**Three electric vectors**

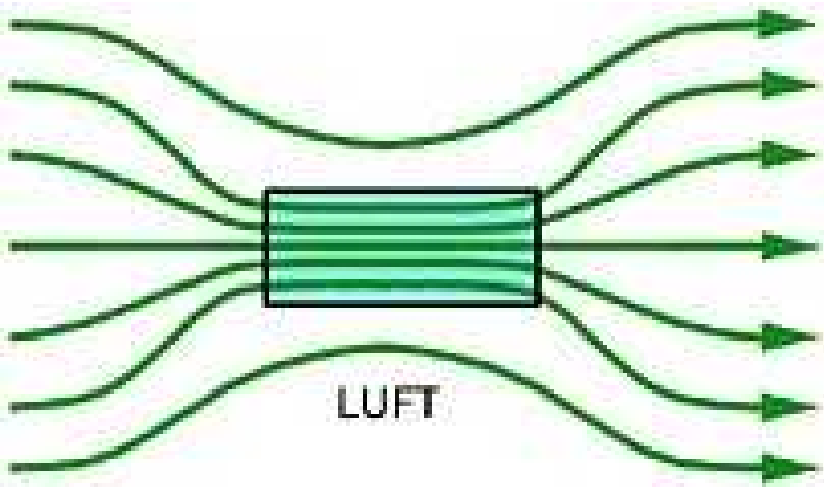
| Name | Symbol | Associated with | Boundary Condition |
|---|---|---|---|
| Electric field | $\mathbf{E}$ | All charges | Tangential component continuous |
| Electric displacement | $\mathbf{D}$ | Free charges only | Normal component continuous |
| Polarization (electric dipole moment per unit volume) | $\mathbf{P}$ | Polarization charges only | Vanishes in a vacuum |

| | |
|---|---|
| Defining equation for $\mathbf{E}$ | $\mathbf{F} = q\mathbf{E}$ |
| General relation among the three vectors | $\mathbf{D} = \epsilon_0\mathbf{E} + \mathbf{P}$ |
| Gauss's law when dielectric media are present | $\oint \mathbf{D} \cdot d\mathbf{S} = q$ ($q$ = free charge only) |
| Empirical relations for certain dielectric materials* | $\mathbf{D} = \kappa\epsilon_0\mathbf{E}$<br>$\mathbf{P} = (\kappa - 1)\epsilon_0\mathbf{E}$ |

**Three magnetic vectors**

| Name | Symbol | Associated with | Boundary Condition |
|---|---|---|---|
| **magnetic field** | **B** | All currents | Normal component continuous |
| **magnetizing field** | **H** | True currents only | Tangential component continuous† |
| Magnetization (magnetic dipole moment per unit volume) | **M** | Magnetization currents only | Vanishes in a vacuum |

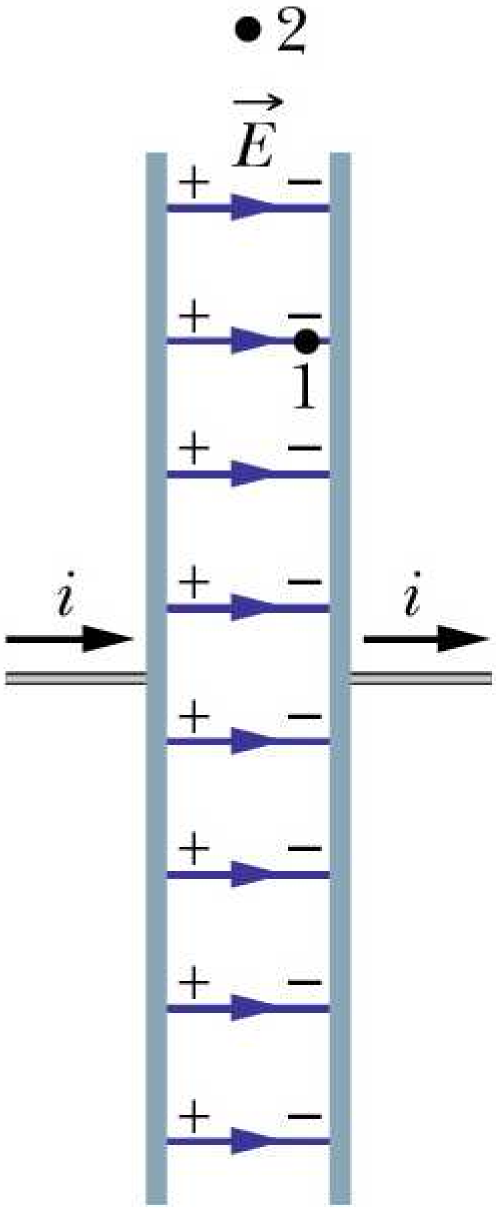
| | |
|---|---|
| Defining equations for **B** | $\mathbf{F} = q\mathbf{v} \times \mathbf{B}$ or $= i\mathbf{l} \times \mathbf{B}$ |
| General relation among the three vectors | $\mathbf{B} = \mu_0\mathbf{H} + \mu_0\mathbf{M}$ |
| Ampère's law when magnetic materials are present | $\oint \mathbf{H} \cdot d\mathbf{l} = i$ ($i$ = true current only) |
| Empirical relations for certain magnetic materials** | $\mathbf{B} = \kappa_m\mu_0\mathbf{H}$ <br> $\mathbf{M} = (\kappa_m - 1)\mathbf{H}$ |



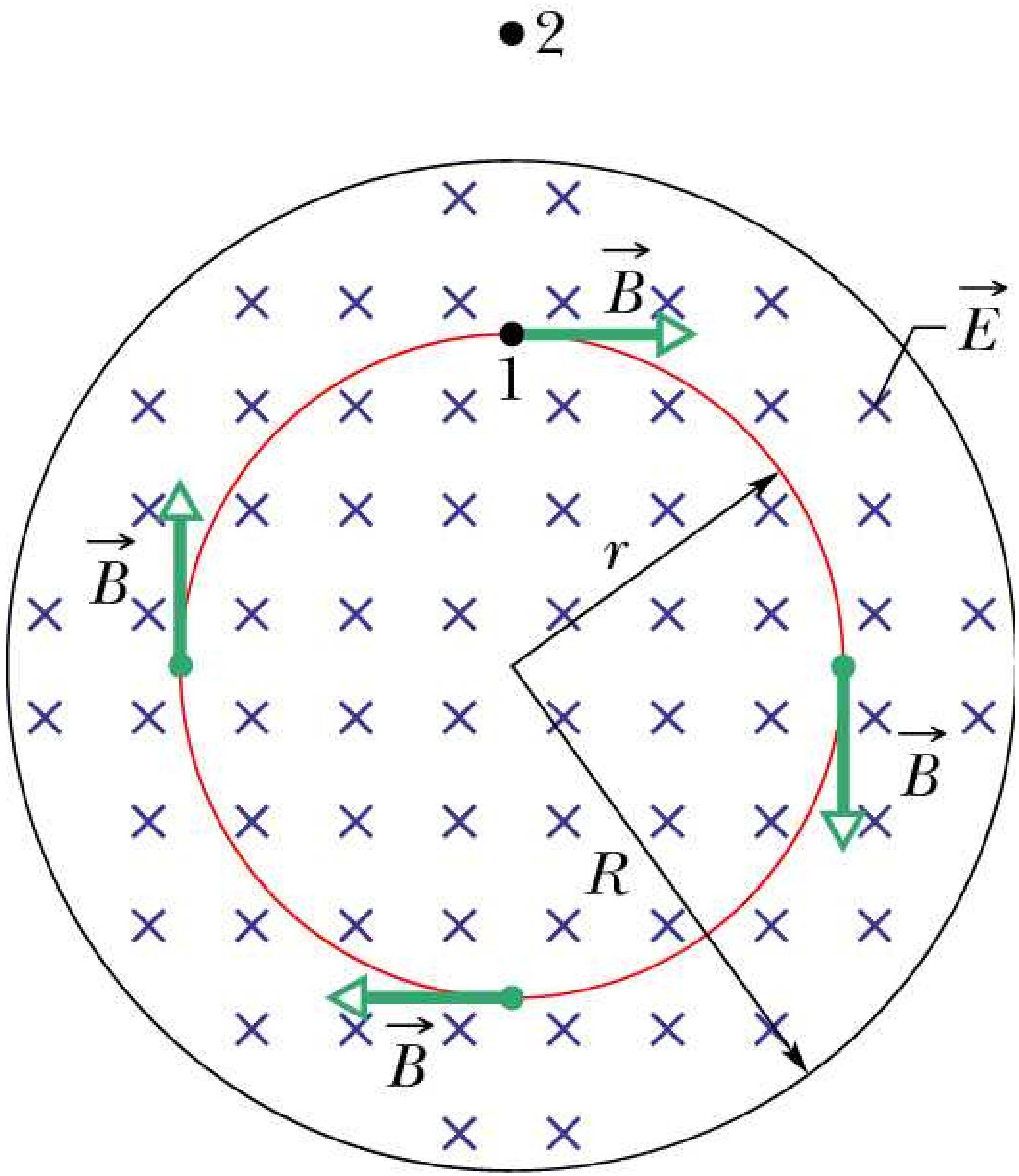

Große Permeabilität:

''Eisen leitet die Feldlinien besser als Luft''

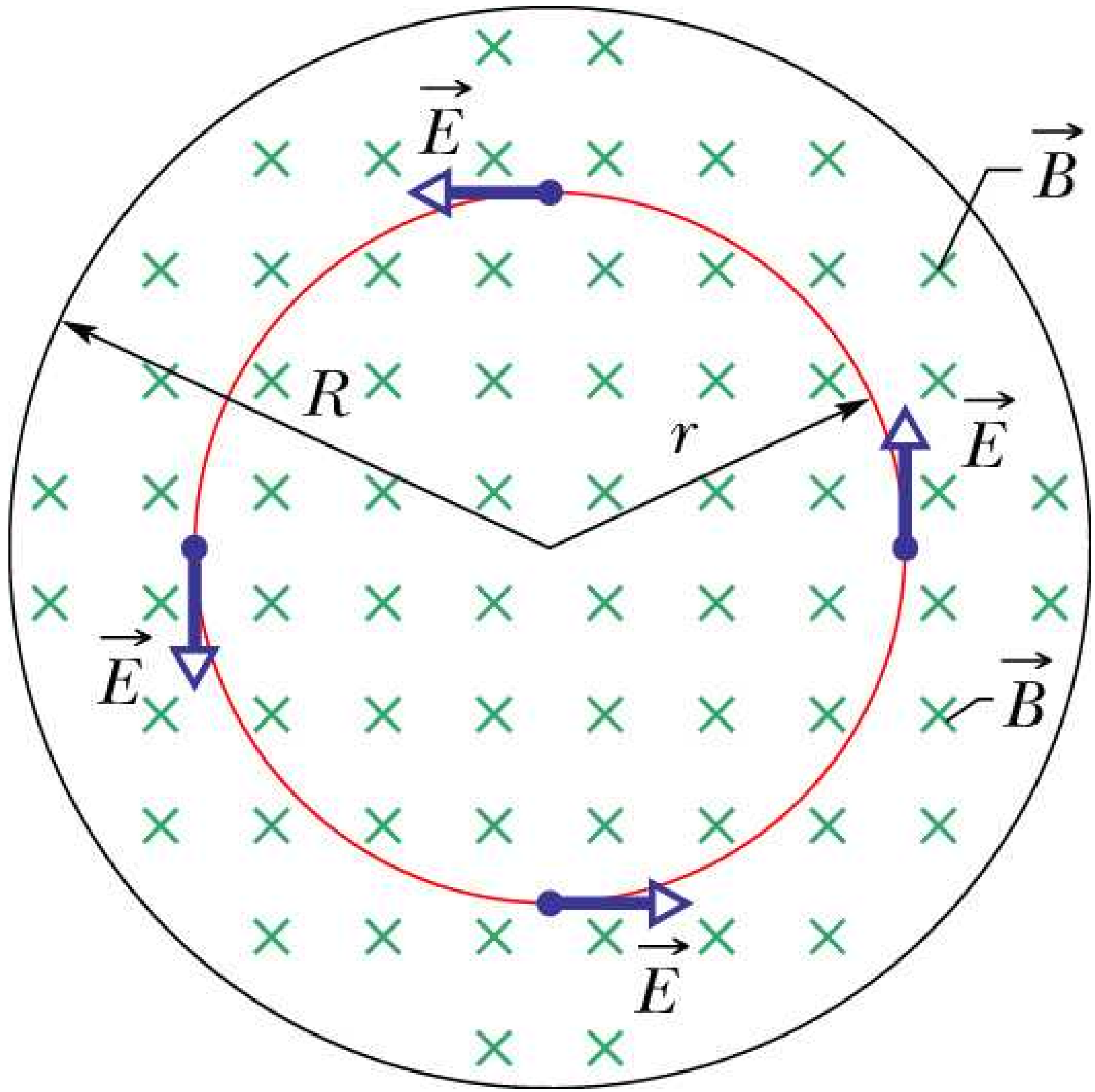
http://www.phyta.net/h-feld4.htm



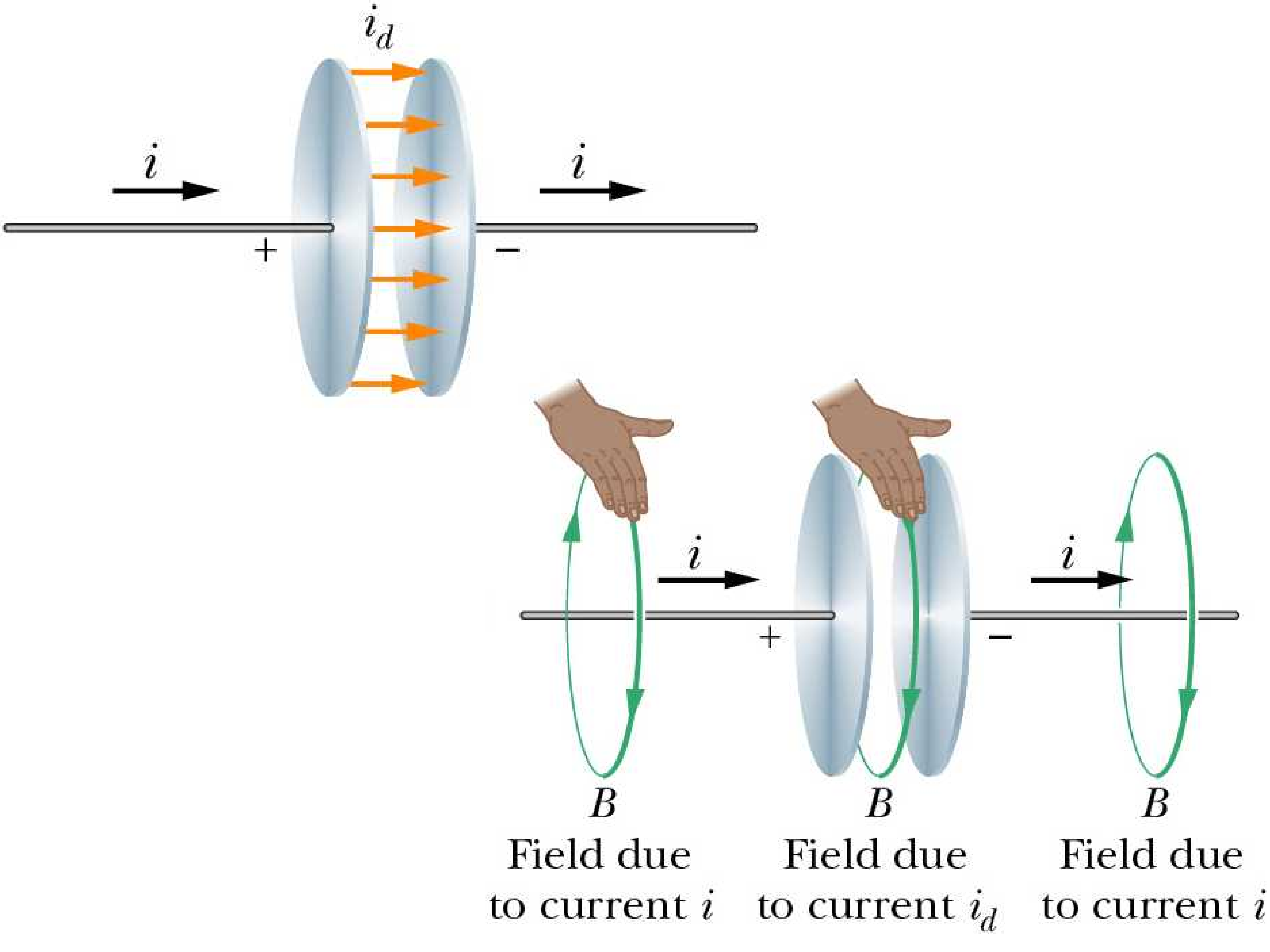
2
$\vec{E}$
+ −
1
$i$
$i$

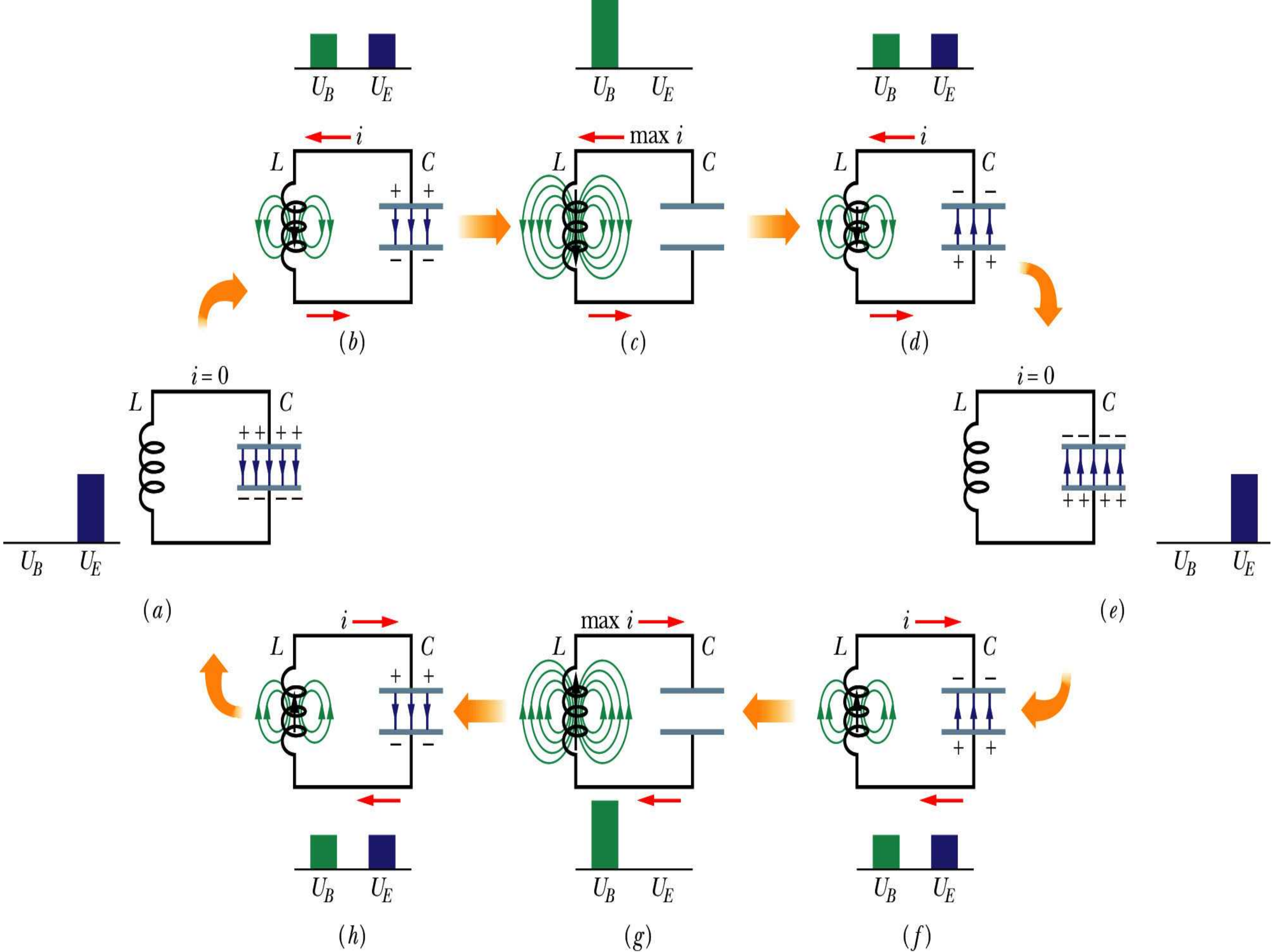
2
$\vec{B}$
1
$\vec{E}$
$r$
$\vec{B}$
$\vec{B}$
$R$
$\vec{B}$



$\vec{E}$
$\vec{B}$
$R$
$r$
$\vec{E}$
$\vec{E}$
$\vec{B}$
$\vec{E}$



$i_d$
$i$
$i$
+
−
$i$
$i$
+
−
$B$
Field due to current $i$
$B$
Field due to current $i_d$
$B$
Field due to current $i$



$U_B$ $U_E$
$i$
max $i$
$i = 0$
L
C
(a)
(b)
(c)
(d)
(e)
(f)
(g)
(h)