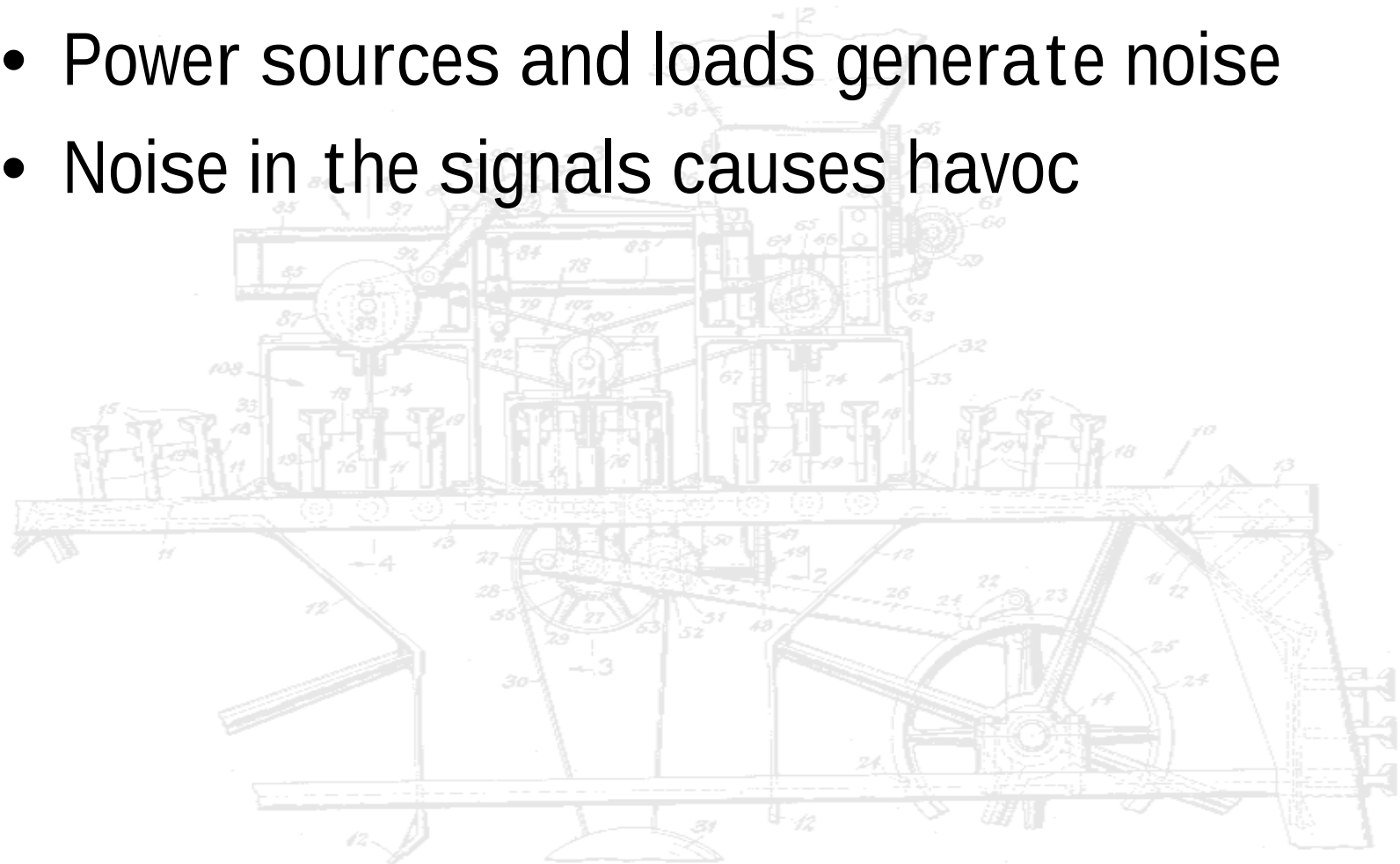
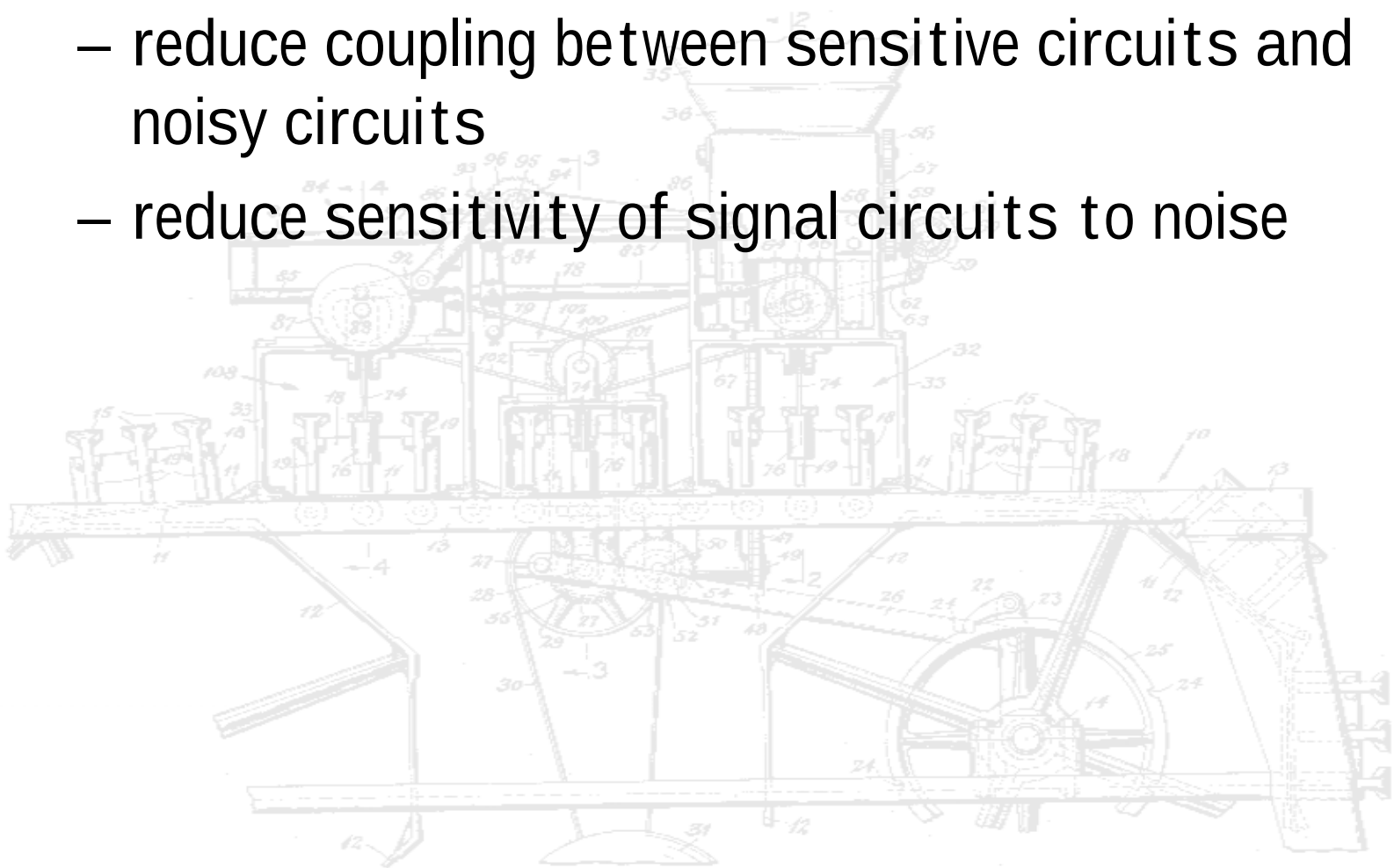
Wiring and Factory Communications

- Big factories use lots of cable
- Some cables carry signals, some power
- Power sources and loads generate noise
- Noise in the signals causes havoc



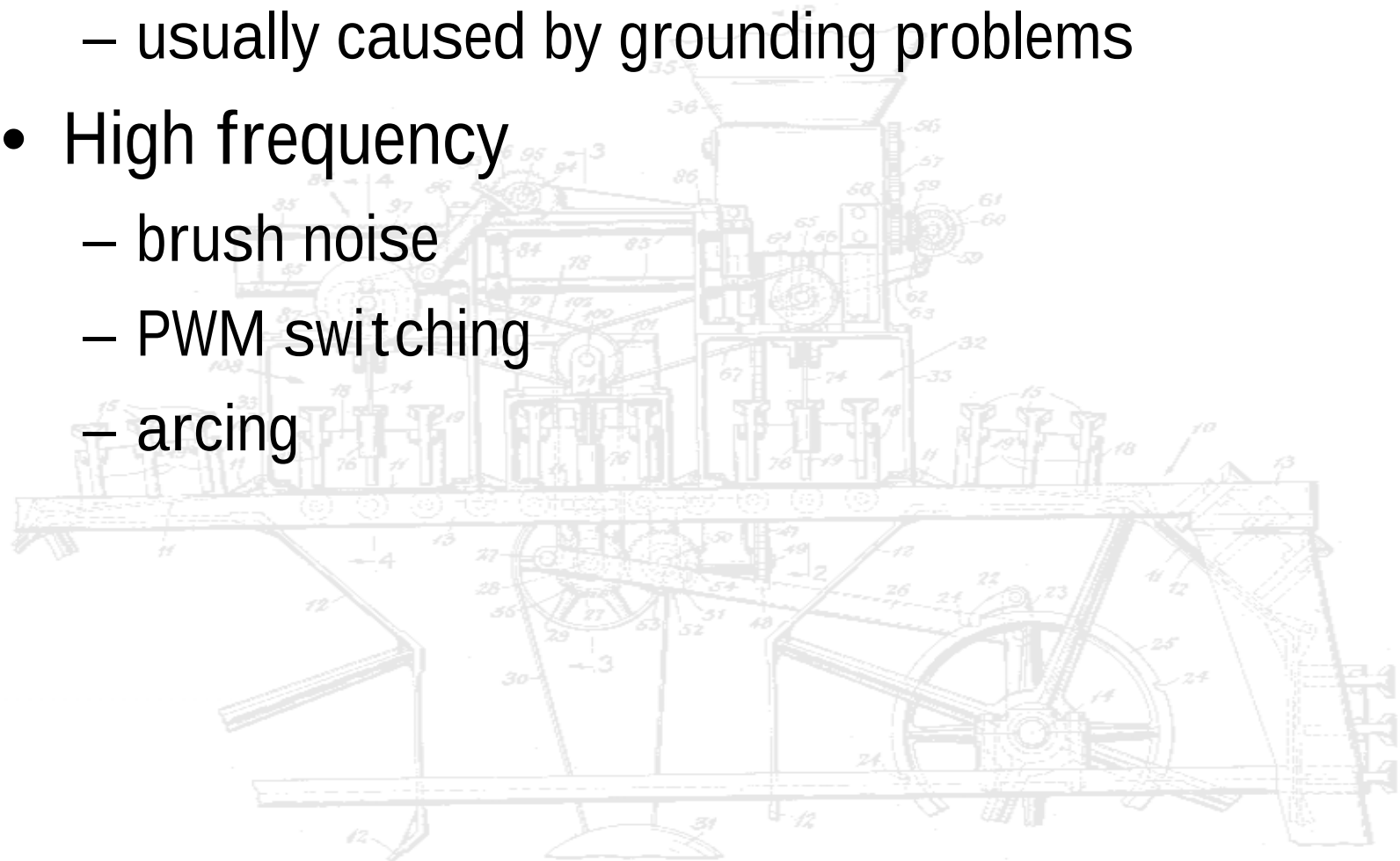
Dealing with Electrical Noise

- Strategies for combating noise
  - reduce noise at source
  - reduce coupling between sensitive circuits and noisy circuits
  - reduce sensitivity of signal circuits to noise



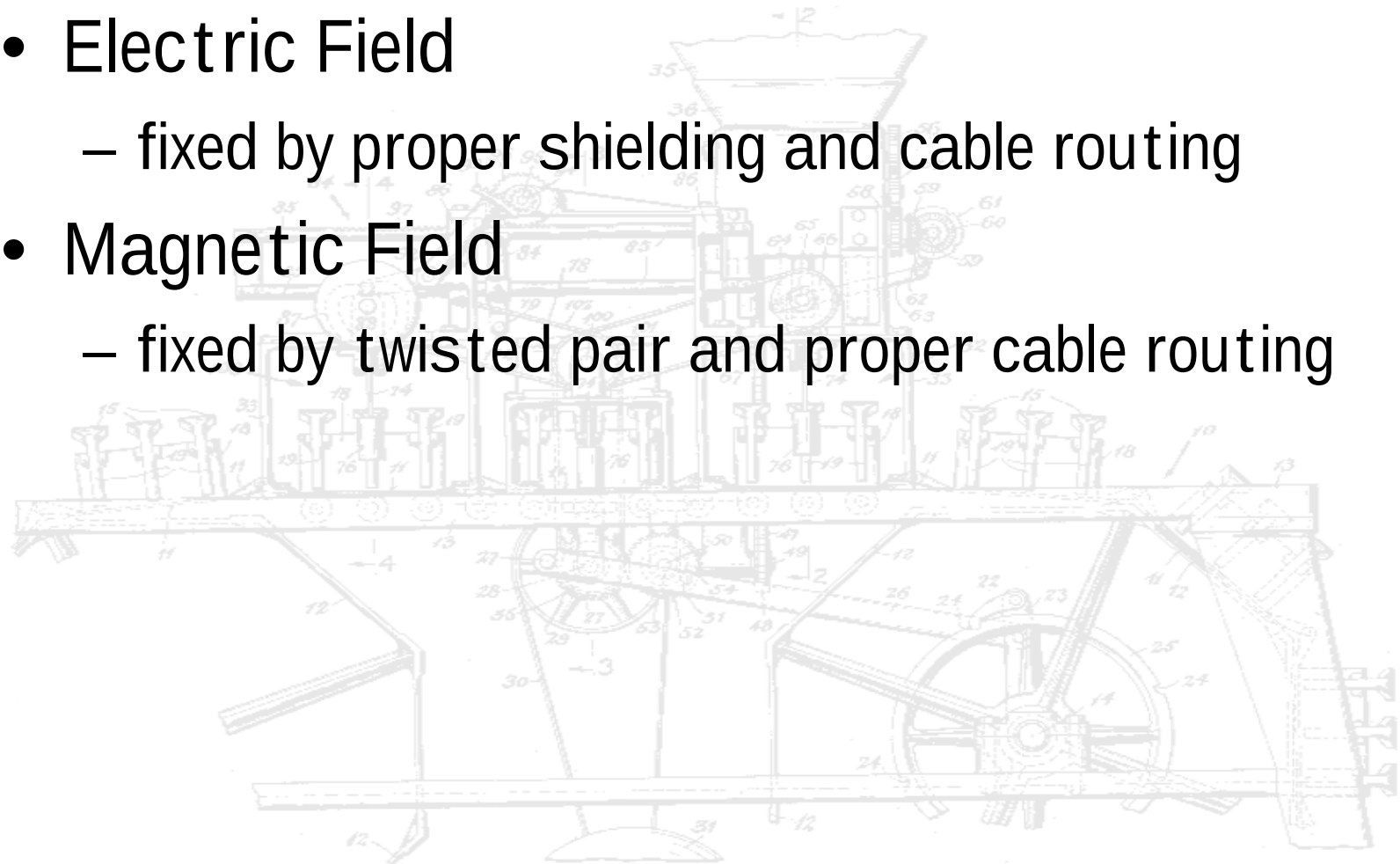
Types of Noise

- Low frequency
  - 60Hz
  - usually caused by grounding problems
- High frequency
  - brush noise
  - PWM switching
  - arcing



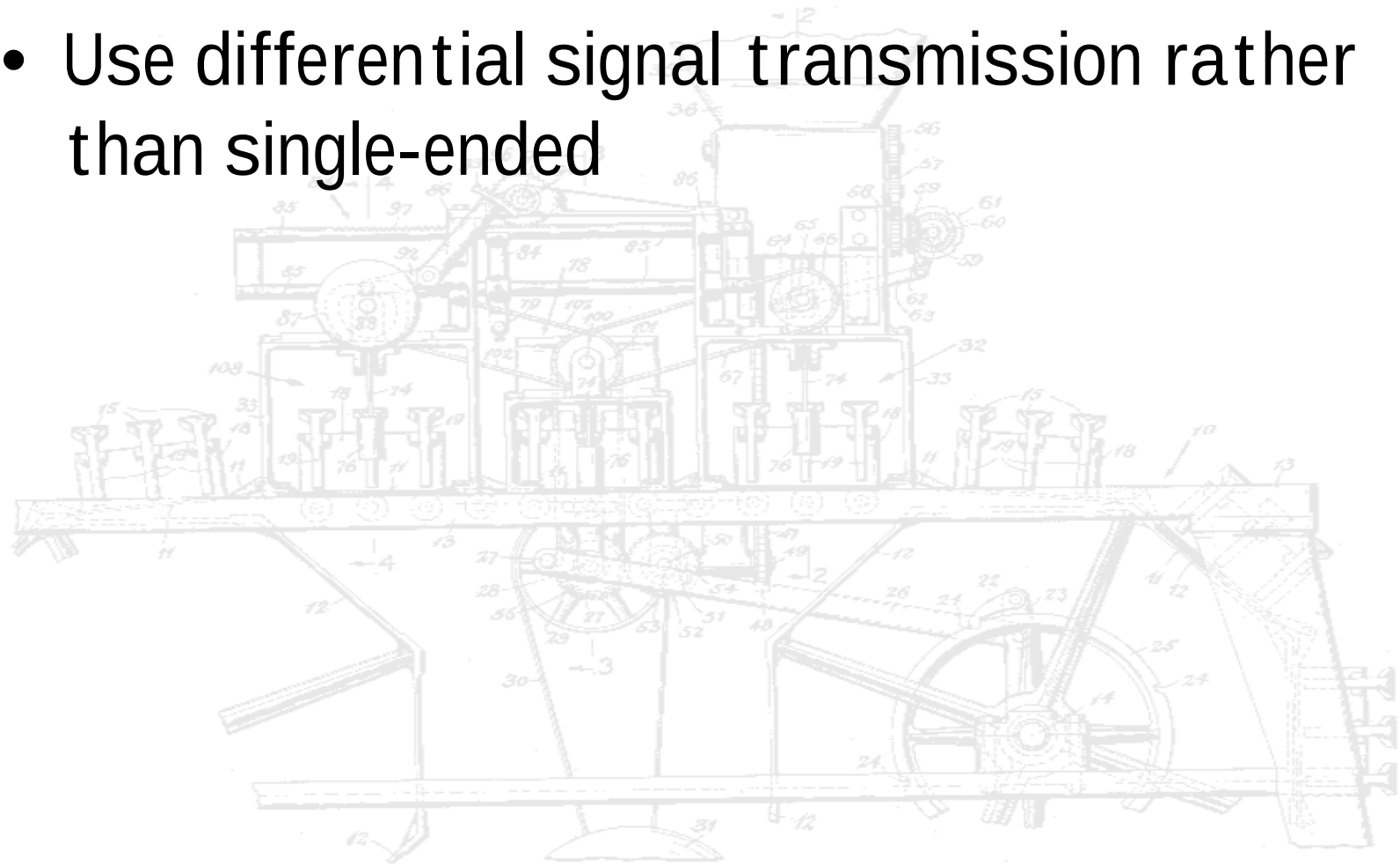
Types of Noise Coupling

- Common Impedance
  - fixed by proper grounding
- Electric Field
  - fixed by proper shielding and cable routing
- Magnetic Field
  - fixed by twisted pair and proper cable routing



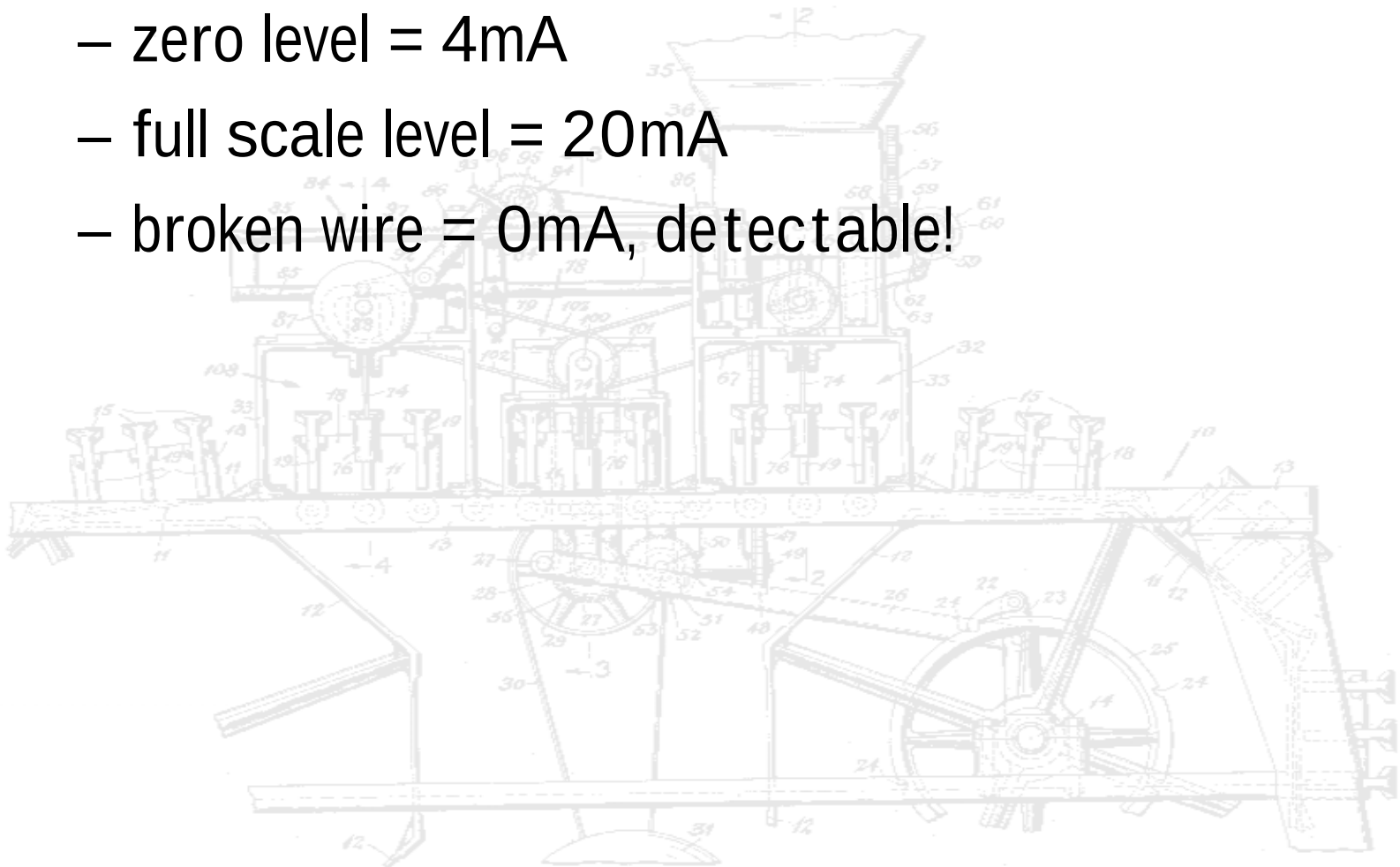
Reducing Sensitivity of Circuits

- Avoid high-impedance sources and loads
- Use digital signaling rather than analog
- Use differential signal transmission rather than single-ended



Analog Signal Methods

- Current Loop sensors
  - low impedance
  - zero level = 4mA
  - full scale level = 20mA
  - broken wire = 0mA, detectable!



Digital Signal Methods

- Discrete (on-off) signals
  - standard is 0v and 24v
- Communication busses (low level)
  - serial bit stream
  - asynchronous:
    - start bit, data bits, “stop” bit
    - receiver and transmitter have to know bit rate
    - RS-232 common standard
    - RS-485 industrial standard (differential signalling)
  - synchronous:
    - clock signal sent with data (Ethernet)

Digital Communications

- Mid-level
  - data sent in packets
  - destination address, packet length, data, checksum (minimum number of fields)
  - Modbus, Profibus, DirectNet, etc.
  - TCP/IP taking over