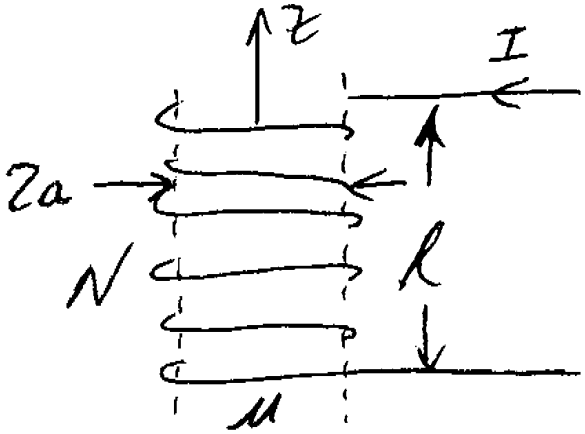
Solenoidal Inductor Example

For a long tightly-wound solenoid where $\ell >> a$, $\bar{B} = \hat{a}_z \frac{\mu N I}{\ell}$



$$\psi_m = \iint_S \bar{B} \cdot d\bar{s}$$

$$= \frac{\mu N I}{\ell} \iint ds$$

$$= \frac{\mu N I S}{\ell}$$ ← cross-sectional area

$$\lambda = N \psi_m = \frac{\mu N^2 I S}{\ell}$$

$$L = \lambda / I = \frac{\mu N^2 S}{\ell} \quad (H)$$

Good for many standard inductors