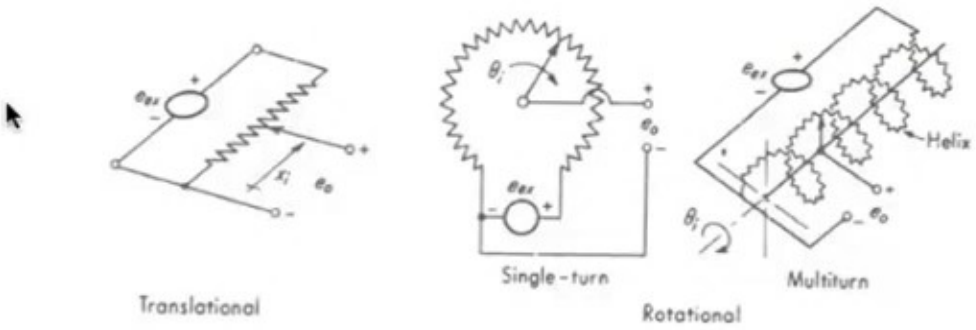
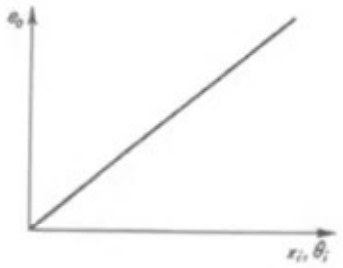
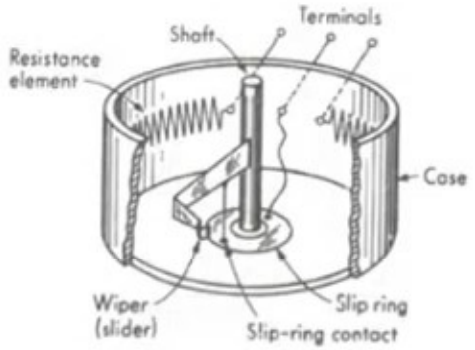
Resistive Potentiometers

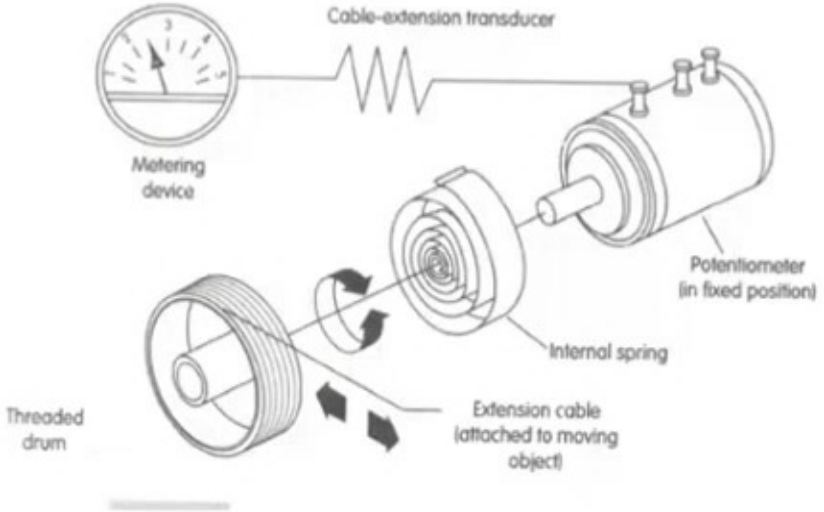
- A resistive potentiometer consists of a resistance element with a movable contact
- The contact can be translation, rotation, or combination of the two (helical motion)
- Translatory devices have range from 2 – 500 mm
- Range of rotational devices 10^{o} – 60 full turns

Resistive Potentiometers (*contd.*)









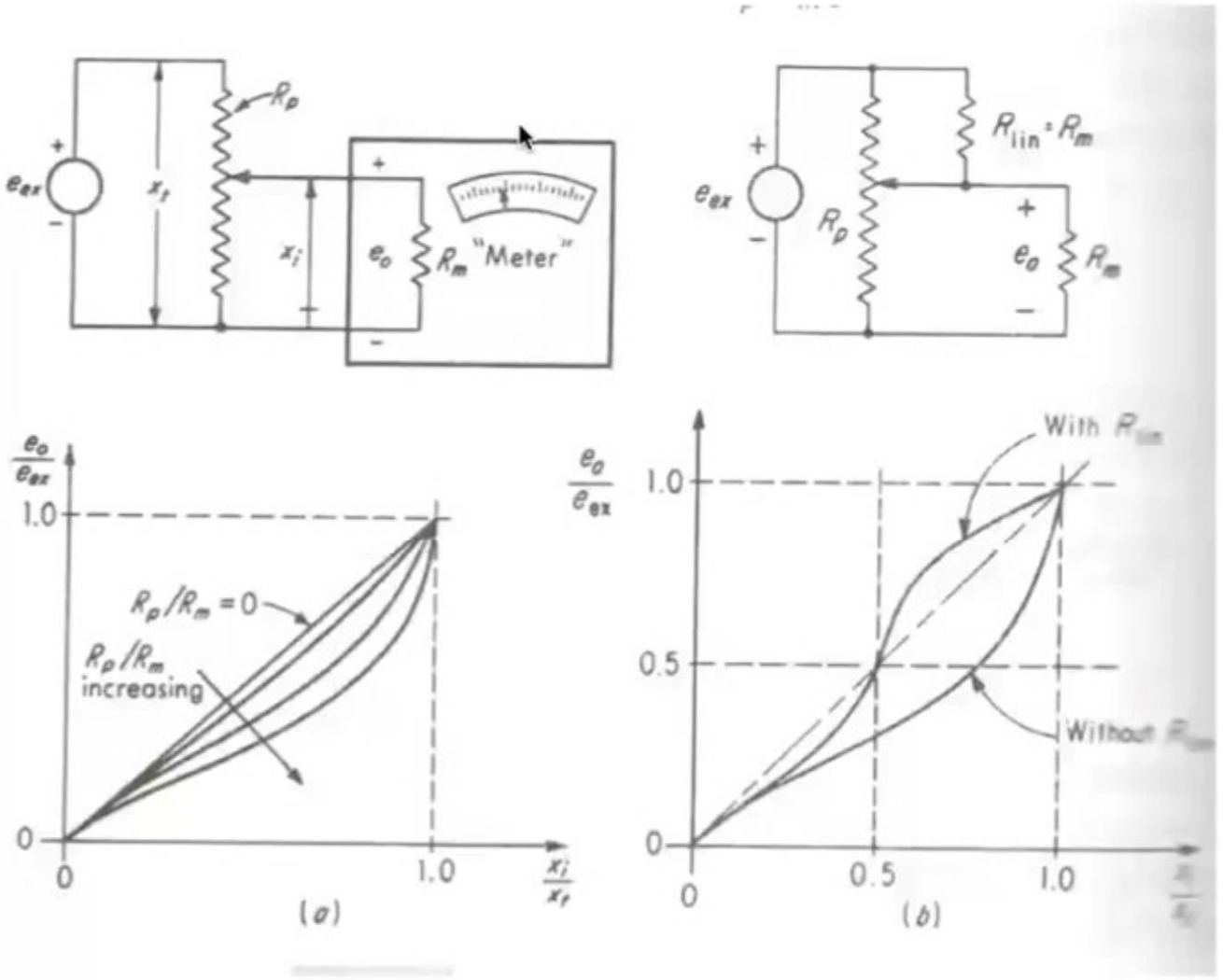
Resistive Potentiometers *(contd.)*

- Linear relation between input and output is expected
- However, since the potentiometer output voltage is input to a meter or recorder, some current is drawn from the potentiometer. This distorts the input-output relationship, to

H-W

$$\frac{e_0}{e_{ex}} = \frac{1}{1/(x_i/x_t + R_p/R_m)(1 - x_i/x_t)}$$

Resistive Potentiometers (*contd.*)



Resistive Potentiometers *(contd.)*

- Note that to achieve good linearity, for a given R_m, want R_p to be small
- Low R_p however means poor sensitivity
- How about increasing e_{ex} to get better sensitivity?
- Increasing e_{ex} increases the power to be dissipated
- e_{ex} is therefore dictated by power dissipating (P) capacity of potentiometer: $\max(e_{ex}) = \text{sqrt}(P\ R_p)$
- So for a given P, if R_p is low, e_{ex} will also be small

Noise in Resistive Potentiometers (*contd.*)

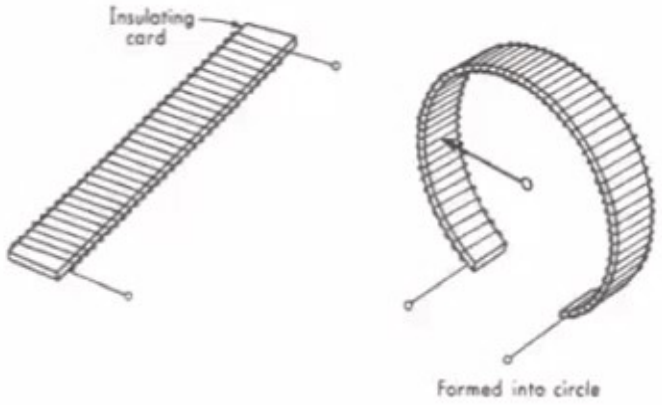
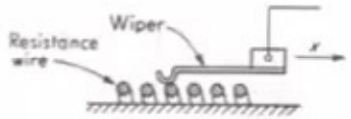


Fig. 4.6 *Construction of wirewound resistance elements.*



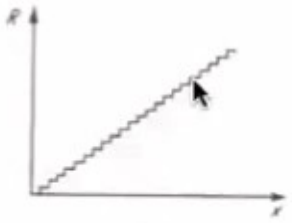


Fig. 4.7 *Resolution of wirewound potentiometers.*

Noise in Resistive Potentiometers

(*contd.*)

- Noise refers to spurious input-output fluctuations due to motion of slider
  - For example, bouncing of slider during motion
  - Dirt and wear products can come between contact and winding
- Speed and wire spacing can be such so to produce bouncing at resonance frequency, leading to intermediate contact
  - By using two contacts, with different resonant frequencies, this problem can be overcome
  - Can also add damping fluid to limit the resonant amplitude
- Noise can also result from other mechanical and electrical defects
- Environmental factors such as high/low temperature, shock, vibration, humidity can act as modifying/interfering inputs
- Design for "under the hood" environment is particularly challenging