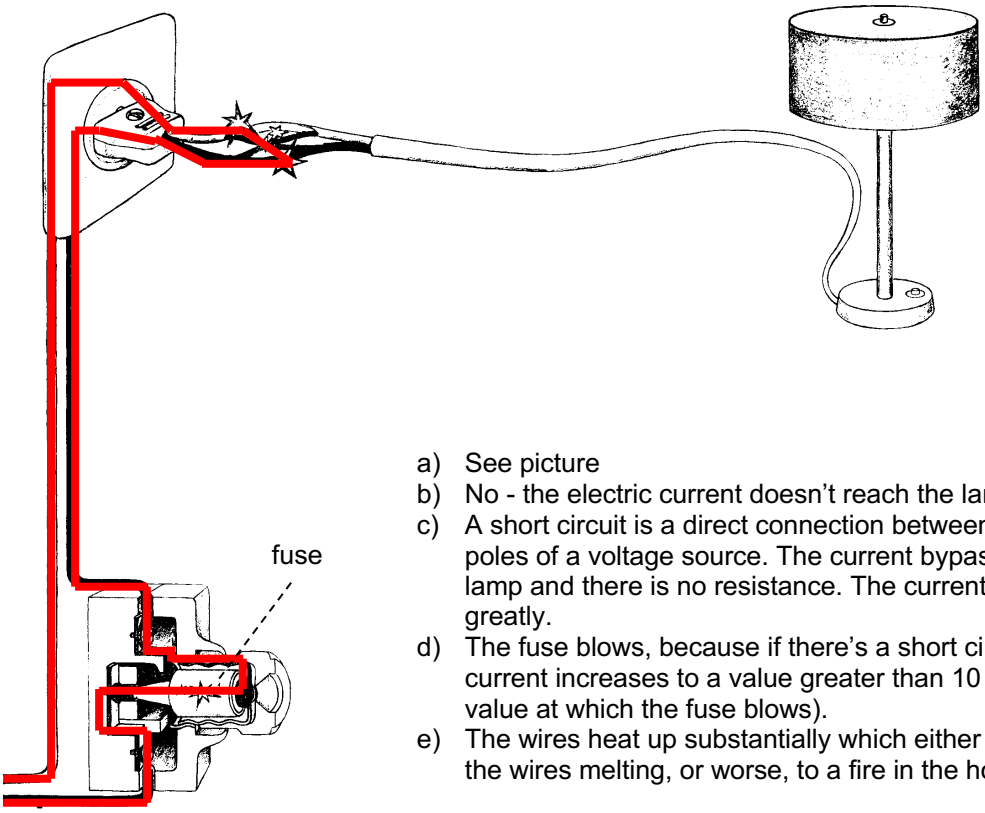
1. The wire has a very low resistance. There is virtually no voltage across the bird's feet. The current passes through the wire and not through the bird, because the bird's resistance is much greater than the resistance of the wire.

   The lamp's resistance is not zero, there is a voltage across the bird's feet. If the lamp's and the bird's resistance were equal, half the current would pass through the lamp and the other half through the bird. Even if the current through the bird is very small, it feels very uncomfortable!

2.

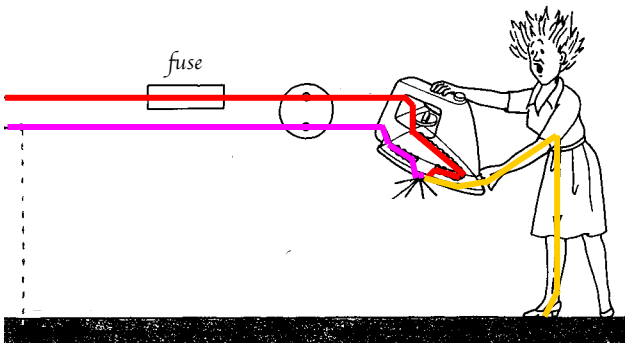
Safety feature	What does it protect?	How does it protect?
fuse	house, wires	Blows if the current reaches a certain value (usually more than 10 A). The circuit is interrupted.
ground	people	Conducts dangerous currents through a third wire which connects the case of the electric device directly to Earth (without passing through the human)
FI circuit breaker (ground fault circuit interrupter)	people	Interrupts the electric circuit within 0.03 s, if the currents in the two wires aren't equal.

3.



a) See picture
b) No - the electric current doesn't reach the lamp.
c) A short circuit is a direct connection between the two poles of a voltage source. The current bypasses the lamp and there is no resistance. The current increases greatly.
d) The fuse blows, because if there's a short circuit the current increases to a value greater than 10 A (usual value at which the fuse blows).
e) The wires heat up substantially which either leads to the wires melting, or worse, to a fire in the house..

4. a) Part of the current passes through the woman into earth. She receives an electric shock.



b) $I_{woman} = \frac{U}{R_{woman}} = \frac{220\ V}{3'000\ \Omega}$

$= 0.073\ A = 73\ mA$

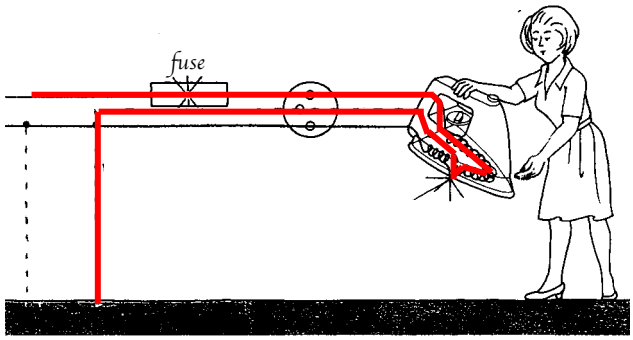
$I_{iron} = \frac{U}{R_{iron}} = \frac{220\ V}{50\ \Omega} = 4.4\ A$

$I_{total} = I_{woman} + I_{iron}$

$= 0.073\ A + 4.4\ A = 4.47\ A$

The additional current that is passing through the woman into earth is too small for the fuse to blow. However, the current is large enough to be dangerous for the woman!

5. a) The ground is a third wire which connects the case of the iron to earth. If the woman touches the iron's case, the current passes rather through the ground wire than through the woman, because the ground wire's resistance is almost zero.

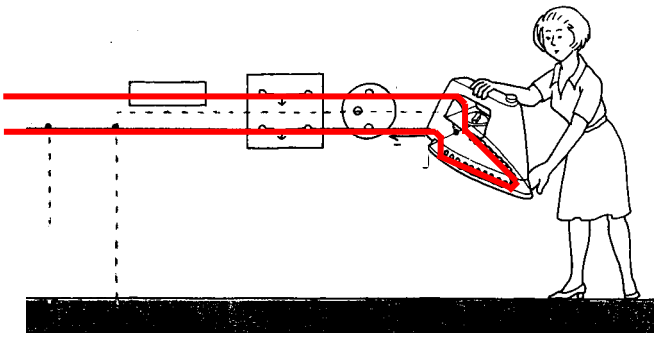


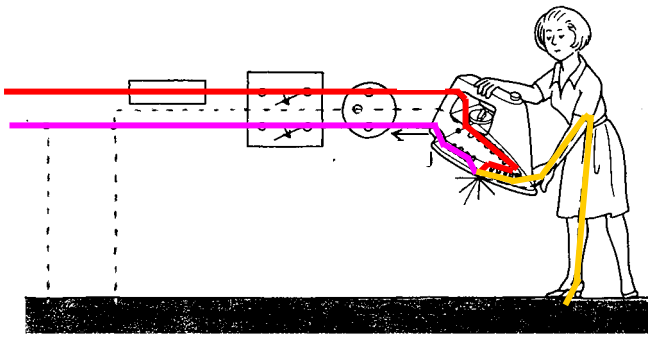
b) The ground wire has virtually no resistance. Therefore the current increases a lot and the fuse blows.

c) Even without fuse the woman would be protected. However, the increase in current could cause the wires to melt (for instance in a wall) or even lead to a fire in the house.

6. Here's an electric circuit prote

Flow of current during the first $\frac{3}{100}$ seconds before the electric circuit is interrupted by the GFCI





b) Interrupts the electric circuit within 0.03 s, if the currents in the two wires aren't equal.

c) $\frac{3}{100}$ seconds