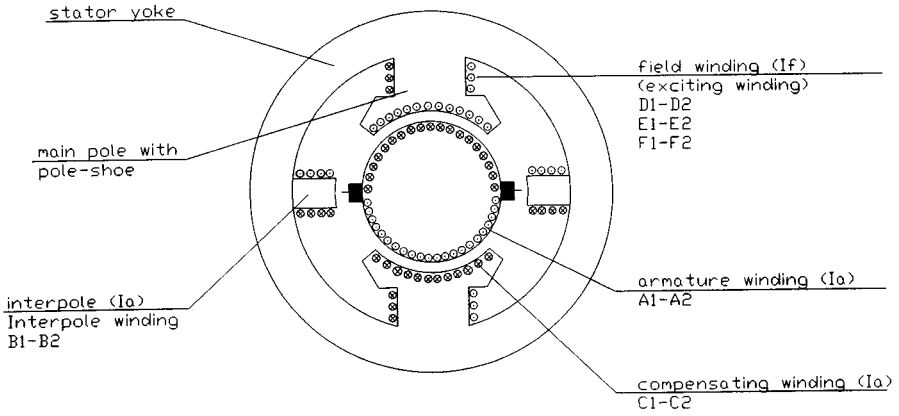
DIRECT CURRENT MACHINES 2

CROSS-SECTION OF DC MACHINE



TOTAL EMF INDUCED IN ARMATURE WINDING

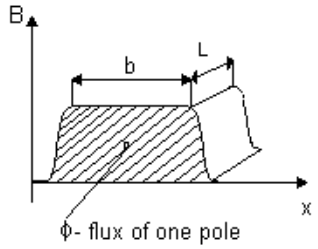
From the chain of armature winding we can conclude the following relation for total electromotive force induced in armature winding (in one parallel branch):

E = *number of active turn sides in parallel branch* $\times L \times v \times B_\delta$

or

$$E = \frac{N}{2a}\alpha \times L \times \omega \frac{D}{2} \times B_\delta$$

where N is total number of conductors (turn sides), $\alpha = \frac{b}{\tau_p}$.



$$\Phi = B_\delta \times b \times L$$

Taking into account the relation between flux density and one pole flux

$$\boxed{E = \frac{Np}{2a\pi}\Phi\omega}$$ or $$\boxed{E = c_E \Phi \omega}$$ when ω is in rad/s

or

$$\boxed{E = c\Phi n}$$ when n is in rev/min

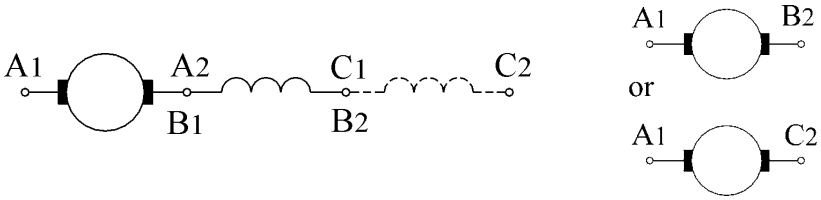
TOTAL ELECTROMAGNETIC TORQUE

$$\boxed{T = c_E \Phi I_a}$$ in N·m

where I_a is total armature current.

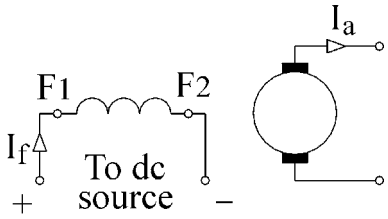
POSSIBLE (MUTUAL) CONNECTIONS OF WINDINGS

Usually the armature winding, commutating (interpole) winding and compensating winding are connected by manufacturer:



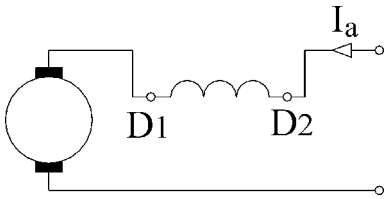
Compensating windings are applicable in very large machines only. Commutating windings are not used in very small machines.

Mutual connections of field winding(s) and armature circuit:



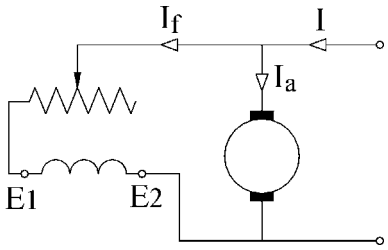
Separately-excited machine

Field winding is supplied from separate source.



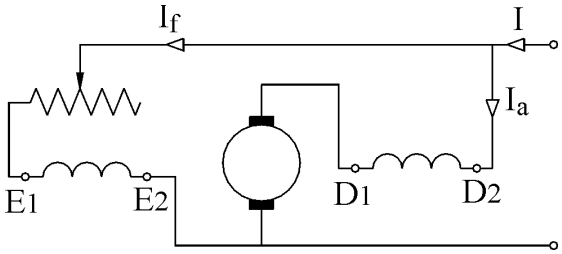
Series machine

Field winding is connected in series with armature circuit.



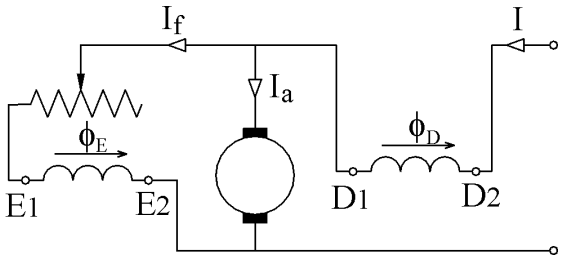
Self-excited machine, or
Shunt machine (shunt connection)

Field winding is connected in parallel with armature circuit.



Compound machine (series + shunt);
Long-shunt connection

Combination of two field windings: shunt and series.



Compound machine;
short-shunt connection;

$\Phi_E + \Phi_D$
cumulative compound

$\Phi_E - \Phi_D$
differential compound

[Figures for this part od DC Machines Theory were drawn with the help of 2002/03 academic year students:
at page 1 – Jakub Ściuba,
page 2 –Marcin Wesołowski]