

# Gelijkstroommachines

L. Butaye – academiejaar 2024-2025

# 1.1 Overzicht

- *Opbouw DC-machine*
- *Werkingsprincipe motor en dynamo*
- *Bekrachtigingswijze (OB-PM-shunt-serie-motor)*
- *Karakteristieken*
- *Ankerreactie*
- *Toerentalregeling*
- *Aanloopstroombeperking*
- *Vermogen en rendement*
- *Remmen*

# 1.2 De bouw van de gelijkstroom machine

## 1.2.0. Inleiding

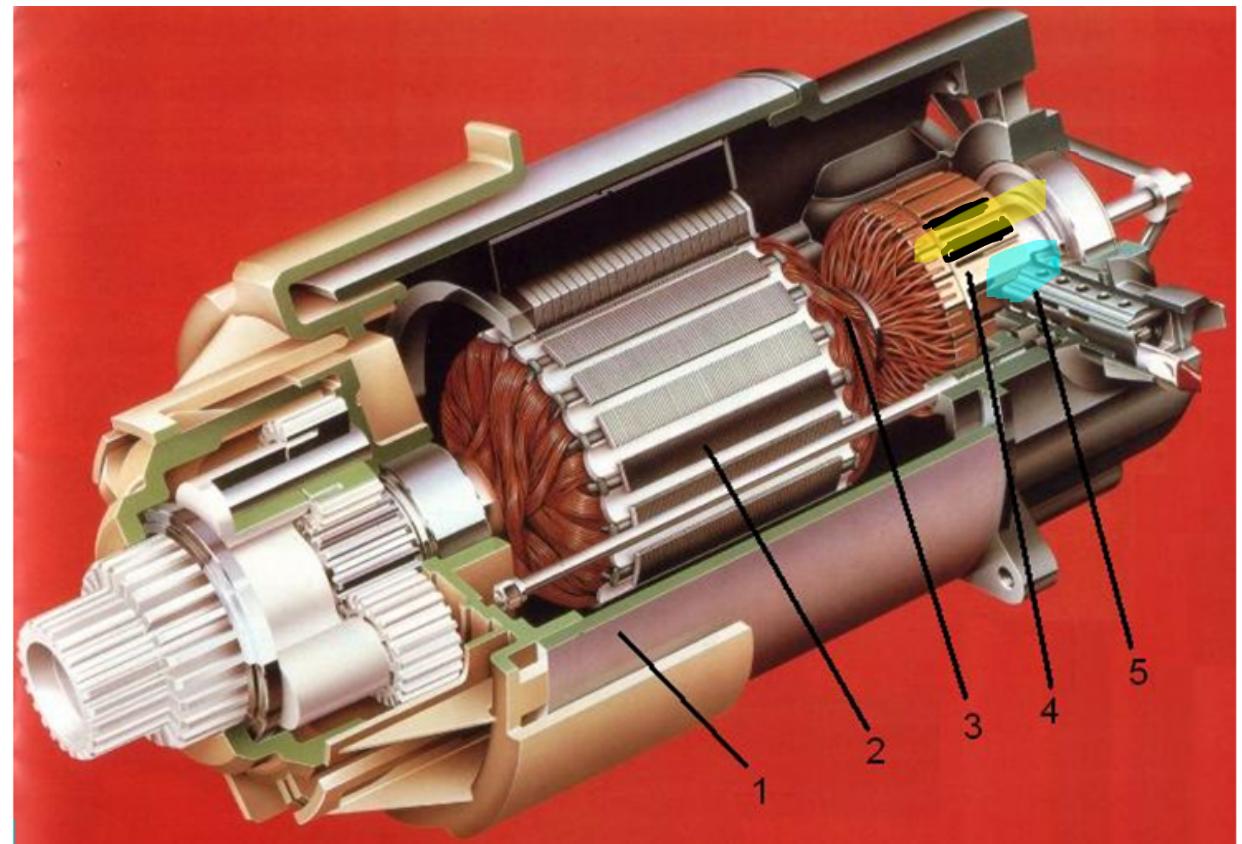
| Transformatoren | ASM         | DC-machine                     |
|-----------------|-------------|--------------------------------|
| Sinusoidaal     | Draaiveld   | $\text{NI} \Rightarrow \Sigma$ |
| Prim            | STATOR      | Stator                         |
| -               | luchtspleet | luchtspleet                    |
| SEC             | ROTOR       | Anker                          |

VELD →

# 1.2 De bouw van de gelijkstroom machine

## 1.2.1. Onderdelen

- VELD  
 $I_a$   
↑  
 $V_a$
- 1. De stator - behuizing
  - 2. De statorwikkeling
  - 3. De ankerwikkeling
  - 4. De collector/commutator
  - 5. De koolstofborstels



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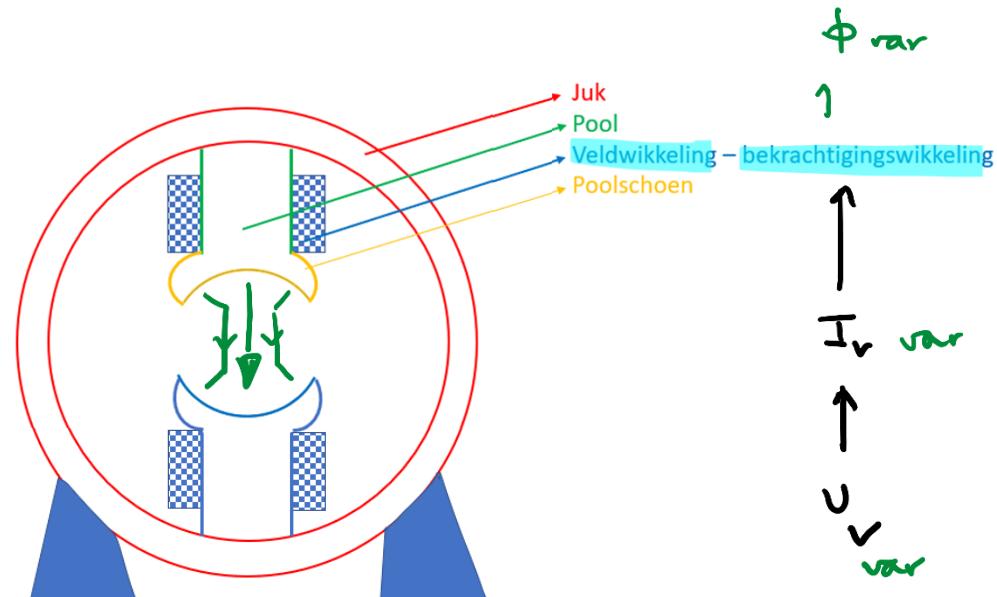
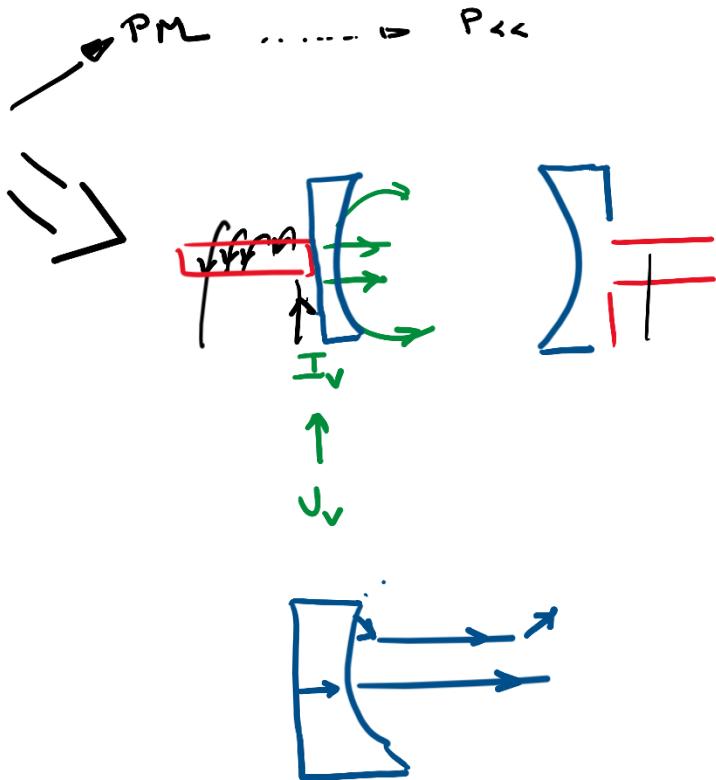
# 1.2 De bouw van de gelijkstroom machine

( $N \ll \rightarrow I_v \gg \Rightarrow \phi$ )  
 $N \gg \rightarrow I_v \ll \Rightarrow \phi$

**DOEL**  
 $\phi = C_m$

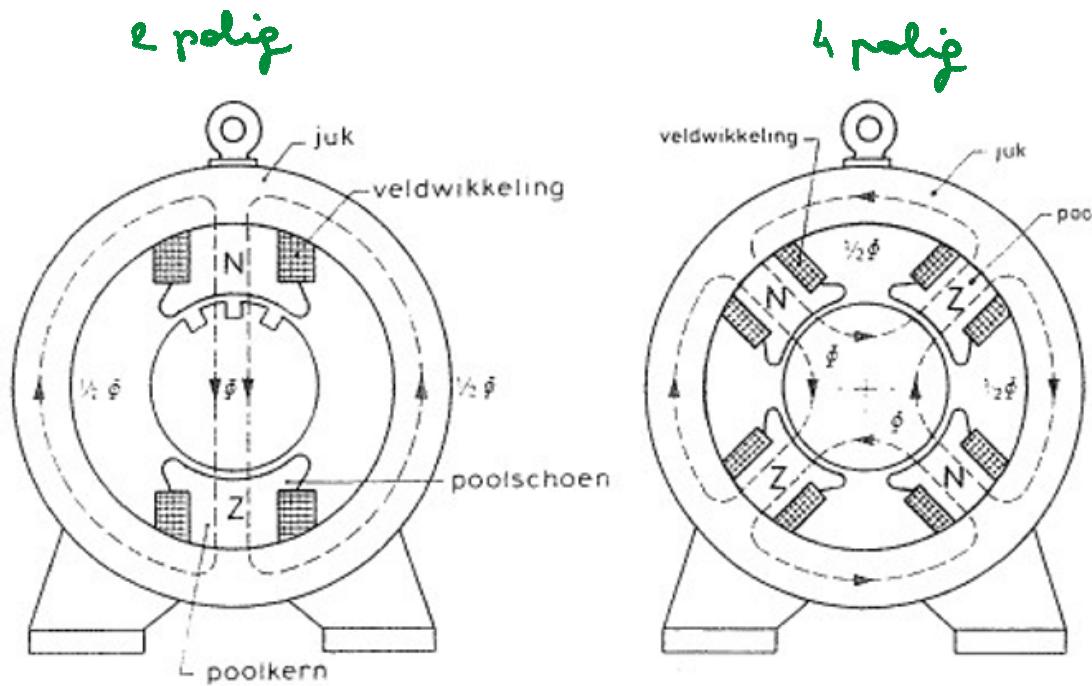
veldweerstand  
 $R_v \gg$

## 1.2.2. De stator



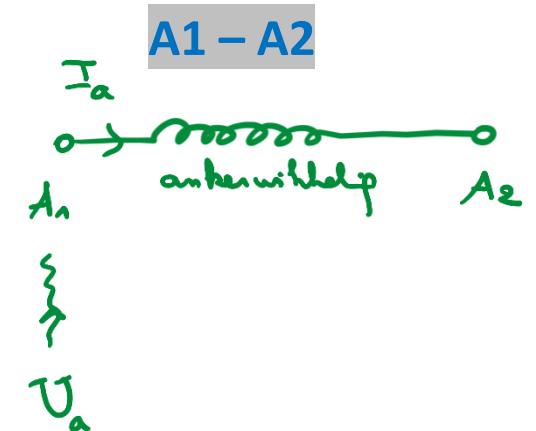
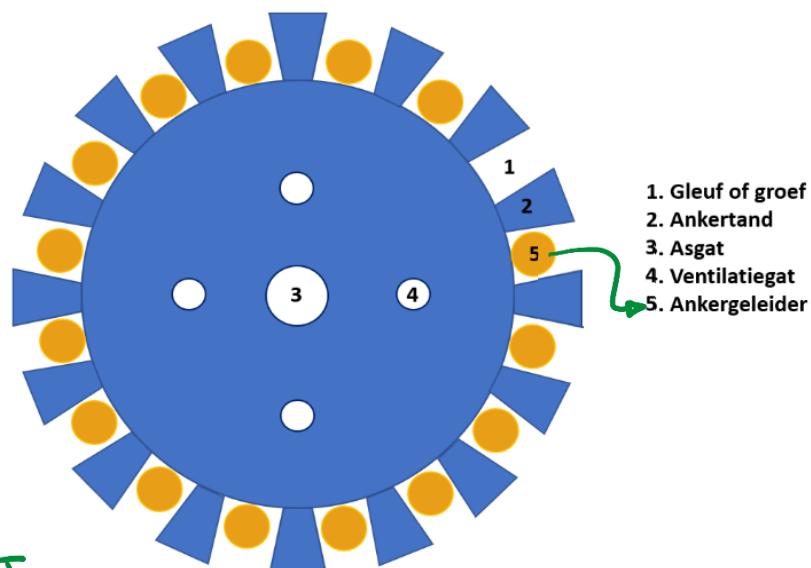
# 1.2 De bouw van de gelijkstroom machine

## 1.2.2. De stator



# 1.2 De bouw van de gelijkstroom machine

## 1.2.3. Het anker



$$M \leq F = B \cdot l \cdot I_a$$

$\uparrow$   
 $I_v \ll$        $>>$

# 1.3 Types gelijkstroom machines

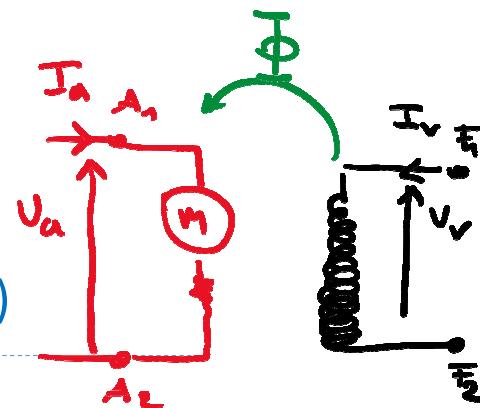
## 1.3.1. Permanent magneet motor (PM-motor)

## 1.3.2. Types bekraftiging

- Onafhankelijk bekraftigde gelijkstroommotor (OB-motor)

$V_a$

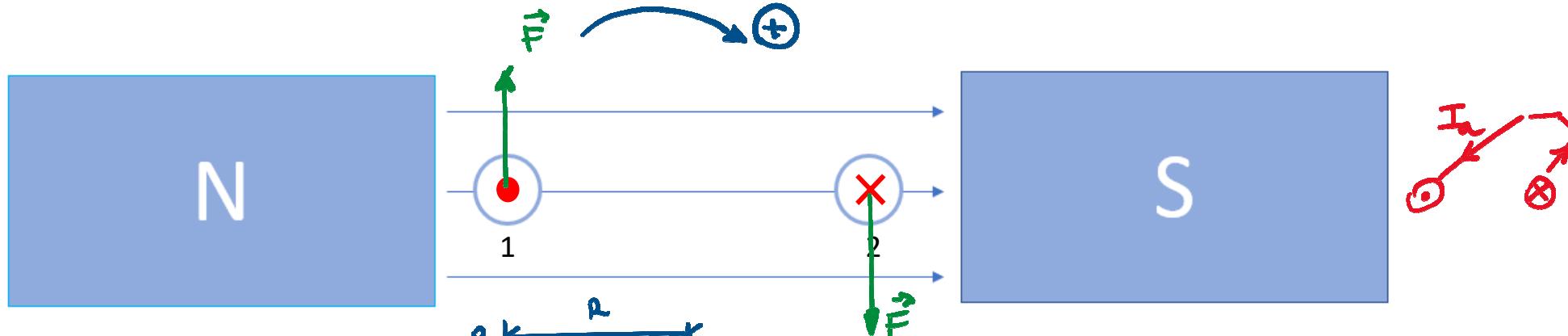
- Serie motor
  - Bekraftigingswikkeling in serie met de ankerwikkeling
- Shuntmotor ~~parallel~~
  - Bekraftigingswikkeling in parallel met de ankerwikkeling
- Compoundmotor
  - Bekraftigingswikkeling deels in serie, deels in parallel met de ankerwikkeling



## 1.3 Types gelijkstroom machines

|                      | Benaming                        | Klemaanduiding                |
|----------------------|---------------------------------|-------------------------------|
| Anker                | ankerwikkeling                  | A1 – A2 $\leftarrow v_a$      |
| Ankerreactie         | hulppoolwikkeling               | B1 – B2                       |
|                      | compensatiewikkeling            | C1 – C2                       |
| Veld - Bekrachtiging | seriewikkeling                  | D1 – D2 <u>worms</u> serie    |
|                      | shuntwikkeling                  | E1 – E2 parallel              |
|                      | onafhankelijke<br>bekrachtiging | F1 – F2 LABO $\leftarrow v_v$ |

## 1.4 Principe gelijkstroom motor



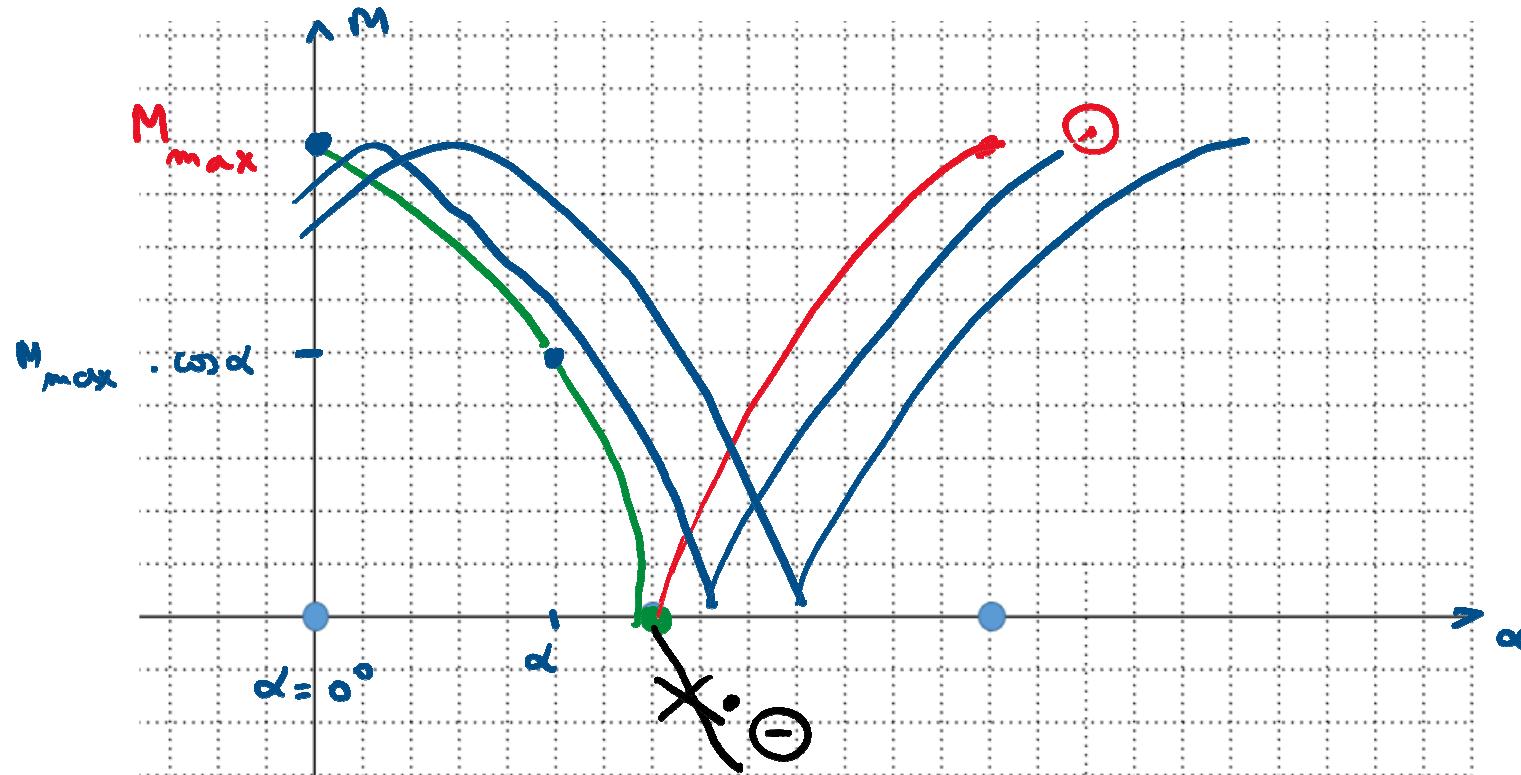
LHR

$$\alpha = 0^\circ \xrightarrow{\text{at. n.}} \xrightarrow{\text{Fig.1}} = (\vec{B}, \vec{st. n.})$$

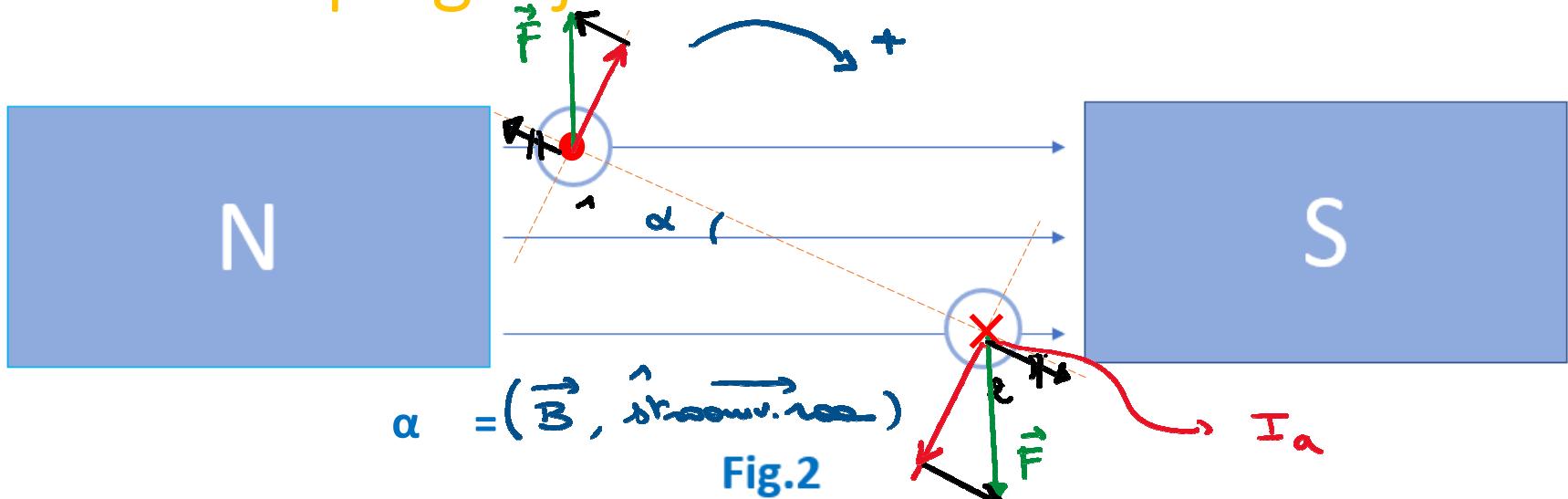
$$F = B l I_a$$

$$M = F \cdot 2R = B \cdot l \cdot I_a \cdot 2R = M_{\max}$$

## 1.4 Principe gelijkstroom motor



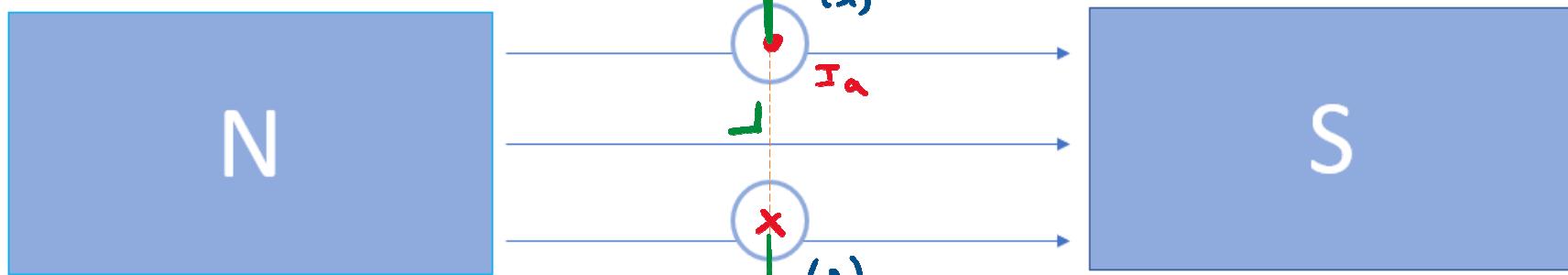
## 1.4 Principe gelijkstroom motor



$$F = F_0 \cdot \cos \alpha$$

$$M = \sqrt{B l I_a} \cdot 2R \cdot \cos \alpha = M_{\max} \cdot \cos \alpha$$

## 1.4 Principe gelijkstroom motor



$$\alpha = 90^\circ$$

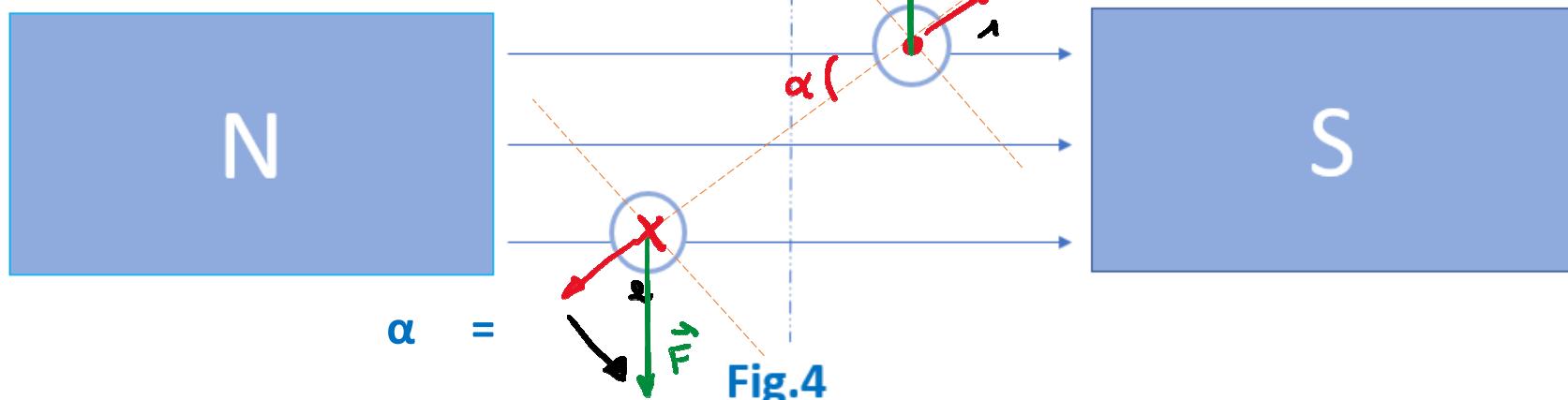
Fig.3

↑  
Neutrale lijn

?  $F =$

$M = 0$

## 1.4 Principe gelijkstroom motor



$$F =$$

$M = \text{negatief}$   $\rightarrow \text{OPL}$        $\text{STROOM} 2 \cdot N$        $\text{OMPOLEN}$   
 $NN'$

$$\begin{array}{ccc} \circ 1 & \longrightarrow & \times 1 \\ \times 2 & \longrightarrow & \circ 2 \end{array}$$

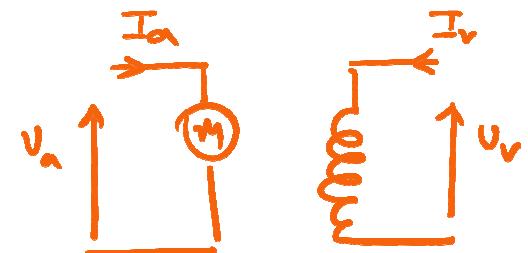
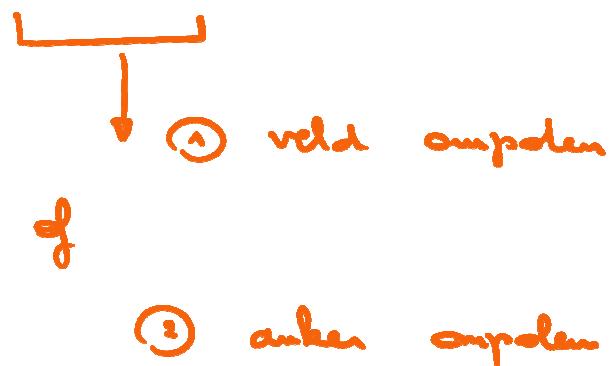
## 1.4 Principe gelijkstroom motor

### 1.4.1. Draaizin motor constant

  
stoornzin ompolen  $\frac{N}{N'}$

## 1.4 Principe gelijkstroom motor

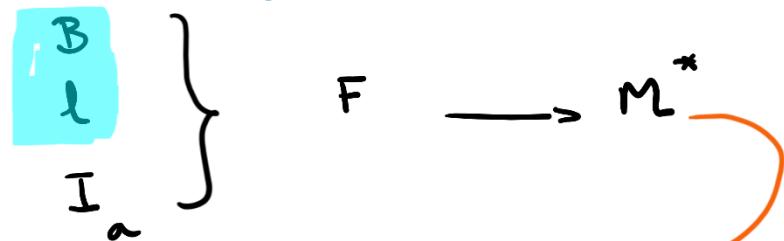
### 1.4.2. Draaizin motor omkeren



SERIEMOTOR ??

## 1.4 Principe gelijkstroom motor

### 1.4.3. Primair verschijnsel



### 1.4.4. Secundair verschijnsel

A diagram showing a blue rectangular frame containing the symbols  $B$ ,  $\ell$ , and  $n$ . To the right of the frame, a brace groups  $B$  and  $\ell$ , and below it is the symbol  $n$ . An arrow points from the frame towards a point labeled  $E_{Tegen}$  (Opposite)  $n$ . To the right of the arrow is the equation  $= B \ell n$ .

START - STIL  $\rightarrow E = 0$   
 $n \uparrow \rightarrow E \uparrow$   
 $n_{\text{max}} \rightarrow E \gg$

## 1.4 Principe gelijkstroom motor

### 1.4.5. Tegenemk

$$\begin{aligned} E_{\text{tot}} &= z \cdot B \cdot l \cdot v \\ \text{TOT Tegen} &= z \cdot \frac{\Phi}{s} \cdot l \cdot \underbrace{w \cdot R}_{\text{DEF } k_1 \text{ vegdelen!!}} \\ &= z \cdot \frac{1}{s} \cdot l \cdot R \cdot \frac{2\pi}{60} \cdot n \cdot \Phi \\ &= k_1 \cdot n \cdot \Phi \end{aligned}$$

$k_1 = \text{machineconstante}$   
 $n = \text{toerental}$   
 $\Phi = \text{flux (Wb)}$

$E_{\text{tot}} = k_1 \cdot n \cdot \Phi$

$\Phi = \Phi_1 \Rightarrow E \sim n$

$\frac{E_1}{E_2} = \frac{n_1}{n_2}$

$\Phi \text{ var} \Rightarrow \frac{E_1}{E_2} = \frac{n_1 \Phi_1}{n_2 \Phi_2}$

# 1.4 Principe gelijkstroom motor

## 1.4.6. Equivalent schema

$m^9$

$$E_{\text{tot}} = k_1 \cdot n \cdot \phi$$

$k_1$  = machineconstante  
 $n$  = toerental  
 $\phi$  = flux (Wb)

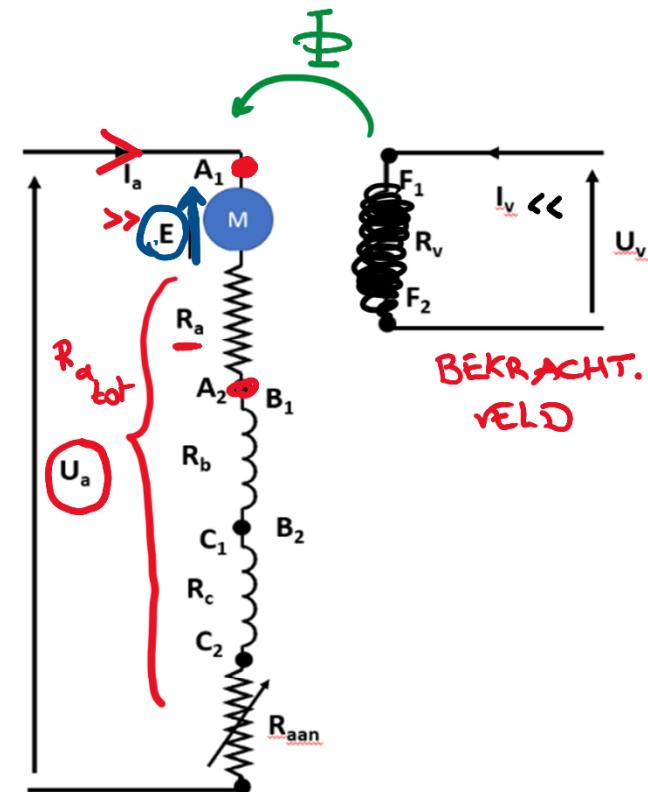
$$U_a = E + R_{a\text{tot}} \cdot I_a$$

$$U_a = k_1 n \phi + R_{a\text{tot}} \cdot I_a$$

$$E = U_a - R_{a\text{tot}} \cdot I_a$$

$$n = \frac{U_a - R_{a\text{tot}} \cdot I_a}{k_1 \Phi}$$

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$R_a >$   
 $I_a >$

$R_v >>$   
 $I_v <<$

# 1.4 Principe gelijkstroom motor

## 1.4.7. Tegenemk

$$n = 0 \rightarrow E = 0 \rightarrow V_a \sim R_{\text{ator}}$$

$$n \text{ stijgt} \rightarrow E = k_s n \phi$$

$R_{\text{ator}}, I_a \downarrow$   
 $I_a \downarrow$

$$n_n \rightarrow E \text{ groot} \rightarrow I_a \downarrow$$

$E \approx V_a$

