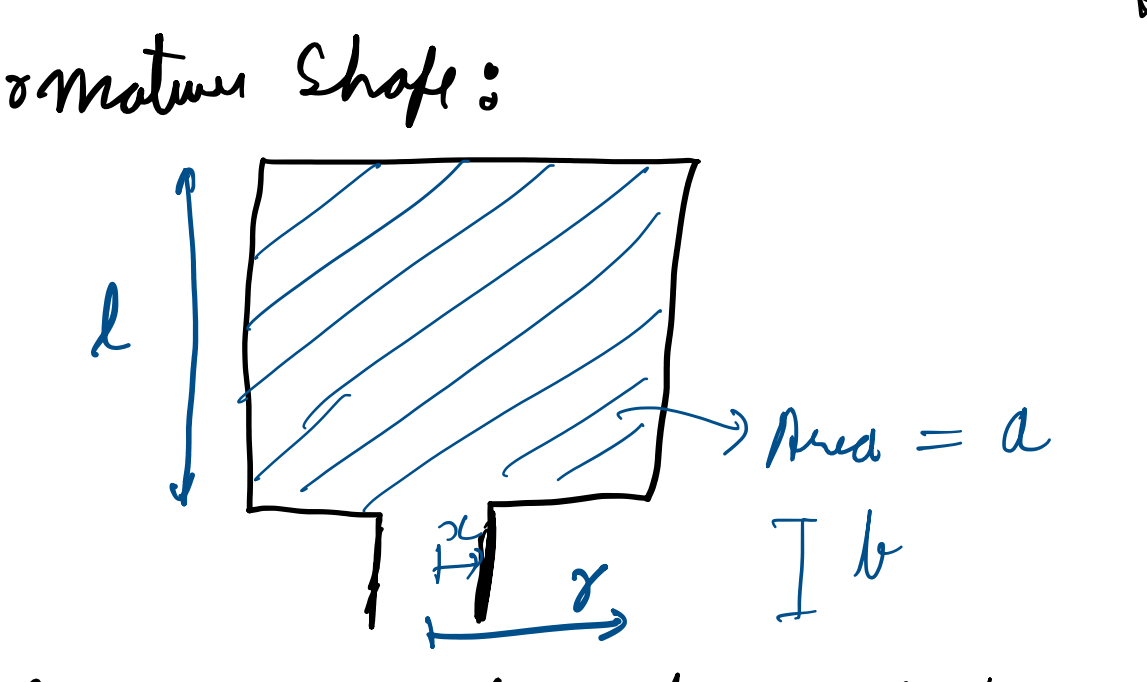
DC Motor project

Monday, 25 August 2025 2:07 PM

Resistivity of Copper $\Rightarrow \rho$, Area of wire $= \pi r^2 = \frac{\pi d^2}{4}$

Single Core Armature Shape:



Resistance of Single Coil $\Rightarrow 4\rho \frac{(2l + 4r + 2b - 2x)}{\pi d^2}$

$\Rightarrow \frac{8\rho}{\pi}\left(\frac{2r + l + b - x}{d^2}\right)$

* Let there be N coil's in Sub-Armature
  Resistance of each Sub-Armature $\Rightarrow \frac{8\rho}{\pi}\left(\frac{2r + l + b - x}{N d^2}\right)$

* No. of Sub-Armature the brushes are in contact with $= n$

  $\Rightarrow$ Armature Resistance $\Rightarrow \frac{8\rho}{\pi}\left(\frac{2r + l + b - x}{n N d^2}\right)$

* No. of Subarmature $= m$
  Length of enamel Wire req. for Armature $\Rightarrow m N (2l + 4r - 2x + 2b)$

$\tau_{ind} = k\phi I_A$

$E_A = k\phi\omega = 2 N n r l B \omega$

$I_A = \frac{V_T - E_A}{R_A + R_{Pot.A}}$, $\phi \propto I_F$, $\phi = C I_F$

$I_F = \frac{V_F}{R_F + R_{Pot.F}}$

$\tau_{ind} = 2(N n I_A l B) r = 2 N n I_A r l B = k\phi I_A$

$k\phi = 2 N n r l B$

$$I_A = \frac{V_T - 2 N n r l B \omega}{R_A + R_{Pot.A}}$$

Length of Copper enamel Wire Req $\Rightarrow$ $2 m N (l + 2r + b - x)$

After 0.5 cm compensation for ends $= 2 m N (l + 2r + b - x + 5 \times 10^{-3})$ metre

Armature Resistance $\Rightarrow \frac{8\rho}{\pi}\left(\frac{2r + l + b - x}{n N d^2}\right)$

Planning:-

m (No. of Sub Armature) $= 6$ or 8

n (No. of Coils active @ a time) $= 1$ or 2

Power of Potentiometer $= I^2 R$

$R_A = \frac{8\rho}{\pi}\left(\frac{2r + l + b - x}{n N d^2}\right)$

$\rho = 1.68 \times 10^{-8}\ \Omega m$

$R_A = 4.278 \times 10^{-8}\left(\frac{2r + l + b - x}{n N d^2}\right)\Omega$

$d = 0.27\ mm = 27 \times 10^{-5} m$

$R_A = 0.587\left(\frac{2r + l + b - x}{n N}\right)\Omega$

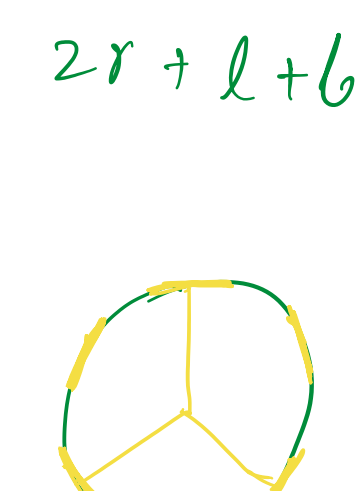
$r = 4\ cm$
$l = 5\ cm$
$b = 1\ cm$
$x = 1\ cm$

$R_A = \left(\frac{0.076}{n N}\right)\Omega$

$n = 1$, $m = 3$

$N \Rightarrow 10$ to 30

$2r + l + b - x = 8 + 5 + 1 - 1 = 13\ cm$



Commutator

$R_A = \left(\frac{0.076}{N}\right)\Omega$

$I_A = \frac{V_T - 2 N n r l B \omega}{R_A + R_{Pot,A}}$

$= \frac{V_T - 2N(1)\left(\frac{4}{100}\right)\left(\frac{5}{100}\right)B\omega}{\frac{0.076}{N} + R_{Pot.A}}$

$I_A = \frac{V_T - 4 N B \omega \times 10^{-3}}{\frac{0.076}{N} + R_{Pot.A}}$

$\tau_{ind} = 2 N n r l B I_A = 2 N(1)\left(\frac{4}{100}\right)\left(\frac{5}{100}\right) B I_A$

$= 4 N B I_A \times 10^{-3}$

* **Length of Copper enamel**

  $\Rightarrow 2 m N (l + 2r + b - x + 5 \times 10^{-3})$ metre

  $\Rightarrow 2(3)(N)\left(\frac{13}{100} + \frac{0.5}{100}\right)$ metre

  $\Rightarrow 6N\left(\frac{13.5}{100}\right)$ metre $\Rightarrow 81 N \times 10^{-2}$ metre

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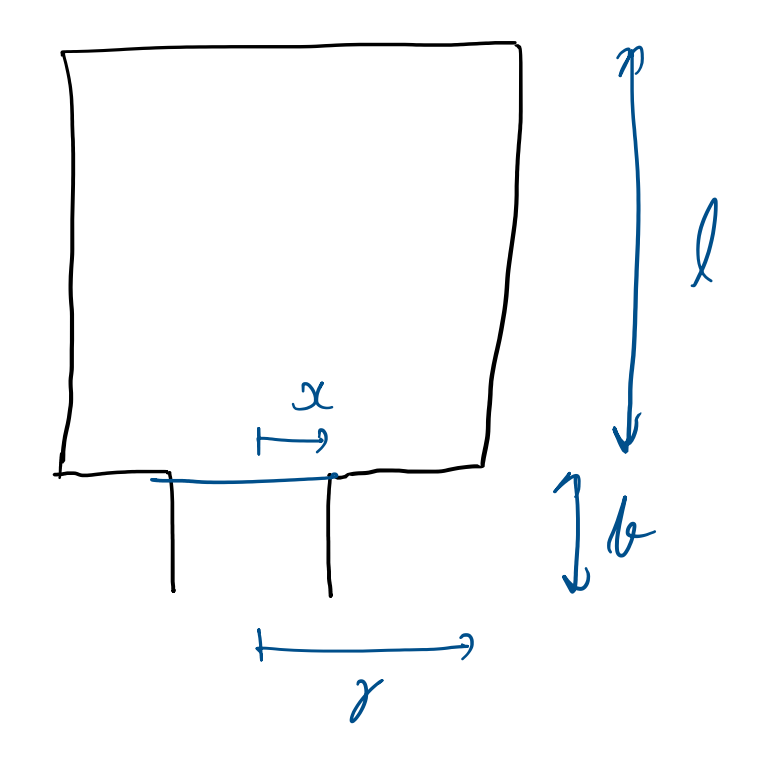
STUPID IDEA NO. 2:-



Resistance of Copper Wire $\Rightarrow \rho$

Cross Section area $\Rightarrow \frac{\pi d^2}{4}$

No. of turns $= N$

Resistance of Coil (Armature Resistance) $\Rightarrow \frac{\rho[N(2r \times 2l) + 2b - 2x]}{\pi d^2/4}$

$\Rightarrow \frac{8\rho}{\pi d^2}[2Nrl + b - x]$

$R_A \Rightarrow \frac{8\rho}{\pi}\left(\frac{2Nrl + b - x}{d^2}\right)$

No. of Subarmature $\Rightarrow m$

Length of wire for Armature $\Rightarrow m[N(2r + 2l) + 2b - 2x + 2/100]$ (metre)

$\tau_{ind} = k\phi I_A$

$E_A = k\phi\omega$

$I_A = \frac{V_T - E_A}{R_A + R_{PotA}}$ $\qquad I_F = \frac{V_F}{R_F + R_{PotF}}$

$\tau_{ind} = 2r(N I_A l B) = k\phi I_A$

$k\phi = 2rNlB$

$E_A = (2rNlB)\omega$

$I_A = \frac{V_T - (2rNlB)\omega}{R_A + R_{Pot A}}$

Planning 2.0:-

$m = 3$

$R_A = \frac{8\rho}{\pi}\left(\frac{2Nrl + b - x}{d^2}\right)$

$= 4.278 \times 10^{-8}\left(\frac{2Nrl + b - x}{d^2}\right)\Omega$

$r = 4\ cm$
$l = 5\ cm$
$b = 1\ cm$
$x = 1\ cm$

$R_A = 4.278 \times 10^{-8}\left(\frac{0.4N}{d^2}\right)\Omega$

$d = 0.27\ mm = 27 \times 10^{-5}\ m$

$R_A = 0.235 N\ \Omega$

$N = 50$, $R_A = 11.75\ \Omega$

$k\phi = 2rNlB$

$= 2\left(\frac{4}{100}\right)(50)\left(\frac{5}{100}\right)B$

$= B/5$

$$I_A = \frac{V_T - B\omega/5}{11.75 + R_{A,Pot}}$$

$$\tau_{ind} = B I_A/5$$

Length of Wire for Armature:

$m[N(2r + 2l) + 2b - 2x + 2/100]$

$\Rightarrow 3\left[50\left(\frac{18}{100}\right) + \frac{2}{100} - \frac{2}{100} + \frac{2}{100}\right]$ metre

$\Rightarrow 3\left[9 + \frac{2}{100}\right]$ metre $\Rightarrow$ **27.06 metre**