

Xerographic Copiers

Observations About Copiers

- Copies consist of colored powder stuck to paper
- After jams, the powder sometimes wipes off
- Copiers run out of colored powder or “toner”
- Copies are often warm after being made
- Copies tend to be static and clingy
- Some copiers scan a light, some use a flash

3 Questions about Xerographic Copiers

- How can light arrange colored powder on paper?
- How does a copier spray charge onto a surface?
- How does a copier make its copies permanent?

Question 1

- How can light arrange colored powder on paper?

The Xerographic Concept

- The xerographic concept
 - sprays electric charge onto a surface and
 - projects an image of the document onto that surface.
 - Wherever light hits the surface, the charge escapes.
 - The remaining charge attracts colored toner particles
 - which are then bonded to paper to produce a copy.
- The surface is a photoconductor,
 - an insulator that turns into a conductor in the light,
 - so illumination allows charge to move and escape.

Question 2

- How does a copier spray charge onto a surface?

Electric Fields (Part 1)

- Consider these two views of electric forces:
- The first view is charge-on-charge
 - Charge₁ pushes directly on Charge₂.
- The second view is charge-electric field-charge
 - Charge₁ creates an electric field
 - That electric field pushes on Charge₂.
- This electric field isn't a fiction; it actually exists!

Electric Fields (Part 2)

- An electric field
 - is a structure in space that pushes on electric charge
 - is vector in character: it has magnitude and direction
 - may depend on position and time
- The electric field at a given position and time
 - is proportional to the force on a + test charge
 - is often represented graphically by an arrow
 - but is actually located at just one point on that arrow

Electric Fields and...

- Consider these two views of electric forces:
- The first view is electric field-on-charge
 - An electric field exerts a force on a + test charge

...Voltage Gradients

- The second view is voltage gradient-on-charge
 - An object accelerates to reduce potential energy (PE)
 - so it experiences a force down the "gradient" of PE
 - + test charge has electrostatic potential energy (EPE)
 - + test charge's EPE is proportional to its voltage
 - + test charge experiences force down voltage gradient
 - A voltage gradient exerts a force on a + test charge
- A voltage gradient *is* an electric field!

Electric Fields In and Around Metals

- Inside a metal, charges can move freely
 - and can rearrange to minimize their EPE.
 - At equilibrium, the metal has a uniform voltage,
 - and there is no electric field inside the metal.
- Outside a metal, charges can't move freely,
 - so they cannot rearrange to minimize their EPE.
 - At equilibrium, voltages can vary with location,
 - and there can be an electric field outside the metal.

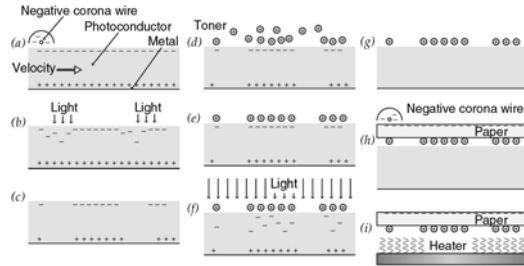
Corona Discharges

- Outside a sharp or narrow metal at high voltage,
 - the voltage varies rapidly with position,
 - so that the electric field is very strong
 - and it can push charges onto passing air particles.
- This phenomenon is a corona discharge
 - in which the narrow metal sprays charges
 - and can easily deposit or dissipate static electricity.

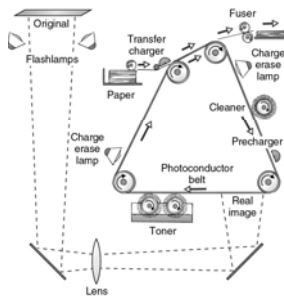
Question 3

- How does a copier make its copies permanent?

Xerographic Process



Copier Structure



Summary about Xerographic Copiers

- It sprays charge from a corona discharge
- That charge precoats a photoconductor
- It projects a light onto the photoconductor
- The charge escapes from illuminated regions
- The remaining charge attract toner particles
- Those particles are fused to the paper as a copy