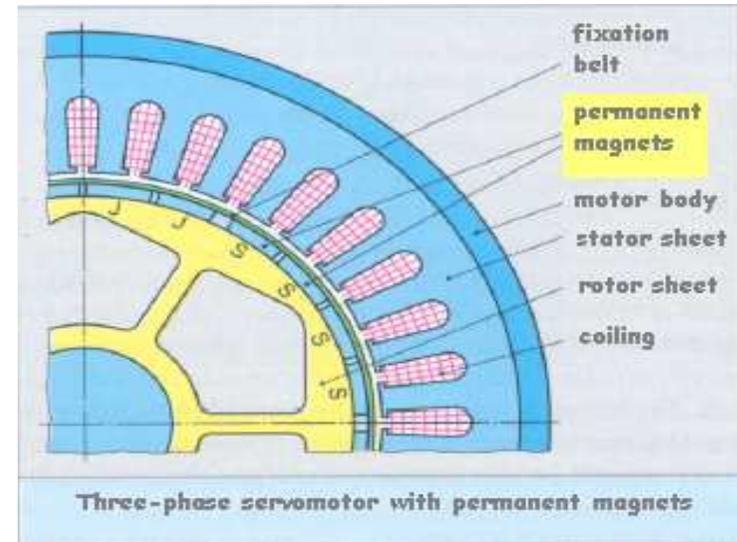
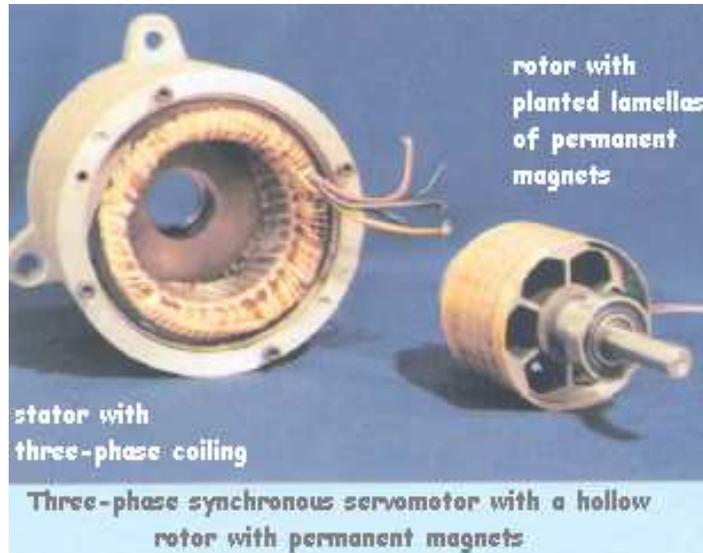
|    |                          |    |                         |    |                                |
|----|--------------------------|----|-------------------------|----|--------------------------------|
| 1  | Pulley                   | 2  | Clutch shaft            | 3  | Rubber washer                  |
| 4  | Clutch lever             | 5  | Pulley Side end bracket | 6  | Mounting base for Clutch plate |
| 7  | Clutch ring              | 8  | Stop ring               | 9  | Side base                      |
| 10 | Fly wheel                | 11 | Ball bearing (5203)     | 12 | Center bracket                 |
| 13 | Rotor                    | 14 | Clutch shaft            | 15 | Stator                         |
| 16 | Polyester enamelled wire | 17 | Frame                   | 18 | End cover                      |
| 19 | Nuts and dust            | 20 | Brake                   | 21 | Spring                         |
|    |                          |    |                         | 22 | Pin                            |



# Modern AC three-phase motor

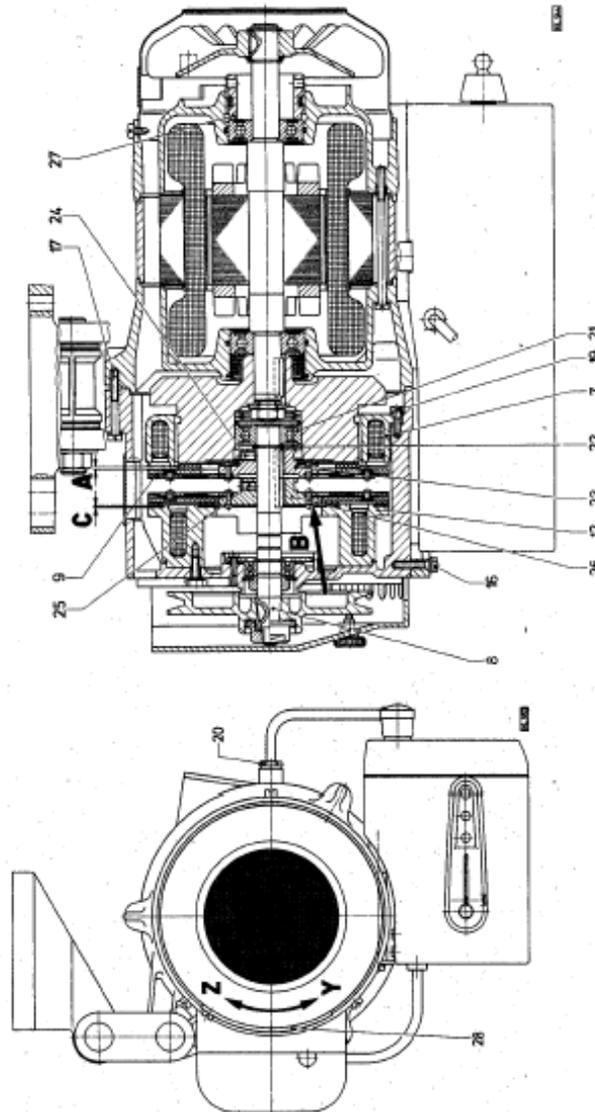
- The most modern AC with permanent magnet armature  
→ brushless motor
- Used for the most recent sewing machines
- Allow to perform many automatic additional functions
- Able to stop exactly at a desired position
- Stop-motor

# AC Motor with Permanent Magnet

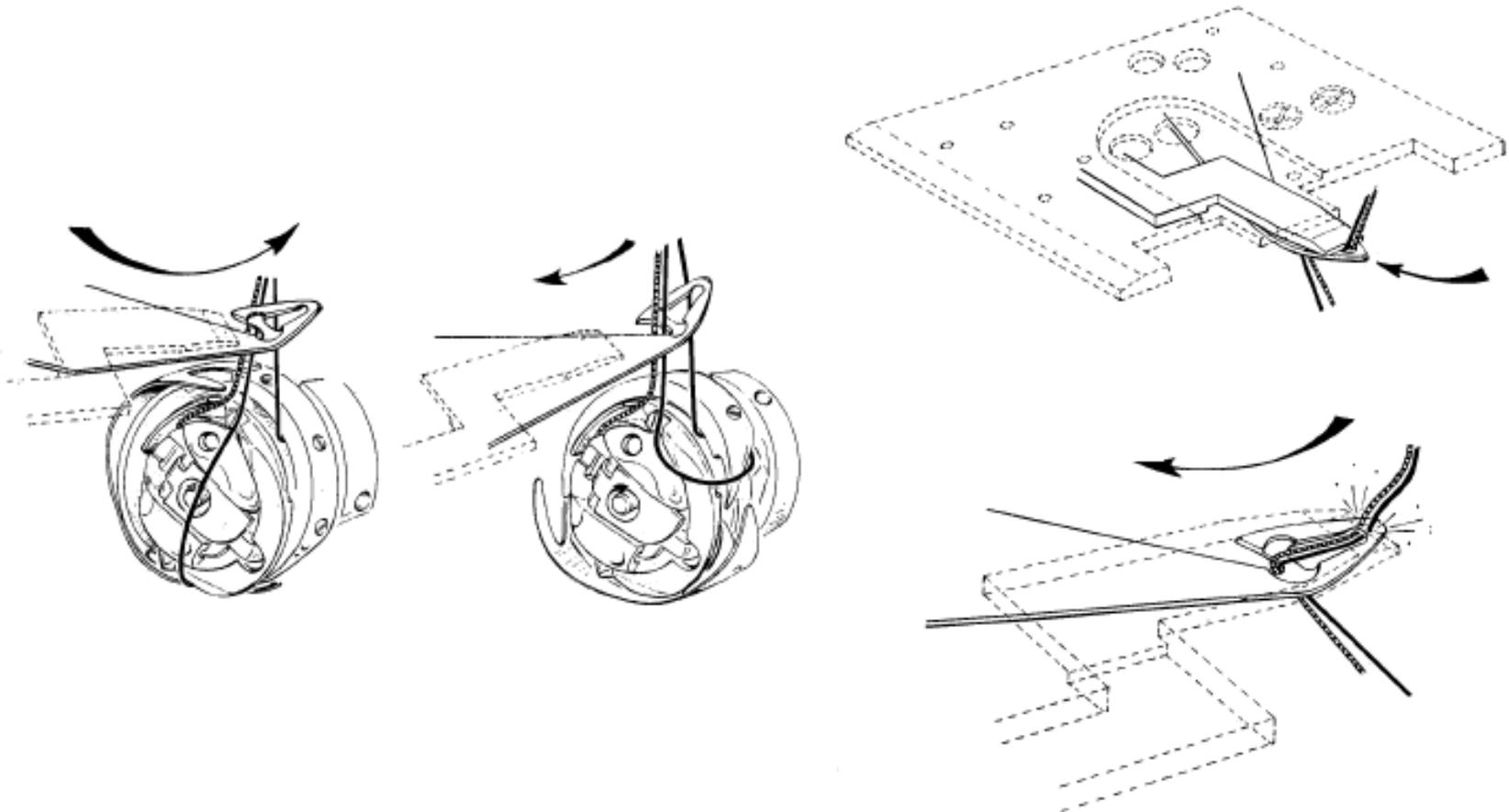


# Classic Electronic Motor – Stop Motor

- Electronic motors, which use non contact clutches, still need controlling of coupling forces between the two non contact clutches to transmit the kinetic energy of motor's main shaft to the sewing machine's main shaft. There is some fluctuation of speed stabilisation, mainly, when the sewing machine runs at a low speed (during the thread cutting process).



- **This motor can for example realize a thread trimmer**



# Technical Parameters AC drive

- Due to servomotor controller's accurate torque control with directly digital control on both speed and position, sewing machine's torque control, speed control (high speed or low speed sewing) and position control (like needle positioning) can be transmitted to its main shaft directly through the motor shaft, with performance, response rate and stability better than those of servomotor with the high performance rare earth permanent magnetic material



|                     |                              |
|---------------------|------------------------------|
| <b>torque</b>       | <b>5 Nm</b>                  |
| <b>max torque</b>   | <b>10 Nm</b>                 |
| <b>speed</b>        | <b>0 ÷ 6.000 rpm</b>         |
| <b>acceleration</b> | <b>3.500 1/s<sup>2</sup></b> |
| <b>power</b>        | <b>0,8 kW</b>                |

# Vario DC Motor

**Doppelschwinge zur optimalen Ausrichtung des Antriebs bei gleichbleibender Riemen­spannung.**  
The well proven twin bracket of the motor fixing enables the most favourable adjustment of the drive with constant belt tension

**Riemenschutz entsprechend den neuesten Sicherheitsvorschriften**  
Belt guard in conformity with the latest safety rules

**Einstellelemente bei geöffneter Serviceklappe**  
Setting elements with opened service cover

**Positiongeber Typ P5 - ...**  

- austauschbarer Nachfolger des Typs P4 - ...
- wartungs- und verschleißfrei
- Positionen sind schnell und ohne Werkzeug einstellbar
- Anbaumaße nach DIN 42705

**Position Transmitter Typ P5 - ...**  

- interchangeable successor of type P4 - ...
- maintenance-free and wear resisting
- positions are easily adjustable without tools
- mounting measures in conformity with DIN 42705

Motorfuß  
Motorfoot

14, 10, 9, 13, 12, 1, 3, 5, 11, 6, 7, 2, 4

S6, S7, S8, S10, P1, P2, P3, P5, P6, P7

# Vario DC Motor

- This Motor Allows:
  - automatic number of stitch + back tack
  - small size of motor → placement in a head of the sewing machine  
[Brother]



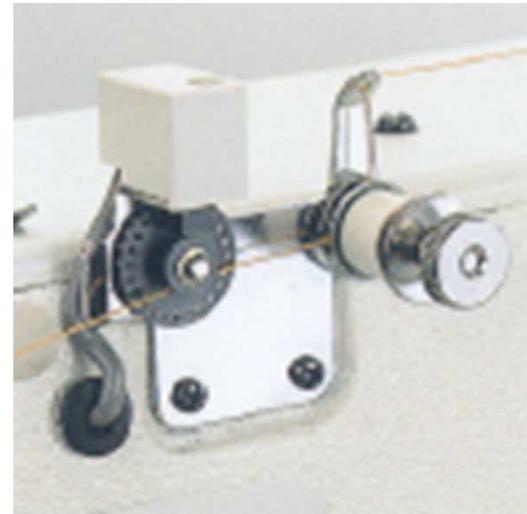
# Possibilities of Servomotors

- thread trimmer (rest thread 2 – 2,5 mm)
- presser foot lifter
- thread wiper
- back tack stitch
- number of stitches
- thread release



# Extra Automatic Equipment

- thread break detector
- needle cooler
- automatic bobbin changer
- needle thread monitor
- bobbin thread monitor



# Direct Drive Mechanism



# Drive Placement Built-in Motor System

*Low noise and low vibration*

Integration of the motor and the machine head and the adoption of a timing belt make sewing machine operation much quieter and reduce machine vibration.





# Literature

- SCHMIDT, D. a kol. *Řízení a regulace pro strojírenství a mechatroniku*. I. vydání. Praha : Europa-Sobotáles, 2005 420 s. ISBN 80-86706-10-9