Electrical Drives
Operating Mode

Applied Mechatronics

Module 5.2.1

by Thomas Schmid

Introduction

- Hints for Learning:
  - Read the chapters in the book carefully. (Can also be part of your homework !!!)
  - Use the key questions to work out the essential learning material.
  - Answer the key questions based on the information from the relevant chapter(s).
  - Create an index of the terms of drive technology with a short description continuously.

Operation Mode (1)

- Overview of electrical machines
  - Chapter 2.1: Einführung (Antriebstechnik)
    - Motoren
    - Generatoren
    - Transformatoren

Operation Mode (2)

- Important physical & electrical terms
  - Chapter 2.2: Grundlagen des elektromotorischen Antriebs
- Left hand rule
  - Repetition of AMEC, second school level HTL
    (see also book page 27, right column)

Operation Mode (3)

- Torque
  - Chapter 2.2.1 Drehmomententwicklung
- Efficiency
  - Chapter 2.2.2 Wirkungsgrad
- Direction of rotation
  - Chapter 2.2.3 Drehrichtung
- Terms
  - See Addendum

Addendum (1)

- Terms
  - Magnetic flux density *B*
    - Unit: Tesla *[T]*
  - Electrical conductor length ***l***
    - Unit: Meter *[m]*
  - Electrical current ***I***
    - Unit: Ampere *[A]*
  - Number of windings *z*
    - Unit: no (or *Wdg.*)

Addendum (2)

- Terms (continued)
  - Mechanical Force *F*
    - Unit: Newton *[N]*
    - Relation: $F = B \cdot l \cdot I \cdot z$
  - Radius of drive shaft *r*
    - Unit: Meter *[m]*
  - Torque *M*
    - Unit: Newtonmeter *[Nm]*
    - Relation: $M = F \cdot r$ (from the standstill, only)

Addendum (3)

- Terms (continued)
  - Mechanical output power P_{Ab}
    - Unit: Watts *[W]*
  - Rotation speed *n*
    - Unit: Rotations per minute $[^1/_{min}]$
  - Torque *M*
    - Unit: Newtonmeter *[Nm]*
    - Relation: $M = 9{,}55 \cdot \frac{P_{Ab}}{n}$ (for rotating machines)

For explanation see book page 27, right bottom

Addendum (4)

- Terms (continued)
  - Electrical input power P_{Zu}
    - Unit: Watts *[W]*
  - Power loss P_V
    - Unit: Watts *[W]*
  - Mechanical output power P_{Ab}
    - Unit: Watts *[W]*
    - Relation: $P_{Zu} = P_{Ab} + P_V$

Addendum (5)

- Terms (continued)
  - Efficiency η (eta)
    - Unit: no
    - Relation: $\eta = \frac{P_{Ab}}{P_{Zu}}$

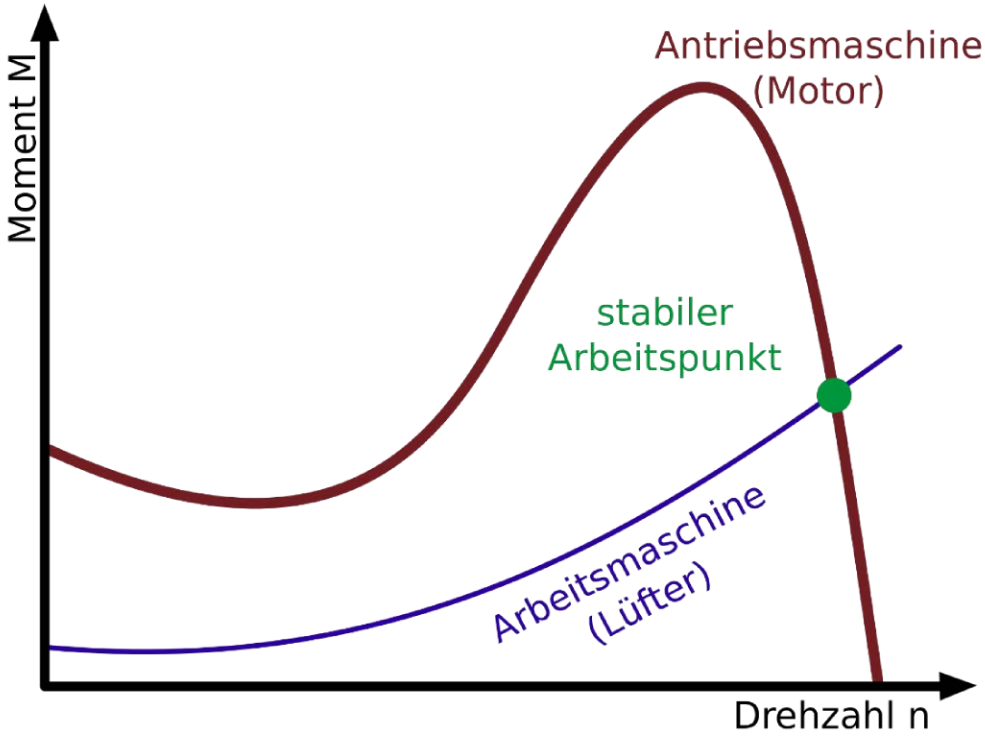
    If Several machines are connected in series:

    - Relation: $\eta_{Ges} = \eta_1 \cdot \eta_2 \cdot \eta_3 \cdot \ \ldots \ \cdot \eta_n$

Addendum (6)

- Illustrations (source: wikipedia.org, GPL-Licence)
  - Beispiel:

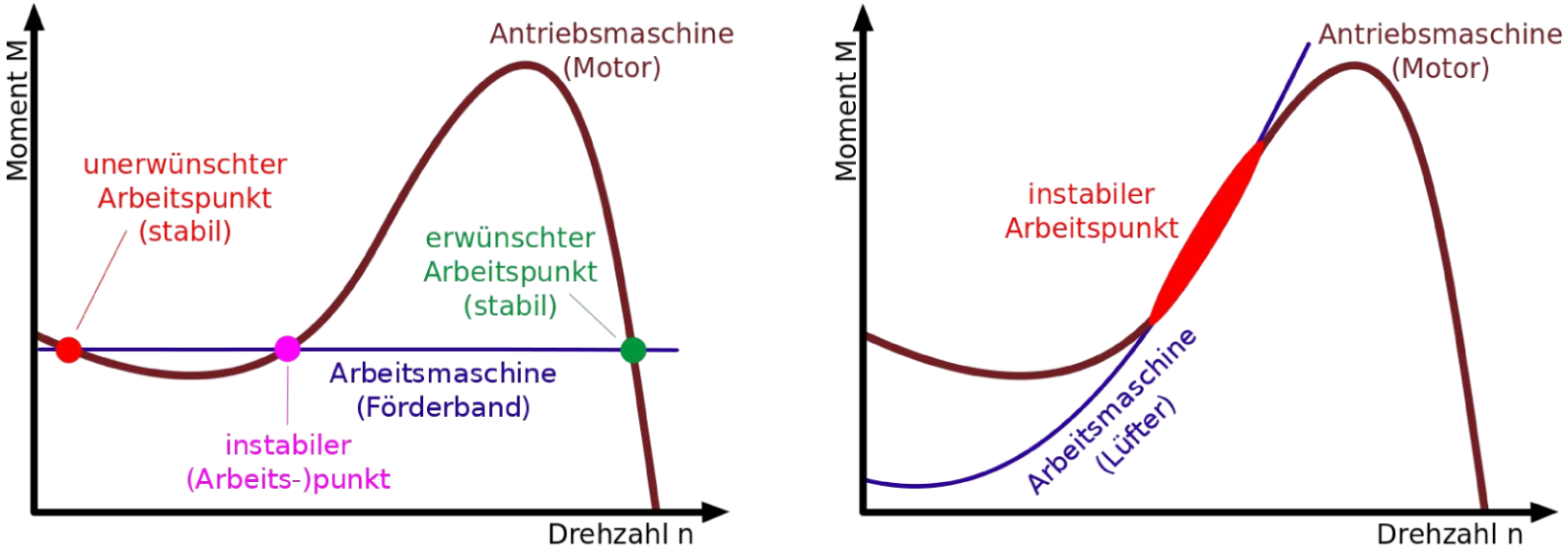
    stabiler Arbeitspunkt eines Lüfterantriebs (Momentenkennlinie)



Addendum (7)

- Illustrations (source: wikipedia.org, GPL-Licence)
  - Beispiel:

    Instabile/unerwünschte Betriebsarten eines Antriebs (Momentenkennlinien)



Bibliography

- Briegler, Adolf; Holzer, Helmut and others. *Elektrotechnik Fachkunde 1*. Wien: Jugend & Volk, 2013. ISBN: 978-3-7100-2911-0.