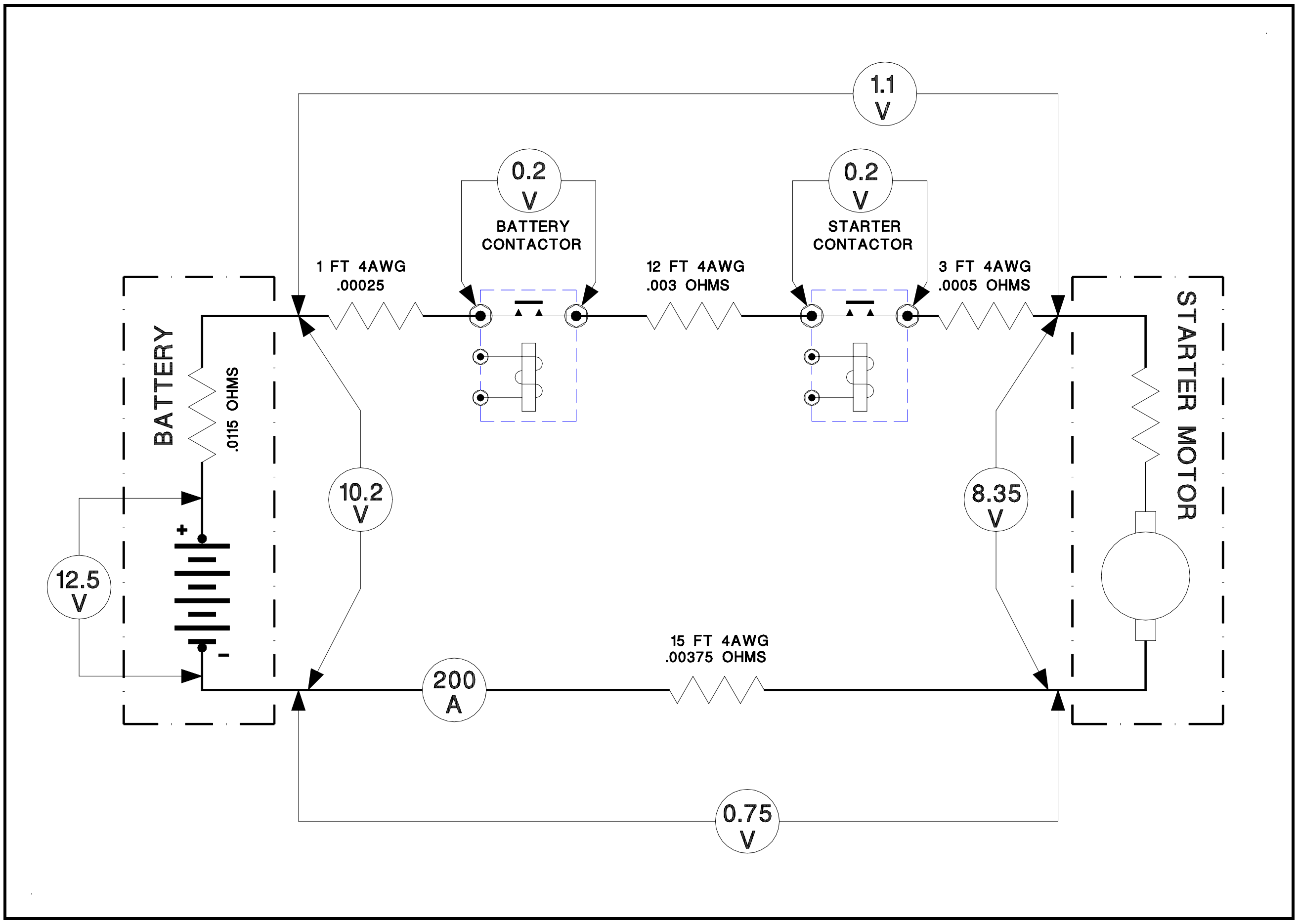

Figure 2-3. Cranking Circuit Analysis.

This calculation shows that the battery has an internal resist ance (some call it "impedance" - for our purposes it's the same thing) of 10.0 milliohms. After you account for all the voltage drops illustrated in the cranking circuit, starter now sees only 8.65 volts at its terminals. This is a fairly typical scenario which also points out the fact that there is no such thing as a 12-volt starter! Starters used in 14-volt systems with 12-volt batteries really need to be characterized for operation between 9 and 10 volts. I did not make any calculations or assumptions about the internal resistance shown for the motor. This resistance is a fairly complex; we'll discuss it in detail in a later chapter on motors. But suffice it to say that the motor has resistance too . . . it's resistance in the motor that generates all that heat in the starter after you've cranked a recalcitrant engine for too long.

Now, let's repeat the exercise substituting a 4 milliohm RG battery for the 10 milliohm flooded device. Wow, cranking voltage at the starter comes up to 9.9 volts! What happens if we put in 2AWG wire instead of 4AWG, we get back some more losses and the starter now sees 10.3 volts. In spite of the fact that we're dealing with very tiny resistances, cranking currents make them more than significant! Our hero's Vari-Ez didn't crank worth a hoot . . . until he replace the 4AWG wire with 2AWG and replaced his motorcycle battery with an RG battery.

Remember the 7 amp flow we got from a dead short on our D-Cell battery? Let's do an estimate on what happens when you put a dead short across the flooded battery. Looking at a shorted battery scenario we can say:

$$\text{Amps} = \frac{\text{Volts}}{\text{Ohm}} = \frac{12.5}{.010} = 1{,}250$$

We can also calculate the power dissipated inside the battery:

$$\text{Watts} = \frac{(\text{Volts})^2}{\text{Ohms}} = \frac{(12.5)^2}{.010} = 15{,}625$$